Turkey 2021

Energy Policy Review

International Energy Agency

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Foreword

The International Energy Agency (IEA) has conducted in-depth peer reviews of its member countries' energy policies since 1976. This process supports energy policy development and encourages the exchange of and learning from international best practices. By seeing what has worked – or not – in the "real world", these reviews help to identify policies that deliver concrete results. Since 2017, the IEA has modernised the reviews by focusing on the key challenges in today's rapidly changing energy markets.

Since the IEA in-depth review of Turkey in 2016, the guiding principles of Turkish energy policy continue to be market reform and energy security. Rapid economic and population growth in the past two decades have not only driven strong growth in energy demand but also an associated increase in import dependency. As a result, Turkey has pursued a restructuring of its energy system with the aim of rationalising energy demand growth, lowering energy prices for consumers and slowing the pace of import growth.

In light of its heavy dependence on oil and gas imports, Turkey has prioritised security of energy supply as one of the central pillars of its energy strategy. The policy includes efforts to boost domestic oil and gas exploration and production, diversify oil and gas supply sources and associated infrastructure, and reduce energy consumption through increased energy efficiency. In particular, Turkey has made huge progress expanding its gas supply options through new gas discoveries, pipelines, LNG terminals and increased storage. Turkey has also made commendable headway in advancing energy efficiency policies, notably for buildings.

I am pleased to observe that Turkey has seen considerable diversification of its energy mix in the past decade. In particular, renewable energy has staged impressive growth, with renewable electricity generation tripling over the period, led by hydro, solar and wind. Still, Turkey could achieve much more growth in renewables given its tremendous resource endowment, not just in electricity but also in the heating sector. The planned commissioning of Turkey's first nuclear power facility in 2023 will further diversify the country's fuel mix.

To achieve a modern, competitive economy, Turkey needs to pay close attention to the sustainability of its energy sector and its longer-term carbon footprint. It is equally important to direct industrial policy toward the next phase of a clean energy transition. To this end, policies to promote innovation in areas such as electric vehicles, energy storage and digital technologies will be critical.

Turkey has made significant progress on liberalising energy markets in the last decade, successfully improving predictability and transparency in pricing. However, additional reforms toward establishing more competitive gas and electricity markets will help mobilise needed investments into these sectors.

I strongly believe that policy and regulatory measures can help Turkey further bolster its energy security and navigate its future energy challenges and opportunities in the most cost-efficient and sustainable way. The IEA is committed to supporting Turkey in these efforts.

Dr. Fatih Birol

Executive Director

International Energy Agency

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1. Executive summary

Overview

Since the 2016 IEA in-depth review of Turkey, the guiding principles of Turkish energy policy continue to be market reform and energy security. Rapid economic and population growth in the past two decades have not only driven strong growth in energy demand, but also an associated increase in import dependency. As a result, Turkey has pursued a restructuring of its energy system with the aim of rationalising energy demand growth, lowering energy prices for consumers and slowing the pace of import growth. These reforms have included measures targeted at modernisation, liberalisation and increased domestic production capacity, including through more private and foreign investments.

Notably, Turkey has seen considerable diversification of its energy mix in the past decade. In particular, renewable energy has staged impressive growth, with renewable electricity generation tripling in the past decade. The commissioning of Turkey's first nuclear power facility in 2023 will further diversify the country's fuel mix.

Still, fossil fuels continue to drive Turkey's economy, with a heavy dependency on imports, especially oil and gas (93% and 99%, respectively). Turkey has prioritised an expansion of domestic exploration and production to help reduce its oil and gas import dependency. However, given limits on upstream resources and with consideration to emissions reduction, Turkey should also place due consideration on cost-optimal demand-side measures such as efficiency improvements and fuel switching in the transport sector, which is still 98% reliant on oil. Moreover, there is still considerable scope for Turkey to target even more ambitious growth in renewables, not just in electricity, but also in other sectors such as heating.

In addition, Turkey's efforts to use more domestic energy resources to meet its consumption needs might interfere with efforts to decarbonise the energy sector, particularly as it relates to the government's policy to use more low-quality domestic lignite in power generation. In a similar vein, as many countries around the world increasingly look toward net-zero greenhouse gas emissions by the middle of the century, Turkey should consider the impact of its energy policy – especially its focus on coal-fired generation – on investor sentiment, local air pollution and the longer term emissions trajectory.

Security of energy supply

In light of its heavy dependence on oil and gas imports, Turkey has prioritised security of energy supply as one of the pillars of its energy strategy. The policy includes efforts to boost domestic oil and gas exploration and production, diversify oil and gas supply sources and associated infrastructure, as well as reduce energy consumption through increased energy efficiency.

Upstream

Given that the share of domestic oil and gas production in consumption is low, Turkey has prioritised upstream oil and gas exploration and production. The Turkish Petroleum Law establishes some incentives to create a more attractive upstream fiscal regime, such as low royalties. Domestic crude oil production grew by 19% from 2017 to 2019, mainly due to the increased upstream activities of Turkish Petroleum Corporation (TPAO) (which holds most exploration and production licenses), though demand is still predominantly met by imports. Even with growth in domestic upstream activities, Turkey will remain heavily dependent on imported oil and gas to meet its consumption needs. TPAO has initiated an offshore investment campaign along with increased operations onshore, including shale oil and gas. Turkey's natural gas import dependence will diminish following the recent discovery of the giant Sakarya field in the Black Sea. The field is planned to commence production in 2023, giving Turkey bargaining power in the renewal of its natural gas import contracts.

Turkey is also pursuing exploration to determine the domestic potential of shale gas, gas hydrates and coal bed methane.

Infrastructure

Beyond upstream efforts, for natural gas security, Turkey is also successfully diversifying its import sources and routes. In the early 2000s, the Russian Federation was the dominant gas supplier, but Turkey began importing gas from the Islamic Republic of Iran in 2001 and from Azerbaijan in 2007. Turkey has recently further expanded its gas import infrastructure, including by increasing the capacity of existing pipelines and introducing new ones, such as the TurkStream route from Russia and the TANAP route from Azerbaijan.

Investments in liquefied natural gas (LNG) and underground natural gas storage are considered priorities to advance energy security. Several new floating storage and regasification terminals have been commissioned in recent years, existing LNG entry capacity has increased and new entry points are being connected to the gas network to ensure supply diversification. Already, the country has ramped up the procurement of spot LNG to boost optionality of import sources. In addition, Turkey has undertaken sizeable recent and planned upgrades to storage capacity, which will also significantly lift the country's gas security.

Turkey has also diversified its sources and modes of oil supply, with crude oil provided by both pipelines and tankers. Its top suppliers of crude in recent years have been Iran, Iraq, Russia and Saudi Arabia. Oil products are provided only through tankers. In addition, Turkey has five operational refineries that meet around half of the country's gasoil and gasoline demand.

Energy efficiency

Turkey recognises that a primary foundation to improve energy security is to slow the rate of consumption growth by improving energy efficiency. To this end, the National Energy Efficiency Action Plan (NEEAP), covering the period 2017-23, aims to reduce Turkey's primary energy consumption by 14% from business-as-usual levels across several sectors, including buildings and services, power and heat, transport, industry and technology, agriculture, and cross-cutting areas.

Though it is a very timely policy initiative, progress to date on the NEEAP has been mixed and additional efforts will be needed to reach the 2023 target of 23.9 million tonnes of oil equivalent (Mtoe) saved with USD 10.9 billion invested. Implementation gaps remain across and within sectors, with policy progress slowed by delays in secondary legislation and lack of demand or incentives for energy efficiency products and services, among other factors. To foster timely progress, the NEEAP Steering and Coordination Board, consisting of high-level representatives of the responsible institutions of the NEEAP under the leadership of the Ministry of Energy and Natural Resources, was established. One of the important recent steps regarding promotion of energy efficiency in buildings are obligatory efficiency targets for public buildings. With the Presidential Decree dated 16 August 2019, public buildings with energy managers assigned according to the Energy Efficiency Law No. 5 627 are expected to procure energy savings of 15% until 2023, in order to use public resources efficiently and to reduce the burden of energy costs on the public sector. The Presidential Decision on the Procedures and Principles Regarding Energy Performance Contracts in the Public Sector from 21 August 2020 sets out the procedures and principles for energy performance contracts to be concluded by public administrations.

Expanding domestic energy production

Beyond expanding upstream oil and gas development, Turkey's strategy to boost the domestic production of energy includes plans for the development of renewable resources, nuclear energy and lignite mining.

Renewables

Turkey has experienced impressive growth in renewables in the past decade (notably solar, wind and geothermal), driven by a favourable resource endowment, strong energy demand growth and supportive government policies. In particular, renewable electricity generation has nearly tripled in the last decade, and its share in total power generation reached 44% in 2019 (including notable growth in distributed solar generation). As such, Turkey has already exceeded its target of 38.8% of power generation from renewables set out under the Eleventh Development Plan (2019-2023). Turkey aims to continue to promote the expansion of renewable energy resources and will commission 10 gigawatts (GW) each of solar and wind capacity in the period 2017-27.

Under the Renewable Energy Support Mechanism (YEKDEM), Turkey offers feed-in tariffs for renewable power plants, including wind, solar, biomass, hydro and geothermal. Additional support is provided if plant components are manufactured in Turkey. The scheme will expire at the end of June 2021 and the government is currently deciding on a new mechanism to replace it. According to the Presidential Decree published on 18 September 2020, the implementation period for the YEKDEM scheme was extended by six months until 30 June 2021 due to construction delays stemming from the COVID-19 pandemic. Renewable electricity generators can benefit from YEKDEM if commissioned before 30 June 2021 and if they apply to the Energy Market Regulatory Authority for the guaranteed price.

In 2016, the government introduced Renewable Energy Resource Areas (YEKA), a tender process for larger scale renewable energy projects in renewable energy zones, which are deemed most suitable for renewable power generation. To date, the support schemes have been successful in driving sizeable new investments in renewables, and the

government has demonstrated a willingness to adjust the terms of the auctions for future projects to ensure investor interest. Such a planned auction of smaller capacities is planned toward the end of 2020.

Though the targets of 10 GW each of additional solar and wind are commendable, there are likely more sizeable volumes that Turkey could achieve given its considerable resource endowment. As such, Turkey could look to further raise the ambition of its targets. In particular, the IEA encourages a higher expansion of wind, given its low costs.

Beyond electricity, both solar and geothermal energy used for heating have more than doubled within a decade, but growth has stalled since 2015. Turkey is among the leading countries for solar water heater installations, notably in the absence of subsidies or policy support. However, technology and infrastructure quality needs to improve significantly to maximise its potential, especially given its geographical location and favourable irradiance conditions. The sizeable share of energy consumption in buildings also offers untapped potential for other renewables, such as direct geothermal and heat pump applications.

Nuclear

Turkey has embarked on an ambitious nuclear power strategy to build its first nuclear power plant to limit the use of imported fuels for power generation. Turkey is planning to install three nuclear power plants (NPPs) for a total of 12 reactor units. Currently, the first NPP (Akkuyu NPP) is under construction in Mersin Province on the southern coast of Turkey and comprises 4 units with a total installed capacity of 4 800 MW. The first unit of the Akkuyu NPP is scheduled to enter into operation at the end of 2023.

State-owned electricity supplier EÜAŞ will buy around half the nuclear power generated from Akkuyu for 15 years at a pre-determined price. Studies are ongoing for the construction of other nuclear power plants, according to the country's nuclear programme.

Coal

Turkey's approach to coal mining and coal-fired generation is also rooted in a strategy to reduce dependence on imported natural gas and imported coal. The policy to reduce gas consumption is focused on the power sector, where gas-to-coal (and nuclear) switching is easier compared to other sectors such as industry. As such, the government has pursued a plan to boost the domestic production and consumption of Turkey's sizeable coal reserves. Lignite, in particular, is a priority area for development, mainly for use in power generation. Hard coal is intended to be used more heavily in the industrial sector. On the flip side, the government is trying to reduce the use of coal in household heating in favour of natural gas.

To advance its goals, Turkey provides several incentives to both encourage coal mining as well as the use of domestic coal in power generation. Efforts by the two state-owned coal companies, TTK and TKİ, to ramp up production have reversed a trend of declining production (led by TTK) since 2015. Moreover, the government has promoted more privatisation of the coal-mining sector and incentivised increased domestic coal production by relicensing the non-producing areas of public companies via a tendering system to private companies. Some of the tenders grant the right to mine coal/lignite on the condition that a thermal power plant be installed near the mine site, from which state-owned power provider EÜAŞ is obliged to purchase power for a fixed term at a pre-determined rate. Most of the tenders grant the right to mine coal/lignite on the condition that they supply

domestic households and industry. To date, five licenses (one with an obligation of installing a power plant and four to supply industrial coal) have been transferred to the private sector under these processes. All other coal plants benefit from voluntary priority power purchase agreements with EÜAŞ for a limited percentage of electricity generated if supplied by domestic coal, as well as from capacity payments.

Air pollution in major cities, including from coal-fired power plants, is a serious concern. Thermal power plants in Turkey are subject to the Industrial Air Pollution Control Regulation, which sets limit values for air pollutants such as SO_2, CO, NO_X and particulate matter. The government's decision to not grant extra time to existing privatised and public thermal power plants that were exempted from securing environmental permits until the end of 2020 was a step in the right direction.

The government and state-owned mining companies have also stepped up efforts in recent years to improve occupational health and safety practices at mine sites, including in response to mining accidents.

Domestic technology and equipment production

Turkey also believes that an important dimension of the country's self-sufficiency in energy and natural resources is the presence of domestic technological capacity. This strategy is reflected in a number of measures to advance R&D, innovation and technology in the country. In particular, the government has implemented policies to increase the domestic production of machinery and equipment used in energy production from renewable energy sources (including by requiring the construction of local production facilities as part of early YEKA auctions) as well as the production of necessary materials and equipment for the construction and operation of nuclear power plants.

Energy market liberalisation

The third pillar of Turkey's energy strategy is to continue to advance the liberalisation of energy markets and improve the predictability and transparency of its pricing.

Following the liberalisation and privatisation of the electricity market in 2001, electricity generation, distribution and supply were opened up to private entities and are now carried out by both private and state-owned companies.

EXIST (Energy Exchange Istanbul) was officially established in March 2015. This was an important step toward the liberalisation of the electricity and gas markets. Organised wholesale electricity markets had been operated by Turkish Electricity Transmission Corporation (TEİAŞ) since 2009. Wholesale electricity markets have been operational on EXIST since 2015 and a wholesale gas trading platform has been operational since September 2018. These markets provide price signals to investors and increase transparency. Development of physically settled power and natural gas futures markets are also underway. The depth and liquidity of the market is expected to benefit from the derivatives market that will be established in 2021, as well as a range of contracts over various time horizons and delivery windows that have become operational in 2020.

Gas market liberalisation is also a critical element of Turkey's efforts to improve transparency in energy markets, with the Energy Market Regulatory Authority serving as the implementing organisation for reform efforts. Its task is to set up and implement

regulatory measures to ensure the establishment of a liberal and competitive natural gas market where all market segments are open to new entrants. A new balancing methodology, under which balancing of the network is carried out by the transmission system operator that enters the continuous trade platform as a residual balancer, has helped ensure that prices are determined in an objective and transparent manner.

However, notwithstanding many positive changes that have been made to the gas market regulatory framework, the dominant position on the gas market of state-owned BOTAŞ remains as progress in releasing gas contracts to other parties has stalled. In 2019, BOTAŞ even increased its market share to 95%, compared to 80% in 2017. This stands in sharp contrast with the Natural Gas Market Law, which in 2001 introduced an obligation to reduce BOTAŞ' market share to 20% by 2009.

More broadly, additional steps toward establishing more competitive energy markets and greater private sector participation will help mobilise needed investments into the energy sector.

The Turkish government has made big strides toward investing in its position as a regional energy trading centre, notably for gas, with the opening of the TurkStream and TANAP pipelines, as well as ongoing investment in gas storage and LNG entry points (including floating storage and regasification terminals). The establishment of a natural gas spot market platform in September 2018 is a big step toward making Turkey an international gas trading hub, if this platform can be expanded with trade in futures contracts.

Key recommendations

- Gradually phase down power market support mechanisms such as subsidisation and the obligated procurement by EÜAŞ of a significant share of electricity generation to keep system costs down.
- Significantly strengthen incentives, market mechanisms and access to finance for energy efficiency projects, especially in the industrial and buildings sectors.
- Develop a cross-governmental road map to reduce oil consumption by strengthening demand-reduction and fuel switching policies in the transport sector, including the promotion of electric vehicles.
- Reduce the dominant position of BOTAŞ and foster increased competition in the Turkish gas market.
- Define long-term targets for the development of renewable energies that take into account the maximum potential per technology.
- Define mid- and long-term emissions reduction and local air pollution targets to help guide sustainable energy policy making, including a plan for peaking of emissions.

2. General energy policy

Key data

(2019 provisional)

TPES: 146.6 Mtoe (coal 28%, oil 29%, natural gas 25%, geothermal 7%, hydro 5%, bioenergy and waste 2%, solar 2%, wind 1%), +49% since 2009

TPES per capita: 1.8 toe/cap (IEA average: 4.1 toe/cap)

TPES per unit of GDP*: 63 toe/USD million PPP (IEA average: 92 toe/USD million PPP)

Energy production: 45.9 Mtoe (coal 38%, geothermal 21%, hydro 17%, bioenergy and waste 7%, oil 7%, solar 5%, wind 4%, natural gas 1%), +41% since 2008

TFC (2018): 103.0 Mtoe (industry 36%, transport 27%, residential 20%, service 17%), +39% since 2008

* GDP data are in USD 2015 prices and PPPs (purchasing power parity).

Country overview

Turkey is at the crossroads of Asia and Europe, with most of its territory located in south-western Asia and a small part in south-eastern Europe (Eastern Thrace). With a population of 83 million (2020) and an area of 783 562 square kilometres, Turkey is the 37th largest country in the world by land area.

With its fluid cultural background and central geographical location, Turkey plays an influential role throughout the region. Turkey has applied for membership to the European Union and has been engaged in accession negotiations since 2005; however, progress toward full membership has been stalled since 2016. Turkey has been a member of the North Atlantic Treaty Organization (NATO) since 1952, of the Organisation for Economic Co-operation and Development (OECD) since 1961, of the International Energy Agency (IEA) since 1974, of the Black Sea Economic Cooperation Organization (BSEC) since 1992, and a major partner in the G20.

After an economic crisis in 2001, Turkey's economic and social development has been rapid, with increased employment and incomes that have placed it as an upper middle-income country in the World Bank categorisation. Turkey's gross domestic product (GDP) per capita[1] almost doubled from USD 13 235 in 2001 to USD 24 811 in 2018. In 2018, Turkey had the 19th largest economy in the world by nominal GDP (USD 902 billion) (World Bank, 2019a). However, the country went through a currency and debt crisis in 2018 due to the Turkish lira plunging in value, resulting in high inflation and

[1] In real USD 2010 prices and purchasing power parity (PPP).

rising borrowing costs and loan defaults. The annual GDP growth rate fell from 7.5% in 2017 to 2.8% in 2018 (World Bank, 2019b).

Turkey's economy is shifting from agriculture to one based on industry and services. By 2019, the services sector engaged 49% of the workforce, while agriculture and industry occupied 15% and 18%, respectively (seasonally adjusted). Nearly half of all trade is with Europe, with Germany serving as the main trading partner. The Russian Federataion and the People's Republic of China are the largest sources of imports, and significant trade also takes place with the Middle East, particularly with Iraq and the Islamic Republic of Iran (Turkish Statistical Institute, 2018).

Turkey has a large variety of natural resources, though few occur on a large scale. Apart from Iran, Turkey is the only country among its neighbours with significant coal deposits. Turkey remains highly dependent on imported oil and gas, but is pursuing energy relationships with a broader set of international partners and taking steps to increase the use of domestic energy sources, including renewables, nuclear and coal.

Turkey is of strategic importance and has a long-standing ambition to become a significant trading centre for the energy trade between Central Asia, Russia, the Middle East, Europe and other markets.

Figure 2.1 Map of Turkey

Supply and demand

Turkey's energy system is characterised by a large share of fossil fuels, which accounted for 83% of the total primary energy supply (TPES)[2] in 2019 and 73% of total final

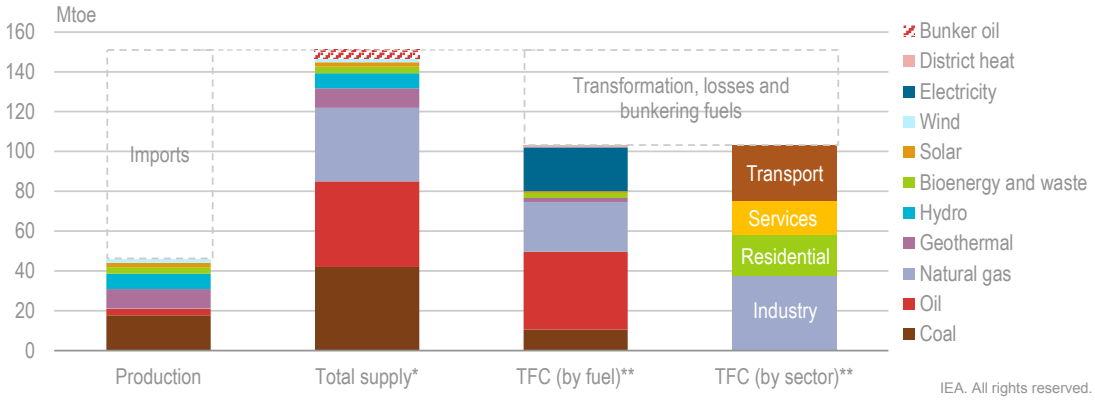
[2] TPES is made up of production + imports – exports – international marine and aviation bunkers ± stock changes. This equals the total supply of energy that is consumed domestically, either in transformation (e.g. power generation and refining) or in final use. Nuclear energy supply in TPES includes losses. The primary energy equivalent of nuclear electricity is calculated from the gross electricity generation by assuming a 33% conversion efficiency.

consumption (TFC)[3] in 2018 (Figure 2.2). The rest is from various renewable sources, most of which consist of geothermal and hydro used in power generation. While nearly all of the oil and gas consumed is imported, around half of the coal and all types of renewable energy are produced domestically. Domestic energy production covered 31% of TPES in 2019. Renewable energy production has more than doubled since 2009, with rapid growth in geothermal, hydro, wind and solar, while the use of traditional bioenergy for residential heating has decreased.

Industry is the largest energy-consuming sector, accounting for over a third of TFC in 2018, followed by transport (27%), residential (20%) and services (17%) (Figure 2.2).

The industry sector consumes mainly oil, natural gas and electricity, with almost equal shares. Oil also dominates energy consumption in transport, while natural gas and electricity dominate in both the residential and service sectors. International bunker fuels for maritime transport and aviation consist of a small addition to the country's oil supply, which is not included in TPES.

Figure 2.2 Overview of Turkey's energy system by fuel and sector, 2018/19



Fossil fuels dominate the energy supply in Turkey, accounting for 83% of TPES in 2019, with roughly equal shares of coal, oil and natural gas, and 73% of TFC in 2018.

* Total supply includes total primary energy supply plus international bunker fuels.

** TFC data are from 2018.

Notes: Mtoe = million tonnes of oil equivalent. TFC = total final consumption. Production and total supply data for 2019 are provisional.

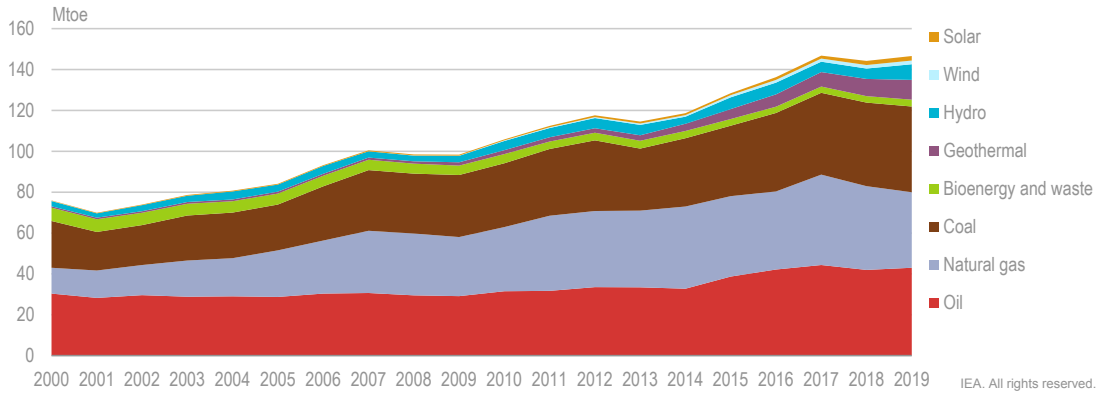
Source: IEA (2020), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Primary energy supply

The energy supply in Turkey has steadily increased to meet the needs of its fast-growing economy. Between 2000 and 2019, TPES grew by 92%, despite a recent decline due to the economic slowdown in 2018 (Figure 2.3). Fossil fuels dominate TPES and their share has been stable at around 90% since 2000. In 2019, the share of fossil fuels in TPES was 83%, which ranked the ninth-highest among IEA member countries (Figure 2.4).

[3] TFC is the final energy consumption (electricity, heat and fuel, such as natural gas and oil products) by end users, not including the transformation sector (e.g. power generation and refining).

Figure 2.3 Total primary energy supply by source, Turkey, 2000-19

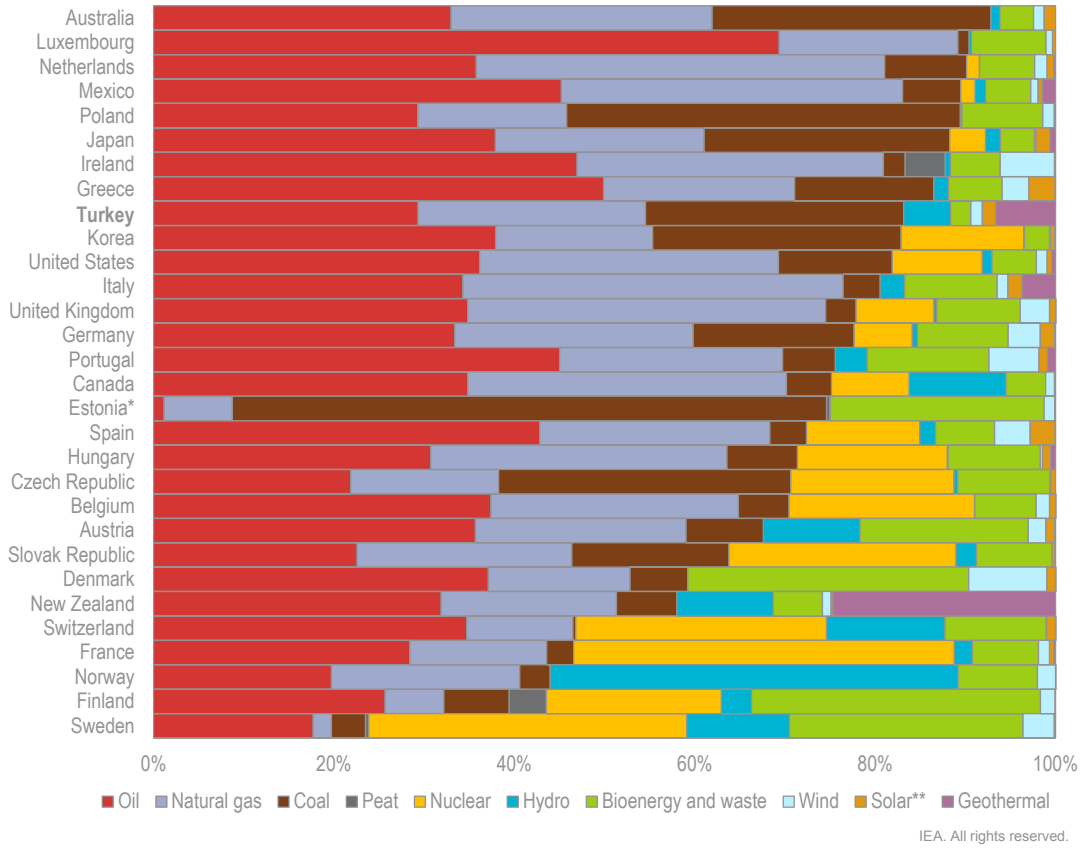


Energy supply in Turkey has increased by 92% since 2000, most of which consists of fossil fuels, despite a growing supply of renewables over the last decade.

Notes: Mtoe = million tonnes of oil equivalent. Supply data for 2019 are provisional. Electricity imports and exports are not shown in the chart.

Source: IEA (2020), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Figure 2.4 Breakdown of total primary energy supply in IEA member countries, 2019



In 2018, fossil fuels represented 86% of TPES in Turkey, which was the ninth-highest among IEA member countries.

* Estonia's coal is represented by oil shale.

** Solar includes solar PV, solar thermal, wave and ocean power, and other power generation (e.g. from fuel cells).

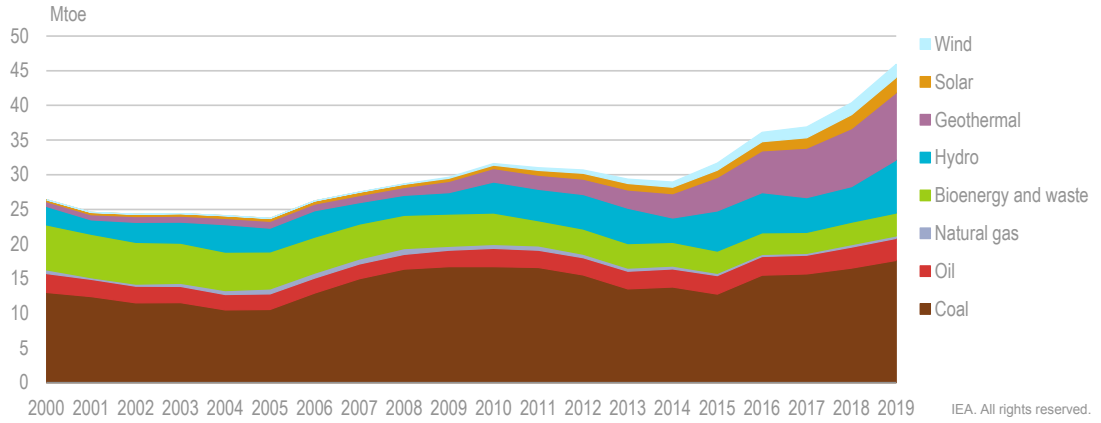
Notes: Supply data for 2019 are provisional. Countries are presented in decreasing order of share of fossil fuels.

Source: IEA (2020), IEA World Energy Statistics and Balances (database), www.iea.org/statistics.

Energy production and import dependency

Domestic energy production has increased rapidly in recent years, with a growth of 59% from 2014 to 2019. This was mostly driven by renewable sources, which accounted for 54% of total energy production in 2019 (Figure 2.5). Geothermal, in particular, has more than doubled since 2014, and accounted for 21% of total energy production in 2019. Coal production has also increased in recent years, after a previous decline during 2010-15. In 2019, coal accounted for 39% of total production. Although there is no operating nuclear power plant in Turkey, the country has commenced a nuclear power programme, with the first unit of a nuclear power plant scheduled to be operational by the end of 2023.

Figure 2.5 Energy production by source, Turkey, 2000-19

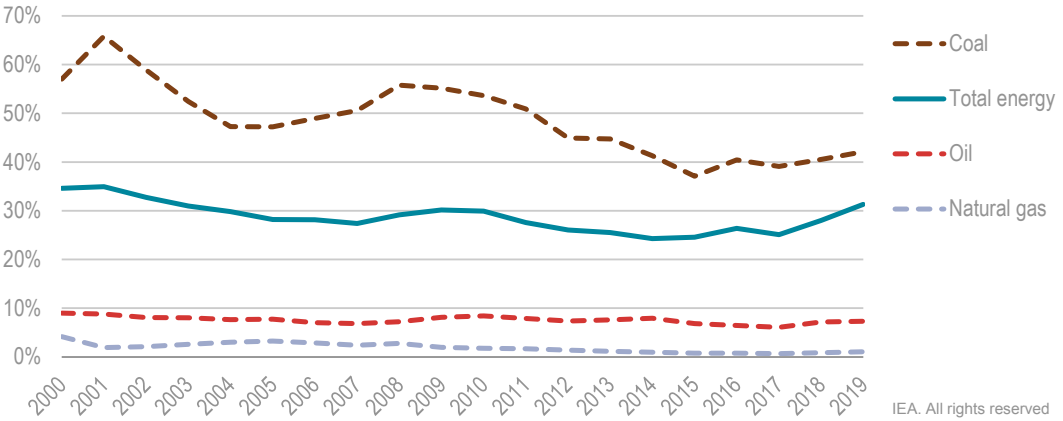


Domestic energy production in Turkey increased by 59% between 2014 and 2019, mainly driven by the expansion of renewables and coal.

Notes: Mtoe = million tonnes of oil equivalent. Energy production data for 2019 are provisional.
Source: IEA (2020), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Despite the rapid growth in domestic energy production, Turkey relies mostly on energy imports for its supply. Nearly all natural gas is imported (Figure 2.6) and domestic oil production accounted for only 7% of total demand (including for international bunkering). Domestic coal production is larger, but despite recent growth, Turkey still relies on imports for 58% of its coal demand.

Figure 2.6 Self-sufficiency by energy source, Turkey, 2000-19



Turkey's natural gas and oil needs are highly dependent on imports, whereas domestic coal production meets nearly half of coal demand.

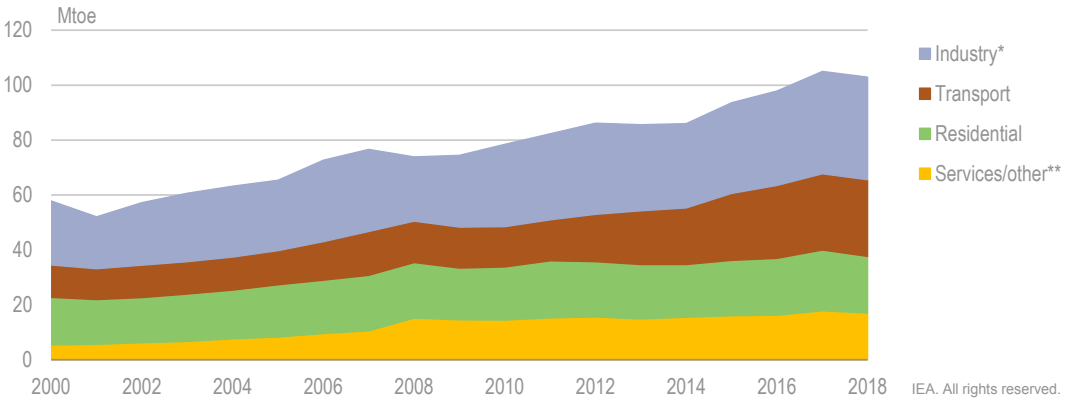
Note: Domestic energy production as a share of total primary energy supply plus international bunker fuels (oil). Data for 2019 are provisional.
Source: IEA (2020), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Energy consumption

In 2018, Turkey's TFC was 103 Mtoe, representing 71% of TPES (Figure 2.7). Industry is the largest energy-consuming sector, accounting for 36% of TFC in 2018, followed by transport (27%), residential (20%) and services (17%), including agriculture and fishing. Turkey's energy demand has increased across all sectors since 2001, with a slight decrease in most sectors in 2018, except industry. From 2008 to 2018, energy consumption in transport increased by 86%, in industry by 60%, and in services and residential by 12% and 2%, respectively.

Oil dominates energy consumption in the transport sector, at 97% of TFC in 2018. Natural gas covers half of total demand in the residential sector (Figure 2.8). Industry and services (including agriculture and fisheries) use a mix of oil, gas, coal and electricity.

Figure 2.7 Total final consumption by sector, Turkey, 2000-18



Energy consumption in Turkey is growing across all sectors, with a total growth in TFC of 39% from 2008 to 2018.

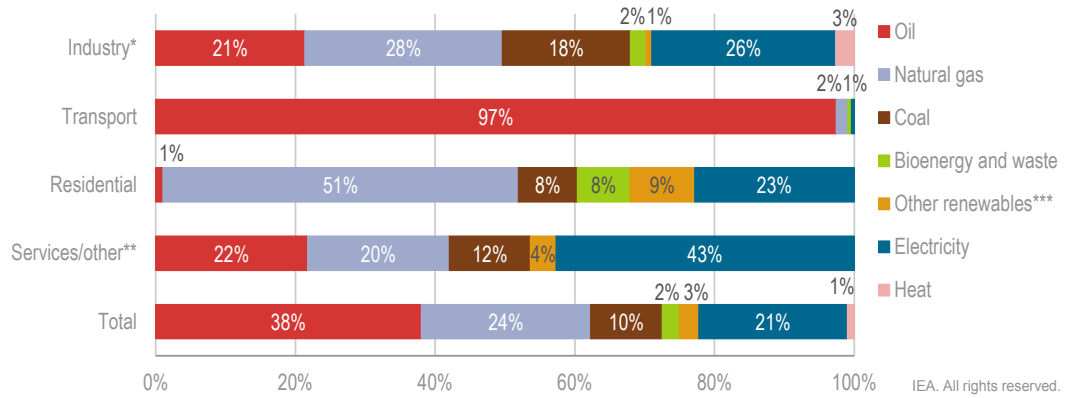
* *Industry* includes non-energy consumption.

** *Services/other* includes commercial and public services, agriculture, and forestry.

Note: Mtoe = million tonnes of oil equivalent.

Source: IEA (2020), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Figure 2.8 Total final consumption by source and sector, Turkey, 2018



Most of Turkey's energy demand is met by fossil fuels across all sectors, while electricity accounts for considerable shares as the third-largest energy source in Turkey.

* *Industry* includes non-energy consumption.

** *Services/others* includes commercial and public services, agriculture, and forestry.

*** *Other renewables* includes geothermal and solar thermal.

Source: IEA (2020), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Institutions

The **Ministry of Energy and Natural Resources** (MENR) is the primary policy institution for the energy sector in Turkey. It is tasked with determining the country's short- and long-term energy needs and assisting in the formulation of the necessary policies to ensure adequate supply to meet demand.

Within the MENR, several general directorates oversee various elements of the energy sector, including:

- The **General Directorate of Energy Affairs** undertakes measures related to the production, transportation and distribution of energy resources in accordance with laws, and supports and co-ordinates research and development (R&D) efforts.
- The **General Directorate of Nuclear Energy and International Projects** co-ordinates among government ministries and other stakeholders to oversee the country's nuclear power plans as well as its international projects. Currently, it is also responsible for implementation of transit pipeline agreements within the scope of international projects.
- The **General Directorate of Foreign Relations** manages the ministry's international energy relations.
- The **Directorate for Strategy Development** co-ordinates general directorates of the ministry and affiliated and related institutions to prepare policy documents such as the ministry's Strategic Plan. In addition, the directorate prepares the ministry's budget.
- The **Department of Energy Efficiency and Environment** drafts action plans, regulations and legislation as it relates to energy efficiency policy; prepares harmonisation and impact assessments of current and new legislation within the scope of the environment-energy relationship; and calculates greenhouse gas emissions for public electricity and heat production in the National Inventory Report.
- The **Department of Natural Resources** promotes and coordinates studies related to the research and development of natural resources, and is in charge of monitoring technological research and development activities in the field and delivering the results to relevant authorities.

The MENR also has a number of affiliated and related institutions that are critical to energy policy, including:

- The **General Directorate of Mining and Petroleum** (MAPEG), which issues permits for the exploration and production of natural resources.
- The **Electricity Generation Company** (EÜAŞ), which is involved in power production and sales.
- The **Turkish Electricity Transmission Corporation** (TEİAŞ), which owns and operates all transmission facilities.
- The **Turkish Electricity Distribution Corporation** (TEDAŞ), which owns electricity distribution assets.
- **Turkish Coal Enterprises** (TKİ), the state-owned company that mines lignite, bituminous schist and asphaltite.
- The **Turkish Energy, Nuclear and Mining Research Institution** (TENMAK), which replaced the previous Turkish Atomic Energy Authority (TAEK) based on a presidential decree in March 2020, undertakes studies and R&D to support nuclear activities. The new entity also incorporates the Institute of Rare Earth Materials (NATEN) and the National Boron Research Institute (BOREN).

- The **Turkish Petroleum Corporation** (TPAO), the state-owned oil company involved in upstream exploration and production activities. TPAO provides a balanced distribution of petroleum products between the regions.
- The **Petroleum Pipeline Company** (BOTAŞ), which is engaged in the construction and operation of oil and natural gas pipelines, natural gas and liquefied natural gas (LNG) storage and trade, LNG terminal operations, marine services, and international gas and oil transportation projects.
- **Turkish Hardcoal Enterprises** (TTK), which leads the country's hard coal production.
- The **General Directorate of Mineral Research and Exploration** (MTA), which investigates areas suitable for mining in Turkey and assesses how mines and quarries can be operated more beneficially.
- The **General Directorate of Eti Mine Operations** (Eti Maden), which deals with making the best use of all types of mineral and industrial raw material resources except hard coal, coal and hydrocarbon resources.
- **Turkish Electromechanic Industries Co.** (TEMSAN), which conducts commercial activities related to the needs of power plants, in particular to ensure the feasibility of power plant design, as well as to provide the supply of required equipment. TEMSAN also performs project approvals and acceptance procedures on behalf of the MENR for licensed hydroelectric power plants (up to 10 MW) and/or unlicensed power generation plants (hydro, thermal and biomass)
- The **Energy Market Regulatory Authority** (EMRA), which issues licenses that determine rights and obligations related to the activities of companies in energy markets as well as issues and monitors the performance of energy companies and their distribution of services to consumers. EMRA makes secondary legislation related to electricity, natural gas, petroleum and liquefied petroleum gas markets.
- The **Nuclear Regulatory Authority** (NDK) regulates the safety and security of nuclear energy activities, including site evaluation, design, construction, commissioning, operation, decommissioning and closure of nuclear facilities, radiation facilities or radioactive waste facilities.

In addition to the MENR, several other ministries and institutions have jurisdiction over aspects of energy policy, including:

- The **Presidency of Strategy and Budget** has a mission to accelerate the economic and social development of Turkey and ensure that development is balanced and sustainable. To this end, it performs co-ordination studies, especially toward the preparation of basic policy documents; the development of sectoral and thematic policies and strategies; and the preparation and implementation of central administration budgets, plans, programmes and resource allocations.
- The **Ministry of Environment and Urbanization** oversees activities related to zoning, building construction and renovations, including as they relate to environmental standards and energy efficiency building codes.
- The **Ministry of Treasury and Finance** has broad oversight over economic and fiscal policy, including energy taxation and climate financing.
- The **Ministry of Transport and Infrastructure** is responsible for infrastructure, networks, systems and services related to transport and maritime activities.
- The **Ministry of Industry and Technology** oversees industrial policies and strategies, including setting environmental standards and guiding energy productivity policies for the sector.

- The **Scientific and Technological Research Council of Turkey** (TÜBİTAK) undertakes, supports, co-ordinates and monitors R&D and innovation activities in the scientific and technological fields, including in the area of energy technologies.
- The **Ministry of Trade** oversees all aspects of domestic and foreign trade in goods and services, including for energy products.
- The **Energy Exchange Istanbul** (EXIST) is the market operator of the day-ahead and intraday electricity markets and natural gas spot market.

National Energy and Mining Policy

Turkey's overall energy policy stems from not only its rapid economic growth in the past two decades that has led to a steep increase in energy demand as well as energy imports, but also from concerted efforts to reduce the country's dependence on imported energy sources. In conjunction, Turkey has pursued a restructuring of its energy sector with an aim toward modernisation, liberalisation and increasing domestic production capacity, including through more private and foreign investment.

In line with Turkey's economic growth and development, in April 2017 the MENR announced the National Energy and Mining Policy. The policy focuses primarily on reducing Turkey's reliance on imported energy resources and is based on three main pillars: 1) improving energy supply security; 2) localisation, including increasing the use of domestic energy resources; and 3) improving predictability in energy markets.

Security of supply

In light of its heavy dependence on oil and gas imports, Turkey has prioritised security of energy supply as one of the pillars of its energy strategy. The policy includes efforts to boost domestic oil and gas exploration and production, diversify oil and gas supply sources and associated infrastructure, as well as reduce energy consumption through increased energy efficiency.

Upstream development

The MENR's Strategic Plan for 2019-2023 promotes security of energy supply by increasing indigenous energy production and diversifying energy sources. Since the share of domestic oil production in consumption is low, domestic oil production is prioritised. Similarly, natural gas production in Turkey has historically been low, meeting less than 2% of demand. An August 2020 gas discovery in the Black Sea by TPAO (Sakarya gas field) represents the largest gas discovery in the country's history and could meaningfully lower its call on imports in the medium term as well as boost its negotiating position with gas exporters.

The Turkish Petroleum Law establishes some incentives to enhance investment in the upstream sector, such as low royalties. Recently, domestic crude oil production grew by 12% from 2.5 million tonnes (Mt) in 2017 to 2.8 Mt in 2018. However, these measures have not resulted in an increase in foreign investment. State-owned TPAO holds 77% of all exploration licenses and 55% of all production licenses in Turkey. The longer term task of decommissioning Turkey's aging oil and gas fields will also largely fall on TPAO.

Turkey is also pursuing exploration to determine the domestic potential of shale gas, gas hydrates and coal bed methane.

Infrastructure

Diversifying import sources and routes is the cornerstone of Turkey's gas security policy. Procurement of spot LNG was also added to improve security of supply.

Based on expectations of growing gas demand, Turkey is planning an expansion of its gas import infrastructure. Several options are envisaged, including increasing the capacity of existing pipelines and introducing new pipelines, such as the TurkStream route from Russia and TANAP from Azerbaijan. Investments in LNG and underground natural gas storage amounting to a minimum of TRY 27 billion (EUR 4.3 billion) are considered priority investments to this end.

In order to mitigate the effect of potential supply disruptions, two new floating storage and regasification unit terminals have been constructed, LNG entry capacity has increased, and new entry points are being connected to the gas network to ensure supply diversification. In addition, loop pipelines are being added to the grid and capacity increase studies are ongoing for storage facilities.

Turkey is also aiming to be a regional energy trading centre given its geographic advantage, situated at the intersection of a number of large producers (in the Middle East and Central Asia) and consumers (in Europe). Two large pipeline projects have recently been commissioned: TANAP and TurkStream. Gas flow through TurkStream began in the beginning of 2020. TANAP is expected to transport gas to European customers in early 2021 by the commissioning of the Trans Adriatic Pipeline (TAP). Both pipelines will eventually transit large volumes of gas to Europe from Azerbaijan and Russia.

Spot import regulations were prepared and published by EMRA in 2019, in order to better facilitate energy infrastructure investments and incentivise projects that are being built or are planned.

Turkey has also diversified its sources and modes of oil supply, with crude oil provided by both pipelines and tankers. Oil products are provided only through tankers.

Energy efficiency

The National Energy Efficiency Action Plan (NEEAP), covering the period 2017-23, aims to reduce Turkey's primary energy consumption by 14% by 2023 through 55 actions defined in 6 categories: buildings and services, energy, transport, industry and technology, agriculture, and cross-cutting areas. It is projected to achieve cumulative savings of 23.9 Mtoe by 2023, toward which USD 10.9 billion of investments will be made. The cumulative savings by 2033 are projected to be USD 30.2 billion at 2017 prices; the effect of certain savings are expected to continue through 2040.

"Localisation"

As part of its efforts to boost energy security, Turkey has also embarked on a strategy to increase domestic production of energy in order to reduce imports. As such, it has prioritised the development of domestic renewable resources; nuclear energy; and domestic oil, gas and coal mining.

Renewables

In the past decade, Turkey has seen significant growth in renewable energy. In particular, renewable electricity has nearly tripled in the last decade, and its share in total power generation reached 44% in 2019.

Turkey aims to continue to promote the expansion of renewable energy resources and will commission 10 gigawatts (GW) each of solar and wind capacity in the period 2017-27. In accordance with forecasts, until 2023 and 2027, the government expects that 76% and 61% of the additional capacity will come from renewable resources, respectively.

Turkey has also realised strong potential for growth in geothermal energy, including for power generation, heating and in the agricultural sector.

Under the Renewable Energy Support Mechanism (YEKDEM), Turkey offers feed-in tariffs for renewable power plants, including wind, solar, biomass, hydro (for reservoir areas of less than 15 square kilometres) and geothermal. Additional support is provided if plant components are manufactured in Turkey. The scheme will expire at the end of 2020 and the government is currently deciding on a new mechanism to replace it.

In 2016, the government introduced the Renewable Energy Resource Areas (YEKA) strategy, a tender process to procure the production of renewable energy in renewable energy zones (RE-Zones), which are deemed most suitable for renewable energy generation. The first auctions were awarded for a solar PV plant in March 2017 and for a wind onshore plant in August 2017. In addition to these auctions, the second wind onshore auctions were awarded in 2019. The process requires developers to include domestic businesses, establish domestic factories, create employment for the local labour force and invest in R&D.

Nuclear power

Though Turkey does not currently have any nuclear power plants in operation, it has embarked on an ambitious nuclear power strategy to limit the use of imported fuel for power generation. The country has two nuclear reactors under construction: the Akkuyu nuclear power plant's Unit 1 and Unit 2 in Mersin Province, and two more in the near future. In total, Turkey has plans to install 3 nuclear power plants with a total of 12 reactor units in the country, including Akkuyu.

The first unit of Akkuyu, which is being developed with Russia, began construction in 2018 and is expected to be completed by the end of 2023. The other units are planned to be in commercial operation at subsequent one-year intervals until the end of 2026.

The second nuclear power plant is the Sinop project on the Black Sea coast, based on an agreement signed with Japan in 2013. However, based on a feasibility study conducted by Mitsubishi Heavy Industries, the government decided not to move forward with the project plan due to high costs and is in talks with other partners to develop the project. A favorable environmental impact assessment report was granted for the project in September 2020.

The site selection process for the third nuclear plant is still ongoing.

Turkey is also pursuing an active role in nuclear-related R&D. The Scientific and Technological Research Council of Turkey's (TÜBİTAK's) Marmara Research Center has

been actively involved in molten salt reactor technology, which is one of the six novel Generation IV nuclear technologies advocated by the International Atomic Energy Agency (IAEA). Turkey was an observer in the Safety Assessment of the Molten Salt Fast Reactor (SAMOFAR) H2020 project and contributed to the design of the primary heat exchanger for molten salt reactors. A follow-up phase is underway under the SAMOFAR project, with commercialisation expected after 2030 by interested companies. Turkey has also been in the process of becoming a member of the GIF Generation IV International Forum since 2018.

Coal

In order to reduce dependency on imported fuels, especially natural gas in power generation, the Turkish government is pursuing a plan to boost domestic production and consumption of Turkey's sizeable coal reserves. Lignite, in particular, is a priority area for development, mainly for use in power generation. As such, with the aim of meeting increasing energy demand in line with industrialisation and population growth, the government has stepped up efforts to find new coal fields and to speed up the development of existing mines.

In an effort to boost production, Turkey has promoted more privatisation of the coal-mining sector. The non-producing areas of the state-owned coal-mining companies TTK and TKİ were divided and relicensed. It is foreseen that coal production and consumption will increase with the start of operations at mine sites that were tendered to the private sector, on the condition that they either supply industrial and household coal or that a thermal power plant be installed near the mine location.

Predictability in energy markets

The third pillar of Turkey's energy strategy is to continue to advance the liberalisation of energy markets and improve the predictability and transparency of its pricing.

Following the liberalisation and privatisation of the electricity market in 2001, electricity generation, distribution and supply were opened up to private entities and are now carried out by both private and state-owned companies.

Generation can be carried out by public and private companies and organised industrial zones with a generation licence from EMRA. EÜAŞ is the state-owned company established to carry out electricity generation activities. According to data for end-2019 published by the Turkish Electricity Transmission Company (TEİAŞ), 78.5% of Turkey's total installed capacity is owned by private entities.

Electricity transmission is a monopoly belonging to TEİAŞ under the supervision of EMRA. Following the passage of the Electricity Market Law in 2013, EXIST was also granted a licence to be a market operator. TEİAŞ continues to operate the balancing power market and the ancillary services market. EXIST is responsible for operating the day-ahead market and the intraday market. EXIST has also been working on forward electricity markets, which will be operational in 2020.

Turkey's electricity distribution network was divided into 21 distribution regions (operated as regional monopolies). After the privatisation process over the period 2009-13, all electricity distribution companies (each privatised through transfer of operations rights of the network for their respective regions) obtained a distribution licence from EMRA.

Although the distribution system assets are still held by state-owned TEDAŞ, the distribution activities are now carried out by the private sector.

Gas market liberalisation is also a critical element of Turkey's efforts to improve transparency in energy markets, with EMRA serving as the lead organisation for reform efforts. Its task is to set up and implement regulatory measures to ensure the establishment of a liberal and competitive natural gas market where all market segments are open to new entrants. It also regulates and approves transmission, storage and wholesale tariffs, and until sufficient competition is achieved, all retail tariffs.

The Natural Gas Market Law was amended in July 2008, liberalising both spot and long-term imports of LNG to allow BOTAŞ to enter into new LNG contracts and private companies to hold contracts with countries with which BOTAŞ already has contracts. Tariffs of the transmission system operator and distribution system operators are regulated by EMRA, though tariffs of LNG terminals (including floating storage and regasification units) are not regulated on a precondition of non-discriminatory access. Similarly, tariffs on storage facilities are determined freely between owners and users, but can be determined by EMRA's board until a threshold level of capacity is reached.

However, the strong position of state-owned BOTAŞ in the gas market remains and has even increased in recent years (to 95% in 2019) due to market conditions, in sharp contrast with the Natural Gas Market Law that introduced an obligation to reduce BOTAŞ' market share to 20%.

Turkey is already engaged in natural gas trading activities with its neighbours and has plans to further expand gas trading operations to become a major natural gas trading centre. Its expansion of gas infrastructure, efforts to cut domestic demand and liberalisation of gas trading through the opening of the Organized Wholesale Natural Gas Sales Market in 2018 are all steps in this direction.

Unlike in the gas sector, where BOTAS still retains an important role, Turkey's oil market has been fully liberalised since 2005.

Eleventh Development Plan (2019-2023)

Most recently, the Eleventh Development Plan of Turkey for the years 2019-23 sets forth important targets for energy as one of the plan's sectoral focus areas. In this context, supply-side targets for the year 2023 include:

- reducing the share of natural gas in electricity production from 29.9% to 20.7%
- increasing the share of renewable energy sources in electricity production from 32.5% to 38.8%
- increasing the amount of electricity produced from local energy sources from 150 terawatt hours (TWh) to 219.5 TWh.

Demand-side targets for the year 2023 include:

- increasing primary energy usage per capita from 1.81 tonnes oil equivalent (toe) to 2.01 toe
- increasing electricity usage per capita from 3.7 MWh to 4.3 MWh to be closer to the world average.

Turkey has already achieved progress toward its energy targets and goals. Not only has the share of private ownership in electricity generation grown from 40% in 2002 to 85% in 2018, but the country has also seen strong growth in renewable energy (led by hydro), bolstered by government support schemes. Looking ahead, with respect to increasing the role of domestic and renewable energy, Turkey has a target to commission 10 000 MW each of solar and wind capacity over 2017-27. In addition, it plans to build 7 500 MW of new domestic coal power capacity. As such, it expects that by 2023, 84% of new power capacity will come from domestic sources, of which 76% will be renewable, while by 2027, 82% will come from domestic sources, of which 61% will be renewable.

However, Turkey has not yet outlined longer term targets for its energy system, including as it relates to primary energy consumption and emissions. The government currently has a project underway that aims to bolster capabilities within the MENR to undertake longer term modelling and scenario analysis, with a target for completion toward the end of 2020. The exception, however, is the electricity sector, for which the Electricity Market Law requires the MENR to publish 20-year projections every two years.

Emissions reduction strategy

In accordance with the United Nations Framework Convention on Climate Change (UNFCCC) Conference of Parties framework, Turkey pledged to reduce greenhouse gas (GHG) emissions by up to 21% from a business-as-usual level by 2030 (including land use, land-use change and forestry). Turkey's growing economy and level of development limits its ability to lower emissions levels from current levels, prompting the country to opt for a business-as-usual baseline, allowing some emissions growth from current levels. An expansion of renewables, including solar and wind, is a critical component to meeting the targets.

Nonetheless, Turkey has not yet ratified the Paris Agreement, and it may update its Intended Nationally Determined Contribution (INDC) in accordance with changing circumstances. Turkey does not currently plan a peak in its emissions. The Ministry of Environment and Urbanization is carrying out the "Capacity Building and Monitoring Project for Achieving the Greenhouse Gas National Contribution Target", which will inform efforts to update Turkey's INDC, including to reflect policies put in place after 2015.

The country's domestic CO_2 reduction strategy is outlined in the 2010 National Climate Change Strategy 2010-2023 and its implementing plan, the 2011 National Climate Change Action Plan (NCCAP) 2011-2023. Central tenets of the NCCAP include an improvement in energy efficiency as well as an expansion of renewable power.

Turkey will need to update its NCCAP and National Climate Change Strategy by the end of 2023 at the latest. Studies to update the NCCAP will begin in 2020, with a goal to complete them within three years. Long-term (2030-50) policy and strategy options will also be considered.

Pricing and taxation

Turkey has low gas and electricity prices in an international comparison. The country has traditionally regulated end-user tariffs for electricity (for non-eligible customers, which as of 2020 include those with a consumption below 1 400 kilowatt hours [kWh] per year).

However, as part of its market reform policy, the country plans to gradually move toward a fully cost-reflective tariff system, with EMRA reducing the eligibility threshold each year. Wholesale electricity tariffs are already deregulated and cost-based. Similarly, wholesale gas prices are liberalised. Retail gas prices are also deregulated for so-called eligible customers, which include all customers with the exception of households (only very large households are considered to be eligible).

Oil prices have been fully liberalised and set by the market since 2005. Prices for gasoline and diesel fuel in Turkey are relatively high from a global perspective, owing to high excise taxes on fuel, although relatively low in an IEA comparison. Excise taxes are identical for both commercial and non-commercial users.

Turkey has introduced a number of taxation measures aimed at supporting its energy objectives. For fuels, the special consumption tax (SCT; *Özel Tüketim Vergisi*, OTV) applies to solid, liquid and gaseous fuels. Bioethanol blended into gasoline is exempt from the SCT, while domestically produced biodiesel qualifies for a refund of 2% of the SCT. Oil and gas fuel products are subject to differential tax rates, with higher rates for unleaded gasoline compared to diesel, for example.

For power, the electricity and coal-gas consumption tax (*Elektrik ve Hava Gazı Tüketim Vergisi*) applies to electricity consumption at an *ad valorem* rate of 1% for several sectors, including manufacturing, communications and transport, and at an *ad valorem* rate of 5% for all other electricity users. For renewable power generators, there are a range of licence exemptions and fee reductions available.

Turkey does not have a carbon tax, though it is at the early stage of considering approaches to carbon costing – possibly through the introduction of an emissions trading scheme as part of the Partnership for Market Readiness Project. To limit the use of water, Turkey levies an environmental cleaning tax on households, workplaces and other buildings based on the amount of water they use.

For energy-efficient products, value-added tax and SCT tax reductions were introduced for home appliances in 2018 and ended in June 2019. For transport, there are some tax incentives for hybrid electric and battery-electric vehicles. New vehicles of these varieties are exempt from the SCT and vehicles with smaller engine sizes are subject to lower rates.

Assessment

The Turkish government has responded to its rapid economic growth and associated increase in energy consumption over recent years by developing a comprehensive energy policy in 2017 – the National Energy and Mining Policy – which focuses on improving energy security of supply; increasing the use of domestic energy resources; and improving transparency in energy markets.

Objectives supporting the energy policy, as set out in the Eleventh Development Plan, are based on clear supply and demand targets for the years 2019-23. However, apart from 20-year electricity demand projections, there are no publicly available longer term energy demand projections, which will be needed to determine supply requirements and to focus efforts on the most important sectors. The MENR does intend to increase resources and upskill staff as part of a planned project to produce longer term demand projections and scenarios; the project is targeted for completion at the end of 2020.

As for many countries, several public institutions have an interest in and influence on energy policy, including the MENR as the primary policy organisation, the Ministry of Treasury and Finance, the Ministry of Environment and Urbanization, and the Ministry of Transport and Infrastructure. In addition to central government ministries, a wide range of state bodies are responsible for regulating markets, operating transmission and distribution, energy production, and overseeing energy efficiency policy. There is still room for improving institutions with respect to the sharing of responsibilities between these different governmental entities and co-ordination among them. For example, the strategic direction for energy RD&D could be administered more consistently, and the Department of Energy Efficiency and Environment could be granted a stronger role to achieve its objectives.

Turkey is to be commended for achieving a rapid increase in domestic energy production, notably from renewables, which constituted 44% of power generation in 2019. Domestic generation of solar, wind and geothermal has increased significantly as a result of incentives for renewables, and Turkey's objective of building 10 000 MW each of additional solar and wind capacity over 2017-27 are expected to be achieved. Private investment in electricity generation more than doubled between 2002 and 2018. It is positive that the Turkish government continues to drive this ambition with a replacement for its renewable support mechanism, the YEKDEM system, which expires at the end of June 2021. The announcement of the new scheme will be an important signal to investors.

There is still considerable scope for deployment of renewables and Turkey has also introduced an auction mechanism across renewable energy zones. This process invites tenders for guaranteed provision of electricity in specific areas to drive larger scale deployment of renewables. In 2017, 1 000 MW each of solar and wind capacity and in 2019 an additional 1 000 MW of onshore wind were tendered. Local content is a requirement for qualifying.

Notwithstanding the progress in renewables, fossil fuels continue to drive Turkey's economy, with a heavy dependency on imports, especially of oil and gas. Turkey has therefore prioritised domestic exploration and production and has an attractive fiscal regime. The majority of exploration is conducted by state-owned TPAO. With this outcome, there are limited incentives to maximise efficient production and a state-owned long-term liability for decommissioning costs looms. Turkey may be better off considering using this investment to drive certain sectors away from an excessive dependency on oil, notably the transport sector, which is still 98% reliant on oil.

The Turkish government has made big strides toward investing in its position as a regional energy trading centre, notably for gas trade, with the opening of the TurkStream and TANAP pipelines, as well as ongoing investment in gas storage and LNG entry points. The establishment of a natural gas spot market platform in September 2018 is a big step toward making Turkey an international gas trading hub, if this platform can be expanded with trade in futures contracts. This is welcomed by stakeholders who view it as important progress for the future development of Turkey's energy market.

However, there is further to go in liberalising gas markets. International suppliers using Turkish pipelines for gas export have to obtain the relevant licences from EMRA in order to access Turkish markets, and in line with EU regulations, entry/exit capacities must be reserved at relevant points. In fact, state-owned BOTAŞ is the sole operator of the transmission system and by far the largest supplier on the market. Gas transit is not a

regulated market activity. Efforts to unbundle and reduce BOTAŞ' market share of the gas market, as monitored by EMRA, are not yet complete, limiting competition in the internal market for gas. As domestic use of gas continues to grow (with 62% of households now having access to gas), further liberalisation of internal markets will be important as a driver for reducing cost and increasing competitiveness.

Coal is still an important primary source of energy in Turkey (around 30% share), with demand growing, and prior to 2015, domestic production falling (though since 2015, production has been increasing gradually in line with policy goals). Turkey's response to these trends has been to introduce measures to encourage domestic coal production and coal power generation via guaranteed purchase of the electricity generated.

The objectives of the Turkish government's policy of increasing the domestic share of energy production are to increase its security of supply, as well as to boost the economy. However, it is possible that these objectives could be achieved at a lower cost via imports, especially given Turkey's considerable diversity of supply sources of coal, gas and oil as well as its success in developing infrastructure as an international energy market and in boosting renewables production. Given the level of financial incentives available to all forms of domestic electricity generation as well as emerging trends in the energy sector, the government might reconsider this approach to securing energy supplies, as well as of the distributional impact of a policy that favours more expensive domestic production over imports.

Likewise, Turkey's policy of requiring developers to include high levels of local content in order to qualify for incentives may act as a deterrent to investment and it is not yet clear whether the incentives on offer, including for RD&D, will be sufficient to overcome structural barriers to developing new industries. Moreover, Turkey may not be able to fully realise international cost reductions on crucial technologies such as wind and solar.

Turkey has great scope to achieve increased energy efficiency, with associated improvements to air quality, cost of living and quality of life in its major cities. It has set the ambitious target of decreasing primary energy consumption by 14% by 2023 compared to business-as-usual, and the opportunities are very significant in transport and the residential housing sectors alone. However, this will require a concerted effort between responsible government departments, including creative fiscal incentives to attract the needed USD 10.9 billion of investment, changes to procurement rules and a continuation of efforts to understand the drivers of public behaviour change.

Turkey has introduced a number of taxation measures aimed at supporting its energy objectives. For fuel, the SCT applies to solid, liquid and gaseous fuels, with some exemptions for domestically produced ethanol and biodiesel blending. Oil and gas fuel products are subject to differential tax rates with higher rates for unleaded gasoline compared to diesel, for example. For power, the electricity consumption tax applies to electricity consumption at an *ad valorem* rate of 1% for industry and transport users, and at an *ad valorem* rate of 5% for all other users. Turkey does not have a carbon tax, though it is at the early stage of considering approaches to carbon pricing – such as an emissions trading scheme. For energy-efficient products, value-added tax and SCT tax reductions were introduced for home appliances in 2018 and ended in June 2019. For transport, hybrid electric vehicles, battery-electric vehicles and vehicles with smaller engine sizes are subject to lower rates. For renewable power generators, there are a range of licence exemptions and fee reductions available. The introduction of a carbon

pricing mechanism will be an important step in factoring in the environmental cost of carbon-intensive energy and steering the behaviour of energy consumers towards lower carbon solutions. A review of Turkey's level of exposure as a carbon-intensive economy might suggest additional changes to the fiscal regime at a strategic level.

In accordance with UNFCCC decisions, Turkey pledged to reduce GHG emissions by up to 21% from a business-as-usual level by 2030, which allows for emissions growth compared to 2018 levels; Turkey does not plan a peak in its emissions. However, Turkey has not yet ratified the Paris Agreement and may update its INDC. There is no strategy for monitoring progress against the INDC. Turkey's successful support for renewables also may provide attractive exportable opportunities.

In the longer term, as international efforts to achieve net-zero carbon emissions gather momentum, high-carbon economies will increasingly find themselves financially exposed. Any new investments in fossil fuel projects with lifetimes of over 20 years could lead to stranded assets if Turkey adopts a more stringent emission reduction strategy in the future. It will be advantageous for Turkey to continue to build on its successful support for renewables and focus on emissions abatement technologies, which could also provide competitive advantages through exports.

Recommendations

The government of Turkey should:

- Develop and publish mid- and long-term projections and scenario analysis for demand across all energy sources on a sector-by-sector basis, as a means of guiding energy supply and technology pathways more accurately.
- Facilitate greater join-up between its governmental institutions with an interest in energy policy (including policy departments, regulators and RD&D institutes) to secure greater coherence and the achievement of policy objectives.
- Review the cost-effectiveness and distributional impact of its policy to support domestic energy supplies over imports in order to meet security of supply objectives.
- Consider how a revised INDC and ratification of the Paris Agreement could help attract foreign direct investment for Turkey's planned energy projects.
- Evaluate risks and opportunities in a carbon-constrained world, including assessing the viability of carbon-intensive investments and considering competitive opportunities in clean energy technologies.

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3. Energy and climate change

Key data

(2019 provisional)

GHG emissions without LULUCF* (2018): 520.9 Mt CO_2-eq, +55% since 2005, +137% since 1990

GHG emissions with LULUCF* (2018): 426.3 Mt CO_2-eq, +62% since 2005, +161% since 1990

Energy related CO_2 emissions:**

CO_2 emissions from fuel combustion: 371.4 Mt CO_2-eq, +72% since 2005, +188% since 1990

CO_2 emissions by fuel: coal 44%, oil 31%, natural gas 23%

CO_2 emissions by sector (2018): Electricity and heat generation 39%, transport 22%, industry 19%, residential 9%, services 7%, other energy 4%

CO_2 intensity per GDP***: 0.16 kg CO_2/USD (IEA average 0.17 kg CO_2/USD)

* Land use, land-use change and forestry (Source: Turkish Statistical Institute, 2020).

** Energy-related CO_2 emissions are calculated by the IEA based on energy use data.

*** Gross domestic product (GDP) in 2015 numbers and PPP (purchasing power parity).

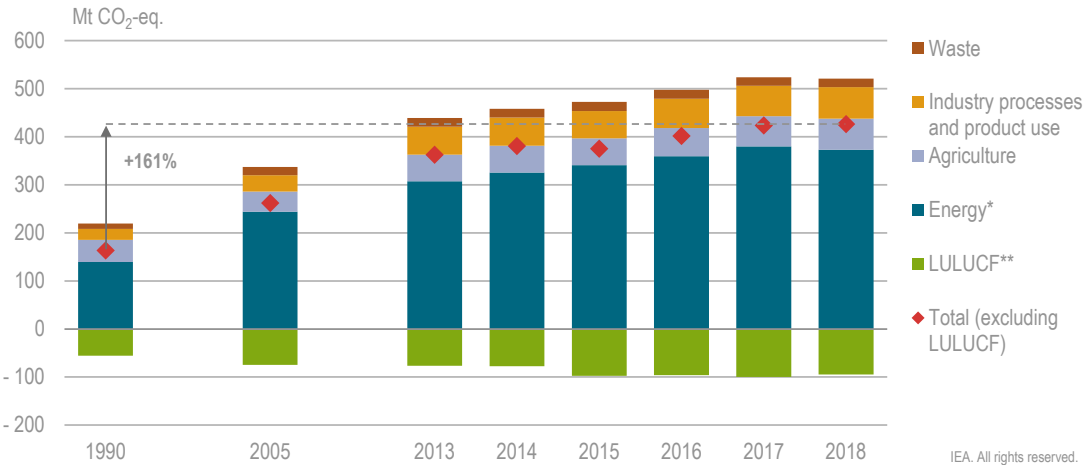
Overview

Total greenhouse gas (GHG) emissions in Turkey were 520.9 million tonnes carbon dioxide equivalent (Mt CO_2-eq) in 2018 (not including land use, land-use change and forestry [LULUCF]), of which energy-related emissions accounted for 72% (Figure 3.1). The rest came from industry process emissions (not including energy use in industry) at 13%, agriculture at 12% and waste management at 3%. The LULUCF sector is a net sink, contributing to lower total emissions. Notwithstanding LULUCF-related negative emissions, GHG emissions have increased across all sectors in recent decades, with the exception of the energy sector in 2018.

As part of its Intended Nationally Determined Contribution (INDC) submitted to the United Nations Framework Convention on Climate Change, Turkey proposed to reduce GHG emissions by up to 21% from a business-as-usual level by 2030 (including LULUCF). In line with population growth and economic development, Turkey's economy is expected to continue to expand, resulting in higher energy demand and consequently rising emissions. However, Turkey has an opportunity to consider ways to expand its economy without a commensurate surge in GHG emissions. So far, Turkey plans to increase

renewable energy capacity and decrease energy intensity through energy efficiency measures in order to reach its INDC targets. The rest of this chapter will focus on energy-related carbon dioxide (CO_2) emissions.

Figure 3.1 Greenhouse gas emissions by sector, Turkey, 1990-2018



Total GHG emissions in Turkey have rapidly increased in recent decades, posting a growth rate of 161% since 1990 (including LULUCF), mainly driven by the energy sector.

* *Energy* includes power and heat generation, commercial, households, industrial energy consumption, and transport, and excludes indirect CO_2.

** LULUCF includes changes to emissions based on land-use, land-use change and forestry.

Note: Mt CO_2-eq = million tonnes carbon dioxide equivalent.

Source: Turkish Statistical Institute (2020), *Turkish Greenhouse Gas Inventory 1990-2019*, https://unfccc.int/documents/223580.

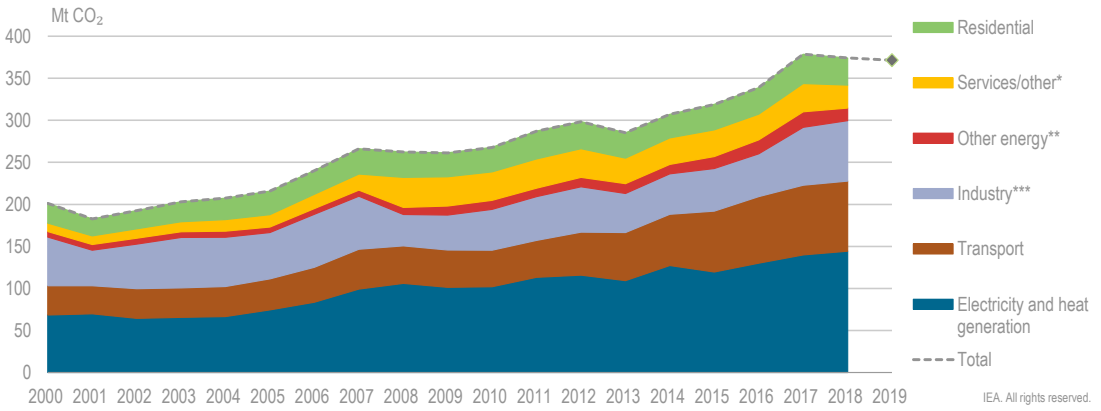
Energy-related CO_2 emissions

In 2018, estimated CO_2 emissions in energy-related sectors were 374 Mt CO_2-eq, growing by 86% since 2000 (Figure 3.2). Emissions in 2018 slightly decreased compared to the previous year. Electricity and heat generation is the largest emitting sector, accounting for 39% of total emissions in 2018. The rest was emitted in transport (22% of total emissions in 2018), industry (19%), residential (9%), services (7%) and other energy (4%). Emissions have increased across all sectors in the last few decades, with particularly rapid growth from 2013 to 2017. In those four years, total CO_2 emissions (excluding LULUCF) grew by 33%, driven by rapid increases in power generation, transport and industry.

A breakdown by fuel gives another perspective on energy-related CO_2 emissions, which have increased from all fossil fuels over the past decades (Figure 3.3). Coal combustion is the largest source of CO_2 emissions, accounting for 43% of total emissions in 2018, most of which came from coal use in electricity generation. The steady growth in electricity generation emissions corresponds to the increase in coal-related emissions. In addition, natural gas emissions increased with growing gas electricity generation from 2000 to 2014, though they have fallen more recently. Oil-related emissions are closely correlated with transport emissions, which accounted for nearly 66% of total oil emissions in 2018.

In 2018, there was a 3% drop in CO_2 emissions from oil combustion and a 10% drop in natural gas emissions compared to the previous year. In 2019, noticeable emissions reduction in natural gas combustion was due to decreasing gas demand in electricity generation, which fell by 39% compared to the previous year. Coal emissions, on the other hand, continued to increase.

Figure 3.2 Energy related CO_2 emissions by sector, Turkey, 2000-19



Energy-related emissions increased by 43% between 2008 and 2018, with growth across all sectors, especially in power, transport and industry.

* *Services/other* includes commercial and public services, agriculture/forestry, and fishing.

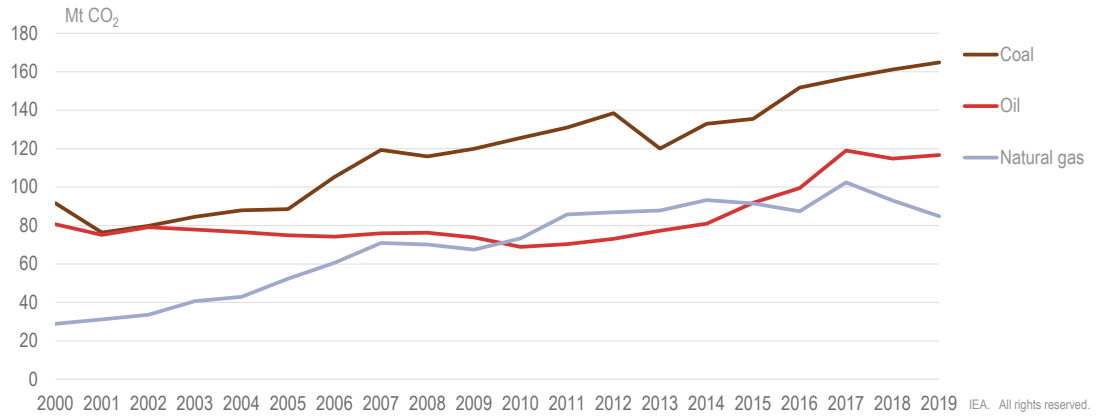
** *Other energy* includes emissions from coal, oil and gas extraction, oil refineries, blast furnaces, and coke ovens.

*** *Industry* includes CO_2 emissions from combustion at construction and manufacturing industries.

Notes: Mt CO_2 = million tonnes carbon dioxide. Data for 2019 are estimates.

Source: IEA (2020), *CO_2 Emissions from Fuel Combustion 2020*, www.iea.org/statistics.

Figure 3.3 Energy-related CO_2 emissions by energy source, Turkey, 2000-19



Coal-related emissions have increased the most in recent years and accounted for nearly half of total energy-related CO_2 emissions in 2019.

Notes: Mt CO_2 = million tonnes carbon dioxide. Data for 2019 are estimates. Energy-related CO_2 emissions from fossil fuels have rapidly increased over the last decade, except during the economic downturn in 2018, when emissions from both natural gas and oil fell, while emissions from coal combustion increased.

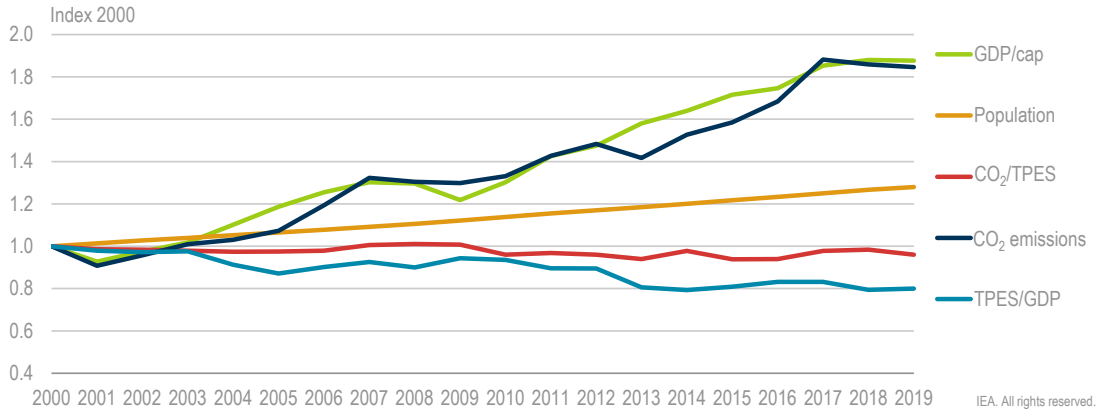
Source: IEA (2020), *CO_2 Emissions from Fuel Combustion 2020*, www.iea.org/statistics.

CO_2 drivers and carbon intensity

Total CO_2 emissions from fossil fuel combustion in a country are driven by population growth and economic development (GDP/capita), along with changes in the energy intensity of the economy (TPES/GDP) and carbon intensity of the energy supply (CO_2/TPES).

From 2000 to 2018, Turkey's gross domestic product (GDP) per capita grew by 88% and its population increased by 27%. Meanwhile, the carbon intensity of the energy supply has been relatively stable and the energy intensity of the economy has decreased only slightly. Together, these trends drove energy-related CO_2 emissions to increase by 86% from 2000 to 2018 (Figure 3.4).

Figure 3.4 Energy-related CO_2 emissions and driving factors, Turkey, 2000-19



CO_2 emissions have increased in line with economic and population growth, while the carbon intensity of the energy supply has been stable.

* *GDP* data are in billion USD 2015 prices and purchasing power parities (PPPs).

Notes: GDP = gross domestic product. TPES = total primary energy supply. Data for 2019 are estimates.

Source: IEA (2020), *CO_2 Emissions from Fuel Combustion 2020*, www.iea.org/statistics.

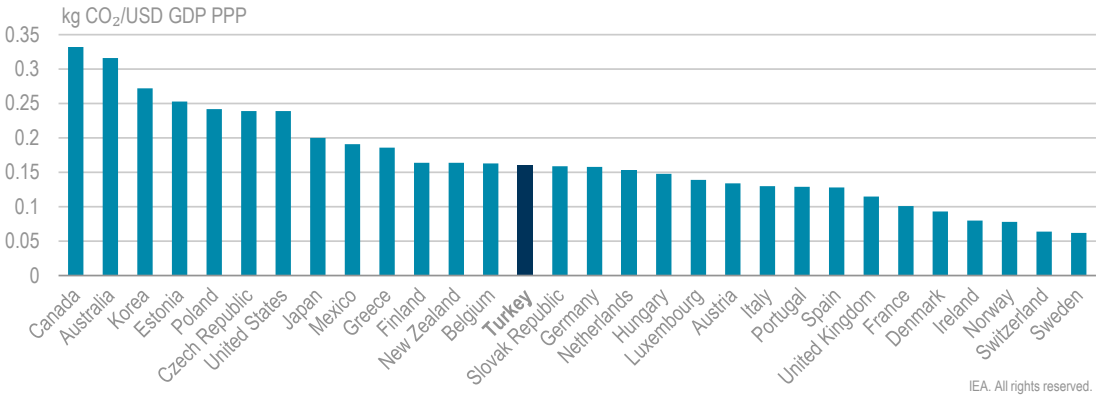
Turkey's CO_2 intensity of the economy was 0.16 kg CO_2/USD[4] in 2019,[5] which ranked around the median in an IEA comparison (Figure 3.5). Despite a decreasing trend for CO_2 intensity, Turkey has climbed in the ranking in recent years, from 11th lowest in 2013 to 14th in 2019. Turkey's CO_2 emissions per GDP have declined by 20% in the last decade, which was slower than in many other IEA member countries (Figure 3.6). The same year, Turkey had the sixth-lowest CO_2 emissions per capita among IEA member countries at 4.5 tonnes of carbon dioxide (t CO_2).

[4] USD in 2015 real values and PPP.

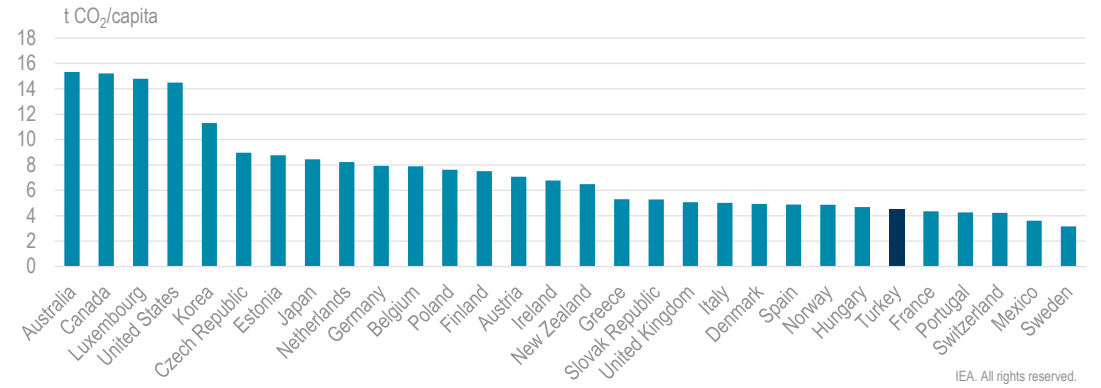
[5] Data for 2019 are estimated.

Figure 3.5 Energy-related CO_2 intensity in IEA member countries, Turkey, 2019

CO_2 emissions per GDP*



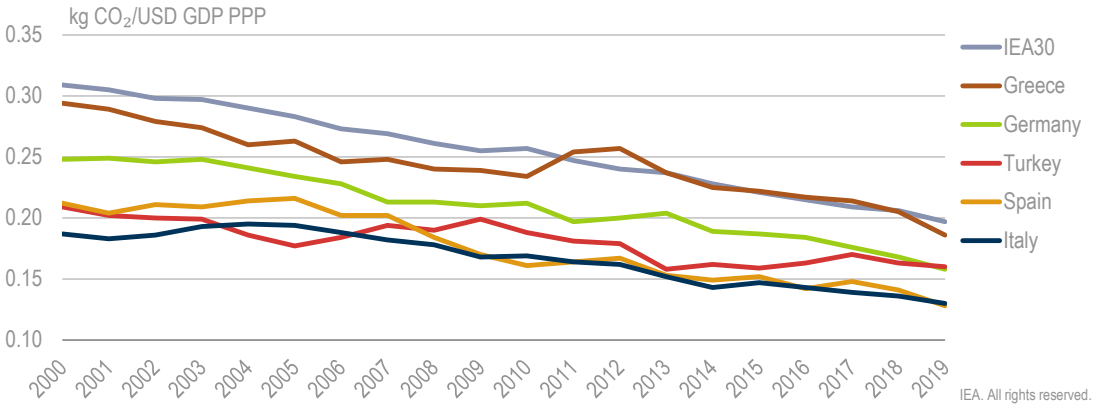
CO_2 emissions per capita



Turkey ranks around the median for CO_2 intensity per GDP among IEA countries, and in the lower half for CO_2 emissions per capita.

* *GDP* data are in billion USD 2015 prices and purchasing power parities (PPPs).
Notes: kg CO_2 = kilogramme of carbon dioxide. t CO_2 = tonne of carbon dioxide. Data are estimates.
Source: IEA (2020), *CO_2 Emissions from Fuel Combustion 2020*, www.iea.org/statistics.

Figure 3.6 CO_2 intensity per GDP in selected IEA member countries, 2000-19

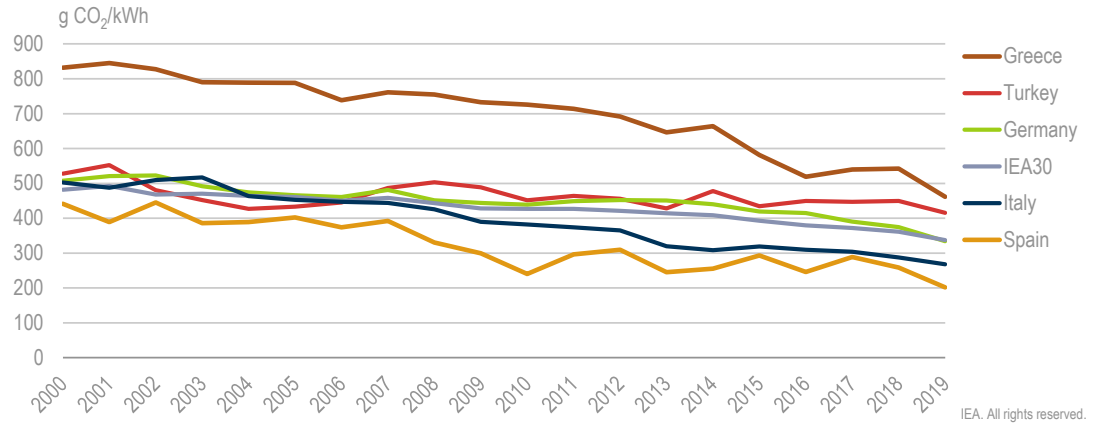


The carbon intensity of Turkey's economy has declined at a slower pace compared to many other IEA countries, with a 23% drop from 2000 to 2019.

Notes: kg CO_2 = kilogramme of carbon dioxide. Data for 2019 are estimates.
Source: IEA (2020), *CO_2 Emissions from Fuel Combustion 2020*, www.iea.org/statistics.

Overall CO_2 intensity of the economy is largely impacted by the CO_2 intensity per unit of heat and power generation. On that indicator, Turkey has seen only a slight decline in recent decades, and even an uptick from 2015, due to rapid growth in coal consumption. Meanwhile, the trend in many other IEA countries is a more significant reduction in CO_2 intensity of power and heat generation (Figure 3.7).

Figure 3.7 CO_2 intensity of power and heat generation in selected IEA member countries, 2000-19



The growth in fossil fuel power generation gives Turkey relatively high carbon intensity per kWh in heat and power, compared to many other IEA countries.

Notes: g CO_2 = gramme of carbon dioxide. Data for 2019 are estimates.

Source: IEA (2020), *CO_2 Emissions from Fuel Combustion 2020*, www.iea.org/statistics.

Institutions

Overall environmental policy in Turkey is directed by the Ministry of Environment and Urbanization, which has taken the lead in drafting the country's main climate change and environmental strategies and action plans. However, a number of other ministries also have considerable jurisdiction over climate change and environmental policies.

For the energy sector, the Ministry of Energy and Natural Resources (MENR) helps to co-ordinate climate and environmental policies. In particular, the Environment and Climate Department, which falls under the MENR's newly created Directorate of Energy Efficiency and Environment (based on a 2019 presidential decree), oversees policies that relate to climate change and environmental management. In the category of climate change, the department's main activities include climate negotiations, mitigation activities and the GHG inventory. In the environmental management category, it includes activities such as environmental impact assessments, water management, air quality, sustainability and soil quality.

The Ministry of Treasury and Finance leads activities related to climate financing and environmental taxation, while the Ministry of Environment and Urbanization also has authority in the area of managing air quality.

In 2013, Turkey established the Climate Change and Air Management Coordination Board to gather public and private institutions, academia, civil society, and other stakeholders on

an *ad hoc* basis to help advance Turkey's National Climate Change Strategy 2010-2023 (OECD, 2019). The board, which falls under the chairmanship of the Minister of Environment and Urbanization, includes representatives from all ministries to help facilitate co-ordination on climate change and air quality across the government. There are seven working groups of experts under this board. The MENR participates in the GHG Mitigation Working Group.

Emissions reduction targets and policies

As part of its INDC submitted to the United Nations Framework Convention on Climate Change (UNFCCC), Turkey proposed to reduce GHG emissions by up to 21% from a business-as-usual level by 2030 (including LULUCF). Turkey's growing economy and population will increase the country's demand for energy in the coming years. As such, the country adopted a business-as-usual baseline for emissions targets, which allows for expansions from current levels.

Turkey has not yet ratified the Paris Agreement, and it may update its INDC in accordance with changing circumstances, based on the results of a technical project being implemented by the Ministry of Environment and Urbanization in co-ordination with member institutions of the Climate Change and Air Quality Coordination Board and private sector representatives, which is due to be completed in March 2021. Specifically, the General Directorate of Industry and Productivity under the Ministry of Industry and Technology is providing sectoral perspectives, information and assessments for the "Capacity Building and Monitoring for Implementation of the GHG Nationally Determined Contribution" project, in co-ordination with the Ministry of Environment and Urbanization. Turkey does not currently plan a peak in its emissions.

Turkey's national climate change plan is embodied in the National Climate Change Strategy, which was approved in May 2010. The implementing plan for the strategy was released in July 2011 as the National Climate Change Action Plan (NCCAP) 2011-2023. Climate change targets are also included in national development plans. The NCCAP includes goals, objectives and actions under sections for mitigation and adaptation. Under the mitigation section, there are plans outlined for the energy, industry, waste, buildings, transportation, land-use and forestry, and agriculture sectors. Under the adaptation section, plans are outlined for water resources management, agriculture and food security, ecosystem services, biodiversity and forestry, natural disaster risk management, and public health sectors.

One of the central tenets of the NCCAP is energy efficiency, first embodied in the National Energy Efficiency Strategy published by the MENR in 2004 and the Law on Energy Efficiency published in 2007. More recently, the government expects the updated National Energy Efficiency Action Plan for 2017-2023 to achieve more significant emissions reductions. The NCCAP also includes plans to expand the capacity of renewables (including hydropower).

In addition to efficiency, Turkey has identified nuclear power as a key low-carbon source to transition to a cleaner energy future, and has included it in its INDC. Although Turkey currently does not have any nuclear power capacity, its development is one of the strategic objectives of the MENR as part of its climate mitigation efforts. Based on an agreement with the Russian Federation, the government expects the first four units of the country's

first nuclear power plant, the Akkuyu nuclear power plant, to be completed by 2026, with the first reactor scheduled to be commissioned in 2023.

Among its targets, the NCCAP calls for reducing primary energy intensity by 10% from 2008 levels by 2015, reducing annual energy consumption in public buildings by 20% by 2023, meeting 20% of annual energy demand in new buildings from renewable sources by 2017, and increasing rail transport for freight to 15% (from 5% in 2009) and to 10% in passenger transport (from 2% in 2009) by 2023. Turkey has made some progress toward these objectives, but is still falling short in many areas given strong economic growth and energy demand. Moreover, the NCCAP did not include quantitative targets for overall emissions reductions, focusing instead on objectives. As such, there is no formal benchmarking or monitoring of progress.

Turkey will need to update its NCCAP and the National Climate Change Strategy by the end of 2023. As part of this exercise, the government also plans to review long-term (2030-50) policy and strategy options. The process for updating the NCCAP is due to start at the end of 2020.

Sectoral policies

The NCCAP included several action items to address emissions in the electricity sector, including improving efficiency and expanding the use of clean energy. Overall, though, Turkey's main objective as it relates to the electricity sector is to continue the promotion of domestic energy resources. This includes the commissioning of 10 000 megawatts (MW) each of solar and wind power capacity over 2017-27 (see Chapter 5). In addition, Turkey is commencing a nuclear power programme, with the first two units of the Akkuyu nuclear power plant (out of four total) currently under construction, and plans for two additional plants to follow (see Chapter 10). In addition, as part of its strategy to reduce dependence on imported energy sources, Turkey wants to add new lignite power generation capacity of 7.5 gigawatts (GW) by 2027, though may change that target according to reserve reports that will be prepared by internationally authorised institutions (see Chapter 11). From a climate change perspective, although the expansion of renewables and nuclear power will lead to a reduction in power sector emissions, the growth in coal-fired generation (on an absolute rather than a percentage basis) risks offsetting some of these benefits, even in a context of reduced combustion of natural gas in power generation.

For the transport sector, the NCCAP 2011-2023 identifies several actions, including: 1) promoting energy-efficient vehicles; 2) developing comparative studies on alternative fuels and new technologies; 3) developing and improving bicycle and pedestrian transport; 4) reducing the use of passenger cars to reduce traffic density in cities; 5) developing and implementing institutional restructuring for urban transport; 6) strengthening maritime transport; and 7) strengthening rail transport and collecting data on transport. Nonetheless, road transport continues to dominate Turkey's transport systems, suggesting more progress can be made on achieving the objectives for the sector.

In the buildings and industry sector, the NCCAP included several action items to increase efficiency, which were more recently updated in the National Action Plan on Energy Efficiency (see Chapter 4).

In agriculture, in order to reduce CO_2 emissions from tractors and fuel oil consumption, the General Directorate of Agricultural Research and Policies (TAGEM) of the Ministry of

Agriculture and Forestry created the National Electric Tractor Prototype; additional R&D studies in the field are ongoing.

Climate financing

Over the years, Turkey has forged successful partnerships with multilateral development banks, which include projects that reduce GHG emissions. These projects usually involve grants and concessional loans from multilateral funds, such as the Global Environment Facility (GEF) and the Climate Investment Funds. To date, Turkey has received approximately USD 435 million from the Clean Technology Fund and the amount of co-financing in the same period is approximately USD 4.9 billion. Since the GEF's inception, Turkey has received GEF grants totalling around USD 111 million that leveraged USD 1.1 billion in private sector co-financing for 34 national projects. Turkey also took part in 34 regional/global GEF projects totalling around USD 299 million and these projects have mobilised a total of USD 1.3 billion in co-financing.

Beyond providing the necessary financing for innovative and sustainable projects, the government of Turkey views such partnerships as an important opportunity for policy dialogue with international partners on climate change action. Turkey is, therefore, open to support from the international community in the form of technical assistance and climate finance to help it combat climate change.

In addition to multilateral development banks and multilateral climate funds, bilateral financial institutions (KFW, AFD, JBIC, etc.) also make important contributions to Turkey's efforts to address climate mitigation and adaptation.

However, due to its current status under the UNFCCC, Turkey is not able to benefit from the Green Climate Fund. The negotiations regarding Turkey's access to climate financing, including the Green Climate Fund, are ongoing under the UNFCCC.

Emissions monitoring

Within the scope of legislation, industries mentioned in emissions data regulation are subject to annual monitoring, reporting and verification processes. The monitoring plans, which are prepared as outlined in law, are delivered to the MENR via the Environmental Information System. Monitoring plans and annual emissions reports from 700 installations and systems cover 50% of all GHG emissions in Turkey.

In addition, the Ministry of Environment and Urbanization and Germany's Federal Ministry for the Environment, Nature Conservation and Nuclear Safety have been co-ordinating and implementing the Capacity Development for the Implementation of a Monitoring Reporting and Verification System for Greenhouse Gas Emissions Project since 2014. The main purpose of this project is to help Turkey introduce an monitoring reporting and verification system that provides a reliable and robust source of data to identify GHG emissions, and thereby create a solid foundation for future mitigation measures.

Turkey is also part of the Partnership for Market Readiness Project (PMR), which brings together more than 30 countries, various international organisations and technical experts to facilitate country-to-country exchange and knowledge sharing toward the establishment of carbon markets. The first phase of the PMR Turkey project, assessing the suitability of carbon pricing instruments, was completed in December 2018; it determined that an emissions trading scheme (ETS) would be the most suitable market mechanism for Turkey

to reduce emissions. While no political decision with respect to carbon pricing in Turkey has been taken yet, the second phase of the PMR, which began in January 2019, aims to complete technical work for a pilot ETS. The PMR also included work to support Turkey's capabilities in monitoring, reporting and verification of emissions (PMR, 2018).

Environmental research

Another focus area for Turkey's climate and energy policies is research, development and deployment (RD&D) (see Chapter 6). The funding mechanisms of the Scientific and Technological Research Council of Turkey (TÜBİTAK) and TAGEM include considerations related to sustainability and environmental impacts. Environmental research activities are conducted within the Environment and Cleaner Production Institute of TÜBİTAK's Marmara Research Center. The institute's fields of activity include resource efficiency, cleaner production, climate change, air quality monitoring, waste management and wastewater treatment applications.

In addition, the United Nations' Sustainable Development Goals are promoted to provide direction to the research community. The co-benefits of climate and energy policies on health and well-being, including air quality, are also seen as an opportunity for linking climate and energy policies to sustainable development.

TAGEM has also started to establish solar power plants in research institutes in order to reduce electricity costs.

Air quality

Air pollution and quality are major concerns, especially in large cities and industrialised regions. Turkey had targeted lowering the limit values for PM_{10}, $PM_{2.5}$ and SO_2 to align them with EU Directive levels by 2019. However, population exposure to particulate matter is higher than the EU and OECD averages, and exceed EU standards and World Health Organization guidelines.

The 2008 Regulation on Ambient Air Quality Assessment and Management is mainly implemented through local clean air action plans (CAAPs). CAAPs for cities with high pollution potential were prepared for 2014-19 by provincial directorates in co-ordination with the relevant stakeholders. By 2020, the CAAPs are due to be revised by the provincial directorates together with municipalities and the regional clean air centres for the period 2020-24.

The Regulation on Air Quality Assessment and Management (BAQAM) is being revised to harmonise it with the EU Clean Air for Europe Directive (2008/50/EC). Other regulations govern emissions from residential heating, exhaust gas emissions of motor vehicles and industry. Ambient air quality standards were revised in 2009 and planned to gradually become more stringent. By 2019, most of these standards had been aligned with EU standards, while those for NO_2 will be in 2024. The by-law is still under revision regarding the structural situation of the regional clean air centres within the country.

The Regulation on Air Quality Assessment and Management is mainly implemented through the CAAPs at the provincial level. The work is co-ordinated by provincial directorates of the Ministry of Environment and Urbanization. Provinces and cities are categorised as having a high or low "pollution potential". Based on the 2012-13 air quality assessment, 64 of 81 provinces had high pollution potential. CAAPs have been prepared

and enacted in these provinces, while for the remaining 17 provinces, the plans are voluntary. The main measures in the CAAPs relate to industry, residential heating and road transport. They stipulate bicycle lanes, city railway networks, filters for industrial processes, closed systems for coal storage, central heating for specific industrial sites (e.g. shoe manufacturing), building insulation, smart traffic control systems, etc. When limit values are exceeded, local environmental boards may enforce some measures, such as alternate vehicle circulation and restrictions on residential heating.

Several institutions at the provincial level are involved in the preparation and implementation of the CAAPs, but the main responsibilities lie with municipalities. Implementation of the CAAPs is slowed down in some cases due to high municipal staff turnover, frequent amendments to the legislation regulating roles and responsibilities, and limited technical and human resource capacity at the provincial and municipal levels, especially in less-developed regions.

Thermal power plants in Turkey are subject to the Industrial Air Pollution Control Regulation, which sets limit values for air pollutants such as SO_2, CO, NO_X and particular matter. According to Temporary Article 8 of the Electricity Market Law, additional time was granted to existing privatised and public thermal power plants in order to realise investments related to the environmental regulation and to complete necessary permits until the end of 2019. The government's decision of not giving extra time for existing privatised and public thermal power plants to receive environmental permits beyond the end of 2019 was part of an effort to address public health concerns over air pollution (see Chapter 11).

Adapting to climate change

The National Climate Change Adaptation Strategy and Action Plan (NASAP), adopted in 2011, constitutes the basis of Turkey's adaptation policies. It includes short- and medium-term objectives and actions to be implemented through 2023 related to:

- water resources management
- the agricultural sector and food security
- ecosystem services, biodiversity and forestry
- natural disaster risk management
- human health.

The NASAP notes that Turkey's location in the Mediterranean Basin makes it more susceptible to arid conditions and heat waves as a result of climate change. For Turkey specifically, the government expects temperature increases in certain inner regions of up to 5°C and in the Aegean and Eastern Anatolia regions of up to 4°C. In addition to negative implications for water and soil resources, it will also significantly increase Turkey's demand for cooling in the coming decades, relative to modest levels at present.

The energy sector will also be effected by the impacts of sea level changes and more extreme weather on infrastructure. In particular, the scarcity of water resources will have direct implications for Turkey's hydropower capacity, which currently accounts for nearly 30% of total electricity generation. As such, the NASAP calls for special consideration of climate change impacts when undertaking site selection and planning for hydro projects. The plan also pushes for a similar approach for geothermal projects. The government

considers district heating plans using geothermal energy as well as increased use of geothermal heats pumps as important tools for climate adaptation (Ministry of Environment and Urbanization, 2011). However, Turkey should more thoroughly examine climate risks posed to its energy sector, including those beyond hydro availability, such as for cooling of thermal power plants, in light of the water stresses that the country faces. A national study (see below) will help towards this end.

Turkey's adaptation plan aims to incorporate climate adaptation planning into national development plans and policies including cost-benefit analyses related to the interplay of climate mitigation and adaptation. It also envisages the creation of a "Climate Change Regional Center" in Turkey to facilitate regional and international co-operation in the field of climate adaptation.

As 2023 approaches, Turkey plans to update the NASAP on the basis of the latest scientific data and information with the aim of building a climate-resilient society, especially targeting the country's most vulnerable communities. In this regard, a comprehensive project called Enhancing Adaptation Action in Turkey has been designed by the Ministry of Environment and Urbanization, which began in October 2019. The objective of the project is to increase societal resilience by strengthening climate change adaptation at sectoral and urban levels. With this project, Turkey aims to update the NASAP by undertaking climate impact and vulnerability assessments for priority sectors, including energy. In addition to the national study, the country plans to undertake local evaluations and prepare local climate change adaptation action plans for four metropolitan areas. Moreover, it aims to establish a Climate Change Platform where all studies, data and scientific publications will be shared and which can provide a communication network for all institutions and experts working in the field of climate change. Additionally, Turkey's capacity for adapting to climate change will be improved with a grant of EUR 6.8 million, which will be provided within the framework of this project.

The NASAP will be updated in line with the European Union Adaptation Framework, after which it will be implemented.

Assessment

In a context of strong economic and population growth relative to other OECD countries, Turkey's GHG emissions have steadily expanded, registering 137% growth in 2018 from 1990 levels and 55% from 2005. Energy sector emissions (including CO_2 emissions from combustion in heat and power generation, services, households, transport, and industry) account for the bulk of GHG emissions, and have driven total growth over the past few decades.

Energy-related CO_2 emissions in Turkey have increased over the last five years and by more than 43% in the last decade. Electricity and heat generation was the largest emitting sector, followed by transport, industry, residential, services and other energy. Emissions have increased across all sectors in recent years, with the exception of the residential, services and other energy sectors. In particular, transport emissions grew by 63% from 2012 to 2018, electricity and heat sector emissions grew by 25%, and industry emissions grew by 33%.

Energy-related CO_2 emissions in Turkey have increased due to growth in energy demand as a result of economic and population growth. According to IEA data, coal combustion has been the largest source of CO_2 emissions since 1997. Emissions from oil combustion were relatively stable up until 2014, but have jumped in the past five years, reflecting rapid growth in oil consumption in transport. Natural gas emissions have also increased in line with growing consumption in the industry and residential sectors especially.

Turkey's ability to manage CO_2 emissions growth will, therefore, primarily stem from policies to decarbonise the electricity and transport sectors. While Turkey's plans to diversify its electricity mix toward nuclear and renewables will help slow the growth in energy-related emissions, this will require in parallel to limit and then decrease the use of coal in electricity and heat generation. However, even though Turkey plans to maintain the same share of coal in its power generation mix, the absolute volumes of coal-fired generation will grow in line with rising electricity demand. Moreover, an almost exclusive dependence on oil in transportation presents opportunities to slow down rising emissions from the sector, not only through fuel efficiency measures, but also by diversification to alternative fuels, including biofuels and electricity. The IEA encourages stronger policies to incentivise these shifts in fuel consumption. When it comes to industry, the primary policy to date has been through energy efficiency measures; Turkey could consider a more strategic approach to fostering low-carbon industrial development.

Compared to other IEA countries, Turkey had the sixth-lowest emissions per capita in 2019 (after Sweden, Mexico, Switzerland, Portugal and France) and is around the median for CO_2/GDP. The carbon intensity per GDP has been relatively stable in Turkey compared to other IEA countries, where it has declined more significantly. The CO_2 intensity of electricity and heat generation has increased since 2015, unlike the trend for most IEA countries.

As part of its INDC submitted to the UNFCCC, Turkey proposed to reduce GHG emissions by up to 21% from a business-as-usual level by 2030 (including LULUCF). The target would still amount to a significant expansion (more than doubling from 2015 levels) of Turkey's emissions from current levels, given a projected rapid expansion in economic activity and energy demand under business-as-usual assumptions in light of its present level of economic development. Whether or not Turkey ratifies the Paris Agreement, it should seek to implement cost-effective opportunities to achieve greater emissions reductions across all sectors of the economy.

Turkey's national climate change plan is embodied in the National Climate Change Strategy, approved in May 2010. The implementing plan for the strategy was released in July 2011 as the NCCAP 2011-2023. A central tenet of the NCCAP is energy efficiency, a position that the IEA commends as the "first fuel" of the energy sector. To this end, the updated National Energy Efficiency Action Plan 2017-2023 is expected to achieve additional emissions reductions. The NCCAP also includes plans to expand the capacity of renewables (including hydropower). Turkey has made some progress toward the NCCAP's objectives, but is still falling short in many areas, given strong economic and energy demand growth. Moreover, the NCCAP did not include quantitative targets for overall emissions reduction, focusing instead on objectives. Quantitative targets would allow for more accurate benchmarking of progress toward environmental goals. In addition, a system for regularly monitoring progress should also be put in place.

Turkey will need to update its NCCAP and National Climate Change Strategy by the end of 2023, a process that will commence in 2020. The government is also reviewing long-term

(2030-50) policy and strategy options. The IEA welcomes a focus on long-term objectives, and encourages the government to expedite its efforts to review and define longer term targets and strategies to reduce emissions. This has thus far been a policy gap in Turkey, as a long-term strategy provides clearer investment signals to the energy sector and can help unlock additional opportunities in clean energy technologies. Defining longer term emissions goals can also help inform broader energy policy-making strategies, such as the role of renewables and nuclear in electricity generation as well as fuel switching in transport, industry and buildings.

From an institutional perspective, though Turkey's Ministry of Environment and Urbanization is the main institution with jurisdiction over climate change and environmental issues, several other ministries and departments also have considerable authority in these areas, including the MENR and the Ministry of Treasury and Finance. The establishment of the Climate Change and Air Management Coordination Board is a good first step toward boosting co-ordination on climate and environmental issues across the government, but additional -ordination of policies across sectors and departments would provide further benefits to ensuring results toward common goals.

Though Turkey offers funding mechanisms through TÜBİTAK and TAGEM that include considerations related to sustainability and environmental impacts, it can build upon progress in the RD&D area to provide support to emerging technologies in the low-carbon space.

Over the years, Turkey has benefited from grants and concessional loans from multilateral funds, such as the GEF and the Climate Investment Funds, focused on reducing GHG emissions. These partnerships are an important opportunity for policy dialogue with international partners on climate change action. Turkey therefore seeks support from the international community in the form of technical assistance and climate finance to help it combat climate change. It should also consider conducting more technical co-operation exercises with other countries, particularly those that would benefit from Turkey's know-how and experience.

While Turkey has no explicit climate policies targeting industrial sectors, it has put in place emissions monitoring for both the industry and power sectors, currently covering over 700 installations and nearly half of national GHG emissions. The resulting data and establishment of measurement, reporting and verification systems will enable policy options to tackle emissions from these sectors. Turkey is investigating technical options for carbon pricing mechanisms under the World Bank's Partnership for Market Readiness Project. The first phase of the project determined that an ETS would be the most suitable market mechanism for Turkey to reduce emissions, while the second phase aims to complete technical work for a pilot ETS. Emissions trading schemes have proven to be effective market-based tools to reduce CO_2 emissions in IEA countries, and other countries such as the People's Republic of China have also adopted them. The IEA encourages the government to promptly launch the pilot programme.

Air pollution related to the energy sector in major cities is also a concern. CAAPs for cities with high pollution levels were prepared for 2014-19 by provincial directorates in co-ordination with the relevant stakeholders. By the end of 2019, plans were due to be updated for 2020-24 by 64 cities. Incorporating clean air policies into the strategy of the MENR's climate and environmental departments would help to better achieve synergies toward realising environmental benefits.

Recommendations

The government of Turkey should:

- Define mid- and long-term emissions reduction targets to help guide sustainable energy policy making, including a plan for peaking of emissions.
- Update the National Climate Change Action Plan in the planned time frame with ambitious and quantifiable measures that reflect new market and technological developments on clean energy, and put in place methods to monitor progress.
- Based on current technical studies from the Partnership on Market Readiness, implement a pilot emissions trading system in the power and industrial sectors, with a view to establish a full ETS or other carbon pricing system.
- Build upon progress from the Climate Change and Air Management Coordination Board to further improve institutional co-ordination on climate and environmental strategies to guide common outcomes across departments and ministries.

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4. Energy efficiency

Key data

(2018)

Total final consumption (TFC): 103.0 Mtoe (oil 38.0%, natural gas 24.2%, electricity 21.3%, coal 10.3%, bioenergy and waste 2.5%, geothermal 1.9%, district heat 1.0%, solar 0.9%), +39.3% since 2008

Consumption by sector: industry 36%, transport 27%, residential 20%, services/other 17%

Energy consumption (TFC) per capita: 1.3 toe/capita (IEA average 2.9 toe/capita), +21% since 2008

Energy intensity (TFC/GDP*): 45 toe/USD million PPP (IEA average: 73.9 toe/USD million PPP), -17% since 2008

* Gross domestic product (GDP) in 2015 numbers and PPP (purchasing power parity).

Overview

Following the global financial crisis in 2008, Turkey has seen both its gross domestic product (GDP) and energy consumption rebound rapidly. Even though the country's energy intensity is low compared to other IEA countries, continued economic and population growth are expected to drive an additional increase in energy demand. As such, Turkey has considerable room to decouple economic and population growth from energy consumption in future years, bolstered by policy measures.

To this end, Turkey has already prioritised the role of energy efficiency in its energy policy making in order to reduce energy costs, lower imports, cut emissions and improve energy security. In 2007, the government passed the Energy Efficiency Law, followed by the Energy Efficiency Strategy in 2012. More recently, the new National Energy Efficiency Action Plan (NEEAP) was finalised in 2018, and serves as the guiding document for measures aimed at reducing energy intensity and encouraging effective use of energy. To be fully effective, the Turkish government should adopt and implement all relevant measures, including secondary energy efficiency legislation, and address market distortions in key sectors.

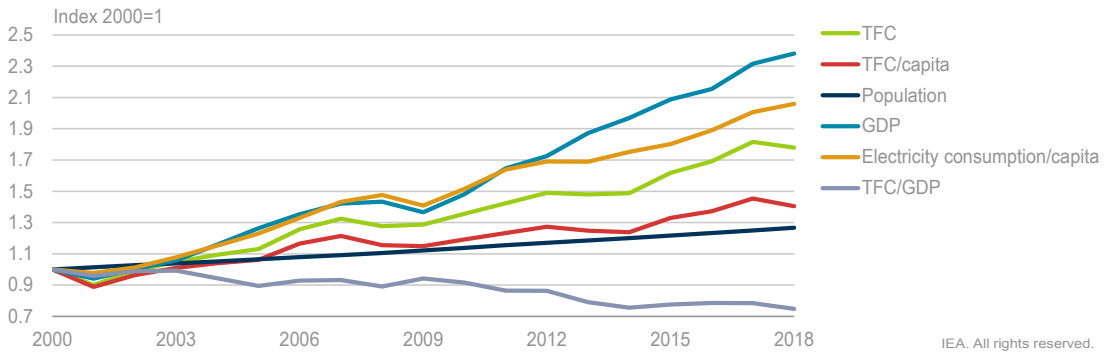
Energy intensity

Turkey has low energy intensity compared to other IEA member countries, but energy consumption has increased significantly in recent decades due to strong economic development and population growth. From 2000 to 2018, Turkey's population increased

by 27%, while GDP measured in purchasing power parity (PPP) more than doubled, leading to GDP per capita growth of 88%.

The global financial crisis in 2008 led to a 4% drop in GDP during 2007-09, which also caused total final consumption (TFC) to decline by 3%, showing the impact of economic growth on energy demand. However, both GDP and energy consumption rebounded to above pre-crisis levels in 2010. TFC has increased rapidly in recent years, except for a decline in 2013, when consumption in industry and residential sectors fell slightly. Turkey has not yet shown a decoupling of energy consumption from population growth, and energy consumption has only slightly decoupled from economic growth.

Figure 4.1 Energy consumption and drivers, Turkey, 2000-18

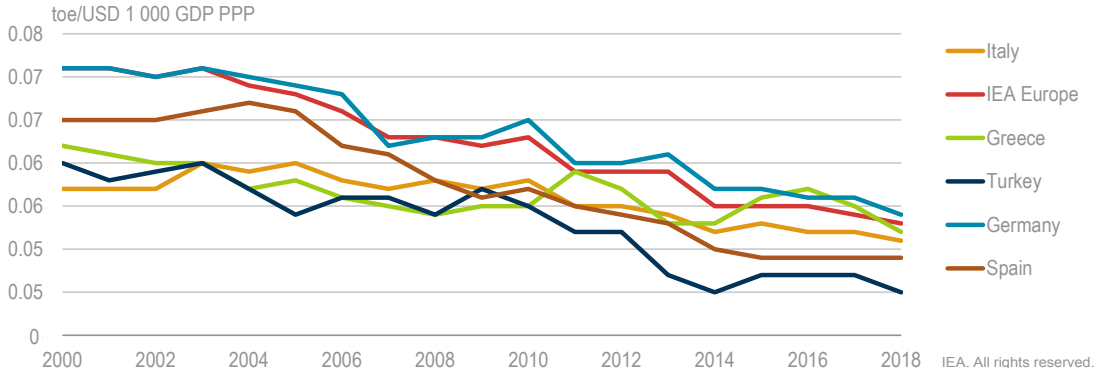


Turkey's total energy consumption is on the rise, in step with population and economic growth. However, energy intensity (TFC/GDP) has declined by 25% since 2000.

* *GDP* data are in billion USD 2015 prices and PPP (purchasing power parity).
Note: TFC = total final consumption. GDP = gross domestic product.
Source: IEA (2020a), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

In 2018, the energy intensity of the Turkish economy, measured as the ratio of TFC per unit of GDP, was 45 tonnes of oil equivalent (toe) per USD million PPP; a decline of 25% since 2000 (Figure 4.2). Turkey has low energy intensity in an IEA comparison, both by capita and by GDP. Turkey's TFC per unit of GDP was the fourth-lowest among IEA member countries, while its energy intensity per capita was the second-lowest after Mexico (Figure 4.3).

Figure 4.2 Energy intensity in select IEA member countries, 2000-18

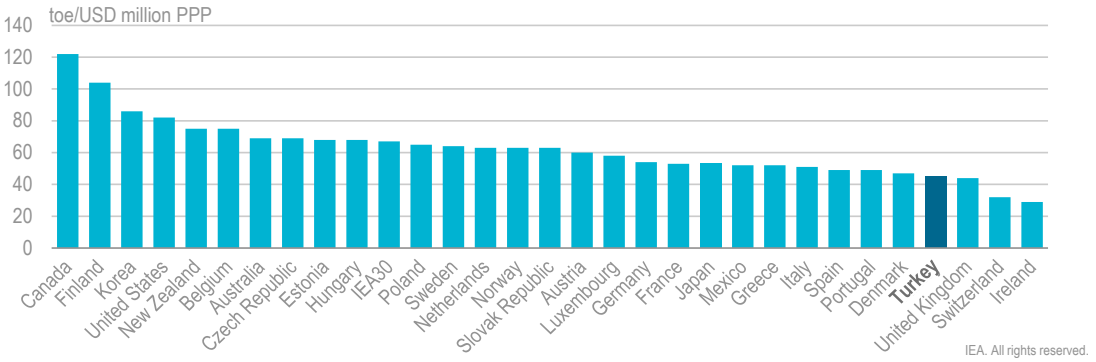


Turkey's energy intensity per unit of GDP has decreased in recent decades, and has been among the lowest compared to other IEA member countries.

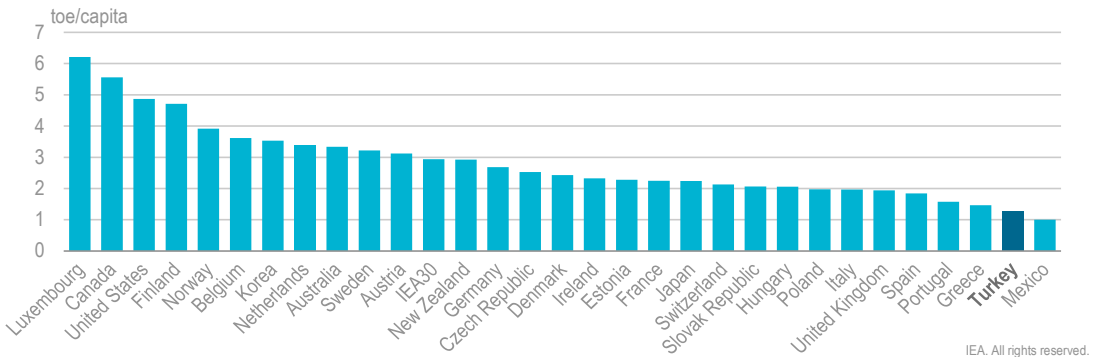
Notes: toe = tonne of oil equivalent. Energy intensity as TFC/GDP (2015 prices with PPP).
Source: IEA (2020a), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Figure 4.3 Energy intensity in IEA member countries, 2018

Energy consumption per GDP (TFC/GDP PPP)



Energy consumption per capita (TFC/capita)



In 2018, Turkey had the second-lowest TFC/capita in the IEA and the fourth-lowest TFC/GDP.

Notes: toe = tonne of oil equivalent. Energy intensity in total final energy consumption, not including the energy transformation sector. GDP data are in billion USD 2015 prices and PPP (purchasing power parity).

Source: IEA (2020a), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Institutions

The Department of Energy Efficiency and Environment (DEEE)[6] was established within the Ministry of Energy and Natural Resources (MENR) by presidential decree in January 2019 to oversee energy efficiency policies and programmes. Another decree from December 2019 (2019/27) put in place a National Energy Efficiency Action Plan Monitoring and Steering Board to monitor and direct energy efficiency programmes and the implementation of the NEEAP. The DEEE is undertaking a technical assistance programme to enhance the institutional capacity of the department in order to help implement efficiency strategies, particularly in line with EU directives.

The DEEE maintains its own database (EnVer Portal), which includes the energy consumption data of buildings and industrial enterprises over a certain size. Using the raw data, DEEE sectoral experts produce annual reports, including indicators such as

[6] Before the establishment of this department, a department under the abrogated General Directorate of Renewable Energy (replaced by the General Directorate of Energy Affairs) dealt with energy efficiency issues.

energy intensity and an energy efficiency index. Generated indicators are also used for preparing national progress reports and benchmarking studies.

The DEEE is the lead organisation tasked with implementing the NEEAP. In addition, 16 institutions are identified as responsible for implementation of the action plan and 36 other organisations, including sector associations, non-governmental organisations and universities, are identified as relevant organisations to help responsible institutions. The DEEE has also responsibilities on certification, authorisation, auditing, trainings and incentives, among other areas.

While the DEEE under the MENR is responsible for preparing drafts of energy efficiency legislation, strategy and action plans as well as regulatory impact assessments and monitoring and evaluation of measures, implementation of energy efficiency policies for the buildings sector are mostly directed from the Ministry of Environment and Urbanization. The Ministry of Transport and Infrastructure oversees efficiency policies and regulations as they relate to the transport sector. The DEEE has a leading role on efficiency programmes in the industry sector, in co-ordination with the Ministry of Industry and Technology; energy efficiency studies in the industrial sector are carried out by the Ministry of Industry and Technology and the MENR under different programmes. The Ministry of Agriculture and Forestry is responsible for the implementation of energy efficiency policies in the agricultural sector.

Turkey also participates in several international collaborations on energy efficiency, including the Energy Efficiency and Low Carbon Supply of Heating & Cooling Project with Denmark, the Energy Efficiency Network Project with Germany, and the International Training on Energy Efficiency and Management in Industry and Buildings Project with Japan. In addition, Turkey is a participant in IEA technology collaboration programmes related to energy efficiency and renewables, including Energy Storage, Hybrid and Electric Vehicles, Photovoltaic Power Systems, and Solar Heating and Cooling.

Energy efficiency policies

Turkey sees energy efficiency as an area that complements and cross-cuts its national strategic goals of easing the burden of energy costs on the economy, ensuring energy supply security, alleviating risks arising from external dependency, transitioning to a low-carbon economy and protecting the environment. In this context, the Energy Efficiency Law adopted in 2007 started a new transformation process. The Energy Efficiency Strategy issued in 2012 set energy efficiency goals for 2023, and the NEEAP was formulated for effective implementation and monitoring.

The NEEAP, covering the period 2017-23, was adopted in 2018 with support from the European Bank for Reconstruction and Development. The NEEAP was designed to closely mirror energy efficiency activities and policies of the European Union (Rosca, 2018). It aims to reduce Turkey's primary energy consumption by 14% over 2017-23 from a business-as-usual baseline (174 million tonnes of oil equivalent, Mtoe) through 55 actions defined in 6 categories: 1) buildings and services; 2) energy; 3) transport; 4) industry and technology; 5) agriculture; and 6) cross-cutting areas. It is projected to achieve cumulative savings of 23.9 Mtoe by 2023, toward which USD 10.9 billion of investments will be made. The cumulative savings by 2033 are projected to be USD 30.2 billion at 2017 prices; the effect of certain savings are expected to continue

through 2040. The government estimates the average payback period for the actions to be seven years. The NEEAP was prepared in compliance with the template set in the EU Energy Efficiency Directive 2012/27/EU, which allows for comparing and monitoring studies with EU countries. Obligated parties under the plan are required to provide data to the DEEE annually for inclusion in its database (EnVer Portal).

Some areas envisaged under the NEEAP have yet to be implemented, including secondary legislation for energy performance contracts as well as national financing mechanisms such as energy efficiency auctions and energy efficiency obligations.

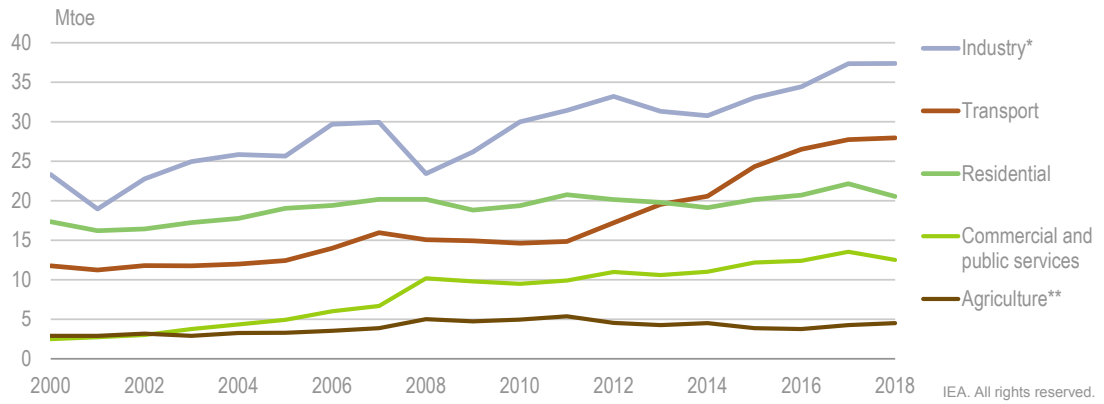
Presidential Decision No. 2850 on the Procedures and Principles Regarding Energy Performance Contracts in the Public Sector was published in the Official Gazette on 21 August 2020. The purpose of this decision was to determine the procedures and principles regarding energy performance contracts to be concluded by public institutions and organisations to reduce their energy consumption or energy costs.

Within the scope of developing financial mechanisms for energy efficiency, the "Supporting the Establishment of National Energy Efficiency Financing and Tender Mechanisms" project, financed by the European Bank for Reconstruction and Development, was launched on 28 May 2019. A road map will be developed for a national energy efficiency mechanism and a competitive energy efficiency tendering mechanism, which has been integrated into the proposed mechanism.

Energy consumption by sector

Industry is the largest energy-consuming sector in Turkey, with 36% of TFC in 2018, followed by transport at 27%; both have increased significantly in the last decade (Figure 4.4). Residential, services and agriculture account for the rest of TFC, with 20% for residential, 12% for commercial and public services, and 4% for agriculture. Energy consumption in these sectors has been more stable in the last decade. The rest of this chapter will look at these sectors in more detail.

Figure 4.4 Energy consumption by sector, Turkey, 2000-18



Energy demand in industry and transport has significantly increased, while energy consumption in other sectors has been relatively stable.

* *Industry* includes non-energy consumption.

** *Agriculture* includes a small share of energy used in fishing.

Note: Mtoe = million tonnes of oil equivalent.

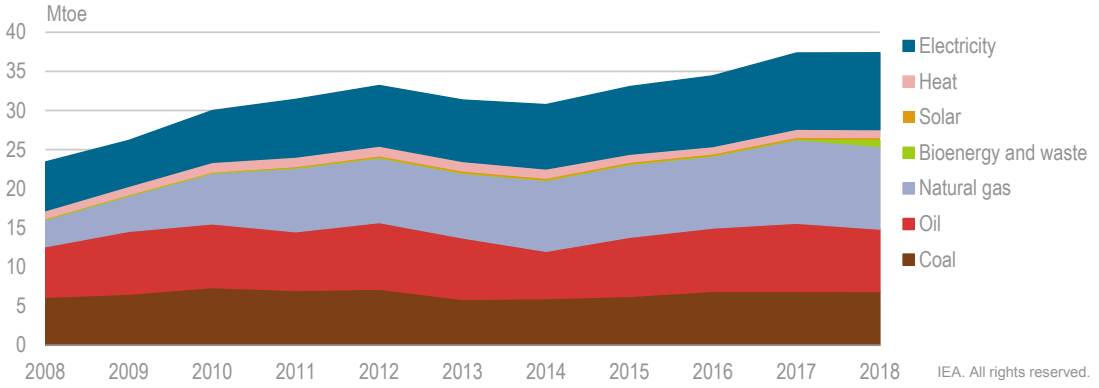
Source: IEA (2020a), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Industry

Energy consumption in industry

As the largest energy-consuming sector, industry used 37.4 Mtoe in 2018 (Figure 4.5). Consumption increased by 60% between 2008 and 2018, despite a slowdown during 2012-14. Over half of the recent increase in industrial energy demand has been covered by growth in natural gas, which has been the largest energy source used in industry since 2011. In 2018, natural gas accounted for 28% of energy consumed in industry, followed by electricity (26%), oil (21%), coal (18%) and small amounts of district heat, bioenergy and waste, and solar.

Figure 4.5 Energy consumption in industry by fuel, Turkey, 2008-18

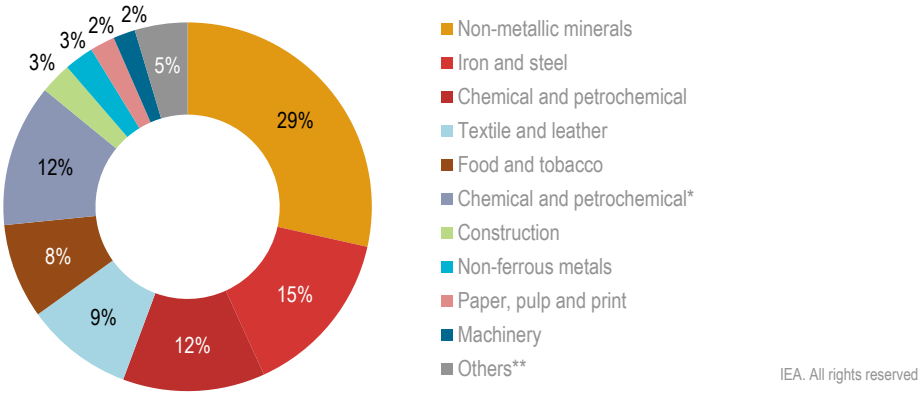


Industrial energy consumption has increased by around 60% over the last decade, and the growth in demand has mostly been met with increasing shares of natural gas and electricity.

Notes: Mtoe = million tonnes of oil equivalent. Includes non-energy consumption.
Source: IEA (2020a), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Turkey's industrial fuel consumption is spread out over several energy-intensive sectors. In 2018, the non-metallic minerals industry, mainly cement production, was the largest energy-consuming sub-sector, at 29% of TFC in industry (Figure 4.6). Turkey is one of the main producers and consumers of cement worldwide; the sector has led energy demand in non-metallic minerals industries to surge almost threefold in a decade. Iron and steel was the second-largest energy consumer in industry, with 15% of total demand in 2018, followed by the chemical and petrochemical industry with 12%, of which around one-third was oil products used for non-energy use. Both of these sectors have also experienced rapid growth in the last decade. From 2008 to 2018, energy consumption in iron and steel increased by 43%, and in chemicals and petrochemicals by 140%. Other industry sectors also grew fast, such as textile and leather (+191%), and food and tobacco (+134%).

Figure 4.6 Fuel consumption in industry sectors, Turkey, 2018



The three largest energy-consuming industry sectors are non-metallic minerals, iron and steel, and chemicals and petrochemicals, which together account for over half of total demand.

* Consumption in chemical and petrochemical includes non-energy use.

** *Other* includes wood and wood products, transport equipment, and mining and quarrying.

Source: IEA (2020a), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Industry policies

Energy efficiency has become a priority area for industry given that energy costs constitute one of the heaviest burdens on enterprises.

Large-scale investments of industrial enterprises in the manufacturing industry with annual energy consumption of 500 tonnes of oil equivalent (toe) and above, which provide at least 15% energy savings compared to the current situation, benefit from regional incentives by the Ministry of Industry and Trade. The technical evaluation of investments is made by the MENR. Enterprises meeting the energy efficiency criteria benefit from a value-added tax exemption, customs tax exemption, insurance premium support, interest support, tax reduction and investment location support.

The Eleventh Development Plan (2019-2023) sets out the following measures with the aim of increasing energy efficiency in the manufacturing industry:

- A support mechanism will be established to replace inefficient electric motors used in the industry with efficient ones.
- Co-generation systems will be expanded in large industrial facilities using heat.
- Energy efficiency projects will be supported with competitions in order to introduce and disseminate exemplary energy efficiency practices, and the establishment of legislation and technical infrastructure for implementation will be ensured.
- Heat market legislation will be prepared for the generalisation of energy-efficient district heating and cooling systems throughout the country and to enable heat trade.
- Projects with high savings potential will be supported by improving efficiency-enhancing project implementation processes.
- Organised industrial zones will be supported to prepare and present their efficiency action plans by completing the Energy Management Unit and ISO 50001 Energy Management System establishment.
- Domestic production in the sector will be developed through activities that increase energy efficiency in the electrical machinery and white goods sector.

The NEEAP identifies seven actions to improve energy efficiency in the industry and technology sectors. These include capacity-building activities, mapping the energy savings potential in industry, increasing the diversity of projects, defining new financial support mechanisms, scaling up co-generation systems in large heat-using facilities, and implementing an environmentally friendly design and labelling system for appliances.

The Regulation on Increasing Efficiency in the Use of Energy Sources and Energy defines requirements for industrial enterprises of a certain size to commission energy efficiency audits every four years and establish energy management structures. Specifically, industrial enterprises with an annual energy consumption of at least 1 000 toe are required to assign energy managers and conduct audits, while those with annual consumption of at least 50 000 toe are required to establish an energy management unit. The DEEE offers training programmes and audit support in this regard. Apart from the DEEE, a professional chamber, a university and MENR-certified companies called “energy efficiency consulting companies” (referred to as ESCOs or EVDs in Turkey) also provide training. Audit support is given by the Small and Medium Enterprises Development Organization of Turkey (KOSGEB) to small and medium-sized enterprises (SMEs). Companies are not obliged to implement measures identified in audits, but they are encouraged to do so.

In addition, various support mechanisms were introduced in 2009 to support efforts at industrial plants to minimise energy waste, losses and inefficiencies such as energy efficiency improvement projects (EEIPs) and voluntary agreements. A company can apply and receive grants for EEIP implementation and voluntary agreements at the same time.

Investments for energy efficiency projects designed with a simple payback period of five years or less in manufacturing industry plants with a minimum of 500 toe of annual energy consumption (lowered in 2019 from 1 000 toe), can benefit from the EEIP incentives. The grants support 30% of a maximum project cost of TRY 5 million (EUR 759 000). An EEIP observation commission checks the eligibility with an initial audit that establishes the potential. In the two-year implementation period, the commission monitors the project to check if the results meet the expectations. After a final review of the project, the grant is provided. While previously the DEEE accepted project applications three times a year for projects with a maximum duration of two years (MENR, 2020), since an amendment to the regulation in January 2020 on “increasing efficiency in the use of energy resources and energy”, it now accepts applications continuously throughout the year.

Voluntary agreements were implemented to motivate companies to achieve a minimum 10% reduction in energy intensity over a three-year period (relative to a company’s energy intensity value over the last five years). The target group is industrial enterprises with a minimum of 500 toe of annual energy consumption. The government makes grants available to stimulate investments in energy efficiency measures. If a company meets the target set by the agreement, then up to 30% of the energy costs can be offset by the grant during the year in which the agreement is made up to a maximum amount of TRY 1 000 000.

ISO 50001 certification became mandatory in 2014 for companies that apply for voluntary agreements and EEIPs that are supported by the DEEE. Companies under this scheme are obliged to set up an energy management unit and/or appoint an energy manager. Based on changes to regulation in January 2020, public buildings, commercial and service buildings, power generation facilities, and industrial facilities are obliged to appoint an

energy manager; together with organised industrial zones, they are responsible for establishing and certifying an ISO 50001 energy management system.

Regarding EEIP projects, within the scope of the support programme implemented since 2009, grants of TRY 31.5 million have been given to industrial enterprises so far. TRY 26 million have been given in the last three years. In recent years, the budget allocated for the grant programme has been over TRY 10 million. The projects are prepared by EVD companies on behalf of industrial enterprises. Project preparation services of EVD companies are also included in the scope of the support. An enterprise applies with a maximum of five projects. Project applications are received continuously throughout the year.

The project has been developed for receiving the project applications on line and transferring all processes to an electronic platform and is planned to be completed by the end of 2020.

In order to set an example and guide the sector, a report on efficiency-enhancing project information was prepared and shared with the sector. Implementation was successfully completed between 2009 and 2019 and the support payment has been made.

In Turkey, ESCOs are able to conduct energy audits and implement projects (not only for the industry sector, but more broadly across the economy). However, many do not have the ability to engage in energy performance service contracts due to budget constraints. Regardless of whether they are able to use an energy performance contract or not, they are considered ESCOs. Overall, there are 46 such ESCOs in Turkey. The size of the ESCO market was estimated to be only USD 5 million in 2018.

The World Bank-sponsored Small and Medium Enterprises Energy Efficiency Project, which took in place between 2013 and 2019, comprised three lines of credit for a total amount of USD 201 million to three financial intermediaries. The overall objective of the SME Energy Efficiency Project was to improve the efficiency of energy use in SMEs by scaling up commercial bank lending for energy efficiency investments. Besides the industrial sector, World Bank funding also covered the building and service sectors.

Turkey also runs the Promoting Energy-Efficient Motors in Small and Medium Sized Enterprises in Turkey (TEVMOT) Project covering the five-year period of 2017-22, funded by the Global Environment Facility. The project is run by the Directorate General of Industry and Productivity[7] under the Ministry of Industry and Technology in co-operation with the United Nations Development Programme Turkey office. The project is designed to encourage additional investments in industrial energy efficiency through the market transformation of electric motors used in SMEs. In addition to replacing the existing inefficient motors used in industrial enterprises, it also aims to promote new energy-efficient electric motors and machines equipped with more efficient motors. The pilot phase of the project targeted the replacement of around 180 inefficient electric motors. In December 2019, a co-operation protocol was signed between the General Directorate of Industry and Productivity and KOSGEB, which established the financing mechanism to underpin the project. In accordance with this protocol, the new “Energy Efficient Electric Motors Exchange Support” was launched by KOSGEB in January 2020 to be in force until 31 December 2021 covering seven selected organised industrial zones. According to the

[7] The Directorate General of Industry and Productivity has been divided into two different directorates general: one for Industry and one for Strategic Research and Productivity.

designed financial mechanism, 60% (75% for domestic products) of the price of a new energy-efficient motor (excluding VAT) that is purchased by an SME as a result of an energy audit will be granted to the SME. Half of the amount to be granted to the SME will be covered by the TEVMOT Project's budget. In this context, a budget of USD 240 000 has been allocated from the TEVMOT Project. Kick-off meetings were completed in seven zones and interviews with SMEs have started. Another important component of the TEVMOT Project is "to strengthen the legal framework related to energy efficiency of new and existing electric motors made in Turkey". In line with EU Regulations, TEVMOT is meant to contribute to the development of a road map for the market transformation of electric motors.

Energy Efficiency in Industry (SENVER) Project competitions are also organised annually at the Energy Efficiency Forum and Fair, as part of efforts to boost public awareness of energy efficiency. The competitions are comprised of two main groups: 1) projects of increasing energy efficiency in industry; and 2) energy-efficient industrial facilities. In 2018, seven companies in the category of energy efficiency improvement in industry and ten companies in the category of energy-efficient industrial facilities were granted awards.

As part of its training and supervisory functions, the DEEE is undertaking benchmarking studies on energy efficiency with key industries, starting with the cement industry, followed by the iron-steel and textile industries in 2020. The department's goal is to complete benchmarking studies for a total of seven sectors under the programme.

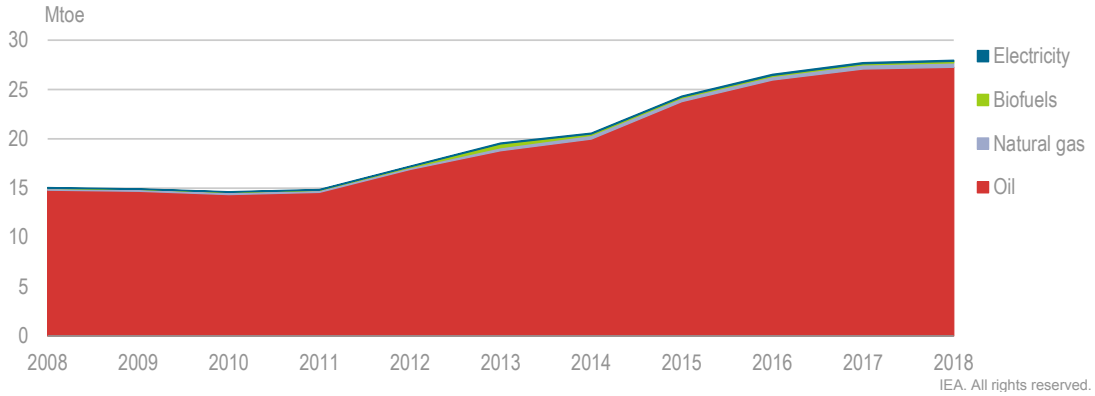
Transport

Energy consumption in transport

The transport sector in Turkey consumed 28.0 Mtoe in 2018, equal to 28% of TFC. Total transport energy demand has increased rapidly, growing by 88% since 2011 (Figure 4.7). The main reason for the remarkable increase in transport energy consumption was the growth in car usage. Vehicle kilometres travelled per capita for cars and light trucks almost doubled between 2006 and 2016 (IEA, 2019b). Road transport accounted for 92% of total transport energy demand in 2018 (Figure 4.8). The remainder was from domestic aviation at 5% and small shares of pipeline transport, rail and domestic navigation (international aviation and navigation are not included).

Oil fuels strongly dominate Turkey's energy supply and accounted for 98% of domestic transport energy use in 2018. Diesel fuel, in particular, accounted for 72% of total transport energy use alone, one of the highest shares in the IEA. Another large energy source is liquefied petroleum gases (LPG), which accounted for 13% of total transport demand, the highest share among IEA member countries. Conversely, gasoline accounted for only 8% of transport energy consumption, the lowest share in the IEA. Diesel, LPG and gasoline are all used mainly in road transport. The rest was kerosene (4%) used in domestic aviation and minor shares of natural gas, biofuels and electricity. Electric vehicles (EVs) accounted for a very small share of cars in Turkey. According to the government, there were 5 714 registered electric and hybrid vehicles in 2019, representing only 0.03% of the total vehicle fleet.

Figure 4.7 Energy consumption in transport by fuel, 2000-18

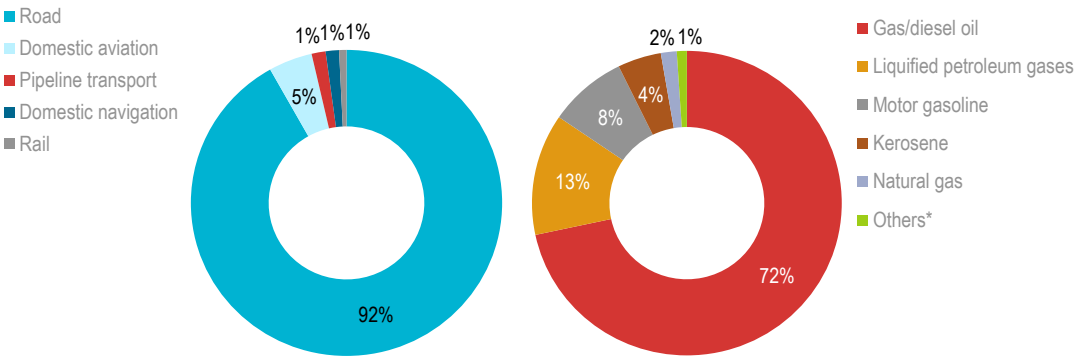


Turkey's transport energy demand increased by 88% since 2011 and is mostly met by oil, which accounts for 98% of transport sources.

Note: The transport sector demand excludes international aviation and navigation.

Source: IEA (2020a), *IEA World Energy Statistics and Balances*, www.iea.org/statistics.

Figure 4.8 Breakdown of domestic transport by mode and fuel, Turkey, 2018



Road transport accounts for most domestic transport energy demand, while gas and diesel oil stand out as the fuels with the highest consumption at 72%, followed by LPG at 13%.

* *Others* includes biofuels, electricity and fuel oil.

Note: Not including fuels for international aviation and navigation.

Source: IEA (2020a), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Transport policies

The Climate Change Action Plan 2011-2023 identifies nine actions for the transport sector to ensure sustainability and promote energy efficiency, which include promoting energy-efficient vehicles, developing comparative studies on alternative fuels and new technologies, developing and improving bicycle and pedestrian transport, reducing the use of passenger cars to reduce traffic density in cities, developing and implementing institutional restructuring for urban transport, strengthening maritime transport, strengthening rail transport, and collecting data on transport.

Given Turkey's heavy reliance on roads for transport, the government aims to promote combined/intermodal/multimodal applications in passenger and freight transport, to increase the share of railroad and maritime transport, and to adopt the corridor approach

in transport planning. Along these lines, the Transport and Communications Strategy Goal 2023 defines objectives to increase the share of rail in freight transport beyond 15% and in passenger transport beyond 10%. It therefore plans to reduce road transport's share in freight to under 60% and passenger transport to under 72% by the end of 2023. However, progress toward these targets does not appear to be on track, with road transport still heavily dominating in both the freight and passenger segments (OECD, 2019). In 2018, roads accounted for 95% of freight transported (based on tonnage) and 97% of passenger travel (based on passenger kilometres) (Turkstat, 2020).

The NEEAP also outlines plans for reducing automobile use in urban areas by promoting bicycle and pedestrian paths as well as public transport, while adjusting parking fees to dissuade driving. Moreover, in recent years, Istanbul has significantly upgraded its public transport systems.

Passenger car taxes in Turkey are relatively high by European standards. The main tax applied is the vehicle registration tax (special consumption tax, or ÖTV), which is applied to new vehicle purchases only (not to used or leased cars) based on engine size; it is designed to encourage the purchase of new cars with smaller engines. Nonetheless, other tax structures favour older cars with higher emissions. In particular, the annual ownership tax (MTV) is lower for older cars, thereby encouraging vehicle owners to hold onto their cars for longer, despite the higher emissions levels associated with older cars (Şenzeybek and Mock, 2019a). Since 2018, the Ministry of Treasury and Finance has offered an incentive to set aside old vehicles (16 years or older) as scrap, given the relatively high average age of Turkey's vehicle fleet.

The NEEAP (2017-2023) called for a differentiated tax regime for vehicles based on fuel consumption and CO_2 emissions. However, to date, Turkey has not implemented a CO_2-based tax system for vehicles (Şenzeybek and Mock, 2019b), which leads to increased demand for diesel cars (OECD, 2019). The country also does not impose mandatory CO_2 limits or fuel efficiency standards on automobiles. Nonetheless, Turkey introduced vehicle labelling in 2009 to inform consumers about fuel economy and CO_2 emissions of new cars.

The tax regime in Turkey, in place since 2004, considers the environmental effects of vehicles based on engine capacity, with larger engines facing higher levels of taxation. Moreover, the framework f the NEEAP provides tax incentives for hybrid electric and battery-electric vehicles. Compared to taxes applied to conventional vehicles at 45-160% of a vehicle's net price (based on engine size), EVs are charged only 3-15%. EVs are also charged only a quarter of the motor vehicle tax since 2019. Still, uptake has been limited to date as EVs account for a very small share of cars in Turkey. Part of the challenge in promoting uptake is expanding the limited charging infrastructure as well as the higher prices for EVs relative to internal combustion engine vehicles, even considering tax breaks.

Buildings

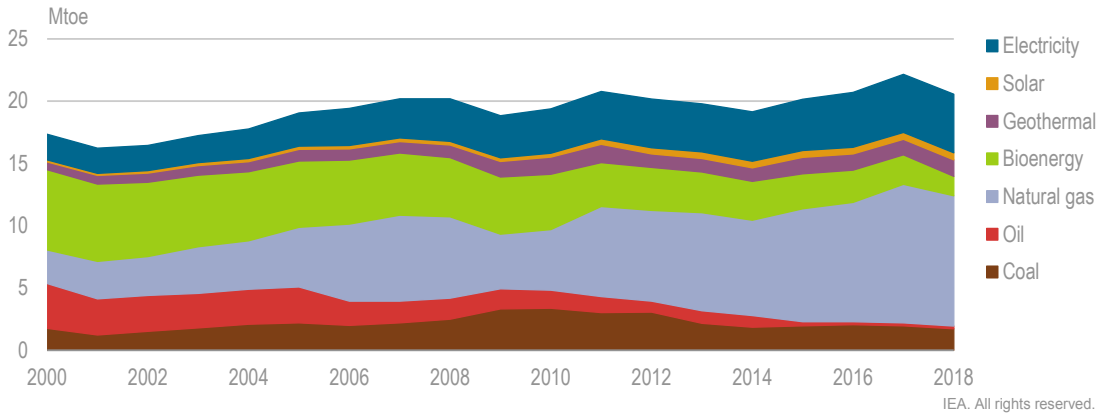
Energy consumption in residential buildings

The residential sector consumed 20.5 Mtoe, accounting for 21% of TFC in 2018. Turkish households use mostly natural gas, which covered 51% of total energy consumption

in 2018 (Figure 4.9). The rest was covered by electricity (23%), bioenergy (8%), coal (8%), geothermal (6%), solar (3%) and oil (1%).

In recent decades, there has been a big shift from biofuels and oil to natural gas and electricity in residential energy consumption. Bioenergy consumption, in particular, has dropped rapidly, with a 76% decline since 2008. Meanwhile, natural gas consumption has increased more than fourfold and electricity use has more than doubled. While natural gas is the main source for heating in buildings, electricity is mainly consumed by appliances.

Figure 4.9 Energy consumption in the residential sector by fuel, Turkey, 2000-18



The growth of natural gas and electricity has partly displaced oil, coal and bioenergy in the residential sector.

Note: Mtoe = million tonnes of oil equivalent.

Source: IEA (2020a), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

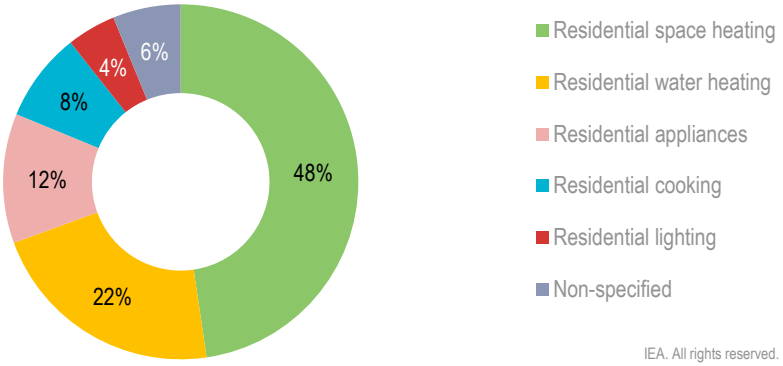
Space heating accounts for almost half of residential energy demand and the rest is used in water heating, residential appliances and cooking (Figure 4.10). Turkish homes are becoming more energy efficient. Energy consumption for residential space heating per dwelling (after temperature corrections) declined by 18% between 2000 and 2018. Per capita consumption also decreased, from 6.3 gigajoules (GJ)/capita in 2000 to 5.2 GJ/capita in 2018 (IEA, 2020b).

Energy consumption in residential water heating and appliances have both more than doubled since 2000. However, per capita use for water heating and appliances was still among the lowest in the IEA. Different from other sectors, energy intensity in residential cooking has declined, thanks to fuel switching from oil to natural gas and electricity.

The Eleventh Development Plan identifies the following measures for the building sector:

- support will be provided to encourage energy efficiency in existing buildings
- buildings that are more efficient and produce their own energy will be expanded
- a National Green Building Certificate System will be established.

Figure 4.10 Breakdown of energy consumption in the residential sector by use, Turkey, 2018



Space heating and water heating accounted for 70% of total energy consumption in Turkish households in 2018.

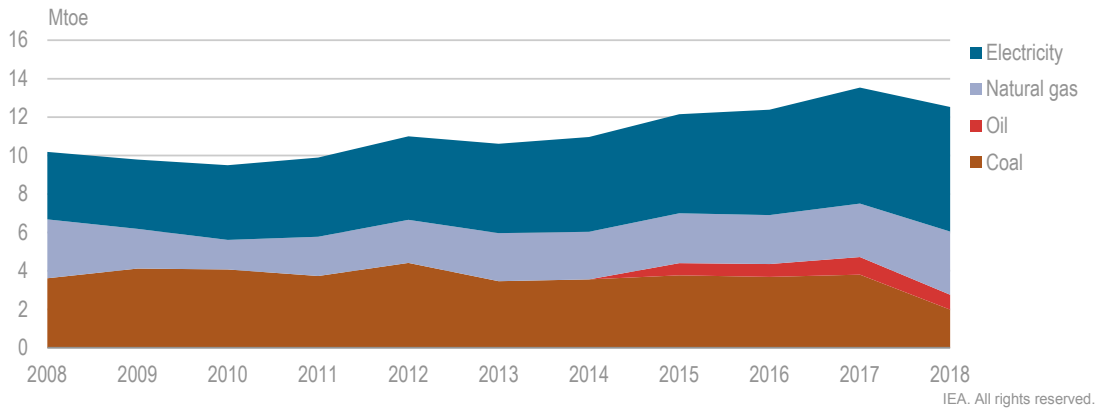
Source: IEA (2020b), *Energy Efficiency Indicators 2020* (database), www.iea.org/statistics.

Energy consumption in commercial and public services

Energy demand in the commercial and public sectors consists mainly of energy use in buildings, mostly for heating. In 2018, energy consumption in the commercial and public services sector was 12.5 Mtoe (12% of TFC). Electricity was the largest energy source in 2018, with 52% of total energy demand in the sector; the remainder was fossil fuels: coal (16%), natural gas (26%) and oil (6%) (Figure 4.11).

Energy consumption in commercial and public services grew by 23% from 2008 to 2018, mostly met by increased supply of electricity. However, as two-thirds of electricity in Turkey is generated from coal and natural gas, the primary energy supply to the sector remains highly dominated by fossil fuels.

Figure 4.11 Energy consumption in commercial and public services by fuel, Turkey, 2000-18



Energy consumption in Turkish commercial and public services has increased by one-third in a decade, with growing electricity supply that complements the consumption of fossil fuels.

Note: Mtoe = million tonnes of oil equivalent.

Source: IEA (2020a), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Buildings policies

Turkey has a rapidly growing and transforming building stock. Turkstat data indicate that as of October 2019, there were 9.5 million buildings in Turkey, of which approximately 90% were residential. The number of housing units was around 24 million. According to occupancy permit statistics, more than 100 000 new buildings are added every year to the building stock. Moreover, the already high energy consumption in buildings is set to grow further, driven by continued population growth and urbanisation (SHURA Energy Transition Center, 2019). In this context, the government sees possibilities to achieve significant energy savings by ensuring that new buildings maximise energy efficiency potential in addition to improving the energy efficiency of the existing building stock.

The Energy Efficiency Strategy defines actions to "introduce maximum energy requirements for buildings and limits for maximum emissions" and "impose administrative sanctions on those which emit carbon dioxide at quantities above the legally defined limits" under the strategic goal to "reduce building energy demand and carbon emissions; scale up sustainable, environment-friendly buildings that use renewable energy resources." The strategy also defines actions to "require sustainability in building licensing" and "scale up on-site generation for mass housing" under the strategic goal to "transform at least one-fourth of the building stock in 2010 to sustainable buildings by 2023."

The Regulation on Energy Performance for Buildings (BEP-TR) was passed in 2008 and updated in 2013. It introduced a common methodology for calculating the energy performance of buildings and set minimum energy performance standards for new buildings and buildings undergoing renovation. Implementation of the regulation falls under the jurisdiction of the Ministry of Environment and Urbanization.

In January 2011, an Energy Performance Certificate (EPC) was introduced to provide information on primary energy demand and CO_2 emissions from new buildings and buildings that have been purchased or are rented. New buildings must have at least C Class EPCs (under EU classification). The EPC is valid for ten years. While existing buildings are also required to have an EPC, there is no minimum threshold requirement they must achieve. The requirement for EPCs in the transactions of sales and leasing of buildings was deferred to 2020. In November 2019, nearly 1 million buildings had an EPC. The government also requires an assessment of the environmental impacts of buildings and settlements as part of the certification process since 2017 under the Regulation on Green Certificate for Building and Settlement.

Since April 2010, new buildings with an area greater than 2 000 m^2 are required to have central heating, while the installation of individual metering and control systems for central heating and hot water has been mandatory since May 2012. In addition, based on an amendment to the Energy Performance Regulation in Buildings, the use of solar energy to support water heating is planned for hotels, hospitals, dormitories, non-residential buildings such as hotels, and sports centres with a usage area of over 2 000 m^2.

Though Turkey's policies and regulations focus heavily on new buildings, the income tax and stamp tax laws were amended in 2018 to promote the renovation of existing buildings, whereby insulation and energy savings measures can be written off in the year they were undertaken.

For public buildings, an August 2019 presidential circular issued a target for public buildings with energy managers assigned according to the Energy Efficiency Law to save

15% energy until 2023. This was preceded by a March 2018 amendment to the Energy Efficiency Law related to energy performance contracts, which allowed energy efficiency measures in public buildings through ESCOs. Specifically, it allowed public institutions to enter into long-term energy performance contracts for up to 15 years, which could offer considerable results in terms of energy savings compared to private organisations, for whom long-term contracts are not accepted as the basis for security by financial institutions. However, there is a need for adopting several pieces of required secondary legislation.

The DEEE is also serving as the technical co-ordinator with the World Bank on the USD 200 million Energy Efficiency in Public Buildings in Turkey Project. This project will be implemented by the Ministry of Environment and Urbanization and the MENR.

In the buildings sector, the NEEAP focused on expanding the use of renewable energy and promoting central and district heating/cooling systems. It outlines a plan for the government to:

1. identify and share best practices on material and technology in construction
2. create a database for data on buildings' energy consumption
3. set energy savings targets for public buildings based on energy efficiency audits
4. improve energy efficiency in municipal services
5. promote renovations of existing buildings and energy efficiency improvements in heating and appliances (including through the creation of a new financial support mechanism)
6. promote central and district heating and cooling systems
7. increase the rate of EPCs in existing buildings
8. promote sustainable green buildings through certifications
9. promote energy efficiency upgrades in new buildings from C Class to A or B
10. improve the energy efficiency of existing public buildings through energy performance contracts
11. increase the use of renewable energy and co-generation systems in buildings
12. extend support funds currently assigned to SMEs to non-public commercial and services buildings that are not under an audit obligation.

Overall, public awareness for energy efficiency is relatively low in Turkey. Moreover, the economic situation of most households makes it challenging to motivate energy efficiency changes, which increases the importance of government support mechanisms. In addition, challenges in securing finance due to the unwillingness of financial institutions to lend to households or small businesses based on creditworthiness is also an impediment.

Within the scope of EU financial assistance (IPA 2015) programming, an energy efficiency equipment procurement project has been carried out for municipalities. Water pumps used in six metropolitan municipalities will be replaced with more efficient pumps. The project's total budget is EUR 3.2 million; 15% of the project cost will be provided by municipalities and 85% by the EU as a grant. Within the scope of the project, 232 pumps will be purchased and installed.

Appliances, lighting and products

In order to achieve compliance with EU legislation, the necessary eco-design and energy labelling processes for electrical appliances, lighting and electrical equipment have been

implemented in Turkey's legislation. Specifically, Turkey has mostly harmonised its product efficiency standards with the EU Eco-design Directive 2009/125/EC and the Energy Labelling Framework Directive 2010/30/EU and its implementing measures as reflected in the 2011 regulation on labelling and standard product information. Under this regulation, 9 of the 12 communiqués regulate the energy labelling of household appliances, such as washing machines, dishwashers, TV sets, refrigerators, air conditioners, dryers and lamps, among others. In addition, new energy labelling and eco-design legislative harmonisation studies, which will take effect in 2021, have begun for simultaneous implementation. Product standards are spearheaded by the Ministry of Science, Industry and Technology.

Value-added tax and special consumption tax reductions were also introduced for home appliances in 2018 and expired at the end of June 2019.

In 2013, Turkey's energy minister announced plans for a project to replace approximately 7 million street lights with more efficient LED lamps, which offer considerable energy savings of up to 70% and short payback periods. The plan was further reinforced by the NEEAP, which included an action item to replace existing sodium vapour public lighting with more efficient LED lamps. Under this action item, the MENR, TEDAS (the state-owned distribution company), the Energy Market Regulatory Authority, distribution companies, the Ministry of Urbanization and Environment, municipalities, and the General Directorate of Highways were meant to prepare detailed transition programmes. A legislative framework was supposed to be put in place in 2017 and 2018, with a transition programme to get underway in 2020. However, thus far, the programme has not made much headway beyond a few pilot projects. The procedures and principles for LED lighting installations in public areas was published by the MENR in January 2020, with an announcement that 20 000 LEDs are planned to be installed in 2020. A challenge in implementation thus far, however, has been the lack of market incentives for utilities and municipalities to make the transition. In particular, the state-owned electric utility EÜAŞ has fixed agreements with municipalities, limiting the motivation for the utility to undertake the conversions absent a requirement or incentive. The energy savings potential remains significant as street lights now number around 8 million and consume around 4.4 terawatt hours (TWh) of electricity annually.

District heating

To date, the use of district heating in Turkey is relatively limited and Turkey has not yet implemented any regulation dedicated to district heating systems. Most district heating systems are operated by municipalities. Around 140 000 households are supplied by geothermal-fuelled district heating systems and there are a few cases of dwellings supplied by the waste heat of power plants. Most co-generation facilities are implemented by factories or commercial buildings for their own energy consumption.

The Eleventh Development Plan defines actions to develop projects to use waste heat from existing coal-fired power plants in district heating and agricultural activities in order to scale up on-site generation, co-generation and micro co-generation as well as electricity generation from waste heat in industry; build a market for trade of waste heat energy; and issue incentives to promote co-generation and micro co-generation installations.

The MENR signed a Strategic Sector Cooperation Project with the Danish Ministry of Climate, Energy and Utilities in 2017. The Energy Efficiency and Low Carbon Supply of Heating & Cooling Project aims to assist the MENR in developing relevant policies,

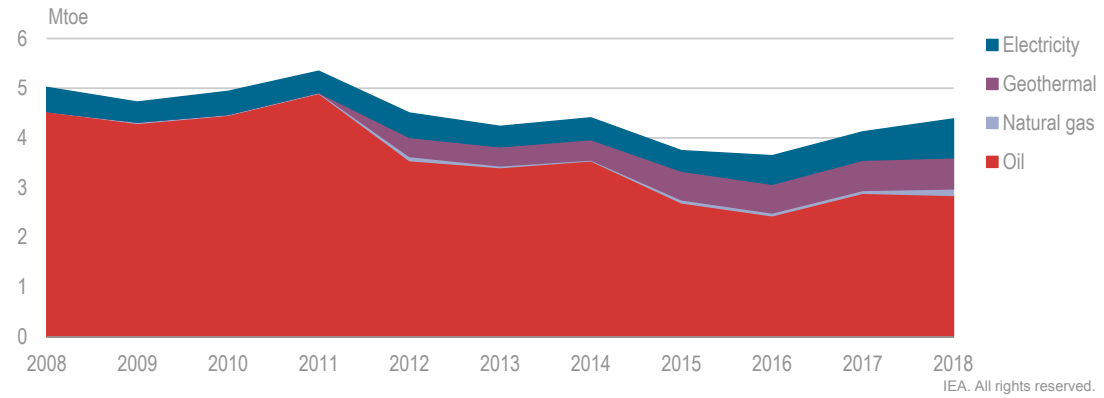
strategies and solutions to enable a low-carbon transition of Turkey's energy sector, achieve the government's long-term objectives for energy efficiency and district energy, and increase Turkey's implementation capacity for planned new legislation on heat supply, modelled after the Danish experience. After three rounds of drafting within the MENR, the next step for Turkey's draft heating legislation is parliamentary submission.

Agriculture

Energy consumption in agriculture

The agriculture and forestry sector (including a small share for fishing) consumed 4.4 Mtoe in 2018, which accounted for 4% of TFC. Consumption has been on a declining trend over the last decade, albeit with some annual fluctuations, and increased in 2017 and 2018 (Figure 4.12). On average since 2008, agriculture energy demand has decreased by 13%. Oil is the largest energy source, accounting for 65% of total agriculture energy used in 2018. However, fuel consumption has diversified slightly in recent years through the growth in geothermal, electricity and a small share of natural gas.

Figure 4.12 Energy demand in agricultural/forestry/fishing sectors by fuel, Turkey, 2000-18



While energy consumption in agriculture has fluctuated, the shares of geothermal and natural gas have increased since 2011.

Note: Mtoe = million tonnes of oil equivalent.

Source: IEA (2020a), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Assessment

With an eye to improving energy security and reducing reliance on imported fuels, Turkey has made commendable efforts in terms of elevating the role of energy efficiency to achieve its energy goals.

Turkey has a low energy intensity in an IEA comparison, in part due to its economic structure. Measured as the ratio of TFC per unit of GDP in PPP, the energy intensity of the Turkish economy in 2018 was the fourth-lowest among IEA countries. Turkey's energy intensity

declined by 22% from 2000 to 2013, but has been quite stable since 2013. Furthermore, Turkey had the second-lowest TFC per capita in the IEA after Mexico.

Nonetheless, significant energy efficiency potential remains across all sectors of the Turkish economy, e.g. in buildings, transport and industry. To advance progress on energy efficiency, the Turkish government has published a comprehensive National Energy Efficiency Action Plan for the period 2017-23, featuring a set of 55 actions designed to reduce primary energy consumption by 14% (compared to business as usual) by 2023 across 6 categories. The NEEAP is projected to achieve cumulative savings of 23.9 Mtoe by 2023, toward which USD 10.9 billion of investments will be needed. It builds on existing energy efficiency measures and related plans, including the 2007 Energy Efficiency Law, the 2012 Energy Efficiency Strategy and the Tenth Development Plan 2014-2018.

The new DEEE was established within the MENR to oversee the delivery of the NEEAP in collaboration with 16 other government institutions. In addition, 36 other organisations, including sector associations, non-governmental organisations and universities, have been identified as relevant institutions to deliver the NEEAP.

The DEEE plays a co-ordination role to deliver the NEEAP, but different ministries oversee efficiency policies within their respective fields. For example, the 2008 Regulation on the Energy Performance of Buildings falls under the responsibility of the Ministry of Environment and Urbanization, while the harmonisation of appliances and equipment standards in line with EU eco-design legislation is the responsibility of the Ministry of Industry and Technology.

Progress to date on the NEEAP has been mixed. According to a DEEE progress report covering the period 2017-19, USD 4.1 billion was invested in energy efficiency, delivering 2.47 Mtoe of cumulative savings. Significant additional effort will be needed to reach the 2023 target of USD 10.9 billion invested and 23.9 Mtoe saved. Implementation gaps remain across and within sectors, with policy progress slowed by delays in secondary legislation, lack of demand or incentives for energy efficiency products and services, among other factors.

The market for ESCOs remains nascent. Currently, only 46 companies in Turkey are registered as so-called energy efficiency consultancy companies, or EVDs, with a total turnover estimated at only USD 5 million per year. With some exceptions, and unlike established ESCOs in other markets, most EVDs do not carry out long-term energy performance contracts, whereby major energy efficiency investments are paid back over multiple years through energy savings. EVD budgets are generally too small to cover high upfront project costs, and Turkish financial institutions generally do not provide project finance based on energy savings due to perceived risks and a lack of standardised energy performance contracts in the Turkish market.

Legislative amendments were introduced in 2018 to enable public institutions to enter into long-term energy performance contracts in order to improve the energy efficiency of public buildings. A presidential circular instructing public institutions to take necessary measures in order to reduce energy consumption in their buildings by 15% by 2023 was published in August 2019. Now, secondary legislation is needed to implement the changes. In addition, the World Bank provided approximately USD 200 million for the Energy Efficiency in Public Buildings Project in Turkey in December 2019, which will be

implemented by the Ministry of Environment and Urbanization and the MENR. This project not only aims to reduce energy use in central government buildings, but also to support the development of the ESCO market in Turkey.

Turkey's buildings sector represents approximately one-third of TFC, with a 4.4% average annual energy demand increase. The government has made some efforts to address energy consumption in new buildings, which are constructed at a rate of 100 000 per year, 80% of which are residential buildings. Under the BEP-TR, new buildings are required to obtain an EPC, with a minimum performance rating of C (under EU classification). While existing buildings must also have an EPC, the requirement for EPCs in transactions of sales and leasing of buildings was deferred to 2020. Building on ongoing reviews in these areas, the government should consider more ambitious energy efficiency measures for new buildings, including near term targets for net-zero energy buildings as well as incentives for the installation of digital energy monitoring and management systems in new commercial and public buildings.

Few provisions currently exist to improve the energy performance of existing buildings (with the exception of the recent energy savings obligation on public buildings), particularly residential dwellings, which accounted for 21% of TFC in 2018. Around 65% of residential buildings in Turkey are not insulated, and consume an average of 130 kilowatt hours (kWh) per square metre, which is relatively high in international comparison. Space and water heating represent, on average, around 65% of this consumption.

While Turkey complies with EU eco-design and energy labelling legislation, which covers lighting, appliances and other energy using equipment including heating and cooling technologies, further scope exists to ensure the most efficient products are deployed in the Turkish market. In particular, measures to improve the efficiency of space cooling, one of the fastest growing sources of energy demand in Turkish buildings, should be explored to ensure consumers are able to afford the most efficient air conditioners. The DEEE has started to address these issues in collaboration with Danish authorities as part of a project that maps and predicts heating and cooling demand in Turkey, and scopes a framework for heat market legislation. The DEEE should build on this project to develop a national strategy for heating (including district heating, direct use of renewables and co-generation) and cooling as part of a strategy for the renovation of existing buildings (particularly residential dwellings) through targets, financial incentives, mechanisms for jointly owned apartment renovations and pathways towards net-zero energy buildings.

Turkey has an attractive opportunity for efficiency gains through the conversion of its approximately 8 million street lights, which consume 4.4 TWh annually and rely on outdated technologies, to more efficient LED alternatives, with a savings potential of over 70% and short payback periods. Already in 2013, the Turkish government announced a nationwide initiative for conversion to LED street lighting. However, the project has been delayed due to market disincentives related to electricity distribution, subsidies and other factors, with limited information available on timing and next steps. Recent regulatory changes required the use of LEDs in park and garden lightning. Moreover, the MENR published procedures and principles regarding the use of LED armatures in general lightning, requiring use of LEDs in new street lightning facilities upon approval of state-owned distribution company, TEDAS. Still, retrofitting the existing stock of street lights would allow for much greater energy savings.

In the transport sector, there is significant opportunity to increase energy efficiency, particularly in passenger and light duty vehicles, and to promote electric vehicles.

Currently, no fuel economy standards exist in Turkey. The government mainly relies on motor vehicle tax breaks to encourage consumers to purchase more efficient internal combustion engine vehicles as well as hybrid electric cars and EVs. Currently, EVs represent only 0.03% of Turkey's total vehicle stock. Beyond improving the efficiency of the vehicle fleet, Turkey should also promote public transportation and modal shifts toward rail to further reduce the growth in fuel demand.

In industry, the government supports efficiency improvements via efficiency increasing projects and voluntary agreements. EEIPs consist of grants of up to 30% for projects under TRY 5 million with a payback limit of five years. Voluntary agreements include grants covering up to 30% of energy bills in an industrial establishment, capped at TRY 1 million. Grants are provisional on companies appointing a certified energy manager, obtaining ISO 50001 certification and registering on the government's EnVer Portal, which is used to collect data on industrial (and buildings) energy consumption. While the government has already increased the thresholds for project size and levels of grants, it should explore ways to incentivise larger scale projects with longer payback periods in order to unlock greater energy savings (beyond support offered to large-scale projects by regional incentives and tax exemptions).

With support from the Global Environment Facility, Turkey has commenced a pilot project to roll out efficient industrial motors in SMEs. The government should explore ways to expand this programme across SMEs, for example through improved data collection, awareness raising and capacity building for energy management, and raising mandatory standards for motors. The use of bulk purchasing or bulk procurement of motors to drive down costs and create economies of scale should also be explored.

Recommendations

The government of Turkey should:

- Fast-track the completion of all secondary legislation required to develop a market for energy services and long-term energy performance contracts.
- Unlock the sizeable energy savings potential from conversion to LED street lighting by addressing market disincentives.
- Develop a national heating and cooling strategy, including for the renovation of existing buildings (particularly residential dwellings) through targets, financial incentives and mechanisms for jointly owned apartment renovations.
- Strengthen incentives, market mechanisms and access to finance for larger industrial efficiency projects and promote the adoption of higher efficiency motors by SMEs.
- Set fuel economy standards for passenger vehicles while strengthening incentives for EV uptake and boosting investment in public transportation and modal shifts.

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5. Renewable energy

Key data

(2019 provisional)

Renewables in total final energy consumption (TFEC) (2018): 11.7 Mtoe/11.9% of TFEC (hydro 4.3 Mtoe, bioenergy 2.0 Mtoe, geothermal 2.5 Mtoe, wind 1.4 Mtoe, solar 1.4 Mtoe)

IEA median (2018): 15.5% of TFEC

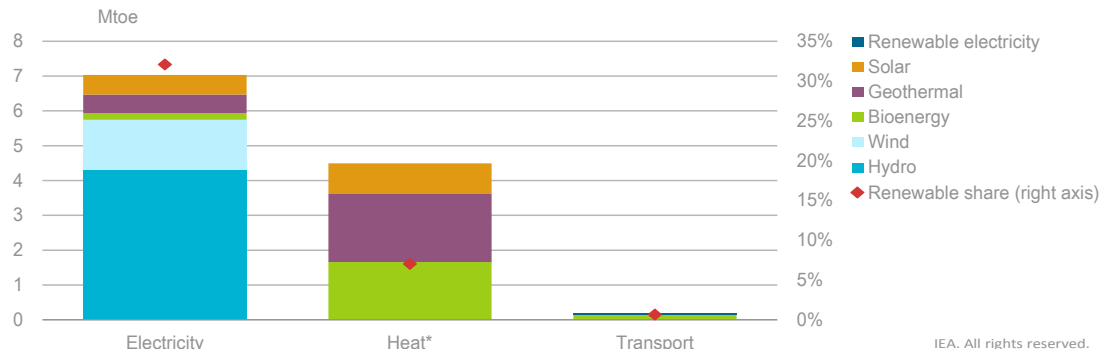
Renewables in electricity generation: 133.4 TWh/43.8% of total electricity generation (hydro 88.9 TWh, wind 21.8 TWh, geothermal 8.9, solar 10.6 TWh, bioenergy 3.2 TWh)

IEA median: 37.7% of electricity generation

Overview

Renewable energy consumption has increased in Turkey in recent decades, most recently led by growth in hydro, wind and solar power. In 2018, renewable electricity accounted for 60% of total renewable energy in total final energy consumption (TFEC). The rest was mainly heat, mostly from geothermal and bioenergy, but solar's contribution is also significant. The share of renewable energy such as biofuels in transport is very small (Figure 5.1).

Figure 5.1 Renewable energy in total final energy consumption, Turkey, 2018



Renewable electricity accounted for over half of total renewable energy consumed in Turkey in 2018, while the rest was mainly used for heating.

Notes: Mtoe = million tonnes of oil equivalent. Heat includes direct use of renewable energy and renewable district heating in industry, and residential and service buildings (including agriculture). Electricity refers to final electricity consumption in the same sectors, with the breakdown by fuel based on domestic electricity generation. Electricity used for heating is included under electricity due to limitations in statistical data collection.

Source: IEA (2020), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Turkey supports renewable electricity through a feed-in tariff (FiT) system under the Renewable Energy Support Mechanism (YEKDEM), which provides a stable return for ten years. As part of the scheme, there are additional premiums for installing domestically manufactured equipment for renewable electricity generation. More recently, the government introduced competitive auctions for larger installations of renewable power and revised the payment scheme for distributed solar installations. Turkey's current support system can be improved to increase cost-effectiveness as well as to expand beyond electricity to other sectors such as heating and transport, where renewable energy has made less progress.

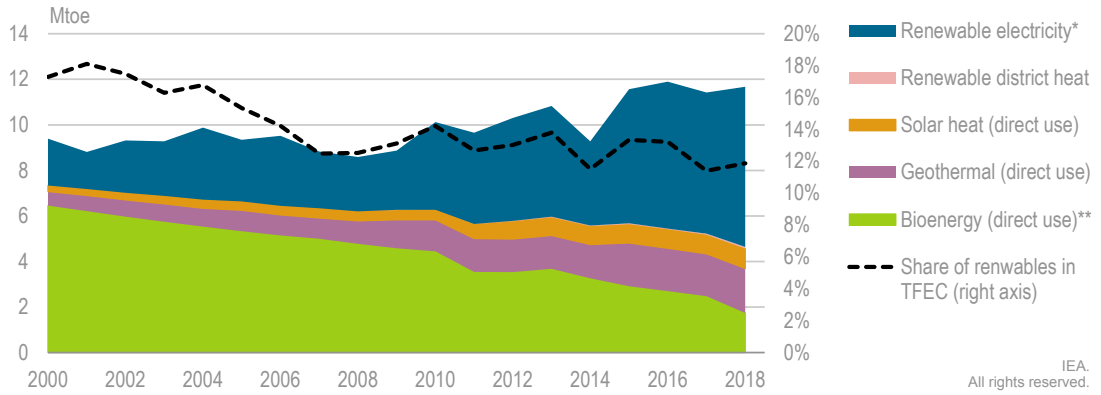
Supply and demand

Renewable energy in total final energy consumption

Renewable energy consumption has changed significantly in the last decade (Figure 5.2). In total, renewable energy consumption grew by 36% in ten years from 8.6 million tonnes of oil equivalent (Mtoe) in 2008 to 11.7 Mtoe in 2018. Bioenergy consumption in the residential sector fell by half, as many households have switched from traditional methods to more efficient, modern heating and cooking technologies. Meanwhile, renewable electricity has nearly tripled since 2008, and its share in total electricity generation reached 44% in 2019. Furthermore, both solar and geothermal energy used for heating more than doubled within a decade, but growth has stalled since 2015.

Despite the growth in total renewable energy consumption, the share of renewables in TFEC has fallen slightly, as renewable energy sources have been outpaced by the growth in fossil fuels. In 2018, the renewable share in TFEC was 11.9%, which placed Turkey in the lower half in a comparison with IEA member countries (Figure 5.3).

Figure 5.2 Renewable energy in total final energy consumption, Turkey, 2000-18



Renewable energy consumption has grown by nearly 30% in the last decade, mostly driven by growth in renewable electricity, which compensated for a 50% drop in bioenergy in heating.

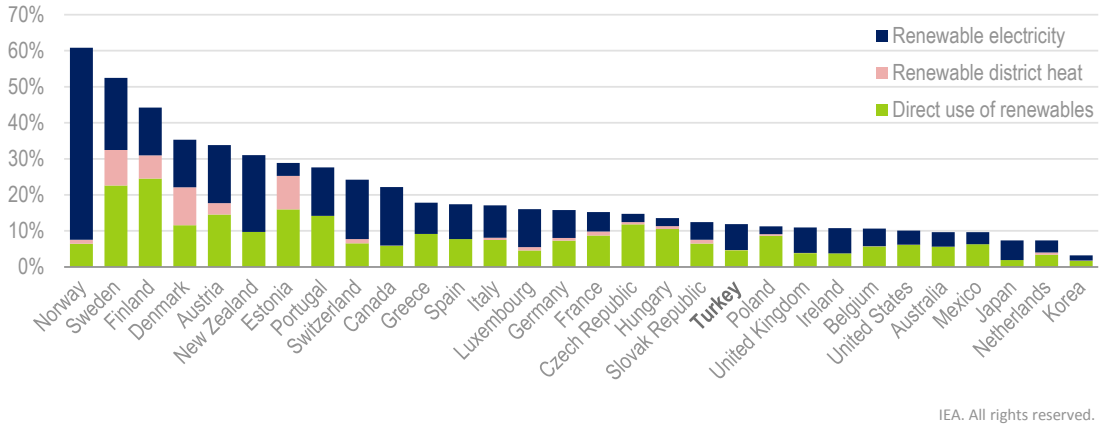
* Electricity consumption x the share of renewable energy in domestic electricity generation.

** Direct use of bioenergy, including mainly solid primary biofuels used for heating in the residential sector and minor shares of liquid biofuels used in transport and renewable district heat.

Note: Mtoe = million tonnes of oil equivalent. TFEC = total final energy consumption.

Source: IEA (2020), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Figure 5.3 Renewable energy as a share of total final energy consumption in IEA member countries, 2018

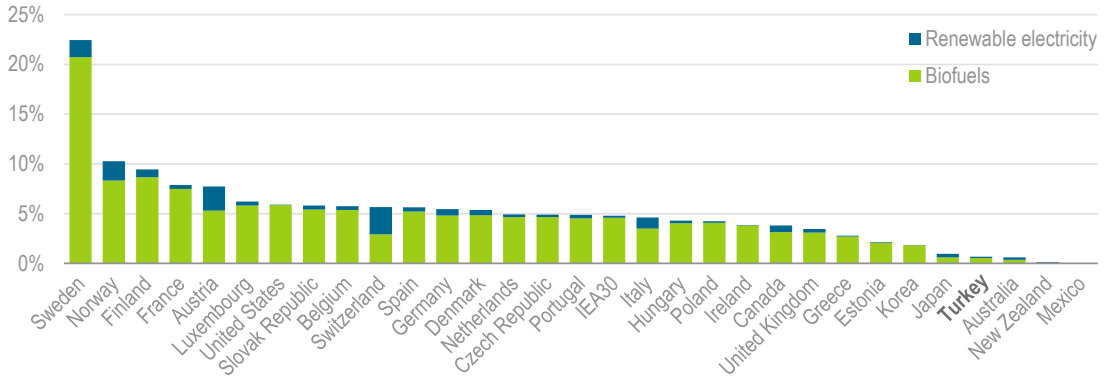


Turkey ranked below the median among IEA countries in the share of renewable energy in TFEC in 2018.

Source: IEA (2020), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Renewable energy accounted for only 0.7% of total energy consumed in Turkey's domestic transport sector in 2018; 0.5% from biofuels and 0.1% from renewable electricity. Compared with other IEA countries, this was the fourth-lowest share (Figure 5.4). Biofuels consumption in Turkey in 2018 was split between 60% bio-gasoline and 40% biodiesel.

Figure 5.4 Renewable energy in transport in IEA member countries, 2018



With only 0.7% renewable energy in domestic transport, Turkey ranks fourth-lowest among IEA member countries.

Notes: The renewable electricity share is calculated as the share of electricity consumed in transport multiplied by the share of renewable energy in domestic electricity generation (electricity trades are not taken into account). Charging of electric vehicles done at home is not always captured as transport energy consumption.

Source: IEA (2020), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Electricity from renewable energy

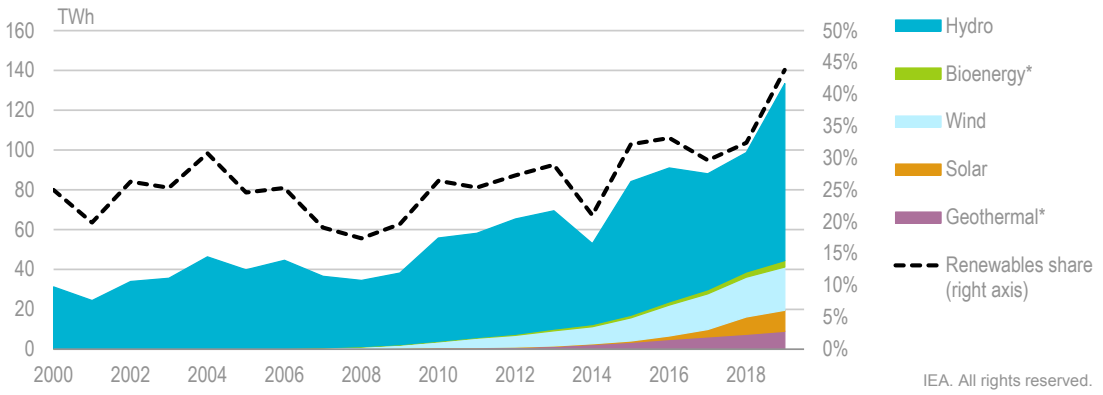
Hydropower used to completely dominate renewable electricity generation in Turkey, but in the last decade, other sources have increased at a rapid rate, in particular wind and, more recently, solar (Figure 5.5).

Hydropower still remains the largest source of renewable electricity, and accounted for 29.2% of total electricity generation in 2019. The availability of hydropower depends on hydrological conditions and can vary significantly; for example, the sudden drop in production in 2014 was due to a drought that year. However, the long-term trend for hydropower is increasing, with electricity generation nearly tripling since 2000, and there is potential for further growth.

Wind power is the second-largest source of renewable electricity. Supported by the FiT system, wind power has seen impressive growth in the last decade, from less than 1.5 terawatt hours (TWh) in 2009 to 21.8 TWh in 2019. Wind power accounted for 7.2% of total electricity generation in 2019. The remainder of renewable electricity was produced from solar photovoltaics (PV) and geothermal energy, which accounted for 3.5% and 2.9% of total electricity generation, respectively, while bioenergy made up 1.1% in 2019. Geothermal and bioenergy for power generation both almost doubled in three years between 2016 and 2019. Solar PV generation has increased even more rapidly, from 3.7 TWh in 2017 to 10.6 TWh in 2018, an impressive growth of 182% in two years.

In total, renewable energy sources accounted for 44% of total electricity generation in 2019. This placed Turkey on the higher end in a comparison among IEA member countries (Figure 5.6). Turkey had the seventh-highest share of hydropower in the comparison and the second-highest share of geothermal after New Zealand, but the third-lowest share of bioenergy.

Figure 5.5 Renewable energy in electricity generation, Turkey, 2000-19



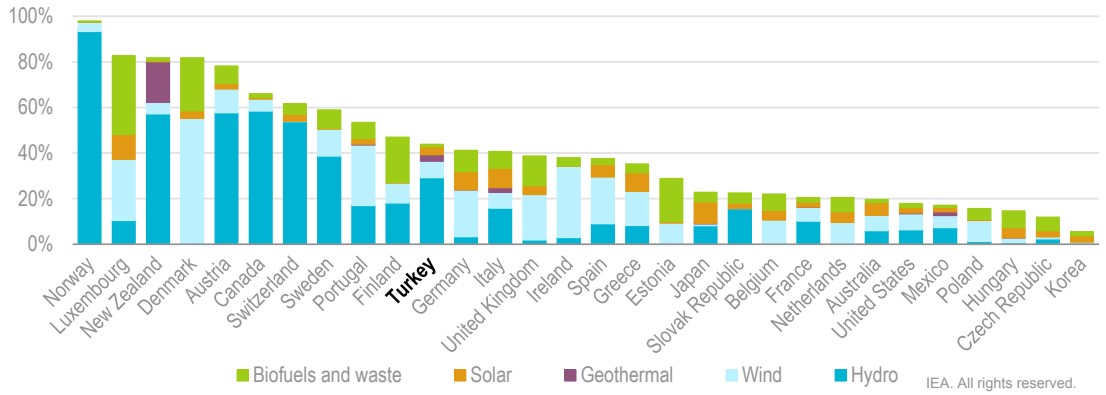
Hydropower dominates renewable electricity generation in Turkey, but other sources have increased rapidly in the last decade.

* *Bioenergy* includes solid primary biofuels, liquid biofuels and biogases.

Note: TWh = terawatt hour.

Source: IEA (2020), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Figure 5.6 Renewable energy as share of total electricity generation in IEA countries, 2019



Turkey's share of renewable energy in electricity generation of 44% in 2018 ranked higher than the median in the IEA; for hydropower, Turkey ranked the seventh-highest.

Source: IEA (2020), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Turkey's future outlook for renewables suggests that recent strong growth will continue (with the exception of hydro after 2023). The IEA projects Turkey's renewable capacity to increase by 49% (21 gigawatts [GW]) over the period 2019-24, primarily in solar PV (including distributed PV), onshore wind and hydropower over the next five years (IEA, 2019).

Institutions

Policy related to renewable energy is largely directed out of the Ministry of Energy and Natural Resources (MENR), based on the rules embodied in Law No. 5346 on the Utilization of Renewable Energy Sources for the Purpose of Generating Electrical Energy, passed in 2005, and the Electricity Market Law No. 6446, passed in 2013. The MENR is, therefore, responsible for overseeing renewable energy support schemes. The Energy Market Regulatory Authority (EMRA) administers the feed-in tariff and competitive auction processes.

Renewable energy project developers can bring investment challenges before a newly established board known as the Energy Investments Coordination Board, headed by the vice minister of the MENR and including representatives from various government ministries, to help facilitate permitting. Still, several ministries and other institutions are involved in permitting for projects as the government faced previous challenges in creating a complete "one-stop shop" for permits.

Policy

Renewable energy targets

Renewable energy forms a critical component of Turkey's plans to increase the share of power generation from domestic resources.

Given the strong renewables growth that Turkey has experienced in the past decade, more recently, under the Eleventh Development Plan (2019-2023), the government increased the target to 38.8% of renewables in power generation by 2023.

As part of these efforts, Turkey plans to commission 10 GW each of solar and wind capacity in the period 2017-27. The targets for wind and solar are easily achievable since a significant proportion has already been realised. As such, the expansion targets represent relatively modest volumes compared to the country's potential.

In accordance with forecasts, the government expects that 76% of power generation capacity will come from renewables by 2023 and 61% of power capacity will come from renewable resources by 2027. The prime locations for wind power generation are along the Aegean coast, while those for solar power are concentrated in the south of the country. The government estimates the wind energy potential of Turkey to be 48 000 megawatts (MW), while that for solar is 1 527 kilowatt hours (kWh) per square metre annually (the Turkish Solar Association estimates Turkey's solar potential at 38 GW by 2030).

Turkey has also realised strong growth in geothermal energy, including for power generation, heating and in the agricultural sector. Building upon this success and to achieve its targets for renewables, the government plans to increase installed geothermal and bioenergy capacity to 2 884 MW by 2023, up from 2 678 MW 2019. Turkey's geothermal potential is estimated to be 31 500 megawatt thermal (MWth).

The government also has a target to maximise the potential of hydropower by 2023. To this end, the government estimates Turkey's hydroelectric potential to be 433 TWh, while the technically usable potential to be 216 TWh and the economic potential to be 160 TWh/year. Given that hydro generation was nearly 89 TWh in 2019, a sizeable share of Turkey's economic potential for hydro has already been realised. In fact, it is envisaged that based on projects already under construction, hydropower capacity will reach 32 000 MW by 2023, indicating that a sizeable amount of the economic potential will have been realised by then. As such, additional hydro will play a limited role after 2023.

The government considers Turkey's biomass potential to be about 100 TWh, and the amount of biogas that can be produced from biomass ranges from 17.4 TWh to 23.3 TWh.

Turkey is also placing an increased focus on pumped hydro energy storage as a means to facilitate the integration of larger shares of variable renewables into the grid. Studies have been undertaken by the MENR since 2005, including to assess the country's resource potential and optimal geographic locations. Based on these studies, the conceptual design of the Gökçekaya Pumped-Storage Hydroelectric Plant (1 400 MW) and the Altınkaya Pumped-Storage Hydroelectric Plant (1 800 MW) were drawn up. Similarly, a feasibility report entitled "Yahyalı Hybrid Project" was prepared in Turkey for a wind farm project that would be integrated into a pumped storage system to optimise wind power potential and connect it to the transmission and distribution system smoothly. Investment in Turkey's first pumped-storage hydroelectric plant will be undertaken by EÜAŞ for the Eskisehir project whose lower reservoirs will be drawn from the Gökçekaya Dam (1 400 MW capacity). Additionally, a 1 000 MW pumped storage hydroelectric plant designed by private sector in Eğirdir Lake (Isparta) is also being planned.

Beyond electricity, Turkey is among the leading countries for solar water heater installations, notably in the absence of subsidies or policy support. In fact, Turkey ranked third worldwide in terms of cumulated water collector installations in 2018, only slightly

behind the United States (Weiss and Spörk-Dür, 2020). However, technology and infrastructure quality need to improve significantly to maximise its potential, especially given its geographical location and favourable irradiance conditions. The sizeable share of energy consumption in buildings also offers untapped potential for other renewables such as direct geothermal and heat pump applications.

Renewable energy support mechanisms

Turkey has offered various support mechanisms to promote an expansion of renewables capacity, including FiTs, competitive auctions and rooftop solar compensation (in the form of monthly net metering).

For onshore wind, the IEA expects that competitive auctions will drive capacity expansions, along with projects that received feed-in tariff licences but are awaiting final permitting and transmission capacity to be auctioned. The forecast expects limited hydropower growth after 2020 in the absence of planned development beyond the commissioning of large-scale projects currently under construction (IEA, 2019), which will already likely allow Turkey to realise its 160 TWh of economic potential.

Overall, affordable financing remains a key challenge in Turkey, especially due to depreciation of the Turkish lira and high nominal interest rates on loans. The IEA projects that Turkey's renewable capacity expansion could occur over 30% faster if macroeconomic conditions were to improve, new distributed PV regulation were implemented smoothly (leading to faster deployment) and more capacity were allocated under competitive tenders (IEA, 2019).

Feed-in tariffs

Under YEKDEM, Turkey has offered FiTs for renewable power plants since 2011. The feed-in tariffs are currently set at USD 0.133 per kWh for solar and biomass, USD 0.105 for geothermal, USD 0.073 for wind and hydro plants; they are valid for ten years. Additional support is provided if plant components are manufactured in Turkey, although the local content premiums are valid for a shorter period of five years.

Table 5.1 Feed-in tariffs for renewable power

Generation type	Tariff (US cents per kWh)
Hydro	7.3
Wind	7.3
Geothermal	10.5
Biomass	13.3
Solar	13.3

Source: Information provided to the IEA review team during its visit to Turkey.

The current FiTs are granted to both licensed and unlicensed facilities that enter into service between 1 January 2016 and 31 December 2020, and are based on an application submitted to EMRA by 31 October of the year prior to receiving payments. Payments are disbursed to generating facilities through the market operator (EXIST), which then passes the costs on to consumers via their electricity bills (RES Legal, 2019).

Importantly, the FiTs are fixed in US dollar terms to protect investors from currency risk. It is estimated that, in 2019, the YEKDEM scheme paid TRY 38.04 billion (USD 6.41 billion) in incentives to 777 renewable facilities with a total capacity of 20.9 GW (Dimitrova, 2020).

The scheme will expire at the end of June 2021 and the government is currently deciding on a new mechanism to replace it. The government expects to lower FiT levels for solar and wind, in light of significant cost reductions in those technologies since the policy was enacted. Given that financial institutions in Turkey still expect renewables project developers to have a stable revenue stream, the government plans to maintain some level of wind and solar FiTs under an updated YEKDEM scheme (in the absence of corporate power purchase agreements). Moreover, the government is likely to keep tariffs for geothermal and biomass around existing levels, as costs have not significantly fallen for these technologies.

In addition to feed-in tariffs, according to the Decision on State Aid in Investments in 2012, renewable energy investments can also benefit from a general incentive system, including value-added tax exemption and some exemptions from customs duties. In order to issue incentive certificates, the investment must amount to at least TRY 1 million (USD 172 200) in the 1st and 2nd regions, and at least TRY 500 000 (USD 86 100) in the 3rd, 4th, 5th and 6th regions (based on economic potential and development levels). Hydro, wind, biomass, geothermal and solar all fall under the scope of the general incentive system.

Nonetheless, in 2017 the government imposed antidumping import tariffs on Chinese PV modules, in addition to the "*gözetim vergisi*" import tax on all PV panels manufactured outside of Turkey. In April 2020, the government announced updated regulations to calculate import duties on a per kilogramme rather than square metre basis (USD 25/kg compared to USD 300/m^2). Higher efficiency modules are now heavier than in the past, so the rules could further disadvantage imported varieties (Bellini, 2020).

Competitive auctions

In 2016, the government introduced the Renewable Energy Resource Areas (YEKA) strategy, a tender process to procure the production of renewable energy in "renewable energy zones" (RE-Zones), which are deemed most suitable, based on resource potential and transmission system connectivity. In particular, the programme is meant to support the buildout of larger renewables projects. The General Directorate of Energy Affairs within the MENR is responsible for designating the zones in some cases, while the RE-Zones are proposed by auction participants in other cases. Participants in the tenders bid for a feed-in tariff, valid for a pre-determined period decided by the MENR according to each RE-Zone. The process mandates developers to include domestic businesses, establish domestic factories, create employment for the local labour force and invest in R&D.

Upon completion of the RE-Zone tender, the winning firm or consortium signs a contract with the MENR in order to be able to own the rights for the RE-Zone and the corresponding generation capacity. The MENR notifies EMRA about the winning firm/consortium that has acquired the right to apply for pre-license. The winning firm or consortium eventually submits a pre-license application to EMRA within 45 days following the signature of the contract. The licensing process is then carried out by EMRA in compliance with the rules of the Electricity Market Licensing By-Law.

To date, there have been three auctions under the YEKA scheme. The first was for a 1 GW solar PV plant in March 2017 at a winning bid of USD 0.0699/kWh for 15 years. It included 65% local content, R&D investments and cell manufacturing factory. The second project was a 1 GW onshore wind plant awarded in August 2017 at a winning bid of USD 0.0348/kWh for a period of 15 years. It included 65% local content and R&D investments. The most recent tender was for 1 GW of onshore wind capacity awarded in May 2019, with winning bids ranging from USD 0.0353 to USD 0.0456/kWh for 15 years. Another 1 GW solar tender was originally planned for January 2019 but pushed back to April 2020 and, more recently, to October 2020. On 3 July 2020, new solar tenders were announced in the Official Gazette with installed capacities of 10 MW, 15 MW and 20 MW. The total capacity of the tenders is 1 GW for 74 projects in different regions of Turkey. The YEKA programme is not limited to only wind and solar, even though to date it has only been used for these projects.

Turkey also held a tender for a 1.2 GW offshore wind facility in 2018, with a ceiling price of USD 0.08/kWh, but the tender was postponed based on concerns raised by participants.

Although the first solar and wind projects granted under the YEKA scheme required investors to build local manufacturing facilities (with 500 MW each of wind and solar capacity), future ones will only include a minimum 65% local content requirement. Moreover, for future solar auctions, the government is planning to issue tenders for smaller capacities (10-50 MW) (Mini-YEKA).

On 26 March 2020, Law No. 5346 was amended so that all future RE-Zone tenders will be held in Turkish lira rather than USD.

Similar to the FiTs, the cost of the YEKA programme is passed on to consumers' electricity bills by the market operator, EXIST.

After winning a bid in a RE-Zone auction, a developer must then apply for a construction permit. It usually takes around three years from the time an investor wins a tender to receive a permit and begin construction.

RE-Zones are designated based on transmission connections, but if a project does not have a Turkish Electricity Transmission Company (TEİAŞ) transmission connection, it can build its own and be reimbursed by TEİAŞ in ten years.

Grid connection auctions

In addition to the RE-Zone tenders, there is also an auction model applied for awarding the available connection capacities to project owners. This auction scheme is only implemented for the wind and solar power pre-license applications received by EMRA. Such auctions are carried out if the total capacity of the projects in a certain connection region exceeds the available connection capacity declared by TEİAŞ or if at least two of the projects' land footprints are intersecting or overlapping. The selection criteria of these auctions is to award connection capacities to those offering the lowest bid from the FiT price, which also enables the offer of negative bids. The "pay-as-bid" method is also adopted in such auctions, i.e. the individual bids of all winners are used as the FiT price during the period of purchase guarantee. On the other hand, winners with negative bids pay an additional penalty to the market operator on a monthly basis, calculated by multiplying the absolute value of the bids with the electrical energy produced, from the first

commissioning of the power plants and for ten years after full commissioning. Onshore wind power auctions for 3 000 MW were held using this auction model in 2017.

While the YEKA scheme only applies to Re-Zones, grid connection auctions apply for wind and solar licensed projects as well. TEİAŞ administers the auctions based on the lowest bidding price to be paid per kWh.

Net metering

Since 2013, requirements for unlicensed power generation have been regulated by the Regulation on Unlicensed Electricity Generation in the Electricity Market. Since then, there has been growth in ground-mounted utility scale solar installations throughout Turkey. In order to contain the growth of unlicensed installations, the government recently updated the conditions to sell surplus power generated back to the grid and be compensated accordingly (net metering).

In May 2019, the government approved a new framework for self-consumption and remuneration of excess generation at retail rates for residential, commercial and industrial applications. The new regulations include provisions for self-consumption and raised connection fees for developers so as to prevent exponential growth in unlicensed facilities.

Qualifying unlicensed facilities have to be rooftop or façade installations and must be in the same distribution region as a consumption facility. Moreover, the installed power cannot exceed the identified power limit for the related consumption facility under the connection agreement with the distribution company. Residential subscribers who apply for unlicensed generation to their respective distribution company can sell the surplus generated beyond self-consumption up to 10 kW for up to ten years.

Notwithstanding the changes in the self-consumption framework, Turkey is expected to experience additional growth in distributed solar capacity in the coming years. As capacity grows, distribution companies will also need to accommodate growing self-consumption generation in their networks, including through additional investments in upgrading and increasing the flexibility of distribution grids.

Heating

There are currently no plans in Turkey to promote renewables-based heating, despite good conditions and significant potential for solar thermal, geothermal and waste use. Solar heating, in particular, is technologically simple, affordable and reliable and can work well in less economically developed regions. Turkey benefits from particularly high solar irradiance, which makes solar heat especially appropriate. Furthermore, solar heating can be easily combined with other sources, including natural gas or heat pumps.

At present, Turkey has a sizeable number of solar heating installations on rooftops, totalling almost 18 gigawatt hours of installed capacity, predominantly in medium and lower income households in the south-eastern part of the country, despite not having regulations or incentives in place. This success is partly due to the high costs of imported fuels. However, the trend is to replace them with natural gas heating systems.

Transport

Turkey has a relatively modest biofuels programme. The government offers a special consumption tax (SCT) exemption for ethanol blended into gasoline as well as an SCT refund for domestically produced biodiesel. In addition, the government requires 3% ethanol blending in gasoline and 0.5% biodiesel into diesel. Still, the share of renewable energy such as biofuels in transport is very small.

Assessment

Turkey has experienced impressive growth in renewables in the past decade, driven by favourable resource endowment, strong energy demand growth and supportive government policies. Renewable energy consumption increased by 36% from 2008 to 2018. The bulk of Turkey's renewable energy supply is concentrated in the electricity sector. To this end, electricity from renewable energy sources amounted to 43.8% of total electricity generation in 2019. Notably, this share has increased since 2000, despite increasing electricity consumption.

Hydropower is the largest source of renewable electricity in Turkey. Hydropower generation can show large annual variations due to hydrological conditions, which has a significant impact on overall renewable electricity generation and therefore on the share of renewables in electricity production. The long-term trend for hydropower is nevertheless growing, with electricity generation almost tripling since 2000. The government estimates that Turkey's hydroelectric potential is 433 TWh, while the technically usable potential is 216 TWh and the economic potential 160 TWh/year. Based on projects already under construction, it is expected that hydropower capacity will reach 32 000 MW by 2023, indicating that a sizeable share of Turkey's economic potential will be realised by then.

Non-hydro renewable electricity generation has seen even stronger growth in the last decade, from 1.2 TWh in 2008 to 44.5 TWh in 2019.

Based on government data, the installed capacity of wind increased from 2 261 MW in 2012 to 7 591 MW in 2019. The government estimated the wind energy potential of Turkey to be 48 000 MW. Accordingly, wind energy still has significant expansion potential.

The installed capacity of solar increased from 0 MW in 2012 to 5 995 MW in 2019. Part of this expansion was due to the rapid 1 600 MW increase in unlicensed (including rooftop) solar production between 2017 and 2018. The Turkish Solar Association estimates that Turkey's solar potential will reach 38 GW by 2030, which represents sizeable residual potential.

Bioenergy accounted for 3.2 TWh of renewable electricity in 2019 (1.1% of total generation), mainly from biogas. It is estimated that the biomass potential in Turkey is about 8.6 Mtoe (100 TWh), of which around a fifth can be used for biogas production.

Geothermal power is also increasing rapidly, from 311 MW in 2013 to 1 515 MW by the end of 2019. Notably, Turkey has the IEA's second-highest share of geothermal in electricity generation after New Zealand. Turkey's proven geothermal potential reached 35 gigawatt thermal (GWth) by the end of 2018.

The government set a goal to increase the share of renewable energy in electricity generation to 38.8% by 2023 (a target that was already surpassed in 2019). The government plans to exploit the full economic potential of hydropower by 2023, and increase the installed capacity of wind and solar generation by 10 000 MW each between 2017 and 2027. The targets for wind and solar are easily achievable since a significant proportion has already been realised, so the expansion targets represent relatively modest volumes compared to the country's potential. In particular, the IEA encourages a higher expansion of wind given its low costs (winning bids under auctions were recently 3.48-4.56 USD cents/kWh).

The growth in Turkey's renewables sector is underpinned by the government's policy support schemes. Under the Renewable Energy Support Mechanism, Turkey offers ten-year feed-in tariffs for renewable power plants that are operational or will come on line before 30 June 2021. The FiTs are generous in amount and set in USD to protect against currency risk. They differ depending on the technology, but are uniform within the technology for all projects irrespective of scale. Should the government continue with the YEKDEM programme after June 2021, it should assess whether support can be made more efficient by introducing a differentiation in the size of projects. There are additional five-year premiums on tariffs for installing locally manufactured equipment (for licensed projects). The local content premiums are designed to promote a local manufacturing industry in the sector rather than promote increased renewable energy production. There could be a risk that the local content premiums will add to overall system costs and prevent Turkey from realising the full benefits of the plummeting costs of wind and solar technologies seen abroad. Import duties and taxes on imported PV components are likely an even more significant impediment, though.

Given the impending expiration of the current YEKDEM scheme at the end of 2020, the government is in the process of updating the policy. While doing so, it should modify support systems to ensure that dispatchable renewables generation reacts to market signals, to account for their respective contributions to reduce overall system costs and ensure smooth integration in the future, taking into account future network requirements, locational variances and flexibility options.

In addition to the FiTs, renewable power installations can benefit from other incentives, such as a reduction in land acquisition and license costs as well as exemptions from value-added tax and customs duties (regional investment incentives). The incentives vary by region. Additional measures, including streamlining the multitude of permits required to receive an operational license, would further improve the investment climate for renewables.

In 2016, the government introduced a new support mechanism in the form of YEKA. Under the scheme, a public tender is carried out for each RE-Zone based on a reverse auction, with the FiT serving as the ceiling price. Depending on the tender requirements, the renewable plants in these zones are either required to use locally manufactured equipment or build local manufacturing facilities. The first two tenders also required the construction of R&D facilities. The first two tenders were large (1 GW), though future tenders (around 1 GW of capacity annually each for wind and solar) will be divided into smaller capacity auctions (10-50 MW), which will also allow smaller companies to bid. In fact, the third tender, for onshore wind in May 2019, was divided among 4 regions of 250 MW each. The IEA urges the government not to link future tenders to R&D or local manufacturing facilities to ensure a level playing field for smaller participants.

Distributed PV has emerged as a notable growth area in the Turkish market based on a new framework for self-consumption and remuneration of excess generation at retail rates for residential, commercial and industrial applications (net metering). In addition, the new regulation raised the size eligible for support for all unlicensed installations from 1 MW to 5 MW, allowing more facilities to qualify.

Though renewables in electricity has been a success story, Turkey should also consider opportunities for using renewables in other sectors. There are currently no plans to promote renewables-based district heating and cooling, despite good conditions and significant capacity for solar thermal, geothermal and waste. Solar heating, in particular, is technologically simple, reliable and affordable, and can work well in economically less developed regions. Furthermore, solar heating can be easily combined with gas systems.

Turkey also has a relatively modest biofuels programme, which offers consumption tax exemptions for blending domestically produced biofuels into petroleum fuels. The government requires 3% ethanol blending in gasoline and 0.5% biodiesel in diesel.

Recommendations

The government of Turkey should:

- Define long-term targets (across all strategies and plans) for the development of renewable energies that take into account the potential per technology.
- Adjust support systems to ensure that dispatchable renewables generation reacts to short-term market signals and that local content requirements and import duties do not impede system cost savings.
- Streamline the licensing process (including by reducing the number of permits required) to improve the investment environment for renewables.
- Support the use of renewable heating, including solar heating as well as geothermal.

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6. Energy technology research, development and demonstration (RD&D)

Key data

(2018)

Government energy RD&D spending: TRY 331 million (USD 58 million)

Share of GDP: 0.08 per 1 000 GDP units (IEA* median: 0.32)

RD&D per capita: 0.72 USD/capita (IEA* median: 14.0 USD/capita)

* Median of 27 IEA member countries for which 2018 data are available.

Exchange rates (2019): USD 1 = TRY 5.68; TRY 1 = USD 0.18.

Overview

Turkey supports research, development and demonstration (RD&D) with the objectives to boost economic growth, promote domestic energy sources and enhance energy efficiency. Under a national strategy to reduce energy imports, the government allocates its research and innovation spending mainly toward renewables and energy efficiency. While the energy RD&D budget as a share of GDP remains modest, research investments in domestic energy sources such as hydropower and coal have recently increased. Turkey actively participates in the IEA technology collaboration programmes (TCPs) and in the Committee for Energy Research and Technology.

Public and private spending on energy RD&D

Since 2014, annual public funding of energy RD&D ranged between TRY 250 million and TRY 360 million, with the highest level in 2017 at TRY 366 million (Figure 6.1). In 2018, the Turkish government allocated TRY 331 million (USD 58 million) for energy RD&D, which was a 9% drop from 2017.

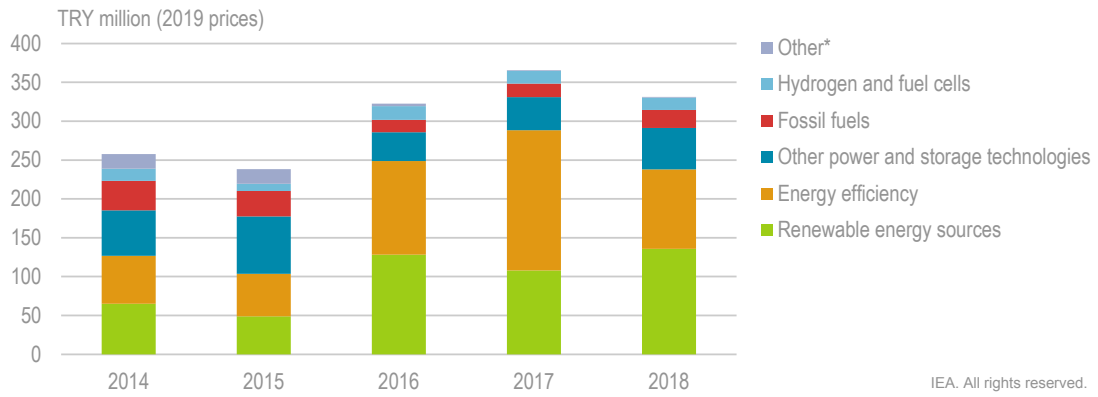
Renewable energy and energy efficiency are the two largest areas supported by the government, together representing 72% of the total RD&D budget in 2018. Support for renewables and energy efficiency has dominated RD&D funding since 2016, in line with the political priority to increase the share of domestic energy production and lower imports. In 2018, 41% of the total energy-related RD&D budget was allocated to renewable energy, most of which was dedicated to hydropower, which received 35% of the total RD&D budget. Small shares of renewable funding went to solar, wind energy and biofuels. While

funding for energy efficiency fell substantially between 2017 and 2018, energy efficiency technologies remain the second-largest area of research and innovation investment, at 31% of the total energy-related RD&D funding in 2018. Most of this went to research in transport, in particular advanced power vehicles, which received 28% of the total energy RD&D budget.

Other power and storage technologies accounted for 16% of total public energy RD&D spending in 2018, over half of which was allocated to electricity transmission and distribution. Fossil fuels received 7% of the total budget, mainly coal, oil and gas conversion, with a very minor share spent on carbon capture and storage technology. Hydrogen and fuel cells received 5% of the total budget, and the remaining energy RD&D spending went to cross-cutting technologies and nuclear power, or was unallocated.

In an IEA comparison, Turkey had the tenth-lowest budget for energy-related RD&D in absolute terms, with USD 58 million in 2018, and the third-lowest spending per unit of gross domestic product (GDP), at 0.008% of GDP (Figure 6.2).

Figure 6.1 Energy-related public RD&D spending by category, Turkey, 2014-18



Energy-related RD&D was TRY 331 million in 2018, most of which went to renewables, energy efficiency and power storage technologies.

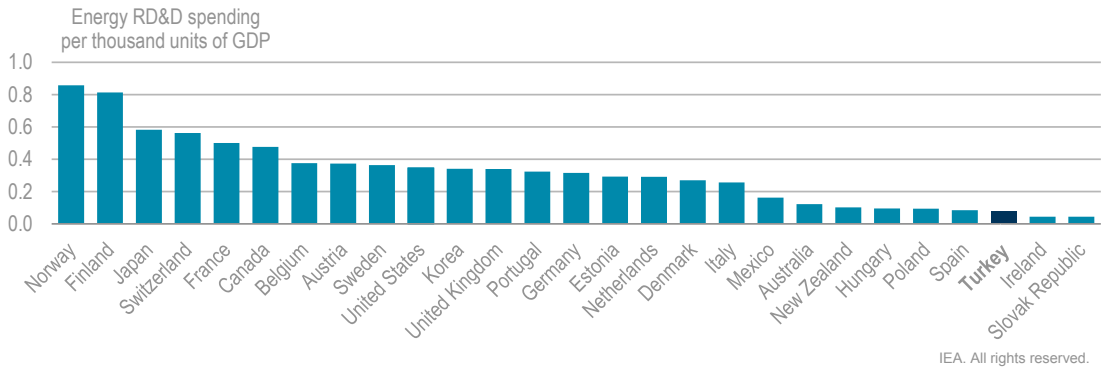
* *Other* includes nuclear, other cross-cutting technologies and unallocated funds.

IEA (2020), *Energy Technology RD&D Budgets 2020* (database), www.iea.org/statistics.

Electricity and natural gas distribution companies can use 1% of their operating expenses for RD&D activities. In these cases, distribution companies submit their projects to the RD&D commission of the Energy Market Regulatory Authority (EMRA). If the project is approved by the commission, companies can finance the projects using their approved RD&D budget. Since 2014, more than 500 projects have been proposed, 213 projects have been approved and 84 have been completed. The 2020 budget for the RD&D activities of distribution companies was approximately TRY 80 million (USD 12.3 million).

Data available to date suggest burgeoning though limited venture capital activity in energy start-ups based in Turkey, with a handful of relevant deals in energy efficiency recorded since 2015.

Figure 6.2 Energy-related public RD&D spending per GDP in IEA countries, 2018



Among IEA countries, Turkey had the third-lowest energy-related public spending per 1 000 units of GDP in 2018.

Note: Missing data for the Czech Republic, Greece and Luxembourg.

IEA (2020), Energy *Technology RD&D Budgets 2020* (database), https://www.iea.org/reports/energy-technology-rdd-budgets-2020.

Institutions and governance

Energy research and innovation policy and financing is primarily managed by the Ministry of Industry and Technology. The decision-making process extends to the Presidency, the Scientific and Technological Research Council of Turkey (TÜBİTAK) and related government ministries, including the Ministry of Energy and Natural Resources (MENR) and the Ministry of Industry and Technology.

The MENR's RD&D projects are carried out within the scope of TÜBİTAK, which is an affiliate of the Ministry of Industry and Technology, under support Program 1007. TÜBİTAK's 1007 Program, started in 2005, is an RD&D support programme that aims to meet the needs of public institutions. The monitoring and funding of approved projects fall under the responsibility of TÜBİTAK.

A number of TÜBİTAK-sponsored energy projects are conducted out of the Marmara Research Center, one of TÜBİTAK's oldest and largest research centres, that conducts applied RD&D activities. Energy-related activities are directed out of the centre's Energy Institute. Fields of activity of the Energy Institute consist of: clean coal and biomass technologies, electric power technologies, energy storage and fuel cells, and transport technologies.

The TÜBİTAK Rail Transport Technologies Institute was established in 2019 and will focus on transport technologies, electric propulsion systems, energy storage and automation technologies.

Besides TÜBİTAK, the General Directorate of Agricultural Research and Policies (TAGEM) has been preparing, assessing and co-ordinating research projects, including in energy-related areas, with 49 research institutes within the scope of the Ministry of Agriculture and Forestry.

Energy research and innovation policy and support measures

RD&D and innovation priorities are shaped in line with the objectives set out in the MENR Strategic Plan.

Energy technology RD&D and innovation priorities are determined through a comprehensive horizon scanning of national and international policy documents, including global trends, as well as the needs and capacities of the local energy system. More recently, TÜBİTAK conducted a high-level technology prioritisation study, which evaluated 27 technology areas based on both impact and feasibility. From this, 11 technology areas were identified to have an above-median impact and feasibility, including big data and data analytics, artificial intelligence and machine learning, and energy storage technologies. These priorities are being used to transform the RD&D and innovation ecosystem into a more target-oriented environment.

The determination of priorities for energy RD&D and energy technology innovation is highly correlated with the national needs of Turkey as well as international trends toward the energy transitions. As a result, the priority areas have been changing based on the priorities in national policy documents, including those for district heating and cooling systems, the rising prominence of renewable energy technologies, and digitalisation in the energy sector, including big data and data analytics and artificial intelligence.

In addition, technological advances require better co-ordination with the social sciences to combine technological progress with enabling business models and human behaviour. For this reason, a multi-disciplinary research environment in the energy sector is being actively pursued within TÜBİTAK. In 2019, TÜBİTAK prepared a target-oriented call plan for energy with a total of 16 calls. These calls will be opened under a new support programme that emphasises cross-sectoral collaboration. All of the calls will include technology readiness levels and identification of the source of the call context, including the National Energy Efficiency Action Plan. TÜBİTAK received project applications for 4 calls in 2019, with a total budget of TRY 8.5 million (USD 1.5 million) for supported projects. The calls cover a wide range of energy technologies, namely:

a. digital technologies in energy and energy system modelling – smart energy networks (including power to x) and big data and data analytics
b. electrical power conversion, electrical transmission and distribution for smart grids
c. energy efficiency – district heating and cooling, nearly zero energy technology buildings
d. energy storage technologies
e. solar energy technologies
f. bioenergy conversion technologies for advanced biofuels products
g. wind power technologies
h. hydropower and geothermal
i. hydrogen and fuel cells
j. fossil fuels and mining – carbon caputure and storage, clean coal technologies, and recycling of critical raw materials.

One of the larger projects as part of the TÜBİTAK 1007 Public Institutions Research Funding Program, "Liquid Fuel Production from Biomass and Coal Mixtures (TRIJEN)", commenced in 2009, led by TÜBİTAK's Marmara Research Center and Turkish Coal Enterprises (TKİ). This project aims to produce environmentally friendly, efficiently refined liquid fuels from coal-biomass mixtures, which can also be applied to thermal power plants to ensure sustainable development and energy security. The budget for the TRIJEN project includes TRY 21 million from the TÜBİTAK 1007 Program, TRY 17.4 million from TKİ and TRY 2.5 million from the TÜBİTAK Marmara Research Center Energy Institute, for a total of TRY 40.9 million (USD 6 million). The pilot scale of the project was completed in April 2020 and industrial scale application is under evaluation. Following the evaluation of results, preliminary feasibility studies will be completed and if the results are positive, a facility that is at least ten times the size of the existing facility is planned, followed by a large-scale (> 1 000 barrels/day) industrial facility or facilities, all within the scope of the Project Results Application Program.

Progress toward the targets defined in the MENR Strategic Plan are monitored and evaluated periodically, led by TÜBİTAK and the Ministry of Industry and Technology. TÜBİTAK's Public Research Grant Program often requires results implementation plans prior to approval of a project in order to conduct monitoring and *ex ante* impact assessments. This includes several national energy projects for which the MENR is the public institution with related public RD&D requirements.

Completed energy projects under TÜBİTAK's programme include: the production of liquid fuel from biomass and coal mixtures, a national wind energy system project, and a project for the development of LED and Organic Light Emitting Diodes production technologies. Ongoing projects include: the development of PV plant technologies, domestic design and production of hydroelectric power plant components, domestic production of gas turbine blades, and the development of back-to-back connected high voltage direct current systems. Several of these focus areas are aligned with Turkey's aim to support the local content rules of the government's renewable energy policy.

Research areas for the Marmara Center's Energy Institute include project systems information technologies, power system analysis and planning, power plant control technologies, and converter technologies. Examples of projects include monitoring and forecasting systems for wind energy, power quality analysers, river flow forecast and optimisation modelling, a national load dispatch system for transmission system operators, power systems rehabilitation and renovation, turbine efficiency analysis, and renewable power electronics interfaces.

The government does not yet have a national energy RD&D strategy road map. TÜBİTAK will be preparing technology road maps according to the 2023 Industrial Strategy, including a technology road map on artificial intelligence and machine learning, and possibly smart cities.

Elsewhere, at TAGEM, RD&D studies are carried out on the use of renewable energy in agricultural production in the field of energy technology research and innovation. To bolster sustainable agricultural production, machines using renewable energy resources have been developed for the energy-intensive livestock sector. These include a solar-powered bovine milking machine and a mobile hybrid milking machine.

RD&D studies are also ongoing into measures to save energy from irrigation and to switch to energy-efficient irrigation methods. The works carried out for this purpose include the installation of a solar centre pivot irrigation system, a solar cell irrigation canal pilot project and exploring possibilities for using drip irrigation systems in paddy fields.

TAGEM also supports the private sector with its R&D calls.

International collaborations

Turkey is currently participating in 5 (out of 38) IEA TCPs, including 2 focused on solar energy, 1 on energy in buildings, 1 on energy storage, and 1 on hybrid and electric vehicles. Turkey also formerly participated in TCPs relating to bioenergy, geothermal energy, hydrogen and advanced fuel cells.

Turkey is an active associate country in the EU's Horizon 2020 programme, with 66 projects and 97 applicants supported under energy technology-related calls as well as 18 projects and 22 organisations supported under transport-related projects (electric/hybrid vehicles, propulsion, power electronic and battery technologies) to date.

Assessment

The Turkish government's priorities for energy RD&D and innovation are set in line with the country's national needs, outlined within different strategic plans, namely:

a. The National Energy and Mining Policy issued in 2017 by the MENR. This plan is based on three pillars, including the goal to significantly increase the use of domestic energy resources. This translates notably into organising calls for renewable energy projects with a criterion of local content as well as the building out of local RD&D capabilities by the awarded companies.

b. Most recently, the Eleventh Development Plan (2019-2023) establishes important targets for energy, including for the share of different energy sources in electricity production, specifically the reduction of natural gas, and the increase of domestic coal and renewable energy in the electricity mix.

c. The National Energy Efficiency Action Plan (2017-2023) sets a target to reduce primary energy consumption by 14% by 2023. The plan defines 55 sectorial actions for buildings and services, industry and technology, energy production, transport, agriculture, and cross-cutting areas. The plan emphasises co-generation and district heating-cooling systems as well as the need to increase the efficiency of existing power plants and the promotion of demand-side management.

The highest governance level for the steering of RD&D and innovation is the Science, Technology and Innovation Policies Council under the Presidency of the Republic of Turkey. Energy technology RD&D and innovation priorities are determined through a comprehensive horizon scanning of national and international policy documents, including global trends and the needs and capacities of the local economy. A high-level technology prioritisation study has been conducted by TÜBİTAK, identifying 11

technology priority areas, including big data and data analytics, artificial intelligence and machine learning, and energy storage technologies.

Nevertheless, the government does not yet have a national energy RD&D strategy road map, which could contribute to the harmonisation of core energy research programmes and ensure a higher level of co-ordination of energy research policies among the ministries and public bodies. Technology road maps are currently being prepared and could transform the RD&D framework into a more target-oriented system.

RD&D projects carried out by public institutions are primarily funded by TÜBİTAK, an affiliate of the Ministry of Industry and Technology. It serves as the leading Turkish agency responsible for promoting, developing, organising, conducting and co-ordinating research and development in line with national targets and priorities.

The Turkish government allocated TRY 331 million to energy-related public RD&D in 2018, which is relatively low in terms of RD&D spending per unit of GDP compared to the average spending by IEA member countries.

In accordance with the political priority to increase the share of domestic energy production, 41% of the total public RD&D budget was allocated in 2018 to renewable energy, most of which was dedicated to hydropower. While public investments for research and innovation on energy efficiency decreased in 2018, this area still received the second-largest share, with 31% of the total budget. Other power and storage technologies accounted for 16% of the total budget, of which a large share went to electricity transmission and distribution and electrical storage.

Other funding sources are also available, including from individual ministries, such as the MENR or the Ministry of Industry and Technology, to address their specific priorities. In addition, renewables energy projects awarded within the framework of the RE-Zone process are requested to support the local development of RD&D capacities. The transmission system operator and distribution system operators in the country are also active in RD&D project financing, as 1% of their budgets needs to be allocated to these efforts. Finally, specific funding may occur at the presidency level for the financing of large research facilities.

In addition to the different funding tools already put in place by the government, a stronger focus could be given to the support of innovative small and medium-sized enterprises and start-ups in the energy sector across a range of market readiness levels, from the incubator stage to market deployment. This would imply the establishment of specific funding schemes ranging from early- to late-stage financing.

In 2019, TÜBİTAK prepared a target-oriented call plan for energy with a total of 16 RD&D and innovation priorities. These priorities, including designation of cross-sectoral collaboration, are launched under relevant support programmes. These priorities include projects focused on digital technologies in energy and energy system modelling, energy efficiency and energy storage, particularly in support of variable renewable energy sources and to reduce curtailment. Significant levels of funding and research capacities in terms of infrastructure and human resources will be required to bring this broad range of technologies to the desired degree of maturity.

In the field of nuclear power generation, the IEA commends the efforts carried out by the Turkish government to put in place the appropriate high-level technology education

framework for the ramping up of its three planned nuclear power plants. This is being carried out by means of university co-operation programmes with the Russian Federation in a first stage, with the intention in the mid-term to build relevant national structures for the capacity building of skilled personnel.

In the framework of the IEA TCPs, Turkey participates as a contracting party in five TCPs related to energy efficiency or renewables (Energy in Buildings and Communities, Energy Storage, Hybrid and Electric Vehicles, Photovoltaic Power Systems, and Solar Heating and Cooling). Turkey could increase its participation in international initiatives related to energy technologies as a means to accelerate results and maximise the impact of domestic efforts in support of national energy priorities. In particular, consideration should be given to further participation in TCPs according to its domains of interest, such as smart grids, bioenergy, geothermal energy, hydrogen and cleaner fossil fuel technologies. The government could also investigate the opportunity and potential benefits of pursuing collaboration through other international partnerships such as Mission Innovation.

At the European level, Turkey is an associate country in Horizon 2020 and participates as well in the Strategy Energy Technology Plan, the technology pillar of the EU's energy and climate policy.

Recommendations

The government of Turkey should:

- Elaborate a high-level RD&D strategy road map in accordance with the energy policy agenda, highlighting national RD&D priorities and the relevant time frames to address RD&D challenges.
- Improve co-ordination between ministries related to energy research policies, projects and funding. Consider further opportunities for international collaboration in support of strategic national energy research and innovation objectives.
- Ensure an appropriate level of public funding for Turkey's core energy RD&D programmes in line with Turkey's energy policy ambitions. Regularly monitor and evaluate the outcomes of energy RD&D programmes.
- Develop additional funding schemes for private sector innovation in the energy sector, ranging from incubator projects to market-ready solutions.

Reference

IEA (International Energy Agency) (2020), *Energy Technology RD&D Budgets 2020*, IEA, Paris, www.iea.org/statistics.

7. Electricity

Key data

(2019 provisional)

Electricity generation: 304.3 TWh (coal 37.2%, hydro 29.2%, natural gas 18.7%, wind 7.2%, solar 3.5%, geothermal 2.9%, bioenergy and waste 1.1%,), +56% since 2009

Electricity net exports: 0.6 TWh (imports 2.2 TWh, exports 2.8TWh)

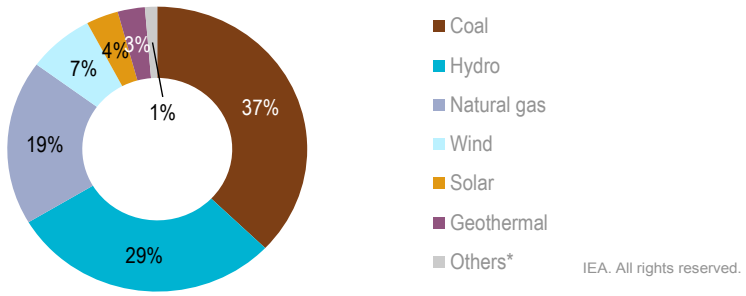
Installed capacity (2018): 88.6 GW

Electricity consumption (2018): 258.2 TWh (industry 44.3%, services/other 32.8%, residential 21.1%, energy 1.3%, transport 0.5%)

Overview

Electricity accounted for 21% of total final consumption (TFC) in 2018, the third-largest energy source after oil and gas, with demand increasing across all sectors. Fossil fuels used to dominate electricity generation, but hydropower increased its share to 29% in 2019, while coal and natural gas together amounted to 56% (Figure 7.1). Coal power, which accounted for over a third of power generation in 2019, has also rapidly increased in recent years, contributing to about half of the total growth in electricity generation in the last decade. However, other renewable sources, such as wind power, are also increasing, resulting in a sharp reduction in the share of natural gas.

Figure 7.1 Electricity supply by source, Turkey, 2019



Turkey has been heavily reliant on coal and natural gas power, which accounted for 56% of total power generation in 2019; hydro rapidly increased its share to 29%.

* *Others* includes oil, bioenergy and others.

Note: 2019 data are provisional

Source: IEA (2020a), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Electricity supply and demand

Electricity generation

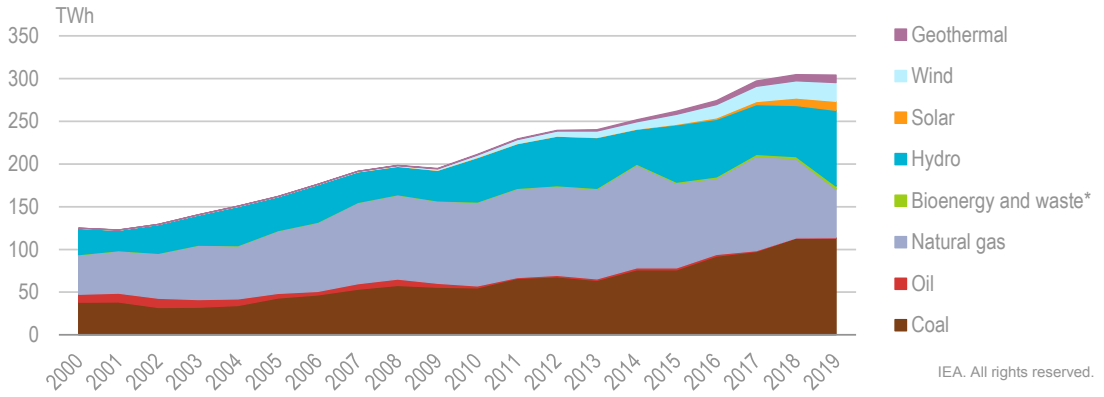
Total electricity generation in Turkey reached a near record high of 304.3 terawatt hours (TWh) in 2019, more than double the production in 2000 (Figure 7.2). While oil does not have a significant contribution in electricity generation and the share of natural gas has been declining in recent years, coal-fired electricity generation has increased. In 2019, coal power generated 113.2 TWh, representing a 103% growth since 2009.

Renewable energy sources maintain a notable share in Turkey's power mix, and their contribution is increasing. Hydropower, in particular, has almost tripled its production since 2000 (albeit with variations year-on-year due to the seasonality of hydro supply and unavailability of old plants). In 2019, hydropower accounted for around 29% of total electricity generation, while wind came in at 7%, solar at 3%, geothermal at 3% and bioenergy at 1%. According to Turkish government data, as of May 2020, hydropower represented the largest source of electricity generation at 34%.

Renewable electricity generation has seen noticeable growth, with an almost threefold increase in the last decade, thanks to investments in a variety of resources. Wind power generation grew from 1.5 TWh in 2009 to 21.8 TWh in 2019, while solar power generation increased from 0.8 TWh in 2009 to 10.6 TWh in 2019. The total share of electricity from variable renewables (solar and wind) was 11% in 2019, up from 2% in 2009.

Turkey does not yet have any nuclear power generation, but is well advanced in its plans to introduce nuclear, with two reactors currently under construction (see Chapter 10). This will further diversify Turkey's power generation capacity.

Figure 7.2 Electricity generation by source, Turkey, 2000-19



Total electricity generation in Turkey has increased by 60% in a decade, mostly from rapid growth in coal power, but also from increases in hydropower, wind and other renewables.

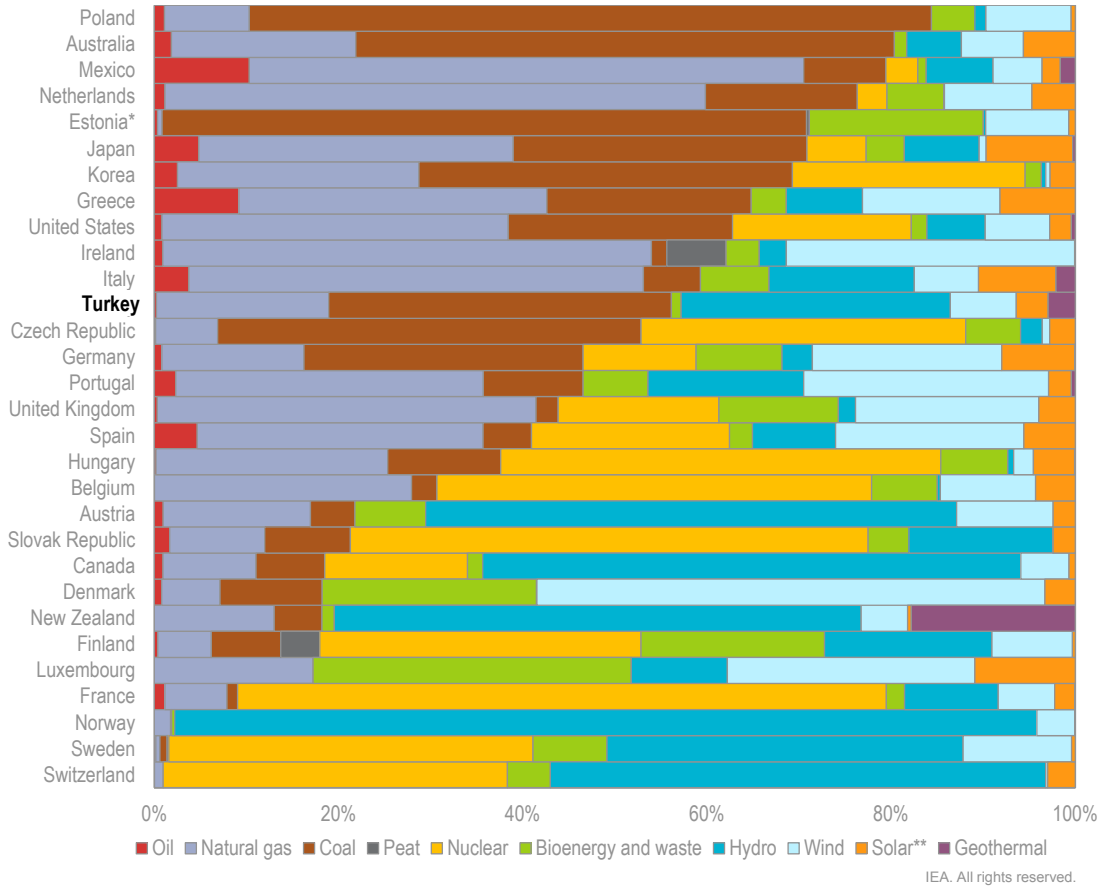
* *Bioenergy and waste* includes biogas, primary solid biofuels, liquid biofuels, and industrial waste and waste heat.

Notes: TWh = terawatt hour. Data for 2019 are provisional.

Source: IEA (2020a), *World Energy Balances 2020* (database), www.iea.org/statistics.

With its high share of hydropower and recent growth in other renewable energy sources, Turkey was around the median for its share of fossil fuels in electricity generation among IEA member countries in 2019 (Figure 7.3). The hydro share was the seventh-highest and Turkey's share of geothermal was the second-highest after New Zealand.

Figure 7.3 Electricity generation by source in IEA member countries, 2019



Turkey's electricity generation was around the median in terms of its share of fossil fuels among IEA countries in 2019, and seventh-highest for its share of hydropower.

* Estonia's coal represents oil shale.

** *Solar* includes solar PV, solar thermal, wave and ocean power, and other power generation (e.g. from industry waste heat and fuel cells).

Note: Supply data for 2019 are provisional.

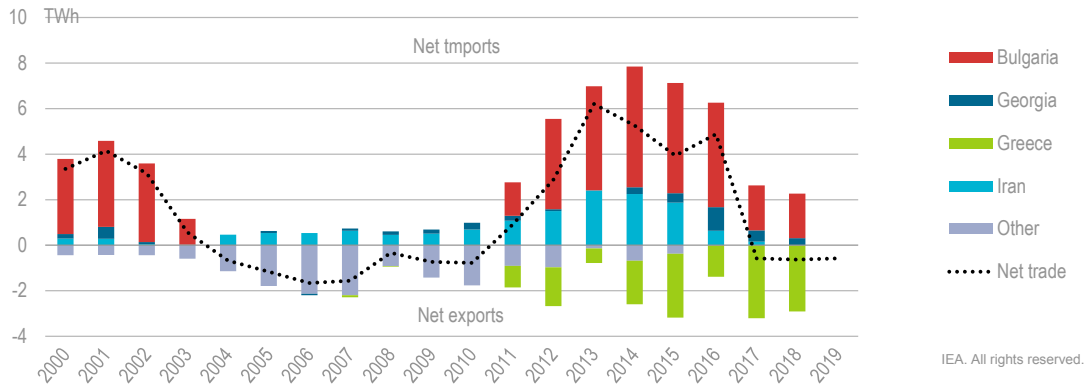
Source: IEA (2020a), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Trade and interconnections

Turkey has interconnections with most of its neighbouring countries, but electricity imports and exports are small compared to domestic generation and consumption. In 2019, Turkey exported 2.8 TWh – or less than 1% of total domestic generation – and imported 2.2 TWh, resulting in total net exports of 0.6 TWh. Trade flows have fluctuated over the past two decades, with Turkey sometimes being a net importer and sometimes a net exporter (Figure 7.4). As Turkey generates nearly 30% of electricity from hydropower, yearly hydrological conditions considerably affect local generation capacity. Turkey's variance in hydro also impacts international trade, though the larger issue

impacting electricity trade is the variation in average market clearing prices among neighbouring countries. The largest share of net imports comes from Bulgaria (1.9 TWh in 2018), followed by Georgia (0.41 TWh), while net exports mainly go to Greece (2.9 TWh).

Figure 7.4 Electricity imports and exports by country, 2000-19



Turkey is interconnected to most of its neighbouring countries, with imports mostly from Bulgaria and exports mostly to Greece, but net trade is small compared to total electricity generation.

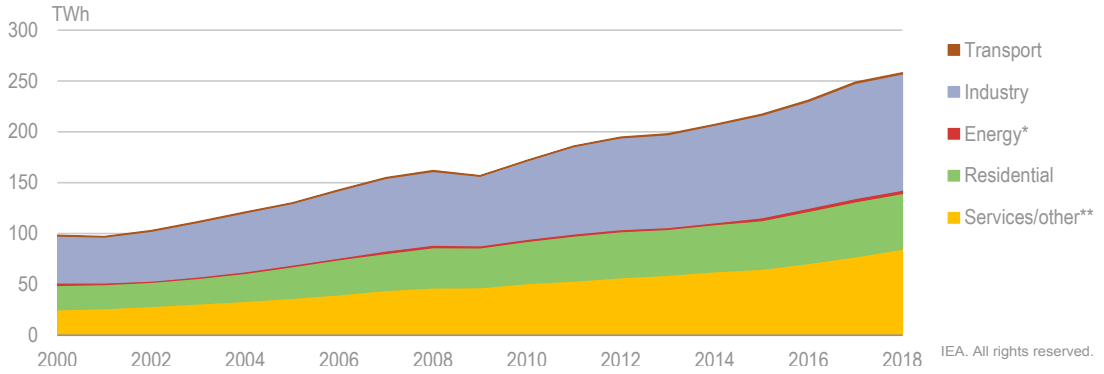
Notes:TWh = terawatt hour. 2019 data are unavailable for electricity trade for specific countries.
Source: IEA (2020b), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Electricity consumption

Turkey's total final electricity consumption was 258 TWh in 2018. The industry sector dominated with 44% of total demand, followed by services at 33% and residential consumption at 21% (Figure 7.5). The rest were minor shares used in energy industries and transport.

Electricity consumption has steadily increased since 2000, with the exception of a small drop in 2009 after the global financial crisis. In the decade from 2008 to 2018, electricity demand grew by 60%. The most rapid growth has been in the services sector, which increased by 82% over the period (driven by overall economic growth and the transition toward more services in the economy), but other major sectors have also experienced significant growth, with 58% in industry and 38% in residential consumption (in part, driven by increased consumption from appliances).

Figure 7.5 Electricity consumption by consuming sector, Turkey, 2000-18



Electricity consumption increased by almost 60% from 2008 to 2018, with rapid growth in all major sectors, in particular industry and services.

* *Energy* includes petroleum refineries, coal mines, and oil and gas extraction.
** *Services/other* includes commercial and public services, agriculture, and forestry.
Note: TWh = terawatt hour.
Source: IEA (2020a), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Institutions

The Ministry of Energy and Natural Resources (MENR) has the lead responsibility for formulating and implementing policies related to the electricity sector, in co-ordination and co-operation with other ministries as relevant.

The Energy Market Regulatory Authority (EMRA) is the central regulatory body for the energy sector, including for electricity. As an independent regulator, EMRA is responsible for granting and renewing licenses; supervising market participants' activities; establishing performance standards by monitoring market performance; preparing, improving and executing secondary legislation; auditing licenses; preparing, modifying and executing regulated tariffs; and ensuring that market activities are in compliance with the Electricity Market Law. Therefore, EMRA closely monitors license holders such as generators, transmission system operators (TSOs), market operators and distribution system operators (DSOs).

Electricity market structure

Turkey began opening up its electricity sector to private participation in 2001. As such, all elements of the electricity supply chain, including generation, distribution and supply, are currently undertaken by both private and state-owned companies.

Both private and public companies participate in electricity generation in Turkey, with a total of 8 755 generators operating in the country (as of April 2020). Industrial zones with a generation license from EMRA can also participate in generation activities. According to government estimates, there are 1 466 licensed generators and 7 289 unlicensed generators operating in the country. Private companies own around 79% of generation capacity, while the state-owned generation company EÜAŞ retains the remaining share either directly or under contract.

In the future, EÜAŞ will serve as the offtaker under pre-determined power purchase agreements for the new Akkuyu nuclear power plant and for new (domestically sourced) coal generation capacity. EÜAŞ sells nearly all of its electricity at a regulated price to 21 regional distribution companies in charge of non-eligible customers (30 TWh) to cover technical and non-technical losses (30 TWh) and street lighting demand (4.4 TWh).

The state-owned Turkish Electricity Transmission Company (TEİAŞ), under the supervision of EMRA, has a monopoly over transmission activities (and is unbundled from generation activities). In this capacity, TEİAŞ operates the real-time, balancing and ancillary services markets.

Turkey's electricity distribution is carried out by 21 regional monopolies. After completing the process of privatisation in 2013, all 21 distribution licenses were handed over to private companies, under the supervision of EMRA. However, distribution infrastructure remains under the ownership of state-owned Turkish Electricity Distribution Company (TEDAŞ). Unbundling requirements under the 2013 Electricity Market Law prohibit distribution companies from participating in other activities in the electricity supply chain. As such, distribution activities are separated from retail activities, which are conducted by "authorised suppliers".

In retail markets, the threshold for customers to choose suppliers was lowered from 2 000 kilowatt hours (kWh) per year to 1 600 kWh per year in 2019. EMRA further lowered the switching threshold to 1 400 kWh per year in 2020. Nonetheless, in 2018, the share of customers who had a contract based on conditions for non-eligible consumers with the retail arms of their local distribution companies rose to 70% – an increase of 65 TWh compared with 2017. This steep increase was driven by a significant hike in wholesale spot-market prices caused by the financial crisis and an unfavourable exchange rate in 2018.

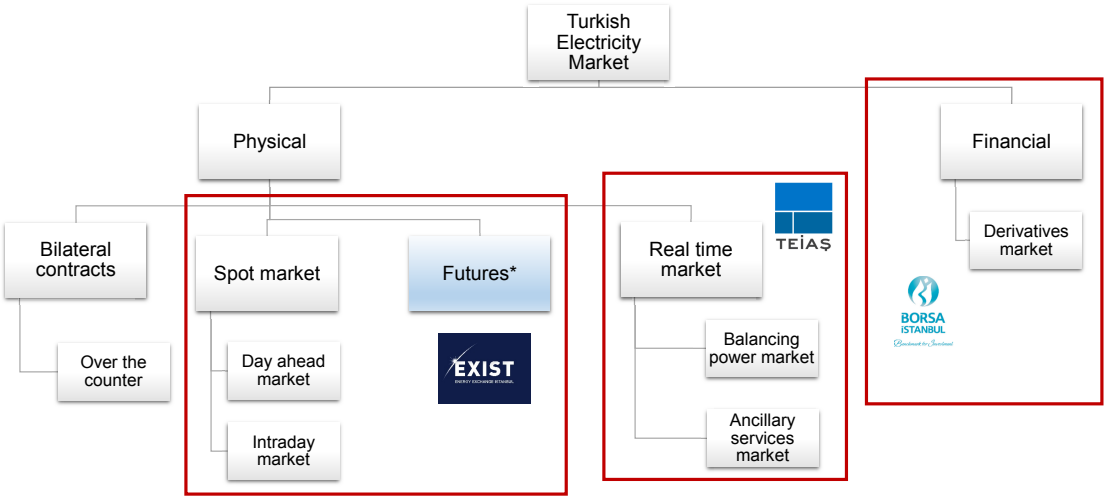
The Turkish electricity wholesale market mostly relies on bilateral contracts, complemented by a spot market and a balancing mechanism. As part of the transition to a liberal and competitive energy market model, day-ahead, intraday and balancing power markets were established to provide market participants a trading platform based on integrity, transparency and competition. Moreover, a physically settled power futures market is planned to start operating in December 2020.

The Energy Exchange Istanbul (EXIST) operates the day-ahead and intraday electricity spot market. EXIST was officially established in March 2015 as part of the 2013 Electricity Market Law No. 6446 and the 2011 Turkish Trade Law No. 6102. EXIST's main activities include planning, establishing, developing and operating energy markets, which are stated in the market operation license, in an efficient, transparent and reliable manner. EXIST is positioned to secure reliable reference price determination without discrimination among providers. TEİAŞ and the Istanbul Stock Exchange hold 30% shares each in EXIST, with private market participants holding the remaining 40%.

Specifically, EXIST conducts the following activities:

- day-ahead market operations
- intraday market operations
- settlements of day-ahead market, intraday market, balancing power market, renewable energy sources, imbalances and losses
- billing (receivables and debt notices of market participants)
- operating eligible customer switching and settlement processes
- providing market data on the EXIST transparency platform.

Figure 7.6 Turkey's electricity market operation



* An amendment to the Electricity Market Law allowing EXIST to operate the "physically settled power futures market" was published in 2019. Studies for opening the market in the near future are ongoing.

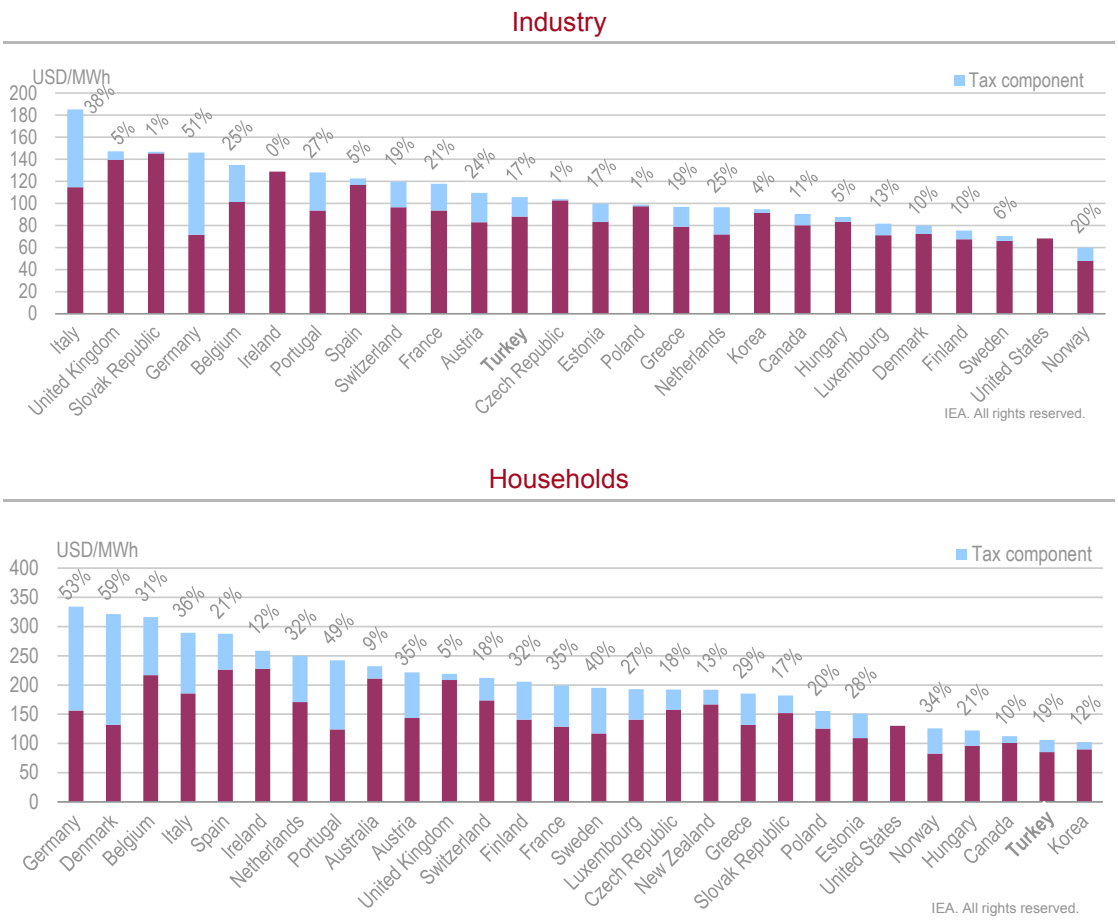
Source: Information provided to the IEA by the Turkish government.

There are around 145 wholesale electricity trading companies currently operating in Turkey. In 2018, EXIST handled 40% of electricity trade, with bilateral contracts capturing a larger portion of the market. EXIST is planning additional steps to enhance liquidity and market access, including the establishment of forward electricity markets, with a planned launch in 2020.

Electricity prices

Turkey has relatively low household electricity prices compared to other IEA member countries. In 2019, residential electricity prices ranked second-lowest behind Korea, while industry prices ranked around the median (Figure 7.7). The level of taxation on electricity prices for both industry and households is around the average IEA level, at 17% and 19%, respectively.

Figure 7.7 Industry and household electricity prices in IEA member countries, 2019



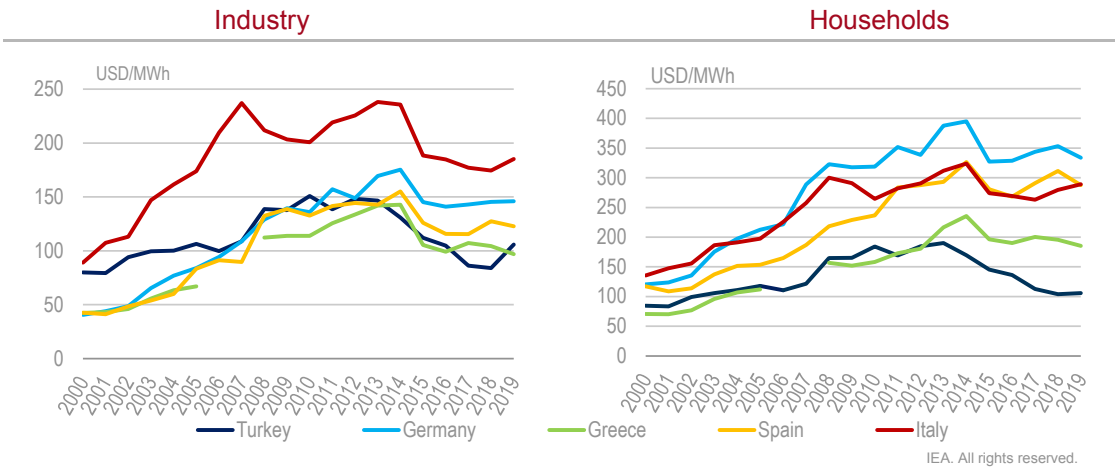
In 2019, Turkey's households paid the second-lowest price in an IEA comparison and prices for industry ranked around the median.

Notes: MWh = megawatt hour. Tax information not available for the United States; for industry electricity prices, data are unavailable for Australia, Japan, Mexico and New Zealand. For household electricity prices, data are unavailable for Japan and Mexico.

Source: IEA (2020c), *Energy Prices and Taxes* (database), www.iea.org/statistics.

The electricity price in Turkey peaked during 2010-13, and started to fall in 2019 to 105.8 USD/MWh for households, and 105.7 USD/MWh for industry (Figure 7.8). Turkey's electricity prices were previously closer to those in countries in southern Europe, but in recent years, prices have declined for both industry and households (although they have gone up again for industry in 2019).

Figure 7.8 Electricity prices in select IEA member countries, 2000-19



Turkey's electricity prices followed similar trends to neighbouring countries. However, they have started declining in recent years.

Notes: MWh = megawatt hour. Data are unavailable for Greece for 2006 and 2007.
Source: IEA (2020c), *Energy Prices and Taxes* (database), www.iea.org/statistics.

Turkey has traditionally regulated end-user tariffs, even though wholesale tariffs are now deregulated and cost-based. End users with annual consumption below 1 400 kWh are obligated to buy electricity from their incumbent supplier at tariffs set by EMRA. The retail tariff is adjusted quarterly by EMRA.

However, end users with an annual consumption above 1 400 kWh (in 2020) can directly negotiate and sign bilateral contracts with energy retailers in the competitive market. The energy prices of these "free/eligible consumers" are not regulated by EMRA, though many choose to return to the regulated prices offered by their local "authorised supplier/ incumbent supplier" company.

As part of its market reform policy, Turkey plans to gradually move toward a fully cost-reflective tariff system by the end of 2020. According to the Electricity Market Law, a temporary price equalisation mechanism will be applied until the end of 2020, in order to partially or wholly protect consumers from the cost differences among distribution regions.

According to the Electricity Market Law, when subsidies are needed to support consumers for specific regions or specific purposes, the subsidy must be made without intervention in the final electricity price.

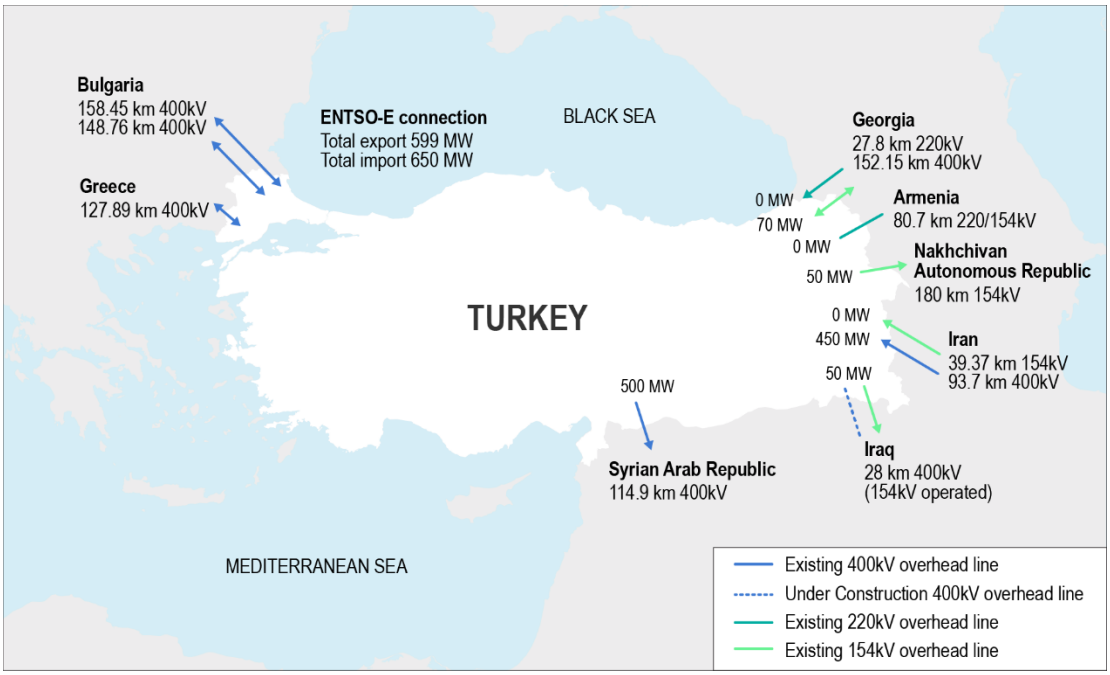
Transmission and distribution

Turkey has a well-established transmission and distribution infrastructure, which is expanded and upgraded by renewal and development projects. From 2016 to 2020, TRY 33 billion (EUR 5.1 billion) was expected to be invested in the distribution grid, as well as TRY 22 billion (EUR 3.5 billion) in the transmission grid by TEİAŞ.

Power generation facilities with power generation licenses, demand facilities and distribution facilities can access the transmission system by signing a system connection and system usage agreement with TEİAŞ. Voltage levels at the connection point to the transmission system is high voltage for power generation and demand facilities and medium voltage for distribution facilities.

The Turkish power system has synchronously connected with the EU since 2010. After fulfilment of ENTSO-E's standards of the Turkish transmission system by TEİAŞ, an observer membership agreement was signed between TEİAŞ and ENTSO-E in 2016. In this capacity, although TEİAŞ cannot participate in committees, boards or the assembly, it participates in several ENTSO-E working groups. Moreover, in accordance with ENTSO-E decisions on the Continental Europe Synchronous Area, the monthly capacity of existing interconnection lines was made available to the market. Through interconnections with Bulgaria and Greece, Turkey can import 600 MW of electricity and export 500 MW to Europe.

Figure 7.9 Cross-border interconnection capacity



Source: Responses from Turkey to the IEA questionnaire.

The distribution activities for voltages of 36 kV and lower are carried out through the 21 electricity distribution companies and distribution-licensed industrial zones. TEDAŞ owns the distribution facilities whose operating rights are in distribution companies. According to the provisional data for 2018, there were 487 644 distribution transformers in the country, with a total power of 183 789 mega-volt amperes (MVA). The total length of distribution lines is 1 190 169 kilometres. Of this, 81.2% consists of overhead lines and 18.8% of underground lines. The average national technical and non-technical loss level is around 12%, though the actual levels vary between distribution regions.

Tariffs

Electricity tariffs for transmission and distribution are cost-reflective, with a preferred revenue cap methodology, and contingent on approval from EMRA. TEİAŞ sets the annual tariffs on transmission, which covers its obligations, including capacity mechanism payments (see below) and ancillary services. Transmission tariffs are determined regionally (14 tariff regions in 2019) by using the Investment Cost Related Pricing methodology and approved by EMRA.

Distribution tariffs are set nationally and prepared by the 21 distribution companies. The methodology to determine them, as established under the Electricity Market Law, is to even out interregional cost differences to protect regulated customers from wide price variations. Distribution tariffs vary by the load profiles of five consumer groups: industrial, commercial, residential, agriculture irrigation and lighting.

Electricity policies

Over the past two decades, Turkey has pursued electricity market reforms that have transitioned its electricity system toward market-based pricing and increased private sector participation and investment.

Turkey's two overarching priorities as they relate to electricity are to ensure generation adequacy to meet rapidly growing demand and to promote the use of domestic energy resources in order to lower import costs to the economy.

The MENR regularly updates demand projections for the next 20 years. Turkey's reference scenario envisions a steep increase in power demand from 315 TWh in 2019 to 376 TWh in 2023, 482 TWh in 2030 and 613 TWh in 2039. Substantial investments will be needed to meet this rising demand. So far, generation capacity development has kept pace with rising demand. Moreover, the MENR is currently working on a longer term energy strategy informed by scenario modelling.

As part of its effort to increase the use of domestic energy, the Eleventh Development Plan (2019-2023) set out targets to achieve 219.5 TWh of electricity production from domestic resources, based on total electricity demand of 375.8 TWh. As part of this effort, the country plans to commission 7 500 MW of domestic coal power capacity (subject to change based on ongoing studies on the country's domestic coal resource base). Looking ahead, Turkey also plans to commission 10 000 MW each of solar and wind power capacity over the period 2017-27. Accordingly, the government expects that by 2023, 84% of new electricity generation capacity will come from domestic sources (of which 76% will be renewables) and 82% of new capacity to 2027 will come from domestic sources (of which 61% will be renewables).

Capacity mechanism

In January 2018, a so-called electricity market capacity mechanism was introduced with the Regulation on Electricity Market Capacity Mechanism. The regulation aims to establish sufficient installed and reserve capacity to ensure security of supply. TEİAŞ is the responsible entity managing the capacity mechanism. Under this framework, power plants that meet the eligibility criteria receive monthly capacity payments (based on a formula set out in the regulation). Qualified plants – natural gas, hydroelectric and domestic coal

generators – can also participate in the energy market, unlike in many other jurisdictions, where capacity payments are only made to generators that are available outside of the market.

In order to be able to receive capacity payments, participants are required to prove that certain thresholds have been satisfied; these are calculated by taking into account the weighted average capacity utilisation rates in the last four quarters. For the power plants utilising domestic resources, the threshold is 10% and for the others, 15% (except natural gas-fired power plants). The payment amounts are calculated according to a formula set out under the regulation based on a monthly budget by taking into account the unit-based generation costs, the costs necessary for the generators to stay within the system and installed power capacities.

TEİAŞ is required to prepare the annual capacity payment budget for each calendar year and submit this for approval to EMRA by the end of October. EMRA needs to approve it in November. In 2018, TRY 1.4 billion (USD 298 million) was paid out in capacity payments, while the budgeted amounts were TRY 2 billion (USD 352 million) in 2019 and TRY 2.2 billion (USD 333 million) for 2020.

Renewables

A critical pillar of Turkey's energy strategy to use domestic resources is an expansion of renewable power, bolstered by the significant cost declines that solar and wind have experienced in the past decade (see Chapter 5).

Turkey aims to continue to promote the expansion of renewable energy resources and commission 10 gigawatts (GW) each of solar and wind capacity in the period 2017-27. In accordance with forecasts, until 2023 and 2027, the government expects that 76% and 61% of the additional generation capacity will come from renewable resources, respectively.

Under the Renewable Energy Support Mechanism (YEKDEM), Turkey offers feed-in tariffs for renewable power plants. The feed-in-tariffs are USD 0.133 per kWh for solar and biomass, USD 0.105 for geothermal, USD 0.073 for wind and hydro plants and are valid for ten years. Additional support is provided if plant components are manufactured in Turkey. The scheme will expire at the end of 2020 and the government is currently deciding on a new mechanism to replace it.

In 2016, the government introduced the Renewable Energy Resource Areas (YEKA) strategy, a tender process to procure the production of renewable energy in "renewable energy zones", which are deemed most suitable for energy generation. The first auctions were awarded for a solar PV plant in March 2017 and for a wind onshore plant in August 2017. The process requires developers to include domestic businesses, establish domestic factories, create employment for the local labour force and invest in R&D. In addition to these first auctions, the second wind auction was awarded in May 2019.

In 2019, the Turkish government also approved a new framework for self-consumption and remuneration of excess generation at retail rates for residential, commercial and industrial applications (net metering) under the Principles and Procedures for Rooftop Solar Power Projects. In addition, the new regulation raised the size of unlicensed (distributed) projects eligible for support from 1 MW to 5 MW. Since the changes, there has still been a significant increase in rooftop installations, which exceeded 2 000 MW as of April 2020.

System integration of renewables

In line with Turkey's energy policy and falling technology costs, the country's power system will see a significant expansion of variable renewable sources, namely wind and solar. Variable renewables already account for a sizeable share in the generation mix (11% on average in 2019, but at one point in 2019 reached 23% penetration). As a result of the higher levels of renewables, especially wind power, western corridors of the Turkish grid have experienced regional congestions. The existing network that had previously been designed for supplying regional loads is now used to carry excess wind generation out of the region. As such, Turkey will need to pay increasing attention to system integration of variable renewables, including storage, smart grids, and transmission and distribution upgrades. It will also need to increase the participation of renewables in day-ahead markets rather than rely on bilateral contracts to ensure efficient dispatch.

Demand-side participation and energy storage are still relatively new activities in Turkey and are defined as unlicensed activities in the 2018 Electricity Market Law.

In early 2019, EMRA published a draft regulation on electricity storage activities for public consultation. For large-scale, integrated storage and generation facilities, which would be able to participate in the wholesale power market, the draft regulation grants a license holder authorisation to construct a storage facility with a capability to store up to 20% of installed power generation capacity. Hydro plants with pumped hydro capabilities would be able to have 100% storage capacity. The facilities would not be able to benefit from feed-in tariffs. The draft regulation also permits end-user facilities with installed capacity of at least 50 kW (such as rooftop solar) to integrate storage solutions, although they will not be allowed to sell excess electricity to the grid. Separate energy storage facilities would be allowed for capacity of at least 10 MW. Lastly, unlike the European Clean Energy Package, EMRA's draft regulation permits network operators to build and operate storage with a maximum capacity of 50 MW for each transformer station of the TSO (TEİAŞ) and 10 MW for each distribution centre. EMRA has not yet released a final regulation.

Turkey also plans to increase the use of pumped hydro energy storage (PHES). In 2017, a PHES Roadmap Report was prepared in order to determine the necessary regulations and methods to follow, in order to clarify the position of PHES in the country's energy sector.

In Turkey, smart grid efforts initially started in 2014 as pilot projects within the scope of R&D activities aimed at advanced measurement infrastructure, demand-side management, smart meters and communication. Turkey's Smart Grid 2023 project (2016-23) aims to create a smart grid road map to inform a smart grid vision to 2035 that would provide guidance to distribution companies (Elder, 2018).

EMRA and the Association of Distribution System Operators (Elder) presented the "Turkey Smart Grids 2023 Vision and Strategy Roadmap Project – TAS 2023" in 2018. The road map was based on interviews with distribution companies regarding their needs and challenges (GSGF, 2018). It calls for 50 million subscribers to have smart meters by 2035, representing 80% of subscribers. DSOs are required to submit plans in line with the road map to EMRA by 2020, including for progress on a first phase over 2021-25. However, DSOs will likely require funding in order to implement the strategy.

Distributed generation is also playing a growing role in Turkey's energy system. With growth in distributed solar generation throughout Turkey, the peak load of the transmission network will be reduced. To observe the effect of distributed generation on the transmission network, Turkey is currently developing monitoring systems. In particular, DSOs will require targeted regulations and technical specifications for rooftop installations.

As the legal owner of high voltage transmission lines, TEİAŞ is responsible for the construction of high voltage lines to connect generation facilities to the grid. With increasing renewable generation, the length of transmission lines in Turkey has significantly increased over the last ten years. Moreover, several new substations are under construction or planned for wind power in the regions with high wind potential. Large amounts of excess wind generation are planned to be sent to the Thrace region via underwater cable crossings in Çanakkale and İzmit. Likewise, the existing network that had been previously designed for supplying regional loads in the Çanakkale-Balıkesir region has been upgraded to carry excess generation. In the regions with high wind potential, many new lines are included in TEİAŞ' investment plans. The industry in Turkey does not foresee that 10 GW each of wind and solar will require additional transmission capacity beyond what is currently planned, but upgrades to the distribution network are expected to improve the operation of the network to accommodate changes to the generation mix.

Moreover, while the gate closure for hourly contracts in the intraday market was previously set at 90 minutes prior to the beginning of each hourly contract, the current gate closure time in the intraday market has been reduced to 60 minutes.

Lastly, Turkey is also pursuing research, development and demonstration (RD&D) programmes through the Scientific and Technological Research Council of Turkey (TÜBİTAK) to support a more integrated, flexible and sustainable energy system, including for the advancement of energy storage technologies (both pumped hydro and battery storage).

Nuclear

In addition to renewables, Turkey's power mix diversification plans include the introduction of nuclear power over the coming years.

Currently, Turkey does not have any nuclear power plants in operation, but two nuclear reactors are under construction: the Akkuyu nuclear power plant's Unit 1 and Unit 2 in Mersin Province; two more reactors are planned in the near future at the plant.

The first unit of Akkuyu began construction in 2018 and is expected to be completed by 2023. The other units are planned to be in commercial operation at subsequent one-year intervals until the end of 2026.

In total, Turkey has plans to install 3 nuclear power plants with a total of 12 reactor units in the country, including Akkuyu. The second nuclear power plant is the Sinop project on the Black Sea coast, following an agreement signed with Japan in 2013. However, based on a feasibility study conducted by Mitsubishi Heavy Industries, the governmenngt decided not to move forward with the project plan due to high costs and is in talks with other partners to develop the project.

The site selection process for the third nuclear power plant is still ongoing.

For Akkuyu, the state-owned Turkish Electricity Trade & Contract Corporation (TETAŞ) signed a power purchase agreement with the project company for 15 years at 12.35 US cents/kWh (weighted average price, no escalation) (IAEA, 2014). Within the context of Decree Law No. 703 from 9 July 2018, TETAŞ and EÜAŞ were merged under the structure of EÜAŞ and the duties, authorities and responsibilities of the former TETAŞ are now being performed by EÜAŞ.

Coal

Turkey's approach to coal-fired generation is rooted in a strategy to reduce dependence on imported energy sources for economic and energy security purposes. As such, the government has pursued a plan to boost the domestic production and consumption of Turkey's sizeable coal reserves. Lignite, although of lower quality, is a priority area for development, mainly for use in power generation. As part of its strategy to reduce dependence on imported energy sources, up to 2027 Turkey wants to add 7.5 GW of new lignite power generation capacity, which may change according to reserve reports that will be prepared by internationally authorised institutions.

In an effort to increase the share of domestic coal in electricity generation, Turkey has promoted more privatisation of the coal mining sector. The non-producing areas of the state coal mining companies TTK and TKİ were divided and relicensed, on the condition that they either supply industrial and household coal or a thermal power plant be installed near the mine location. The licenses are awarded based on bids in an auction, and include a long-term power purchase guarantee from EÜAŞ at a pre-determined price, depending on the specific tender. (The terms and purchase price will change according to the tender.)

As of January 2020, installed electricity capacity to use domestic coal was 11 317 MW (10 101 MW lignite, 811 MW hard coal, 405 MW asphaltite), which represents 12.4% of total installed capacity. Installed capacity for imported coal was 8 967 MW. Together they constitute 22% of total power generation capacity. Overall, the government expects that growth in coal-fired generation capacity will keep pace with total generation capacity expansions, keeping the share of coal in the power mix stable in the medium term.

Notwithstanding Turkey's efforts to promote the construction of coal-fired generators, the sector has seen a notable slowdown in recent years, in large part due to challenges for securing loans for coal plants. Some local opposition to the siting of coal plants has also presented setbacks to plans, as when Turkey's Council of State in 2019 cancelled an environmental impact assessment decision of a coal power plant in the Bartin Province's Amasra district on the grounds that the cumulative effects were not reviewed in the report. The company has submitted a revised environmental impact assessment report to the Ministry of Environment and Urbanization.

The government is also keen to prevent the closure of existing coal-fired generators operated by the private sector. As such, in addition to the capacity mechanism described above, EÜAŞ purchases electricity from coal power plants that generate electricity using domestic coal with a guaranteed price between 5-5.5 US cents/kW (50-55 USD/MW, revised quarterly) until the end of 2027. A (domestically sourced) coal plant can claim both a capacity mechanism and this purchase option.

At the same time, the government is moving forward with stricter enforcement of environmental limits on coal plants. In particular, it moved forward with a requirement to install filters on existing privatised and public thermal power plants based on a December 2019 presidential veto of a law that would have delayed implementation on ten plants to 2022. The veto was based on public health concerns over air pollution. In accordance with the environmental requirements, the government ordered five coal plants to completely shut down due to failure to install filters in January 2020, while one was ordered to partially shut down; four other plants earned temporary certificates of activity.

Electricity security

As the sole TSO, TEIAŞ is responsible for balancing electricity markets. It determines the final commitment and dispatch order of power plants through its national dispatch centre in the day-ahead and intraday balancing markets, abiding by N-1 security criteria and ensuring sufficient spinning reserves.

According to the Electricity Market Law (No. 6446) of 2013, the MENR is responsible for monitoring and evaluating electricity supply security. The Electrical Energy Demand Projection Report (produced by the Ministry of Development and EMRA) and the Long-Term Development Plan for Electricity Generation (produced by TEIAŞ), both issued biennially, provide demand projections for the next 20 years. In addition, TEIAŞ produces an Electricity Capacity Projection Report while EMRA produces an Electricity Market Development Report. These four reports feed into an annual Security of Electricity Supply Report, covering the supply-demand balance, source diversity, as well as the states of the transmission and distribution systems and generating facilities, which is prepared by the MENR and presented to the president.

Based on its most recent demand projections for 2019-39, the government does not foresee a problem meeting electricity demand. In fact, currently Turkey has a relatively large reserve margin (capacity payments are made to address perceived longer term adequacy concerns). Relative to 2019's electricity demand of 304 TWh, the government projects an average of 3.5% growth to 376 TWh in 2023, 452 TWh in 2028 and 613 TWh in 2039.

TEIAŞ, along with the DSOs, has the operational responsibility for grid management and system security. TEIAŞ is carrying out major upgrades to the transmission system to prepare for the anticipated large-scale deployment of variable renewable generation. TEIAŞ is expected to reinforce and expand Turkey's electricity grid, and support regional integration with the pan-European electricity grid.

EMRA plans to improve the continuity of supply as well as the technical and commercial quality in electricity distribution with new regulations regarding quality, which will come into force in 2021. These regulations will affect distribution tariffs and offer a reward or penalty for distribution companies based on their performance.

Assessment

Since the last in-depth review in 2016, Turkey has successfully expanded its electricity wholesale spot market and put into place legislation to support wind and solar generation as well as nuclear and domestic coal. As a result, in five years (2014-18), major private investments increased generation capacity by 38%, mostly driven by renewables (16.8 GW) and coal (6.5 GW).

Meeting rapidly rising power demand remains a key challenge for Turkey. The Turkish reference scenario envisions a steep increase in power demand. Substantial investments will be needed to meet this rising demand. So far, capacity development has been able to keep pace with rising demand. Turkey plans to continue on this path by expanding solar and wind capacity. Additionally, Turkey wants to add 7.5 GW of lignite power generation and 4.8 GW of nuclear power to its capacity in the near future. However, progress on these power generation investments could be set back due to financing challenges, which are affecting the sector at large, but appear particularly difficult for coal-fired generation projects. Moreover, some market participants consider the schedule for nuclear plants to be overly ambitious (four reactors to be commissioned between 2023 and 2026). Permitting processes can also slow down renewables projects.

In additional to generation adequacy, another building block for security of generation supply is the regional integration of Turkey with the European Union. The Turkish transmission operator TEİAŞ operates three interconnection lines at 400 kV, has implemented ENTSO-E's standards and signed an observer membership agreement with ENTSO-E in 2016. Another interconnector is planned. The exposure to exchange rate risks is a main driver for Turkey's ambition to build and rely on domestic generation capacity. For this reason, electricity imports play a minor role in the overall strategy to tackle rising power demand.

Securing power generation from domestic sources is at the heart of the Turkish generation strategy. To this end, the government has passed legislation for direct support (renewable feed-in tariffs) and indirect support (fixed price contracts with EÜAŞ for domestic coal and nuclear) in the past few years. However, it remains somewhat unclear how these measures feed into a long-term energy strategy. While commitment to renewables in Turkey is strong, the expansion of coal capacity should be reviewed against long-term greenhouse gas impacts.

Turkey is now taking next steps to develop a long-term approach to the electricity sector. The MENR regularly updates demand projections for the next 20 years, but plans for generation capacity have so far not been put into a long-term perspective. The MENR is currently working on a long-term energy strategy informed by scenario modelling. The publication of a long-term strategy for the sector would also most likely increase investor confidence and create better investment signals given the decades-long time horizon for most power investments.

Achieving necessary investments at the lowest possible costs and keeping power prices affordable in the long run is a concern. Domestic coal, renewables and – in the future – nuclear all receive significant financial support. Both coal and future nuclear plants receive funding through long-term power purchase agreements with EÜAŞ, with fixed average prices over a given time period. Renewables benefit from fixed feed-in-tariffs. Tenders introduce some competitive elements to these types of support schemes, however a part

of the payments is still not subject to competitive pressure, which can raise energy system costs. Additionally, subsidised generation can artificially push more cost-efficient alternatives such as unsubsidised gas generation in certain cases (depending on fuel prices) out of the market. A long-term perspective, with a rigorous assessment of the system costs of different technology pathways, taking into account projections of cost developments in the future, should inform government decisions on what type of generation capacities should receive support. The potential for PV and wind is high in Turkey and global trends point to falling costs. On the other hand, financing costs for coal projects – if financing is available – will most likely rise due to the decarbonisation efforts of international investors. The operational results of nuclear power in Turkey, beyond the initial 15 years of the first project, are hard to predict; close monitoring and cost analysis is important for a balanced assessment of Turkey's options.

Since the last in-depth review, EXIST has successfully established a transparent, more efficient and increasingly liquid electricity market with day-ahead and intraday markets, which provide real-time trading opportunities and offer market participants the opportunity to manage short-term portfolios. In 2018, EXIST handled 40% of electricity trade, with bilateral contracts capturing a larger portion of the market. EXIST is planning additional steps to enhance liquidity and market access. It has been working on future electricity markets with a planned launch in 2020, initially with physical settlement. Further reducing the time between intraday trade and physical delivery to less than the current 60 minutes can open up the intraday market to more renewable generators and demand response, and reduce balancing needs (many other markets have shifted to 15-minute intervals). In short, Turkey's wholesale spot market is increasingly efficient, but a significant share of electricity generation is at least partially subsidised and therefore excluded from full competition. A relatively high share of bilateral contracts and subsidised generation can also impede efficient dispatch in liberalised wholesale electricity markets.

It is unclear how large the share of electricity that is subsidised directly or indirectly is, but just counting domestic coal and tariff-supported renewables, the share is probably at least 35% of the market, and rising with more domestic coal generation, renewables and nuclear coming on line. Turkey also recently introduced legislation to fund financially challenged gas- and coal-fired generators (using domestic energy sources) to bolster security of supply by preventing them from exiting the market. TEİAŞ is the responsible entity managing and financing this so-called capacity mechanism. Under this framework, power plants that meet the eligibility criteria receive monthly payments.

The outsized role of EÜAŞ in the electricity market should also be considered in a context of liberalisation. In power generation, the share of independent generation companies has grown to 79% since the 2016 in-depth review. The remaining capacity is either owned by EÜAŞ or connected to EÜAŞ by contract. In the future, EÜAŞ will both fulfil the power purchase agreement for the new Akkuyu nuclear power plant and contract new (domestically sourced) coal generation capacities, both above today's market prices. EÜAŞ sells nearly all of its electricity to the retail arms of the 21 regional distribution companies at a regulated price to cover technical and non-technical losses, lighting demand, and retail. The contract on lighting between EÜAŞ and network distribution companies, which can be set at relatively high prices, can deter energy efficiency measures such as the deployment of LED bulbs.

Competition in electricity markets driven by eligible consumers also leaves room for improvements. In retail markets, the threshold for customers to choose suppliers was lowered to 1 400 kWh per year in 2020. However, in 2018, the share of customers who had a contract based on conditions for non-eligible consumers with the retail arms of their local distribution companies rose to 70% – an increase of 65 TWh compared with 2017. This steep increase was driven by a significant hike in wholesale spot-market prices caused by the financial crisis and an unfavourable exchange rate in 2018. This development suggests that the tariffs of regional retail companies – which are identical to regulated tariffs for non-eligible customers – might not react to market signals in the short term under challenged macroeconomic conditions.

Turkey plans to expand capacity in solar and wind. To this end, regional tenders in renewable energy zones were introduced in 2016. Additionally, market participants expect strong investments in rooftop PV in the coming years following the establishment of net metering rules under the Principles and Procedures for Rooftop Solar Power Projects up to 10 kW, and lifting the limit for unlicensed generation to 5 MW. With further penetration of variable renewables into the electricity market, flexibility options such as demand response and storage, as well as smart grids and network expansion will become more important. TEİAŞ operates the balancing market and market for ancillary services. The government has introduced first steps towards a regulatory framework for both demand-side and energy storage participation in electricity markets. The draft of Turkey's Energy Storage Roadmap has been prepared and EMRA has published a draft Regulation on Electricity Storage Activities. Turkey's transmission and distribution infrastructure is thus far coping well with the rapidly rising share of PV and wind capacities. In order to accommodate more variable renewables and rising demand, TEİAŞ put forward an ambitious investment programme for the transmission network.

At the distribution level, the rapidly rising number of unlicensed power generators, mostly rooftop PV, can pose challenges – both because of variable generation feeding into networks, but also because of potential challenges related to net metering and financing network costs. The latter should be monitored carefully. The government and EMRA should also support efforts to standardise and streamline permitting procedures for distribution networks. Turkey is working on a road map for smart grids, which will also contribute to better market integration of renewables. In general, investment and higher network efficiency at the distribution network level are needed to cope with these new challenges. With 12% technical and non-technical losses, there is still room for improvement on the quality of electricity supply in Turkey.

Recommendations

The government of Turkey should:

- Pursue integrated scenario planning of generation capacity for different technologies and networks in a long-term context of energy policy goals, demand expectations (including electrification) and system cost development.
- Phase down measures such as subsidisation and the obligated procurement by EÜAŞ of a significant share of electricity generation to keep system costs down.

- Introduce freedom of supplier choice for all customers (including currently non-eligible ones), remove retail price regulation, while continuing direct support to vulnerable customers, and encourage switching of suppliers.
- Create market conditions and rules for network expansion, storage and smart grids as flexibility options to prepare for more integration of variable renewables.

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8. Oil

Key data

(2019 provisional)

Domestic crude oil production: 60.3 kb/d, +24% since 2009

Net imports of crude oil: 623.7 kb/d, +117% since 2009

Domestic oil products production: 774.1 kb/d, +100% since 2009

Net imports of oil products: 271.8 kb/d, -14% since 2009

Share of oil: 31.7% of total supply*, 38.0% of TFC (2018)

Oil consumption by sector (2018): 943.4 kb/d (domestic transport 63.6%; international bunkering 10.2%; industry including non-energy consumption 16.0%; residential, services and agriculture 8.5%; energy sector including power generation 1.4%)

*Total supply includes total primary energy supply and international bunker fuels.

Overview

Oil remains the largest energy source in Turkey's total final consumption (TFC) and the second-largest in total supply.[8] In 2000, the share of oil in total supply was 41% and in TFC was 45%; the shares remained relatively stable over the following years, growing from 31% of total supply and 38% of TFC in 2009 of to 31.7% total supply in 2019 and 38% of TFC in 2018 (Figure 8.1).

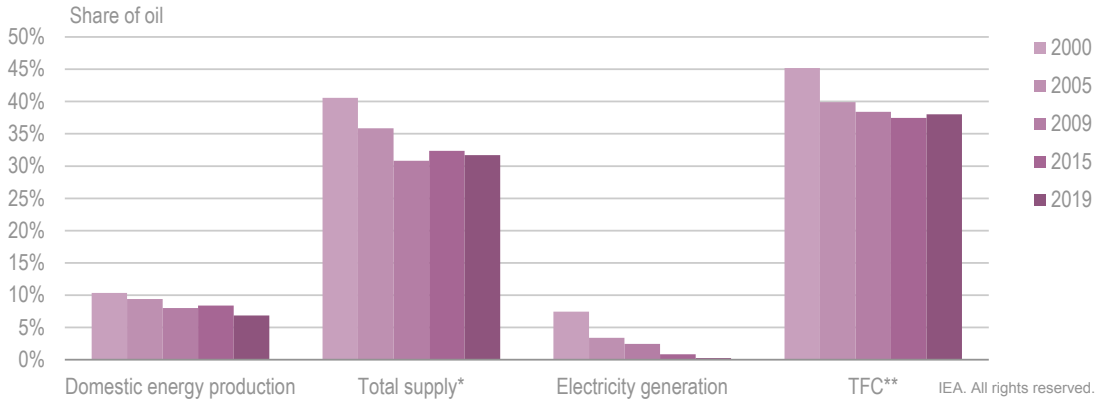
Transport consumes most oil in Turkey and increased energy demand in the transport sector has driven rapid growth in total oil consumption. Diesel fuels, in particular, dominate oil consumption in Turkey. Demand reduction and fuel switching in the transport sector will be important to keeping oil demand from increasing further.

Growth in total oil consumption also increases the need for effective emergency response systems to ensure security of supply. Turkey is a net importer of both crude oil and refined products. Oil supply sources and routes have been diversified. Crude oil is provided through pipelines and tankers (oil products exclusively by tankers). In 2019, Turkey imported crude oil from 16 countries and oil products from over 30 countries. During 2019, 623.7 thousand barrels per day (kb/d) of crude oil and 271.8 kb/d of oil products consumed were imported. Estimated data for 2019 show that overall oil consumption in the country increased by 5% to 991 kb/d.

[8] Total supply includes total primary energy supply and international bunker fuels .

Domestic crude oil production is small and dominated by the Turkish Petroleum Company (TPAO), which holds the majority of all existing licenses and acquired all new licenses in recent bid rounds. Attracting more international investments could help increase domestic production and reduce Turkey's oil import dependency, especially given the Turkish lira's sizeable depreciation against the US dollar since 2015.

Figure 8.1 Share of oil in total supply and total final consumption, Turkey, 2000-19



The share of oil in total supply and TFC decreased after 2000 but has remained relatively stable since 2009.

* *Total supply* includes total primary energy supply and international bunkers.

** *TFC*: total final consumption; the latest data are for 2018.

Note: 2019 data are estimated.

Source: IEA (2020a), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

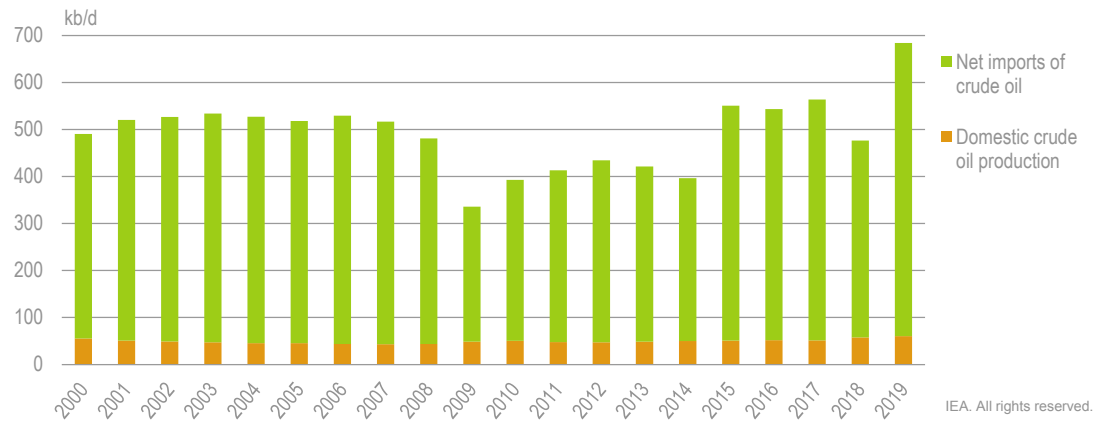
Supply and demand

Crude oil production and trade

Turkey's crude oil production is growing, but remains a small share of total supply. Domestic production grew by 24% in a decade, from 48.5 kb/d in 2009 to 60.3 kb/d in 2019. Nevertheless, net imports accounted for 91% of total crude oil supply in 2019 (Figure 8.2). Crude oil net imports increased from around 350 kb/d in 2010-14 to around 400-500 kb/d in the following years, and to over 600 kb/d in 2019 after the opening of the STAR refinery in late 2018, which added 214 kb/d of crude processing capacity in the country (a 30% increase). Most imports have traditionally come from the Middle East, with the Islamic Republic of Iran, Iraq and Saudi Arabia accounting for almost three-quarters of total imports in 2018 (Figure 8.3). The past decade's growth in imports has been covered by more crude from Iran and Iraq, while oil imports from the Russian Federation declined over the 2008-18 period. Due to US sanctions, however, imports from Iran fell considerably in 2019 and as of May 2019 were entirely halted. While the crude oil imported from Iran made up 34% of the total in 2018, this rate dropped to 7% in 2019. The gap was substituted by increased crude oil imports from Russia and Iraq – to the tune of 212.1 kb/d and 191.9 kb/d in 2019, respectively. Russia became the biggest crude supplier to the country in 2019 with a share of 33%, followed by Iraq (30%) and Kazakhstan (10%) (EMRA, 2020a). In addition, increases in crude oil imports from Kazakhstan, Libya and Nigeria have also been seen. For

the purpose of further diversifying crude oil supply routes, in 2019 and 2020, several new oil sellers were also added, including Norway, Turkmenistan and Tunisia.

Figure 8.2 Crude oil net supply, Turkey, 2000-19

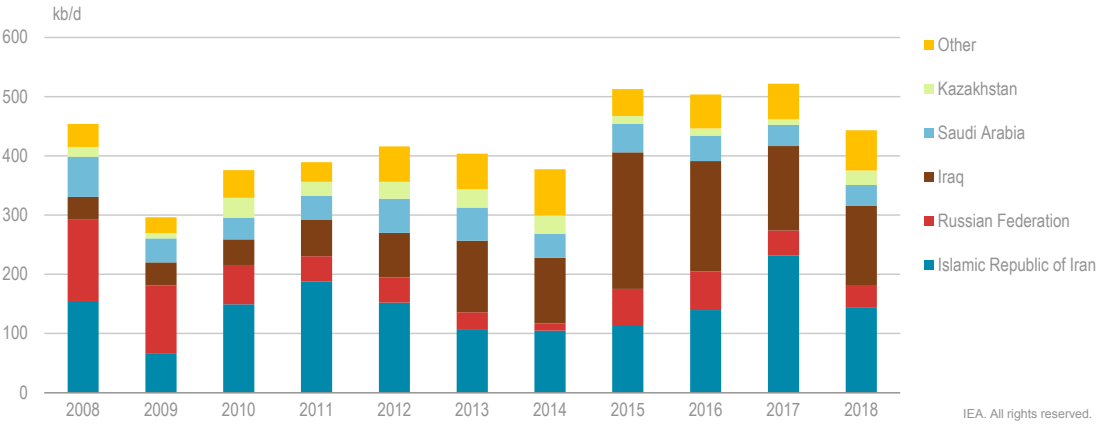


Turkey's crude oil production has increased from 43.5 kb/d in 2008 to 60.3 kb/d in 2019, but net imports of 623.7 kb/d in 2019 accounted for 91% of total supply.

Notes: kb/d = thousand barrels per day. 2019 data are estimated.

Source: IEA (2020a), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Figure 8.3 Turkey's crude oil net trade by country, 2008-18



Turkey has traditionally imported most crude oil from the Middle East, with almost 75% coming from Iran, Iraq and Saudi Arabia in 2018.

Notes: kb/d = thousand barrels per day. 2019 data are estimated

Sources: IEA (2020a), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics; Turkish administration.

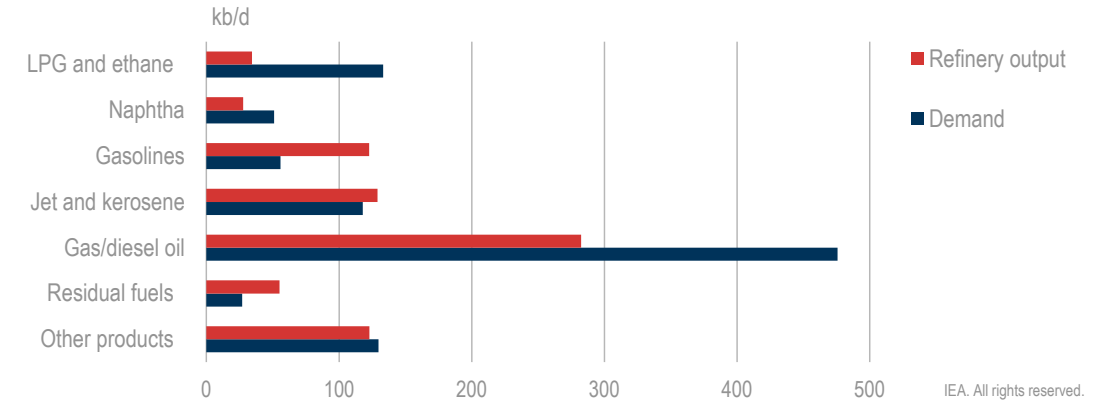
Oil products' production and trade

Turkey has five operational refineries that cover close to 80% of total oil product demand in the country. In 2019, total demand[9] stood at 991 kb/d compared to total domestic

[9] Total oil demand data for 2019 is available for oil demand by product but not for oil demand by sector.

production at 774 kb/d, with fuel production profiles not entirely matching domestic demand (Figure 8.4). Production is limited compared to demand for diesel and liquefied petroleum gas (LPG), while for gasoline, Turkey had excess domestic production of over 67 kb/d in 2019.

Figure 8.4 Refinery outputs and domestic demand, Turkey, 2019

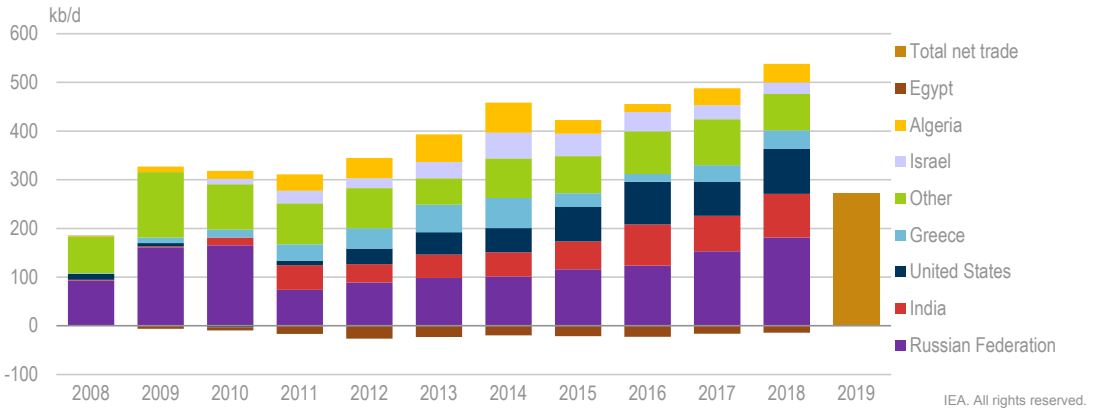


Turkey is self-sufficient in jet fuel and a net exporter of gasoline and residual fuels, but highly import dependent for diesel, LPG and naphtha.

Notes: kb/d = thousand barrels per day. Refinery outputs exclude refinery losses.
Source: IEA (2020b), *Oil Information 2020*, www.iea.org/statistics.

Recent growth in oil product demand has been covered by increased imports and higher runs of domestic refineries. As of 2019, not only did existing refineries increase crude throughput, but the opening of the new STAR refinery in late 2018 added 214 kb/d to Turkey's crude processing capacity. While between 2008 and 2018, total net imports more than doubled from below 200 kb/d to nearly 500 kb/d, in 2019 they fell to 271.8 kb/d (Figure 8.5). Russia accounted for over a third of total net imports. Russian imports have increased steadily since 2011 and were especially significant in diesel, while growth in imports was also registered from Algeria, India and the United States. Turkey is also a net products exporter to some countries, including Egypt.

Figure 8.5 Turkey's oil products net trade by country, 2008-19



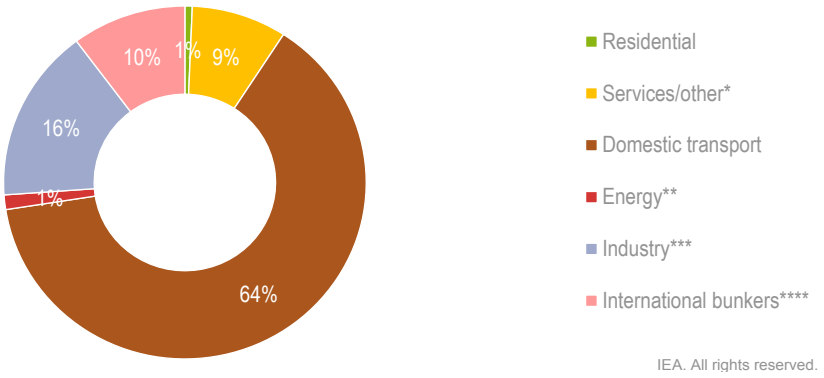
Oil product imports increased from around 200 kb/d in 2008 to around 500 kb/d in 2018, with Russia being the largest supplier.

Note: kb/d = thousand barrels per day.
Source: IEA (2020a), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Oil consumption

Oil is consumed across all sectors, but is particularly dominant in transport. In domestic transport, oil fuels accounted for 98% of total energy consumption in 2018 and the sector consumed over 63% of Turkey's total oil demand (Figure 8.6). Bunker fuels for international shipping and aviation accounted for another 10%, leading total transport demand to account for over 73% of total oil consumption. The industry sector was the second-largest consumer with 16% of total oil consumption in 2018, half of which was oil products used for non-energy purposes in construction and in the chemical and petrochemical industries. Remaining oil product consumption was in the services sector, including agriculture, and the energy industry, including refineries and power generation.

Figure 8.6 Oil consumption by sector, Turkey, 2018



Domestic transport and international bunkers together account for nearly three-quarters of total oil consumption in Turkey.

* *Services/other* includes commercial and public services, agriculture and forestry, fishing, and residential.

** *Energy* includes refineries, other energy industry and electricity generation.

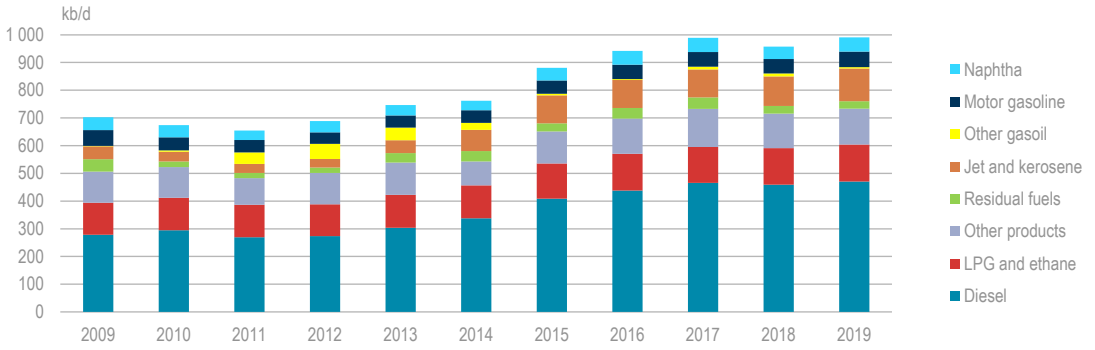
*** *Industry* includes oil used for non-energy purposes.

**** *International bunkers* includes international aviation and marine bunkers.

Source: IEA (2020a), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Oil products' consumption has increased significantly in the last decade, although it has stabilised in recent years. Between 2011 and 2019, oil products' consumption grew by 51%, mainly due to rapid growth in diesel used in the transport sector (Figure 8.7). In 2018, total oil consumption decreased by 3% from the 2017 peak as a result of the recent economic downturn. In 2019, however, demand returned to levels from 2017 and of total oil products consumed in the country, 48% (470.8 kb/d) was diesel oil used almost entirely in road transport. Kerosene (jet fuel type) accounted for 12% (118 kb/d) and LPG represented 13% (133 kb/d) of total oil consumption, mostly used in road transport (80%) but also in buildings (cylinder gas, 18%) and industry. Motor gasoline consumption is much lower than diesel, accounting for only 6% (56 kb/d) of total oil consumption in 2019.

Figure 8.7 Oil consumption by refined product, Turkey, 2009-19



Oil demand grew rapidly from 2011, reaching a peak of nearly 1 000 kb/d in 2017. Diesel accounts for nearly half of total oil products consumption.

Note: kb/d = thousand barrels per day.
Source: IEA (2020b), *Oil Information 2020*, www.iea.org/statistics.

Oil industry structure

The Ministry of Energy and Natural Resources (MENR) oversees the legal and regulatory framework for oil activities through the General Directorate of Mining and Petroleum Affairs (MAPEG), which was established in 2018 by merging the previous General Directorate of Mining Affairs and the General Directorate of Petroleum Affairs.

The Turkish Energy Market Regulatory Authority (EMRA) was established in 2001 in order to perform regulatory and supervisory functions in energy markets. The fundamental objective of EMRA is to ensure the development of financially sound, competitive and transparent energy markets. In doing so, it is to ensure the autonomous regulation and supervision of the electricity, natural gas, fuel and lubricants markets. EMRA also monitors the competitive price formation in the refining and distribution sectors and can impose price caps under certain conditions (EMRA, 2018).

The Turkish Competition Authority is an independent law enforcement agency that is dedicated to promote and protect competition in markets for the benefit of consumers, businesses and the economy as a whole. Its mission is to detect and prevent anti-competitive business practices, including in the oil sector (Turkish Competition Authority, 2018).

Turkey's state-owned companies continue to maintain a strong position in the upstream, midstream and refining sectors, which has not changed since the previous in-depth review.

TPAO, a state-owned company, is the country's main domestic crude oil producer, responsible for over 70% (14.7 mb) of domestic oil production in 2019. It holds 66% of Turkey's remaining oil reserves and all offshore exploration licenses issued to date (TPAO, 2020).

Türkiye Petrol Rafinerileri A.Ş (Tüpraş) is the country's largest industrial company and is also active in the oil sector. Tüpraş operates four out of five Turkish refineries with combined processing capacity of 646 kb/d (Tüpraş, 2020).

BOTAŞ Petroleum Pipeline Corporation is the state-owned pipelines and trading company. It was established in 1974 as a subsidiary of TPAO for construction and operation of the Kirkuk-Ceyhan Oil Pipeline. In 1995, it was formed as a separate company and its operations have expanded into energy transmission, trade, storage and marine activities (BOTAŞ, 2020).

Upstream

Oil upstream activities are conducted in Turkey according to the provisions of the Petroleum Law (Law No. 6491) of 30 May 2013 and its executive acts (mainly the Implementation Regulation put into place on 22 September 2017).

Under the Turkish Constitution, the ownership, right to explore, exploit and dispose of natural resources belongs to the Turkish state. The state delegates the right to explore and develop natural resources through a licensing regime. Licensing is carried out by MAPEG depending on the type of activity and natural resource. Currently, there are limited decommissioning obligations or liability regulations in relation to upstream oil and gas activities.

The MENR's Strategic Energy Plan 2015-2019 promoted security of energy supply by increasing indigenous energy production as well as diversifying the mix of energy sources in road transport. In particular, energy is one of the key industries singled out for further development, with the primary aim to reduce the country's heavy reliance on imported energy. As such, boosting upstream development is a priority area for Turkey (MENR, 2019).

Before the Petroleum Law was enacted in 2013, previous legislation – Petroleum Law No. 6326 – had been in force for 59 years. The 2013 Petroleum Law was amended in June 2016 to allow for coal bed methane exploration.

The objective of the Petroleum Law is to provide that Turkey's petroleum resources are rapidly, continuously and effectively explored, developed and produced while preserving the national interests. The main objective of the new Petroleum Law was to remove hurdles to attracting foreign investment into the country's upstream sector. As such, the law aims to minimise bureaucracy, simplify application procedures, establish incentives for exploration and production operations, reduce the costs of such operations, and create a more competitive environment to increase domestic oil production.

With the enactment of the law, a new structure was put into place to increase oil upstream activities:

- No petroleum activities can be conducted in Turkey without licenses and leases. In granting licenses, the work and investment programme, technical and financial capability, and experience of applicants are taken into consideration.
- The duration of the exploration license is set at five years for onshore and eight years for offshore licenses. Onshore license terms can be extended twice, each for two years. Offshore license terms can also be extended twice, each time for three years. The total term of exploration licenses, including extensions, cannot exceed nine years for onshore and 14 years for offshore licenses.
- Production leases can be issued for a term of 20 years by taking into consideration recoverable hydrocarbon reserves and can be extended twice, each for ten years depending on the productivity performance of the production field.

- A bond corresponding to 2% of the work and investment programme is taken from license holders. For offshore blocks, it is set at 1%. Investment bonds for underexplored blocks or for unconventional resources may be reduced based on the MENR's approval.
- A 12.5% royalty is collected for both oil and natural gas production. The royalty is calculated based on the market price of crude oil and paid monthly depending on volumes of production.
- After starting production, foreign investors have the right to transfer their capital investments on the condition that they pay the royalty.
- Companies also pay a 20% (increased to 22% for the years 2018-20) corporate income tax and a 15% withholding tax on dividend payments (different tax rates may be applicable depending on double taxation agreements). The total tax cannot exceed 55% of a petroleum right holder's income.

There are some incentives in the Petroleum Law to encourage upstream investments. For the purpose of petroleum exploration, the first acquisition of some motorised special purpose vehicles, including work trucks, mobile drilling derricks and crane lorries, are exempted from the special consumption tax. Petroleum activities and service contracts are also exempt from the stamp tax. Upstream equipment such as seismic equipment, drilling equipment, vehicles, vessels and aircraft imported for exploration activities are free of all taxes, tariffs and fees. However, materials imported for production activities are subject to the value-added tax.

The Petroleum Law stipulates that petroleum right holders are entitled to export up to 35% of onshore and 45% of offshore crude oil production from fields discovered after 1 January 1980; the Council of Ministers is the ultimate body for regulating the procedures and principles on the redetermination and implementation of these ratios.

In the last few years, Turkey has indeed increased domestic production after applying secondary recovery techniques and discovering 18 new fields in the past three years. Ninety-nine new wells were drilled in 2018 and 153 in 2019, with the sector registering an average success rate of around 11%. In total, over 5 000 oil and gas wells were drilled in the country in 148 crude oil fields. Over 30% of the wells have been drilled in the last decade. As a result of geological, geophysical and drilling activities carried out in the last five years, almost 170 million barrels (mb) of incremental recoverable oil reserves were added by the end of 2018, raising the total to 390 mb. In all, 19 companies conducted oil upstream activities in Turkey in 2019, resulting in the extraction of 60.3 kb/d of crude oil (6% of the country's consumption).

Turkey's offshore exploration and drilling activities in the Black Sea and Eastern Mediterranean have expanded in 2019 and 2020. TPAO deployed two drilling vessels alongside two seismic ships to the East Mediterranean Sea in 2019 to begin hydrocarbon exploration (TPAO, 2020).

Downstream

Downstream activities in Turkey are conducted according to provisions of the Petroleum Market Law (Law No. 5015).

As stipulated by Article 1, the objective of the law is to regulate the guidance, surveillance and supervision of activities in order to ensure the transparent, non-discriminatory and

stable performance of market activities pertaining to the delivery of petroleum supplied from domestic and foreign resources to consumers, directly or after processing, in a reliable, cost-effective manner within a competitive environment.

The maximum term of downstream licences granted by EMRA under the Petroleum Market Law is 49 years. There is no statutory minimum term.

The terms of the licences can be renewed by EMRA upon application. As of December 2018, it is possible to make the applications through an online platform for certain types of licences under the Petroleum Market Licensing Regulation.

As of January 2020, there were five refineries operating in Turkey with a total crude distillation capacity of 860 kb/d.

Table 8.1 Refineries operating in Turkey, 2019

	Capacity (b/d)	Location	Company	Nelson complexity	Year of construction
İzmir refinery	257 000	Izmir	Tüpraş	7.7	1972
İzmit refinery	244 000	Körfez/Kocaeli	Tüpraş	14.5	1961
STAR refinery	214 000	Aliağa/İzmir	SOCAR	7.4	2018
Kırıkkale refinery	115 000	Kirkkale	Tüpraş	6.3	1986
Batman refinery	30 000	Batman	Tüpraş	1.8	1955

Notes: The Nelson Complexity Index is a measure of refinery complexity. This index was developed in the 1960s by W.L. Nelson in a series of articles for the *Oil & Gas Journal*. The index measures the complexity and cost of each major type of refinery equipment. In forming the index, the distillation column is given a value of 1 and the other units are assigned a value based on conversion and cost relative to the distillation column. The larger the Nelson Index of a refinery, the more complex it is (as defined in: https://www.eia.gov/todayinenergy/detail.php?id=8330).

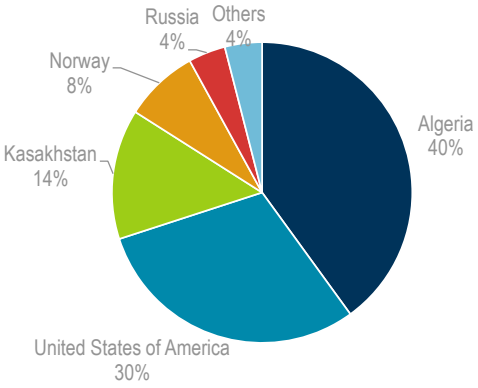
Sources: Turkish response to the IEA questionnaire; Tüpraş (2020), "Refineries" (webpage), https://www.tupras.com.tr/en/rafineries; SOCAR (2020), "About us", www.socar.com.tr/en/about-us/socar-turkey.

Turkish refineries operated in 2019 with an average capacity utilisation rate of 90% (EMRA, 2020a). Total refinery production increased in 2019 by 31% to 774.1 kb/d, with increases in all refined products: diesel production rose by 54.3% (to 272.9 kb/d), aviation kerosene by 24.6% (to 128.8 kb/d), gasoline production by 12.9% (to 122.7 kb/d), LPG by 18.6% (to 34.4 kb/d) and naphtha production more than tripled to 27.7 kb/d in 2019.

Domestic diesel production from all refineries in 2019 stood at 272.9 kb/d, covering 59% of the country's demand of 470.8 kb/d (up from 40% coverage in 2018). Meanwhile, domestic gasoline production is twice the level of consumption. As such, domestic gasoline refiners were focused on exports; most Turkish gasoline was delivered to Egypt, Spain, the United States and Gibraltar. There were no imports of gasoline in 2019.

With over 4.7 million cars converted to run on LPG (38% of the fleet), Turkey is the largest autogas market in the world. Seventy-four per cent of LPG consumed in the country was imported (98.6 kb/d out of a demand of 133 kb/d), which was an improvement from 2018 when LPG import dependency exceeded 80% (WLPGA, 2019).

Figure 8.8 Turkey's liquefied petroleum gas imports by country of origin, 2019



74% of LPG consumed in Turkey is imported, but the origin of supply has changed in recent years, with volumes from the United States tripling over 2017-19.

Source: Calculation based on EMRA (2020), *Turkish Liquefied Petroleum Gas Market Report 2019* https://www.epdk.gov.tr/Detay/Icerik/5-8163/turkish-liquefied-petroleum-gas-lpg-market-repo.

The Izmir, Izmit and STAR refineries are supplied with crude oil by sea tankers (as they are located in direct proximity of oil terminals). The Kirikkale refinery is supplied via a dedicated pipeline from Turkey's Mediterranean oil hub in Ceyhan. The Batman refinery processes crude from a number of smaller oil fields in Batman Province, delivered to the refinery both via an existing pipeline network and by road tankers. The STAR refinery, a USD 6.2 billion investment by State Oil Corporation of Azerbaijan (SOCAR), started operations in October 2018 and is the first newly built oil processing plant in the country since 1986. The refinery processed over 180 kb/d of crude in 2019, significantly helping to reduce Turkey's dependence on imported oil products, most notably diesel (SOCAR, 2020; EMRA, 2020a).

Figure 8.9 Turkish oil infrastructure

Retail

In 2019, Turkey's total domestic sales of gasoline and diesel combined increased year-on-year by 2.9%, amounting to 526.7 kb/d. Diesel accounted for 89% of the total (470.8 kb/d), while gasoline made up the remaining part, underlying the heavy reliance of road transport on diesel. Turkey also has a very large share of LPG in the fuel market, totalling 133 kb/d in 2018, 80% of which (98.6 kb/d) was autogas. Compared to 2018, consumption of autogas increased by 1.2% (EMRA, 2020b). Assuming that the average car needs 15% more LPG than gasoline to drive the same distance, road use of LPG in Turkey is twice as high as for gasoline.

In 2019, the retail fuel market was 70% controlled by the five biggest distributors, a situation that has remained stable since the last in-depth review. These are Petrol Ofisi (21.8% of the market), Opet Petrolcülük (18.6%), Shell&Turcas Petrol (16%), BP Petrolleri (9.1%) and Total Oil Türkiye (Güzel Enerji) (5.6%) (EMRA, 2020a).

Table 8.2 Licenses in the Turkish petroleum market (with separate LNG-only licenses)

Type of license	2015	2016	2017	2018	2019
Retailer	12 928	12 671	12 863	12 961	13 002
LPG retailer (autogas)	10 559	10 659	10 530	10 644	10 760
Distributor	91	92	110	89	93
LPG distributor	84	87	99	95	98
Storage	107	107	101	98	95
LPG storage	104	109	108	110	105
Bunker supplier	62	61	60	63	69
Refinery	6	6	7	6	6
Total licenses	23 941	23 792	23 878	24 066	24 228

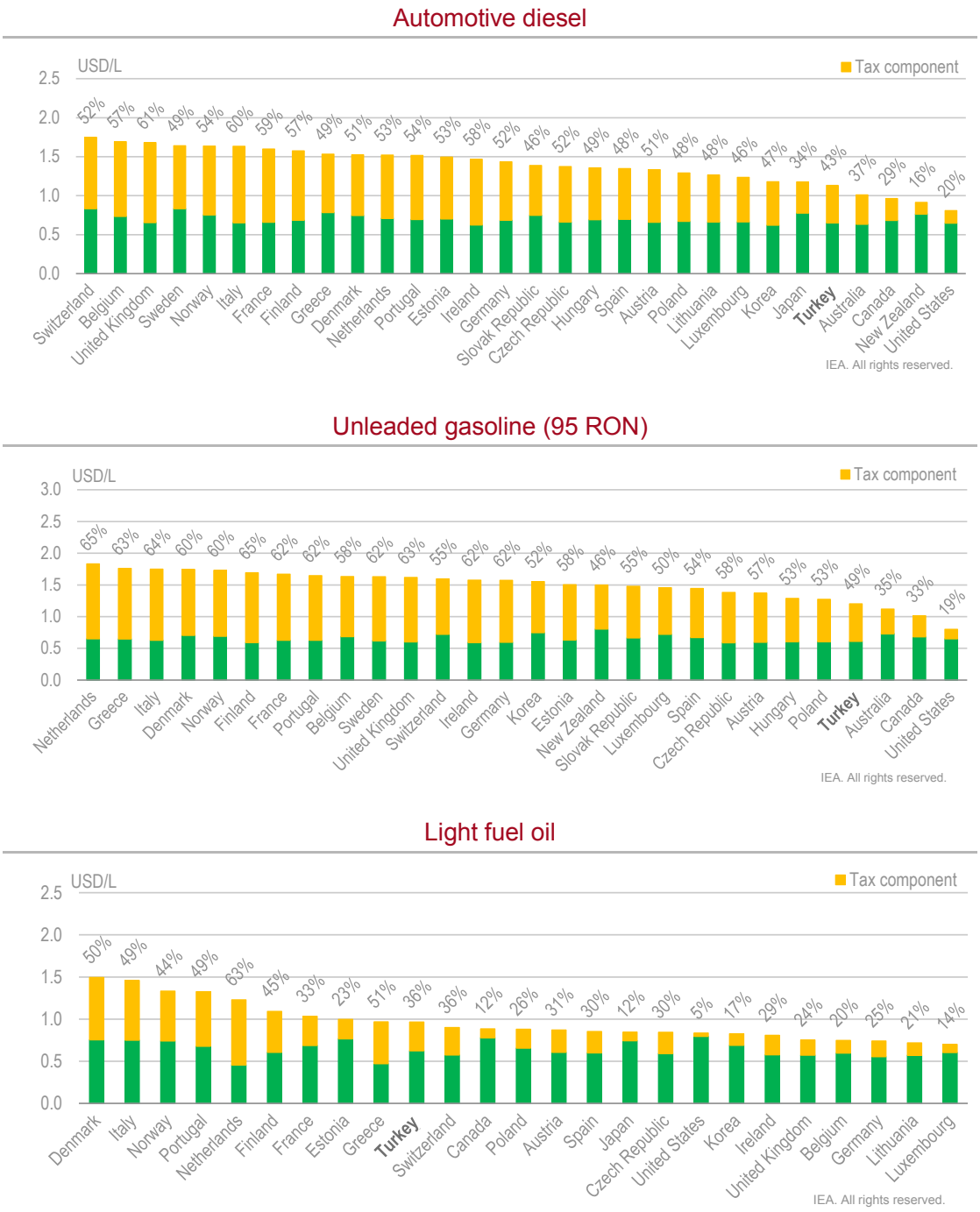
The number of retail licenses has remained stable since the last in-depth review, with a large number of separate autogas retailing stations. One license for a refining operation has remained idle.

Source: Turkish response to the IEA questionnaire.

Prices and taxation

Fuel prices in Turkey are low compared to other IEA countries for most fuels. For automotive diesel, Turkey had the fifth-lowest prices in the IEA in the fourth quarter of 2019, at USD 1.13/L, with the tax component amounting to 43% (Figure 8.10). For unleaded gasoline, Turkey ranked fourth-lowest at USD 1.20/L, 49% of which was tax. However, light fuel oil prices were comparatively high, at USD 1.0/L, ranking tenth-highest, with the tax component accounting for 36% of the fuel price.

Figure 8.10 Price comparison for oil fuels in the IEA, 4Q 2019



Turkey has low fuel prices compared to other IEA countries, with the fifth-lowest diesel and fourth-lowest gasoline prices in 4Q 2019, but light fuel oil prices were above the median.

Note: Automotive fuel prices are not available for Mexico; unleaded gasoline prices for Japan and Lithuania; light fuel oil for Australia, Hungary, Mexico, New Zealand, the Slovak Republic and Sweden.

Source: IEA (2020c), *Energy Prices and Taxes Fourth Quarter 2019*, www.iea.org/statistics.

According to Part IV of the Petroleum Market Law, pricing for the purchase and sale of petroleum should track those in the nearest accessible global free market area. For domestic crude oil, the "market price" of the nearest delivery port or refinery shall be accepted as the

price. Thirty-day term prices of Arab medium crude oil (31 API) for 26 API or lighter crude oil and Arab heavy crude oil (27.5 API) for crude heavier than 26 API shall be taken as the basis for domestically produced crude oil. 2 US cents are added to or deducted from the barrel price of the equivalent crude for each 0.1 API gravity difference between the equivalent petroleum and domestic crude oil. Refineries purchase domestic crude oil at this minimum price upon the proposal of crude oil producers and are supposed to give priority to domestic crude oil. Refineries are meant to provide a written response within 15 days to producers' proposals offering the crude oil with the minimum price. Disputes on prices are settled within 30 days by the arbitration of EMRA. Imported crude oil prices shall be considered as prices obtained according to petroleum agreements made in line with the globally announced prices and spot market values (Petroleum Market Law No. 5015).

Oil supply infrastructure

Turkey has a very strategic geographic position at the crossroads of Europe, Eurasia and the Middle East. Its direct proximity to the rich energy deposits of the Caucasus, Iran, Iraq and Russia, combined with the country's connectivity to Europe, gives Turkey unique opportunities to exploit these advantages economically. Around 3% of global oil supply is shipped through the Turkish Straits – in 2018, close to 86 000 ships passed through it, serving as one of the busiest sea routes in the world (TSVTS, 2020).

Ports

Turkey has a large number of oil ports and terminals located along over 8 000 kilometres of the country's coastline, giving it access to seaborne imports from the Mediterranean and Black Seas. Among Turkey's oil import ports, Izmir, Kocaeli and Mersin are the most significant in terms of crude oil imports. In 2018, the utilisation rate of these ports was around 84%.

In 2018, 38 Mt of crude oil and refined products (excluding LPG) were accepted at Turkish ports.

Table 8.3 Import volumes of the main Turkish ports (in tonnes)

Location	Crude oil	Aviation fuels	Diesel	Fuel oil	Marine fuels	Others
Antalya		**31 876**	**428 075**			
Iskenderun			921 709			
Istanbul		96 107	46 138			
Izmir	9 282 736	65 967	1 637 956	209 184		446 198
Kocaeli	8 400 835	287 483	1 811 518	261 162	10 254	2 507 778
Mersin	2 533 371		4 280 719	83 205		
Samsun			705 528			
Tekirdag		302	3 233 635			
Trabzon			686 842			
Total	20 216 942	481 735	13 752 120	553 551	10 254	2 953 976

Among Turkey's oil ports, Izmir, Kocaeli and Mersin are the most important in terms of crude oil imports to the country.

Source: Turkish response to the IEA questionnaire.

Pipelines

Apart from playing a role in transporting Russian and Caspian oil from the Black Sea ports of Novorossiysk (Russia) and Supsa (Georgia) through the Turkish Straits to the Mediterranean Sea, Turkey is a significant transit route for pipeline oil coming from the Caspian region and Iraq. The Baku-Tbilisi-Ceyhan (BTC) pipeline has a throughput capacity of 50 million tonnes (1 mb/d) of oil per year from the Azeri-Chirag-Deepwater Gunashli field and condensate from Shah Deniz through Azerbaijan, Georgia and Turkey. Occasionally the BTC also transports Turkmen and Kazakh oil. This most important transit pipeline in the region was built by the Baku-Tbilisi-Ceyhan Pipeline Company (BTC Co.) and became operational in June 2006. While the Azerbaijan and Georgia sections of the pipeline are operated by BTC Co, the BOTAŞ-owned company, BOTAŞ International Limited, operates Turkey's 1 076 km portion of the pipeline. The second transit pipeline running through Turkey is the Iraq-Turkey Pipeline (ITP) with a capacity of 70.9 million tonnes/year (1.4 mb/d), and the Turkish section of the pipeline is operated by BOTAŞ.

The main domestic crude oil pipelines are the Batman-Dörtyol, the Selmo-Batman and the Ceyhan-Kırıkkale pipelines as well as 26 product lines serving refineries and distributors.

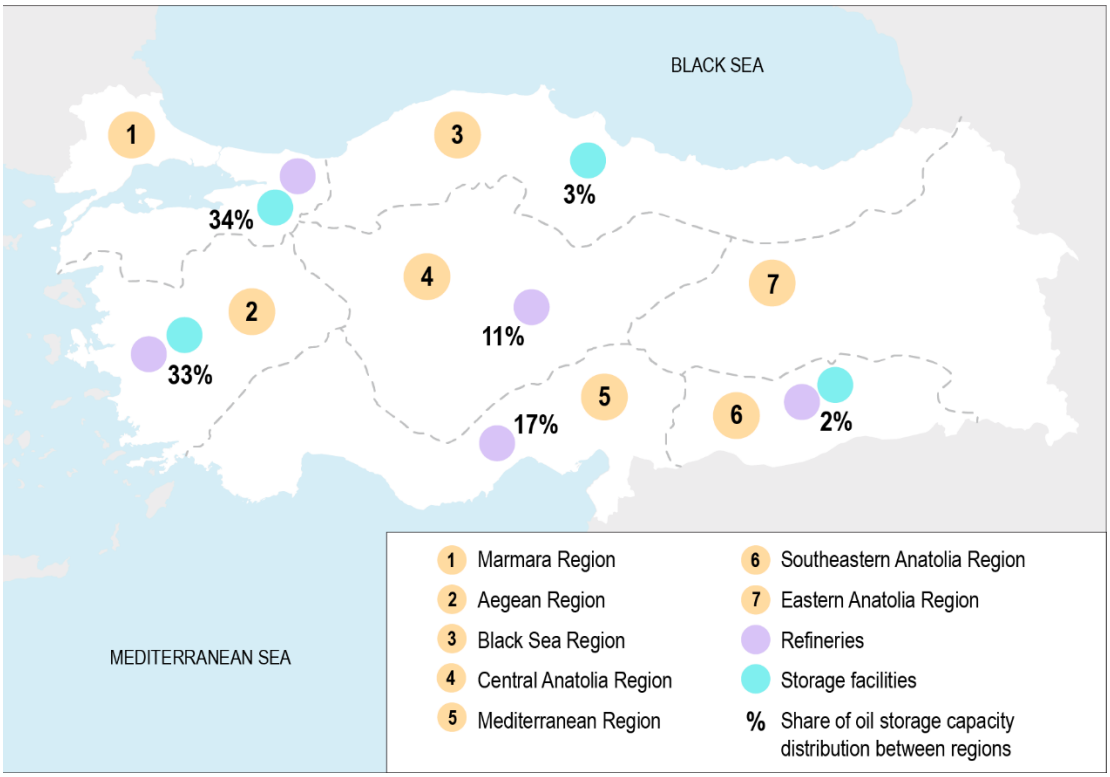
Storage

Turkey has both government and private sector oil storage facilities. State-owned storage facilities belong to BOTAŞ and TPAO. Privately owned oil storage facilities belong to refineries and distributors.

As of 2019, the total oil storage capacity registered to EMRA amounted to 14.2 million cubic metres (mcm) (89.3 mb). In addition to this capacity, TPAO has 140 000 m^3 of crude oil storage capacity and BOTAŞ another 1.8 mcm of storage capacity connected to the Kirkuk-Ceyhan oil pipeline, although those capacities serve operational purposes and are not counted as accessible storage for the market (they are allocated to transport and export crude oil coming from Iraq as per an intergovernmental agreement between Turkey and Iraq. The storage tanks are used for storing pumped crude oil from Iraq before loading on tankers for export.) In total, Turkey's storage capacity is over 16.14 mcm (101.5 mb), all in above-ground tanks.

Fifty-four per cent of oil storage facilities belong to refineries, followed by storage license holders (34%), BOTAŞ (11%) and TPAO (1%). Refineries have 539 tanks (71 of which of belong to the new STAR refinery), distributors have 9 tanks and all other storage facilities have 1 277 tanks. The total number of tanks amounts to 1 825.

Figure 8.11 Turkish oil storage facilities



Source: Turkish response to the IEA questionnaire.

Oil storage facilities are located throughout the country in proximity to densely populated areas and according to the deployment of refineries and distributors. Sixty-eight per cent of storage facilities are situated in the west of Turkey, 27% in the central part of the country and 5% in the east.

Table 8.4 Capacity and regional breakdown of oil storage facilities in Turkey

District	Storage facilities	Refineries	Distributors	Total capacity (m^3)
Aegean Region	492 519	4 216 762		4 709 281
Black Sea Region	411 677			411 677
Central Anatolia Region	217 894	1 267 985	5 286	1 491 165
Marmara Region	1 857481	2 996 192		4 853 673
Mediterranean Region	2 414 544			2 414 544
Southeastern Region	27 942	268 265		296 207
Total (m^3)	5 422 056	8 749 204	5 286	14 176 546

Note: The table shows only capacities available to the market and registered to EMRA, thus excludes the 1.94 million cubic metres of storage belonging to BOTAŞ and TPAO serving only operational purposes of the Kirkuk-Ceyhan oil pipeline.

Source: Turkish response to the IEA questionnaire.

Oil emergency policies and organisation

Emergency response policy

Turkey's oil stockholding regime is regulated under the Petroleum Market Law, LPG Market Law and their sub-regulations. The current law obliges both industry and government to hold oil stocks. According to Article 16 of the Petroleum Market Law, Turkey has to keep at least 90 days of oil stocks, calculated on the basis of net-imports of the previous year. Refineries are obliged to hold at least 20 days of oil stocks. Each fuel and LPG distribution licensee is obliged to hold at least 20 days of product stocks based on average daily sales of the previous year. These stocks should be held at the obligated party's storage facilities. Eligible consumers, consuming more than 20 000 tonnes on an annual basis, also previously held obligatory stocks equivalent to 15 days of their consumption, but this obligation was rescinded in February 2018 due to its very small impact on the national stock obligation level.

Regarding fuel types, refineries may meet their obligations by holding crude oil, feedstock and/or finished products; distributors are allowed to hold only finished products and/or biofuels.

The remaining oil stock obligation to 90 days is called complementary oil stocks. Besides obligatory industry oil stocks, the existing law imposes an obligation on refineries to hold the complementary portion of national oil stocks on behalf of the government. The cost of complementary oil stocks held by refineries on behalf of the government is levied on consumers.

The amount of the levy is determined by EMRA at a maximum of USD 10 per tonne. The current levy, which was collected in 2019, was as follows (1 Turkish lira [TRY] = 0.18 USD in 2019):

- for gasoline varieties: 3.93 TRY/m^3
- for kerosene and jet fuel: 3.93 TRY/m^3
- for gas oil and biodiesel: 3.93 TRY/m^3
- for fuel oil: 4.18 TRY/tonnes
- for LPG: 8.83 TRY/tonnes.

Levies are determined each year according to rates set by the Ministry of Treasury and Finance. As of the end of 2019, about TRY 2.2 billion (USD 340 million) had been collected. The collected levy has not been used so far, though it may be used following the enactment of the Complementary Oil Stock Law.

Emergency response decision-making

The National Oil Stock Commission (NOSC) was established to take necessary decisions regarding oil stocks.

With the Presidential Decree, numbered 1 (Article 522), published in the Official Gazette on 10 July 2018, the NOSC has been reconstituted under the chairmanship of the deputy minister of the MENR. It includes representatives from the Ministry of Treasury and Finance, Ministry of National Defence, Ministry of Foreign Affairs, Ministry of Interior Affairs, EMRA, and MAPEG, which serves also as a NESO secretariat.

Turkey's emergency stockholding obligation has been fulfilled by compulsory and complementary oil stocks held by industry. Monitoring of these stocks is conducted by EMRA and the MENR. While EMRA is charged with monitoring and auditing the compulsory oil stocks, the MENR is responsible for calculating Turkey's 90-day oil stocks obligation and the complementary oil stocks. Any misleading actions of stockholders (refineries, fuel and LPG distributors) are determined and fined under the provisions of existing law by EMRA. According to the existing law, license holders that are obliged to hold national oil stocks shall be fined TRY 250 for each tonne of product that is incomplete on the date of determination. The administrative fine imposed under this sub-paragraph is used to partly finance the complementary national oil stocks.

EMRA conducts regular on-site audits of randomly selected facilities to monitor physical availability and quality of compulsory stocks, in co-operation with the Ministry of Science, Industry and Technology. Technical requirements are also tested on site by experts. If there is a failure to comply with stock obligations in terms of quality, quantity or location of oil products, companies can be sentenced to fines. The company's license may be cancelled in case of a serious infringement.

The NOSC has the right to take all decisions concerning oil stocks. In April 2017, it called upon EMRA to make arrangements for a ticket system by the end of the year and to put it into practice as of 1 January 2018. Relevant regulations were made by EMRA and published in the Official Gazette in October 2017.

According to the new regulation, refineries and fuel distributers may hold part or all of their obligatory oil stocks through ticket contracts on Turkish territory. LPG distributors will be allowed to hold a maximum of 50% of their obligations through ticket contracts. Turkish legislation prevents companies from holding emergency oil reserves abroad in order to guarantee their availability and physical accessibility in the event of an emergency. Therefore, Turkey has neither bilateral agreements nor ticket arrangements with other countries.

Oil stocks can be released by a decision from the NOSC. The commission has the right to take a release decision on the compulsory industry and complementary oil stocks. There is currently no handbook for the process for an oil stock release. However, the oil stock release process to the market is carried out in accordance with instructions from the NOSC by obligated stockholders that the commission instructs to release stocks. It is envisaged that the administration will prepare a handbook after the enactment of the Complementary Oil Stock Law, which is in preparation.

According to a prepared draft law, complementary oil stocks will be held by the parties with whom the administration signs contracts. The parties, to whom contracts are going to be assigned, will be determined by the administration among refineries, distributors and owners of bunker licensees. All these entities will be able to use third-party storage facilities. The volume and types of complementary oil stocks will be determined by the NOSC.

The NOSC acts according to the Decree of the Council of Ministers named Working Procedure and Principles of National Oil Stock Commission (Decree No. 2005/8374 of 28 January 2005). In normal times, the commission convenes at regular intervals based on the call of the chairman, or the call of two members at the same time, to take decisions on stocks. Decisions are taken by majority vote.

In the case of an emergency, convening a meeting and taking a decision takes approximately two days. The NOSC's decisions are implemented by MAPEG in close co-operation with the industry.

Emergency oil reserves

To meet IEA stockholding obligations, refineries and distributors use 14.2 mcm of registered storage capacity. All of them are above-ground storage tanks and most of them are owned by refineries. When their capacities are taken into account, refineries and storage facilities have 539 tanks with 8.7 mcm storage capacity (61%) and 1 277 tanks with 5.4 mcm capacity (39%), respectively (Table 8.5).

Table 8.5 Storage capacity by category of license holders

Type of license holder	Number of storage tanks	Capacity (m^3)
Refineries	539	8 749 204
Distributors	9	5 286
Storage facilities	1 277	5 422 056
Total (in tonnes)	1 825	14 176 546

Source: Turkish response to the IEA questionnaire.

In the last four years, Turkey's oil stocks have shown a trend of fluctuating between 90 and almost 110 days. In the last two years, stock levels have been slightly above 90 days.

As of end May 2020, 53% of total oil stocks in Turkey were crude oil, 25% middle distillates, 12% other products including LPG, 4% residual fuel oil, 3% natural gas liquid feedstocks and 3% motor gasoline. Total stocks as of end May 2020 amounted to 88.6 mb.

Oil demand restraint

Demand restraint measures are considered only as a complement to an emergency stock release. Specific measures and the degree of implementation are adjusted according to the severity and anticipated duration of a particular crisis.

Demand restraint measures in Turkey range from light-handed to heavy-handed measures. While light-handed measures include information and energy-saving campaigns, heavy-handed measures include mandatory speed limits, odd and even plate number driving restrictions, and bans on weekend and/or short distance driving. Heavy-handed measures also include temporary restrictions on lighting of shop windows, prohibition of motor sports, the introduction or increasing of taxes, and rationing.

Light-handed measures, such as public awareness and energy-saving campaigns, are implemented by the administration in the first week of January every year as part of an "intensive energy and natural resources saving campaign". An Energy Efficiency Forum and Exhibition are held during the second week of January every year.

A decision by the president is required to implement heavy-handed measures. Such a decision would be prepared by the Coordination Board of the Disaster and Emergency Management Authority, an institution supervised by the Ministry of Internal Affairs that works to prevent disasters and minimise disaster-related damages. Approval by parliament is required for implementation of any tax increases or rationing/allocation measures. Local governors would be asked to implement any demand restraint measures decided upon by the Coordination Board, which would vary according to type and size of

the crisis. Turkey has only once implemented a 2.5% petroleum tax increase as a demand restraint measure, during the Gulf War in 1991.

Although there is no comprehensive research, it is estimated that odd/even plate number-based restrictions could save up to 35% of transport fuel consumption while a weekend driving ban could save up to 5%. Also, it is estimated that a combination of several other demand restraint measures targeting the transportation and heating sectors could provide potential savings of about 10% of total consumption.

A recent government-imposed lockdown in Turkey, which was announced in mid-March 2020 due to the COVID-19 pandemic, has negatively impacted 2020 oil demand in the country.

Assessment

In April 2017, the MENR launched the National Energy and Mining Policy with the main objective of reducing Turkey's reliance on imported energy resources, based on three main pillars: 1) improving energy supply security; 2) increasing the use of domestic energy resources; and 3) improving transparency in energy markets.

Oil accounts for 31.7% of Turkey's total supply, about equal to the shares of coal and natural gas. Oil consumption has increased by around 35% since 2014, mainly due to higher demand from the transport sector. The main products are diesel, LPG, jet and kerosene, and gasoline. Without significant policy changes, it is expected that oil demand will continue to grow in the coming years.

Domestic oil production in Turkey covers around 6% of demand, and most oil has to be imported. Total imports of crude oil were 623.7 kb/d in 2019, and the main suppliers were Iraq and Russia in the first quarter of 2020. Due to US sanctions, imports from Iran fell considerably in 2018 and were halted entirely as of May 2019, and the gap was covered by significantly increased deliveries from Russia and Iraq. Domestic crude production grew by 17% between 2017 and 2019. In the last few years, Turkey has increased production after applying secondary recovery techniques and discovering 18 new oil/gas fields in the past two years; 99 new wells were drilled in 2018 and 151 in 2019, with the sector registering an average success rate of around 11%.

The Petroleum Law establishes some incentives to enhance (international) investment in the upstream sector, such as low royalties. However, these measures have not resulted in an increase in foreign investment. TPAO has 77% of the exploration licenses, including all offshore ones, and 55% of all production licenses in Turkey, and in recent application rounds, 60% of licenses were issued to TPAO. The permitting process appears to be open and transparent with selection criteria set in the Petroleum Law. However, given low interest from investors, the government should investigate whether a more attractive framework needs to be implemented in order to stay on track with its objective. Unconventional oil reservoirs have been evaluated with good results. So far, there has been no public opposition related to hydraulic/acid fracturing activities.

Turkey is currently not facing any issues concerning decommissioning of oil and gas installations and pipelines. However, there are limited decommissioning obligations or liability regulations in relation to upstream oil and gas activities. This situation could result in a lack of clarity over responsibilities and may ultimately become a future burden on taxpayers.

Turkey has five operational refineries (four of them owned by TÜPRAS and one by SOCAR) with a total processing capacity of 860 kb/d. The five produce enough products to satisfy approximately 80% of the country's demand for petroleum products, but are proportionately lower in diesel oil, LPG and naphtha production. Turkish refineries have not been significantly affected by the recent IMO 2020 regulations.

Turkey imports substantial amounts of consumed oil products: 41% of diesel and 74% of LPG, mainly from the United States, Russia and India. Diesel demand has grown significantly, driven by economic growth. This growth is expected to be disrupted in 2020 due to COVID-19 impacts. The administration assesses that 2020 annual oil consumption may decrease on average by 13%, with aviation fuels decreasing by 46.3% and diesel oil by 6%.

Almost two-thirds of oil consumption in Turkey is in transport, with particularly high use of diesel. However, the government has not developed a clear strategy to reduce the share of oil in the sector. Policies promoting public transport, fuel-efficient cars or fuel switching from fossil fuels to cleaner alternatives such as electricity or hydrogen would help toward this end.

The downstream sector is fully liberalised with diesel and gasoline prices below the IEA average, but the government should continue working on the transparency of the retail service station market in order to increase its competitiveness.

Regarding oil emergency stocks, Turkey has a system with two types of stocks: obligatory industry stocks and complementary stocks. Both refineries and distribution licensees (fuel and LPG distributors) are obliged to hold at least 20 days of their previous year's supply as oil stocks. The obligation to maintain stocks for eligible consumers with a consumption higher than 20 000 tonnes was recently removed. The remaining level of stocks to reach the obligation of 90 days of net imports has to be held by refineries on behalf of the government (complementary stocks). The costs of holding these stocks is financed by a levy of a maximum of 10 USD/tonne of product sales. This levy is reflected in the retail price of diesel oil, gasoline, jet fuel, fuel oil and kerosene. Until the end of 2019, the Turkish government had collected a total amount of USD 340 million from the levy; however, it has not yet decided how to use the funds.

More than 50% of total emergency stocks are held in the form of crude oil. The government is keen to reduce the share of crude oil stocks and substitute them for final petroleum products. This transition will allow Turkey to improve its energy security.

The NOSC is the authority responsible for releasing emergency oil stocks. In the event of a supply disruption, the stock release process would be determined by decisions and instructions from the NOSC. Although there are some ongoing studies on this issue, there is neither an officially detailed drawdown procedure nor a handbook containing a clear description of institutional roles, responsibilities, and operational and communication procedures, including the decision-making process for oil supply emergencies.

Recommendations

The government of Turkey should:

- Review the regulations and procedures for upstream licensing with an eye toward attracting interest from a wider range of companies.
- Develop a cross-governmental road map to reduce oil consumption by strengthening demand-reduction and fuel switching policies in the transport sector.
- Develop an emergency response handbook by finalising ongoing studies, outlining domestic operational procedures in the event of an oil supply disruption, including the stock release process.

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9. Natural gas

Key data

(2019 provisional)

Domestic production: 0.4 bcm (0.39 Mtoe), -32% since 2009

Net imports: 44.4 bcm (45.2 bcm imports, 0.8 bcm exports)

Share of gas: 0.8% of domestic energy production, 25.2% of TPES, 18.7% of electricity generation, 24.2% of TFC (2018)

Gas consumption by sector (2018): Power and heat 34.8%, residential 25.5%, industry 25.8%, services 8.5%, other energy 4.3%, transport 1.1%

Overview

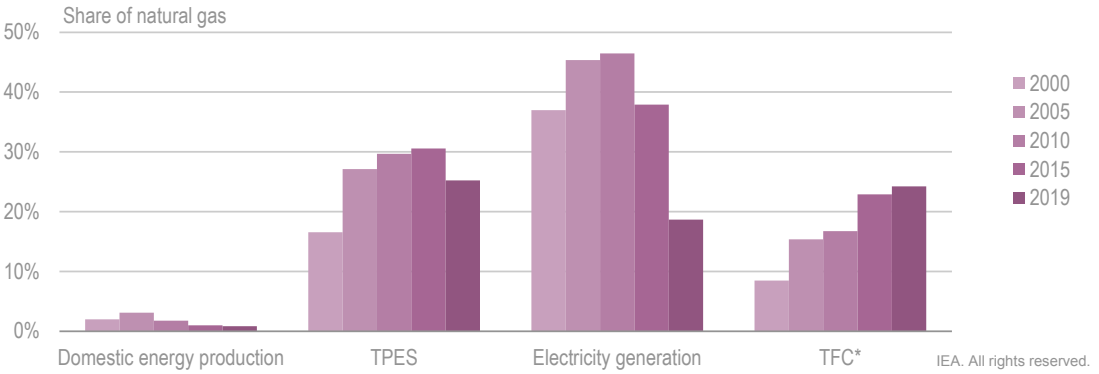
Since the early 1980s, natural gas has become a main fuel in Turkey's energy mix along with coal and oil. Natural gas is the second-largest energy source in total final consumption (TFC), at 24.2% in 2018, and the third-largest in total primary energy supply (TPES), at 25.2% in 2019 (Figure 9.1). Natural gas power accounted for 18.7% of total electricity generation in 2019, the second-largest source after coal. However, the share of natural gas in power generation fell by 32% in 2019 compared to 2009, as coal power and renewables have increased while natural gas power has declined in recent years. In terms of installed capacity, the share of gas-fired generation has declined, from 36.1% in 2008 to 27.1% as of May 2020.

Given its heavy dependence on imports for natural gas, along with the balance of payments and energy security vulnerabilities they create, Turkey's overarching priority with respect to natural gas is to reduce the share of imported gas and increase the share of domestically produced energy resources, especially in power generation. Moreover, it seeks to boost security of supply of natural gas by expanding infrastructure and diversifying import sources, both through pipelines and liquefied natural gas (LNG).

The trend of reduced dependence on natural gas in electricity generation is in line with Turkey's Eleventh Development Plan (2019-2023), which aims to boost natural gas supply security and access. To this end, the government set a goal to reduce the country's dependence on energy imports and replace imported gas with domestically produced energy sources, such as coal and renewables. Turkey's natural gas supply was the 11th-largest among IEA member countries in 2019, and the share of gas in TPES was the 12th-highest.

As part of its efforts to lower import dependence, Turkey has pursued gas market liberalisation over the past two decades, notably through wholesale and LNG price deregulation, unbundling of the state-owned system operator, and the establishment of a trading platform, processes that are still ongoing.

Figure 9.1 Share of natural gas in the Turkish energy system, 2000-19



Natural gas consumption has steadily increased in Turkey, becoming the second-largest energy source in TFC (2018) and third for electricity generation (2019).

* Latest data for TFC are for 2018.

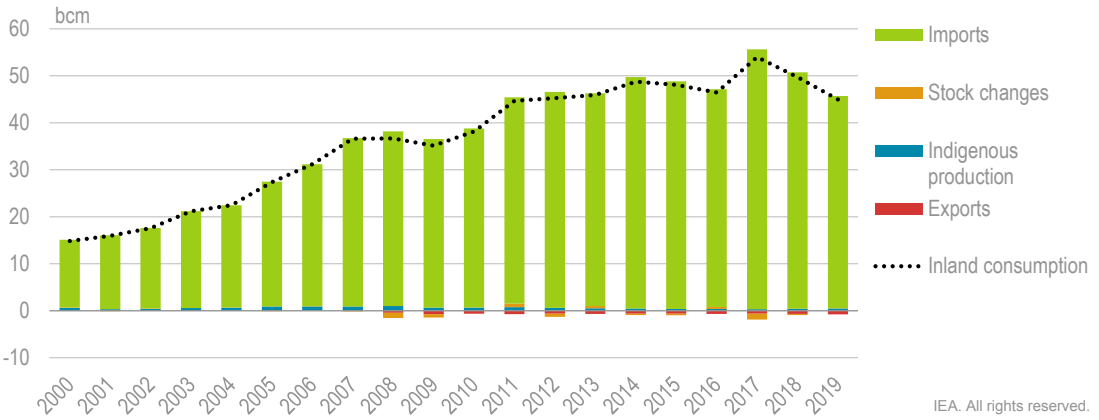
Notes: TPES = total primary energy supply. TFC = total final consumption. 2019 data are provisional.

Source: IEA (2020a), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Supply and demand

Due to very low domestic gas production, covering less than 1% of total gas demand, Turkey relies almost entirely on gas imports. In line with increasing gas demand over the past decade, the volume of gas imports has increased by 26% in the last decade, despite a drop in 2019. Turkey's total gas supply was 45.0 billion cubic metres (bcm) in 2019, down from 49.8 bcm in 2018 (Figure 9.2), mainly due to decreased use of natural gas in power generation and milder weather.

Figure 9.2 Natural gas supply by source, Turkey, 2000-19



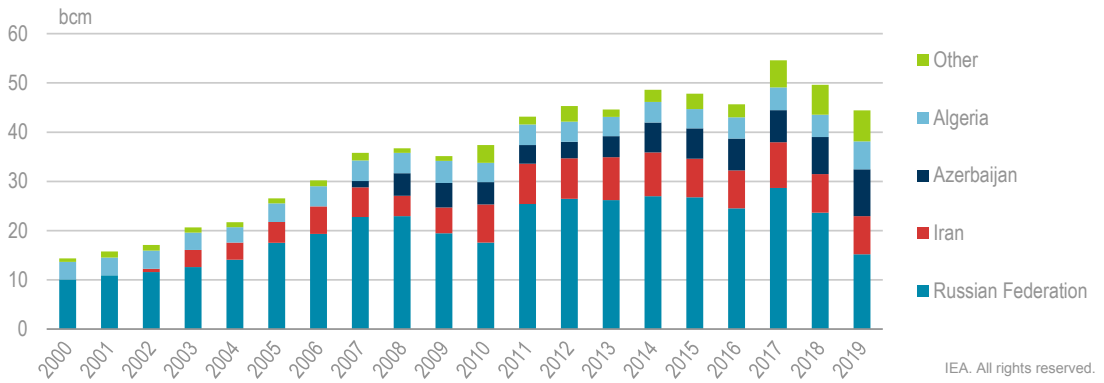
With little domestic gas production, Turkey relies on gas imports, which have increased by 26% in the last decade, although they declined in 2019.

Notes: bcm = billion cubic metres. 2019 data are provisional.

Source: IEA (2020b), *Natural Gas Information 2020* (database), www.iea.org/statistics.

In 2019, 34% of natural gas imports came from the Russian Federation, followed by Azerbaijan with 21% and the Islamic Republic of Iran with 17% (Figure 9.3). Turkey has diversified its gas supply sources to minimise the risk of a supply disruption. In the early 2000s, Russia was the dominant gas supplying country. Turkey began importing gas from Iran by the end of 2001, from Azerbaijan in 2007 and from Qatar in 2013. Unlike for oil, Turkey continued to import natural gas from Iran in 2019, as US sanctions do not apply to pipeline exports of gas from Iran; Turkey imported 7.7 bcm from Iran in 2019, out of a total of 9.6 bcm/year allowed under its long-term contract with Iran. More recently, Iranian natural gas imports have temporarily fallen to zero following a late March explosion on the main pipeline transporting gas from Iran, which was repaired in June.

Figure 9.3 Turkey's natural gas trade by country, 2000-19



In 2019, 34% of Turkey's gas imports were supplied from Russia, followed by Azerbaijan (21%) and Iran (17%).

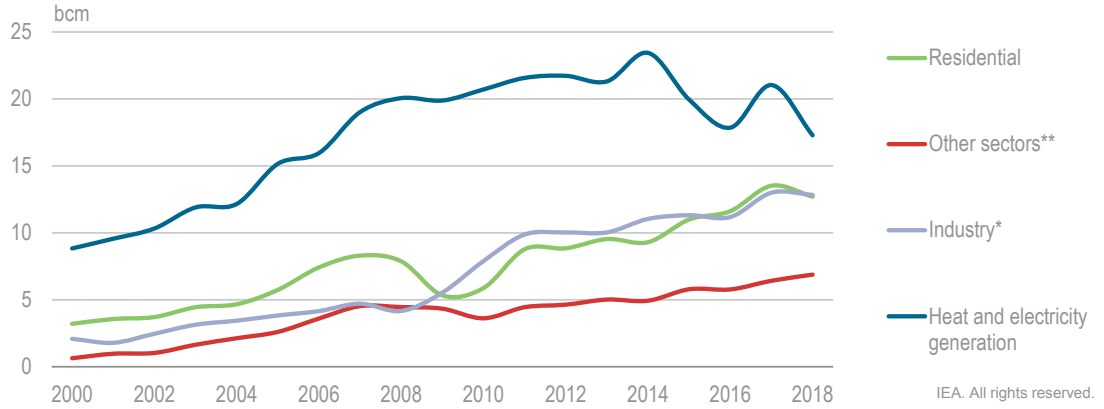
Notes: bcm = billion cubic metres. 2019 data are provisional.
Source: IEA (2020b), *Natural Gas Information 2020* (database), www.iea.org/statistics.

Natural gas demand has increased steadily over the last few decades, making Turkey the fourth-largest gas consuming market in Europe. It reached a historic high of 54 bcm in 2017, following 16% growth in one year with increasing demand in electricity generation, industry and the residential sector (Figure 9.4). However, supply data show a decline in gas consumption in 2018 of around 8%, corresponding to a drop in gas power generation.

Heat and electricity generation is the largest gas consuming sector, accounting for 35% of total demand in 2018. Gas power plants are typically flexible power sources that can accommodate for variations in supply from other sources, especially hydropower, whose availability fluctuates with hydrological conditions. Reflecting this, gas consumption in the power sector has varied between 23.4 bcm in 2014 and 17.3 bcm in 2018.

Industrial and residential consumption has seen more stable growth, and the sectors accounted for around 26% each of total gas consumption in 2018. Gas demand in industry has grown sixfold compared to 2000 and it has become the largest energy source in industry. Gas consumption has also increased rapidly in the residential sector, with more than a fourfold growth over the same period. In 2018, natural gas covered 51% of total residential energy consumption in Turkey, the fifth-highest share among IEA member countries.

Figure 9.4 Natural gas consumption by sector, Turkey, 2000-18



Turkish gas consumption has steadily increased, peaking in 2017, driven by high demand in heat and electricity generation, and increased demand in the industry and residential sectors.

* *Industry* includes non-energy use.
** *Other sectors* includes services, other energy sectors and transport.
Note: bcm = billion cubic metres.
Source: IEA (2019b), *Natural Gas Information 2019* (database), www.iea.org/statistics.

Looking ahead, natural gas is expected to decline in the power generation sector, while population growth, urbanisation and industrialisation will support its demand in the residential, commercial and industrial sectors.

Institutions

Natural gas exploration and production (E&P) activities are performed within the framework of Petroleum Law No. 6491. E&P licenses are issued by the General Directorate of Mining and Petroleum Affairs, which is an affiliate institution of the Ministry of Energy and Natural Resources (MENR).

The key institution for market reform in Turkey is the Energy Market Regulatory Authority (EMRA), the independent regulator for electricity, natural gas, petroleum and LPG markets. Its task is to set up and implement regulatory measures to ensure the establishment of a liberal and competitive natural gas market, where all market segments are open to new entrants. It also regulates and approves transmission, underground storage tariffs, and until sufficient competition is achieved, all retail tariffs.

EMRA is required to undertake and publish annual gas market projections for the upcoming year. The government does not currently publish longer term gas consumption projections, although a project is underway to study longer term scenario assessments.

Market structure

As with oil, the state-owned Turkish Petroleum Corporation (TPAO) is the dominant upstream player in the domestic gas sector. TPAO is estimated to have held 51% of Turkey's natural gas reserves in 2018. Although 15 companies were active in producing gas between 2014 and 2018, TPAO produced approximately 60-70% of Turkey's domestic natural gas production, reaching 74% in 2018.

Although upstream production is not regarded as a market activity under the Petroleum Law, production companies can sell the natural gas that they produce to wholesale companies, import companies, export companies, distribution companies, compressed natural gas sales companies at the wellhead, compressed natural gas transmission and distribution companies, and eligible consumers provided that they obtain wholesale licenses from EMRA according to the Natural Gas Market Law. Moreover, production companies can export the natural gas they produce provided they obtain an export license.

The state-owned Petroleum Pipeline Company (BOTAŞ) is the sole operator of the gas transmission system. The Turkish government passed a Natural Gas Market Law in 2001 with the objective of establishing a competitive natural gas market. Although the law was supposed to unbundle BOTAŞ, the firm remains a major player in the natural gas market, importing 82.5% of all natural gas (including LNG) consumed in 2017. Since the private sector reduced gas purchases, BOTAŞ' market share of imports had increased to 95% as of October 2019. Given that BOTAŞ owns and operates the domestic natural gas transmission network, companies need to acquire a standard transportation contract with BOTAŞ to import, wholesale and export natural gas.

The Natural Gas Market Law includes a plan to restructure BOTAŞ as a horizontally integrated legal entity, a process which is ongoing. Prior to building any new infrastructure connected to the Turkish natural gas network, the relevant license must be acquired from EMRA. Regulated third-party access is granted to all network segments, in accordance with the separate "Usage Principles and Procedures" prepared and published for each facility separately by EMRA. The EMRA Board is authorised to resolve all disputes related to third-party access.

The natural gas spot market operator in Turkey is EXIST, which oversees the day-ahead, intraday and balancing markets. In accordance with the 2013 Electricity Market Law, the Energy Exchange Istanbul (EXIST) was established in March 2015 and was granted a market operator license by EMRA. EXIST manages the financial settlement of gas market trades and helps to ensure reliable and transparent reference price formation.

The Organized Wholesale Natural Gas Sales Market Regulation was published in March 2017 and the Organized Wholesale Natural Gas Market Operating Procedures and Principles were issued in September 2017, establishing the Organized Wholesale Natural Gas Sales Market/Continuous Trade Platform (CTP), which allows users of the natural gas transmission system to trade in the wholesale market. Through 2018, a total of 43 wholesale trading licenses were issued, including 1 for transmission, 1 for export, 21 for import and 20 for domestic wholesale trading. The EMRA Board Decision in January 2020 amended the market rules with a decision to launch physically delivered natural gas weekly products; in line with the decision, EXIST introduced physically delivered natural gas weekly products to the market on 1 June 2020.

The CTP has been operational since 1 September 2018 and is operated by EXIST. The market design and secondary legislation adopted by EMRA allows market players to trade anonymously in an organised, liberal market operated under continuous trading principles. It also allows the transmission system operator (BOTAŞ) to balance the system via a continuous trading platform; the network code was amended by EMRA accordingly. The balancing regime is fully compliant with EU regulations. A derivatives market is planned to be launched in 2021.

The “Natural Gas Market Weekly Products”, launched in June 2020, offers market participants up to seven days of delivery products and flexible imbalance management opportunities. Natural gas market participants are offered the opportunity to trade for HS – weekend (two days), HI – weekdays (five days) and HT – weeks all (seven days), with which they can trade in a way similar to daily spot transactions.

Wholesale activities are carried out by companies that have import licenses or wholesale trading licenses. As of the end of 2018, there were 18 import (long-term) licensees, out of which 7 companies with 8 import licenses (Shell, Avrasya Gaz, Enerco, Kibar, Batı Hattı, Akfel and Bosphorus Gaz) carried out wholesale import of gas supplied to the domestic market. BOTAŞ primarily imports gas through long-term import contracts, which requires an intergovernmental agreement. The export of gas requires a separate agreement with BOTAŞ for its gas export capacity. In 2018, only BOTAŞ was active among the eight export companies licensed to export natural gas to Greece.

At the end of 2018, there were 47 spot LNG import licensees. Among those, only 2 (BOTAŞ and EgeGaz) imported LNG through the global spot market, while 14 of the remaining 45 license holders participated in domestic wholesale trading activities. The remaining license holders did not operate within the scope of their licenses in 2018.

On the retail level, around 50% of total consumption in 2018 was sold by importing companies, 44% by distribution companies, 5% by wholesale companies and less than 1% by compressed natural gas companies to final consumers.

As part of Turkey’s policy to increase access for consumers to natural gas, all 81 cities in the country have been granted access to natural gas through more than 16 000 kilometres (km) of gas transmission pipelines.

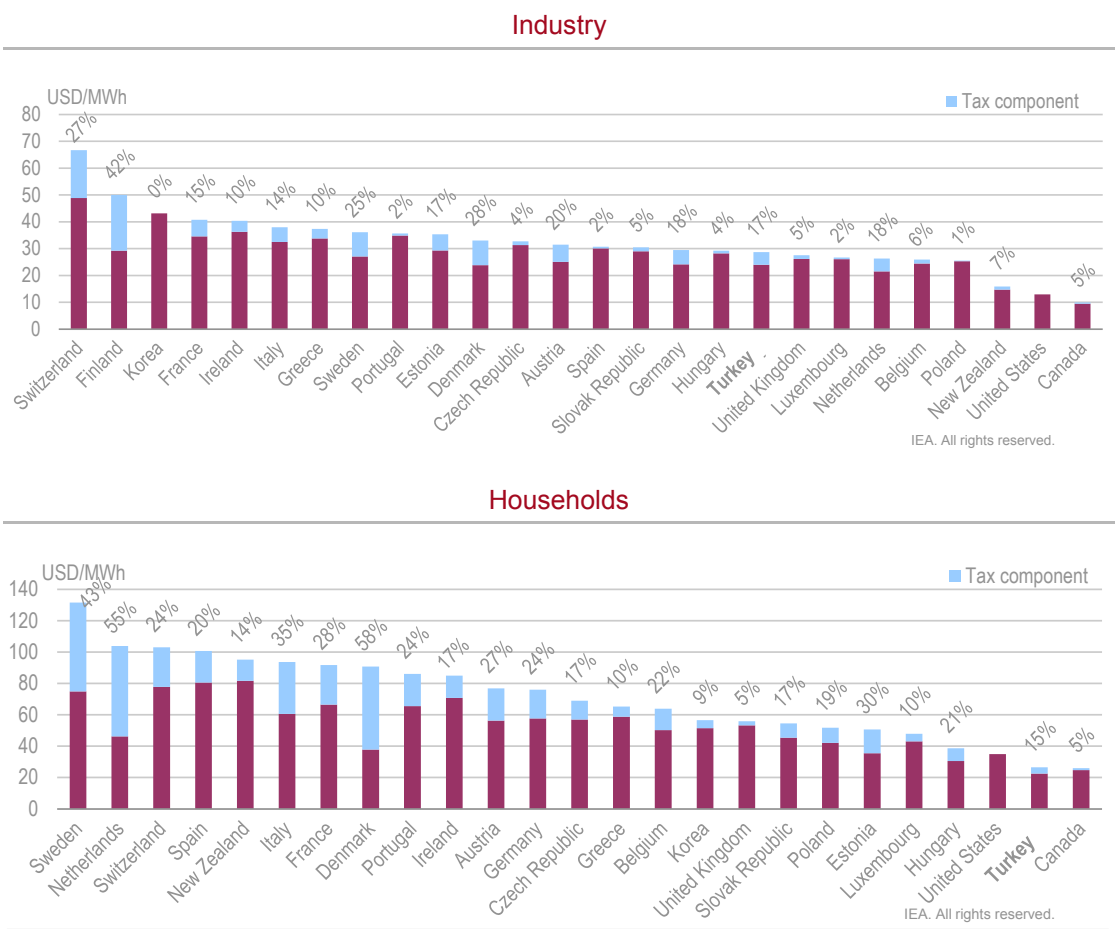
According to law, there are two kinds of consumers; eligible and non-eligible consumers (subscribers), and the eligibility threshold for household customers is 75 000 cubic metres per year, determined by the EMRA Board. Eligible consumers are those who can purchase natural gas from any generation company, import company, distribution company or wholesale company through bilateral contracts. On the other hand, non-eligible consumers (residential consumers with less than 75 000 cubic metres of consumption) have to purchase natural gas from distribution companies. Eligible consumer prices (wholesale pipeline and LNG) are not regulated by EMRA. As of the end of 2019, the total number of non-eligible subscribers for natural gas distribution companies had increased by 7.53% to reach 15 865 809, and the number of eligible consumers increased by 3.75%, reaching 623 930.

Non-eligible customers are bound to their local distribution system operator (DSO). There are 72 DSOs operating in Turkey, of which all except one have been privatised (including ownership of assets). New DSOs are licensed through a tender process conducted by EMRA.

Retail prices

Turkey has low gas prices for both industry and households in an international comparison. In 2019, the industry price was the ninth-lowest and the household price was the second-lowest among IEA member countries, after Canada (Figure 9.5). In 2019, the average industry price in Turkey was 29 USD/MWh, of which 17% were taxes. Turkish households paid 27 USD/MWh, which was nearly three times lower than the IEA median of 69 USD/MWh.

Figure 9.5 Natural gas prices in IEA member countries, 2019



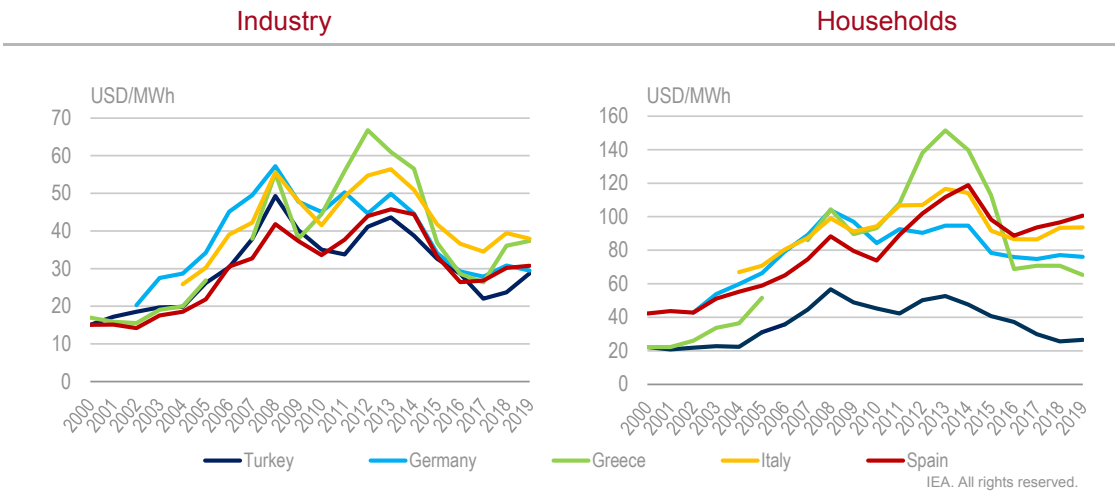
In 2019, Turkish households paid the second-lowest gas price among IEA member countries, while the industry gas price was the ninth-lowest.

Notes: MWh = megawatt hour. Missing industry data for Australia, Japan, Mexico and Norway; missing household data for Australia, Finland, Japan, Mexico and Norway; tax data are unavailable for the United States exclusively.

Source: IEA (2020c), *Prices and Taxes 2020* (database), www.iea.org/statistics.

Turkey's gas prices demonstrate trends similar to those of neighbouring countries, yet household prices are significantly lower (Figure 9.6). Prices increased and peaked in 2008 at 49 USD/MWh for industry and 57 USD/MWh for households. After the peak, prices fell during the years 2009-11, and increased again until 2013. Since 2013, prices have fallen significantly for both industry and households to the lowest level in over a decade. For households, in particular, the 2019 price was close to the level from the early 2000s, with only a marginal increase.

Figure 9.6 Natural gas prices in selected IEA member countries, 2000-19



Gas prices in Turkey follow trends similar to those of neighbouring countries, while household prices remained significantly lower.

Notes: MWh = megawatt hour. Data not available for some years for Greece (2006), Germany (2001) and Italy (2000-03).

Source: IEA (2020c), *Prices and Taxes 2020* (database), www.iea.org/statistics.

Tariffs

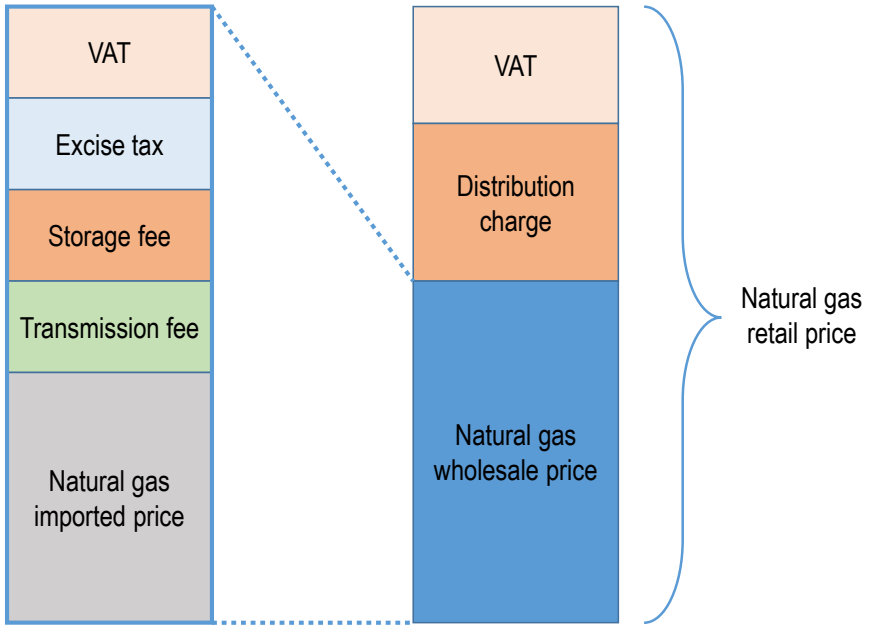
According to Natural Gas Market Law 4646, EMRA is responsible for determining retail prices. The retail price applied to consumers consists of the wholesale price, distribution charge and a value-added tax. EMRA applies a price cap methodology for setting retail tariffs, which can be revised in the case of extraordinary or unexpected circumstances (such as *force majeure* or macroeconomic crises), changes to regulations and amendments to licenses that impact tariffs. These prices only apply to non-eligible customers, as eligible consumer prices are not regulated by EMRA (see above section on market structure). There is no supplier-of-last-resort tariff in the Turkish natural gas sector. Therefore, if eligible consumers do not choose their supplier or their supplier goes bankrupt, they must purchase natural gas at retail tariffs.

Transmission tariffs can be set for a period of three to ten years, but are currently set for three years for BOTAŞ. The pre-tax weighted average cost of capital (WACC) was set at 11.52% for the most recent transmission tariffs on BOTAŞ (2020-22) with a depreciation period of 22 years. One per cent of operating expenses are allocated for the company's research and development (R&D) and training budgets, which amounted to around TRY 25 million for the latest three-year period.

Storage tariffs in the wholesale price are used to support the gas storage facilities at Silivri. The expected minimum capacity utilisation of the facilities is 60%. A minimum WACC of 10% is applied, with a depreciation period of 12-22 years. The tariff implementation period is one to ten years. All financial costs and risks during the construction of the storage facilities are also taken into account when calculating the storage tariff.

Distribution tariffs are set separately for each DSO for a period of five years. For DSOs that secure licenses in tenders, the tariff is set in the tender for a period of eight years, after which it is determined by EMRA. The depreciation period for distribution tariffs is set at 22 years. The pre-tax WACC was recently revised up to 14.38% from 12.85% due to deteriorating macroeconomic conditions. Losses and bad debts are not considered as part of the tariff calculations. One per cent of operating expenses can be used by DSOs for R&D activities, which amounted to around TRY 41 million in the 2017-21 period.

Figure 9.7 Natural gas price components in Turkey



Source: Information provided to the IEA by the government of Turkey.

Natural gas policy

Given its heavy dependence on imports of natural gas, along with the balance of payments and energy security vulnerabilities they create, Turkey's overarching priority with respect to natural gas is to reduce the share of imported gas and increase the share of other domestically produced energy resources, including hydro, coal, lignite, nuclear and renewables (especially in power generation). Specifically, as part of its Vision 2023 policy, the government targets a reduction in the share of natural gas in electricity generation to 20.7% by 2023, compared to 29.8% in 2018 per the Eleventh Development Plan.

Gas market liberalisation

Gas market liberalisation forms an essential part of Turkey's strategy to lower import dependence. To this end, over the past two decades, Turkey has embarked on an ambitious effort to liberalise its gas markets, as in other sectors such as oil and electricity. Changes to its natural gas laws in 2001 and 2007 underpin these efforts.

Market reform has been promoted by secondary legislation on licences, tariffs, market certificates, transmission network operation, distribution and consumer services, and

facilities (infrastructures and equipment). The Natural Gas Market Law was amended in July 2008, liberalising both spot and long-term imports of LNG to allow BOTAŞ to enter into new LNG contracts and private companies to hold contracts with companies in countries with which BOTAŞ already has import agreements. The original law called for BOTAŞ' share of imports to be lowered from 80% in the early 2000s to 20% by 2009, though the company remains the dominant importer even today.

Tariffs of the TSO, storage facilities and DSOs are regulated by EMRA, though tariffs on LNG terminals have not been regulated since 2017.

Wholesale prices are not regulated for LNG or pipeline gas. The Board Decision of EMRA dated from 22 December 2011, No. 3577, also stipulates that wholesale prices implemented by wholesale companies are to be set freely, without any discrimination among equal parties.

Looking ahead, Turkey plans additional steps to advance gas market liberalisation. In addition to the current 54-hour time horizon for the traded product in the Turkish gas market, transactions in 2-, 5- and 7-day products were introduced in June 2020. A market maker mechanism will be introduced to increase transaction volumes on the market. Legislation on the Natural Gas Futures Market, aiming to increase price discovery and provide hedging tools to market players, is being prepared by the government in collaboration with EXIST. Lastly, the government is also undertaking the necessary legal and operational preparations for the introduction of a supplier of last resort in the gas market.

Upstream

Natural gas E&P activities are carried out under E&P licenses granted by MAPEG according to Turkish Petroleum Law No. 6491. Gas can be marketed by producers based on the relevant license from EMRA.

Turkey's natural gas reserves were measured at 3.8 bcm in 2018 and TPAO's reserves were 1.9 bcm in the same year. Turkey's gas output is limited, predominantly coming from the Thrace and Western Black Sea regions at small gas fields.

Natural gas production has been on a declining trend in Turkey in recent years. If new gas fields are not discovered, production will cease completely in the near future. However, some of the depleted natural gas fields in the Thrace Basin can be used for storage purposes after they terminate production.

As part of its efforts to reduce import dependence, Turkey is pursuing exploration to determine the domestic potential of unconventional gas. Initial shale gas exploration in Turkey shows that it has potential, although additional studies are needed to make more detailed assessments. Shale exploration studies are underway in the Thrace Basin (the Hamitabat formation) and the Southeastern Anatolia Basin (the Dadas formation).

Exploration activities are also underway to determine offshore gas reserves potential, especially in the Mediterranean Sea and Black Sea. On 21 August 2020, Turkey's president announced the discovery of the Sakarya Gas Field by TPAO in the Tuna-1 Zone in the Black Sea. With an estimated reserve base of 320 bcm of natural gas, it is the largest gas discovery in Turkey's history, equating to around six to seven years of the country's annual gas consumption. Considering the size of the field and the announced production

target date (2023), it could reduce Turkey's gas import dependency by 36% and its energy import bill by 10% through the medium term, and improve the negotiating position of Turkish importers at a time when the majority of Turkey's long-term gas import contracts are set to expire.

Assessments of coal bed methane potential are also ongoing in the Zonguldak coal basin in northwestern Turkey and other lignite basins. An amendment to the Turkish Petroleum Law was made in June 2016 in order to allow production of coal bed methane in this and other areas. More information on coal bed methane potential is expected to emerge over the coming years. To date, one production lease for coal bed methane has been issued. Drilling investments worth a minimum of TRY 5 million (USD 742 000) can benefit from regional subsidies implemented in the second investment region.

Trading centre

Turkey plans to become an energy trading centre, an aim that is one of the key policy areas outlined in the Eleventh Development Plan. Its expansion of gas infrastructure, efforts to cut domestic demand and liberalisation of gas trading through the opening of the Organized Wholesale Natural Gas Sales Market in 2018 are all steps in this direction.

The gas spot market, operating under continuous trading principles since 1 September 2018, not only provides price signals to the market, but also acts as an additional tool for flexibility, promoting both source and price diversity. The organised market allows the TSO to supply balancing gas from the continuous trading platform as a residual balancer, and to price balancing gas through market mechanisms. Such market-based balancing aims to prevent asymmetry between prices in the electricity and natural gas markets that can occur if balancing gas is not priced in the market. The establishment of the organised market makes Turkey the first country in the southeastern European region to establish a full-fledged natural gas exchange that operates on a daily basis to generate market-based prices.

Moreover, in April 2019, EMRA prepared the "Regulation on Determination of Spot Pipeline Import Methods and Quantities" and published it for public consultation; it was approved by the EMRA Board in September 2019. Along with the flexibility provided by the organised spot gas market, the increase in cross-border trade ensured by the new regulation will be beneficial for Turkey's aim to be a more active player in the regional gas trade. Within this scope, auctions are held 12 times a year on a monthly basis, 4 times a year on a quarterly basis and once a year on an annual basis by EMRA.

Further to advancing its goal to be a regional trading centre, Turkey has boosted its natural gas import sources in recent years, both through the June 2018 opening of the Trans-Anatolian Natural Gas Pipeline (TANAP), which will carry Azerbaijani gas to Europe via Turkey, as well as increasing its LNG imports through expanding import capacity (see next section).

Infrastructure

Turkey's gas transmission network length approached 16 000 km and 17 entry points, with a total import capacity of 320 million cubic metres (mcm) a day in 2019 (relative to peak demand of 245 mcm/day in 2018-19). The transmission network, including nine compressor stations, is operated by BOTAŞ. There are seven international pipeline import points, five LNG entry points and five domestic entry points (two from storage facilities and

three from production fields). Capacity allocations for the transmission network, storage facilities and LNG terminals are assigned on a proportional basis annually. In addition, Turkey had 148 346 km of distribution lines as of the end of March 2020.

Turkey's target is to reach a total import capacity on its transmission system (including from pipelines, LNG regasification and storage facilities) of 463 mcm in 2023.

Storage

Turkey's Eleventh Development Plan (2019-2023) and the MENR's Strategic Plan 2019-2023 include a focus on expanding natural gas storage capacity; the country plans to increase cumulative storage capacity to 10 bcm by the end of 2023.

The Silivri, Kuzey Marmara and Değirmenköy Natural Gas Storage Facility (which acts as a single storage cluster), operational since 2007, has a total working gas capacity of 2.84 bcm and withdrawal capacity of 25 mcm/day. It was taken over from TPAO by BOTAŞ in order to be used effectively for ensuring seasonal supply-demand balance and supply security. The Kuzey Marmara Natural Gas Storage Expansion Project plans to increase total storage capacity at the facility to 4.6 bcm. Third-party access has been granted at the facility since 2012.

The send-out capacity of Turkey's second underground storage, Tuz Gölü (Salt Lake) Natural Gas Underground Storage Project, which started operation in 2016, reached 20 mcm/day in 2018. In addition, the Tuz Gölü Project (whose first phase is currently underway) aims to reach 5.4 bcm working gas capacity and 80 mcm/day of withdrawal capacity by 2023. Third-party access is currently not offered at the site, though after completion of commissioning works and legal requirements, it is expected to be opened up for third-party access starting from the 2021-22 season.

The current daily send-out capacities of the two facilities add up to 45 mcm/day and the volume of the reservoirs to 3.5 bcm. With the realisation of the planned upgrades, the two facilities will be able to store 10 bcm of gas by 2023, 20% of total 2018 demand; the daily send-out capacity will reach 155 mcm/day. As a result, the daily entry capacity is expected to exceed 476 mcm by 2023. The Strategic Plan 2019-2023 calls for a target of 463 bcm by 2023.

Table 9.1 Turkey's underground gas storage projects

Projects	Daily capacity increase (mcm)	Annual capacity increase (bcm)	Status
Tuz Gölü Underground Storage (Phase I)	0 → 20	0 → 0.6	Completed
Silivri Underground Storage capacity increase	20 → 25	2.66 → 2.84	Completed
Tuz Gölü Underground Storage (Phase II)	20 → 40	0.6 → 1.2	Ongoing
Tuz Gölü Underground Storage (Phase II)	40 → 80	1.2 → 5.4	Ongoing
Silivri Underground Storage capacity increase	25 → 75	2.84 → 4.6	Ongoing

Source: Information provided by the government of Turkey.

Liquefied natural gas

Turkey has four LNG terminals currently in operation. BOTAŞ operates the Marmara Ereğlisi LNG Terminal, which has been in service since 1994. The Izmir Aliağa Terminal, owned and operated by the private company EgeGaz, has been operational since 2006. The first Floating Storage and Regasification Unit (FSRU) developed by the private sector, Etki LNG, was completed in 2016. BOTAŞ recently opened the country's second FSRU in Dörtyol in 2018. BOTAŞ is also currently studying the connection of its planned new terminal in the Gulf of Saros to the natural gas transmission system, which will be the fifth LNG entry point. To this end, the engineering design is complete and the project received a positive Environmental Impact Assessment Certificate on 25 June 2020. The construction tender is planned for the last quarter of 2020.

In 2017, regasification capacity of the Izmir Aliağa LNG Terminal increased to 40 mcm/day from 16 mcm/day. BOTAŞ upgraded the regasification capacity of the Marmara Ereğlisi LNG Terminal from 22 mcm/day to 37 mcm/day in 2018. With the inclusion of Etki and Dörtyol, total daily regasification capacity in Turkey stands at 120 mcm, nearly half of the country's winter peak daily demand. The Saros FSRU Project, expected to be realised by BOTAŞ in the following years, will further increase Turkey's regasification capacity.

Table 9.2 Turkey's liquefied natural gas import terminals

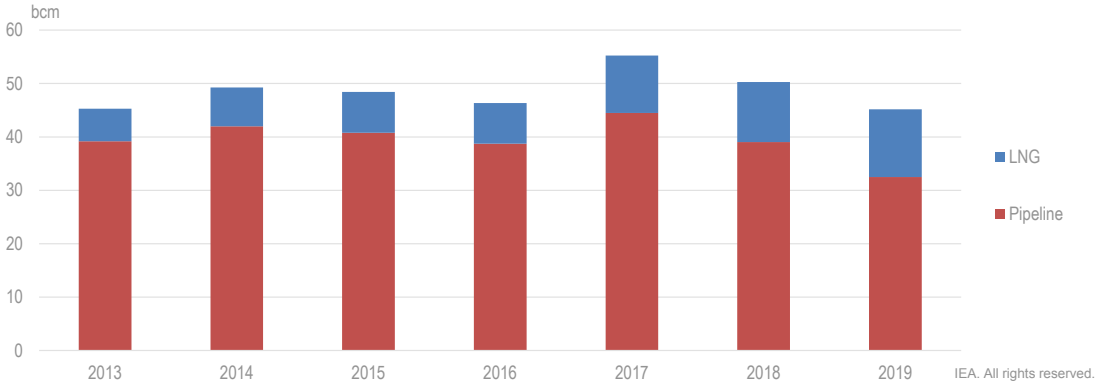
Project	Daily capacity (mcm)	Operator	Status
Marmara Ereğlisi LNG	37	BOTAŞ	In service
Izmir Aliağa LNG	40	EgeGaz	In service
Etki LNG	28	Etki	In service
Dörtyol LNG	20	BOTAŞ	In service
Saros FSRU	20	BOTAŞ	Under construction

Sources: Turkish response to the IEA questionnaire; GIIGNL (2020), *The LNG Industry: GIIGNL Annual Report 2020*, https://giignl.org/sites/default/files/PUBLIC_AREA/Publications/giignl_-_2020_annual_report_-_04082020.pdf.

Pipelines

Turkey receives the bulk of its imported natural gas supply through pipelines (71.9% in 2019), though the share of LNG has been increasing in recent years (Figure 9.8). As such, pipeline infrastructure remains a critical part of Turkey's gas consumption and energy security.

Figure 9.8 Share of Turkish gas imports by type, 2013-19

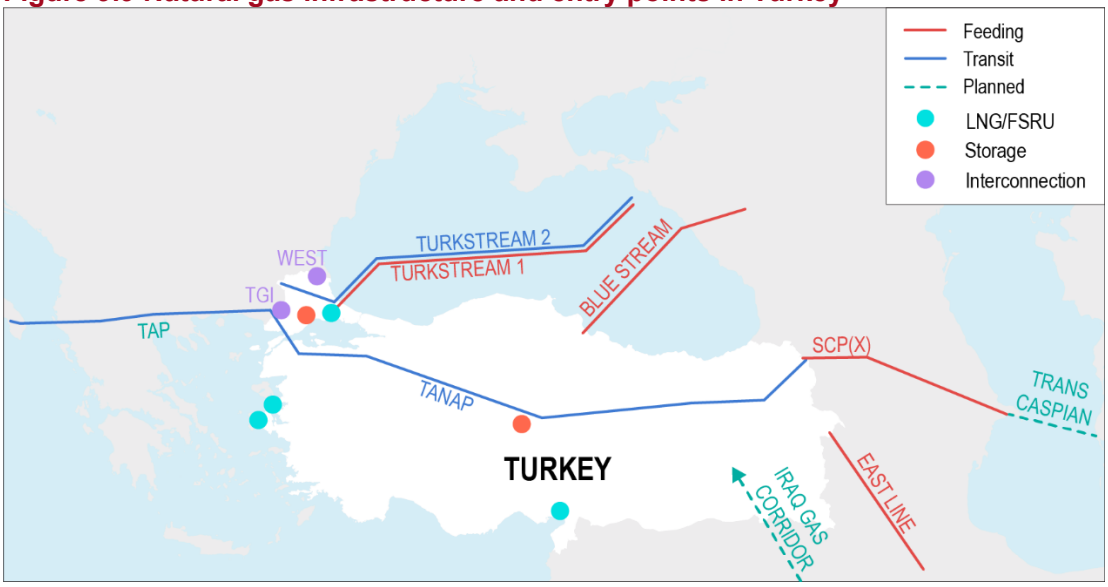


Notes: bcm = billion cubic metres. LNG = liquefied natural gas. 2019 data are estimates.
Source: IEA (2020b), *Natural Gas Information 2020* (database), www.iea.org/statistics.

In the face of expected rapidly growing gas demand, Turkey has plans to further expand its import infrastructure, both by increasing the capacity of existing pipelines and by introducing new ones.

Turkey's largest gas supplier is Russia, and several pipelines underpin gas imports from Russia to Turkey. Under the scope of a long-term supply contract, Turkey began receiving gas on the Russia-Turkey Natural Gas Pipeline (West Line) in 1986. The West Line enters Turkey at the Malkoçlar entry point on the Bulgarian border. The line was extended to reach Ankara in 1988. The current capacity of the pipeline is 18.8 bcm per year. Per a requirement in the Natural Gas Market Law 4646, BOTAŞ transferred 4 bcm per year in contracted capacity on the West Line to private importers (Enerco Enerji, Bosphorus Gaz, Avrasiya Gaz and Shell Enerji) in 2005, and these companies began imports in 2009; the contracts are due to expire in 2021. Following that, after the expiry of a 6 bcm per year contract between BOTAŞ and Gazprom in 2011, four private companies (Akfel, Bosphorus, Bati Hatti and Kibar Enerji) signed contracts with Gazprom for the same amount in 2013; these contracts run until 2043. The West Line has not been used since the beginning of 2020 as those volumes now transit on the TurkStream line (see below).

Figure 9.9 Natural gas infrastructure and entry points in Turkey



Source: Information provided to the IEA by the government of Turkey.

The Blue Stream pipeline, which entered into service in 2003, has an import capacity of 16 bcm of gas annually from Russia through the Black Sea to Turkey, under an agreement between BOTAŞ and Gazprom (MENR, 2020).

Turkey also started importing pipeline gas from Iran via the Eastern Anatolian Natural Gas Main Transmission Line (Iran-Turkey) in 2001. The maximum capacity of the pipeline is 10.4 bcm per year.

Lastly, the Baku-Tbilisi-Erzurum Natural Gas Pipeline went into service in 2007, based on a 6.6 bcm per year contract between BOTAŞ and SOCAR (MENR, 2020) to import gas from the first phase of the Shah Deniz field in Azerbaijan. A project to expand a portion of the pipeline in Azerbaijan and Georgia (South Caucasus Natural Gas Pipeline) began in 2015, in parallel to the second phase of the Shah Deniz project (see below).

The Southern Gas Corridor, which runs from the Shah Deniz field in Azerbaijan through Turkey and on to Italy, is an important strategic project to help Turkey diversify its import sources and improve pricing optionality. The project has a capacity to deliver 6 bcm of gas to Turkey and 10 bcm to Europe. Turkey is one of the largest investors in the corridor (through BOTAŞ and TPAO), with TPAO holding a 19% stake in each Shah Deniz field and the Southern Gas Corridor, while BOTAŞ owns 30% of TANAP, which is the part of the Southern Gas Corridor that runs from the border of Turkey with Georgia across Turkey to Greece. In June 2018, TANAP was physically connected to the Turkish transmission system in Seyitgazi/Eskişehir, and gas flow was initiated from this point. Moreover, one physical connection in Gelibolu/Çanakkale was commissioned in 2019. The new entry point on TANAP is fully compliant with EU interoperability rules based on regulations put into place by EMRA.

Table 9.3 Pipeline entry points and capacity in Turkey, 2019

Entry point	Capacity (mcm/d)
Durusu (Blue Stream)	47
Malkoçlar (West Line)	45
Gürbulak (Iran-Turkey)	29
Türkgözü (BTE)	19
Seyitgazi (TANAP)	11.4
Kıyıköy (TurkStream)	41.6

Source: Turkish response to the IEA questionnaire.

In addition, in 2016, the governments of Turkey and Russia signed an intergovernmental agreement to establish the technical, legal and economic framework for the TurkStream gas pipeline project. The project is a new gas pipeline system with a maximum annual capacity of 31.5 bcm on two lines, each having a capacity of 15.75 bcm per year. It will run from Russia through the Black Sea to the Thrace region in Turkey. From the Turkish receiving terminal in Kıyıköy, one of the two underground onshore pipelines will connect to the existing Turkish gas network at Lüleburgaz. The second pipeline will extend to the Turkish-European border (TurkStream, 2020). In November 2018, the offshore section of TurkStream was completed, and the project began commercial flows in 2020 (while gas flows on the West Line via Bulgaria dropped to zero). Moving forward, 14 bcm of Russian contracted gas received through the West Line is being delivered to Turkey via TurkStream without any changes to the terms and conditions of existing contracts.

Turkey plans to establish itself as a key energy trading centre for Europe, and the TANAP and TurkStream projects will help to this end. Together, the two pipelines will increase daily pipeline entry capacity in Turkey to 215 mcm in 2021.

Moreover, given that current contracts with Russia via the Malkoçlar entry point from the West Line were transferred to the TurkStream Kıyıköy entry point, capacity on the Malkoçlar entry point has the potential to create more opportunities for interconnection with Europe and cross-border trade, along with the planned infrastructure upgrades to that entry point that will allow bidirectional flows through it. EMRA has already announced an auction for spot pipe gas import through the Malkoçlar entry point.

Turkey has long-term import contracts with Algeria, Azerbaijan, Iran, Nigeria and Russia, all through BOTAŞ (Table 9.4). The long-term contracts that BOTAŞ holds with Russia (diverted to TurkStream from the West Line) and Azerbaijan (from Phase I of Shah Deniz) are due to expire in 2021, opening up a possibility to introduce more players into the gas import business in Turkey.

Table 9.4 Turkey's gas import agreements

Agreement	Signature date
Nigeria (LNG)	1995
Iran	1996
Algeria (LNG)	1988
Russia (Blue Stream)	1997
Russia (TurkStream 1)	1998
Azerbaijan (Shah Deniz Phase 1)	2001
Azerbaijan (TANAP)	2011

Source: Information provided to the IEA by the government of Turkey.

Based on the Regulation on Determination of Spot Pipeline Import Methods and Quantities published by EMRA in September 2019, spot pipeline capacity auctions have been introduced in Turkey in 2020. It is expected that the "pay-as-bid" auctions will encourage new suppliers and result in greater diversity of both import sources and prices. Importers with existing long-term contracts will retain their market share, but the remaining capacity will be allocated to the spot market. The breakdown of uncontracted capacity is as follows: 30% for annual products, 40% for quarterly products and 30% for monthly products.

Turkey's only pipeline export capacity through its national gas transmission system is to Greece. In addition, there is TANAP export capacity to Greece and TurkStream 2 export capacity to Bulgaria; these export points are not part of the national gas transmission system and therefore not regulated by EMRA. The export capacity of the Kipi interconnection point at the border with Greece has doubled from its original capacity, increasing the maximum capacity to 4.6 mcm/day (1.7 bcm/year), creating capacity that exceeds BOTAŞ' current exports to Greece. Initial volumes of Trans Adriatic Pipeline gas were tested at this exit point in November 2019.

Security of supply

Turkey has made notable progress in expanding gas access for consumers in the past two decades. Where only 5 metropolitan areas had access to natural gas before 2002, Turkey has connected all 81 of its cities (in 552 settlement areas as of the end of May 2020) with

gas access over 2002-18. On a population basis, 66.4 million Turkish people now have access to natural gas, or 80% of the population.

Market liberalisation has played a role in boosting Turkey's natural gas security. In particular, the market-based balancing described previously helps prevent asymmetry between prices in the electricity and natural gas markets that can occur if balancing gas is not priced on the market, and thereby prevent resulting behaviours that can undermine operation of the system and security of supply.

Diversifying import sources and routes as well as boosting domestic storage capacity are cornerstones of Turkey's gas security policy. As such, Turkey has been undertaking an expansion of its gas import and storage infrastructure (see previous section on infrastructure). The 2018 commissioning of the TANAP pipeline opened up additional imports from Azerbaijan, reducing Turkey's dependence on its dominant supply source, Russia. Several additional options are envisaged, including increasing the capacity of existing pipelines and introducing new pipelines, such as the TurkStream route from Russia, which entered into commercial operations in 2020. Investments in LNG and underground natural gas storage amounting to a minimum of TRY 27 billion (EUR 4.3 billion) are considered priority investments to this end (though final costs will well exceed this level), and Turkey has already boosted its spot LNG import purchases.

In order to mitigate the effect of potential supply disruptions, new FSRU terminals are being constructed and new entry points are being connected to the network to ensure supply diversification. In addition, loop pipelines are being added to the grid and capacity increase studies are ongoing for storage facilities. The 2001 Natural Gas Market Law requires gas importers and wholesalers to provide storage for a portion of their imported gas. According to the Natural Gas Market Law, EMRA is authorised to determine the ratio of storage liabilities for import companies for annual gas imports for five years in the national territory not exceeding 20%, by taking into account the existing underground storage capacity in the country. The EMRA Board decision from February 2020 sets the ratio of the underground storage liabilities of pipeline importers at 2%, and imposes a 0.5% liability to all suppliers supplying gas to distribution regions and holding wholesales or spot import licenses. The expanded supply infrastructure will mitigate against risks of seasonal supply shortages that Turkey has faced in the past.

BOTAŞ has undertaken additional investments in recent years to add compressor stations to address bottlenecks on its transmission system that previously created constraints in transporting imported gas from the east to demand centres in the west of the country.

The network code of the Turkish natural gas system regulates the normal operation of the natural gas system and its operation in exceptional situations, including supply disruptions.

The MENR co-ordinates Turkey's natural gas security plan. In case of an emergency situation (for example an N-1 situation), in order to balance linefill,[10] needed gas is supplied from EXIST using related codes. If it cannot be supplied from EXIST, then an interruption plan, which is co-ordinated by the MENR, is applied. These rules are continuously revised and updated by a panel comprised of representatives from the gas industry and public organisations.

[10] A minimum quantity of gas is required in a pipeline for the initial pressurisation of the system. The quantity is defined with an assumed pressure for each pipeline, and is known as linefill.

Natural gas import capacity is utilised 60% in the winter and 30% in the summer, on average. In 2018 and through August 2019, daily peak demand for gas was 0.2 bcm, while the monthly peak was 6 bcm. Compared to the annual average peak demand over 2018-19 of 245.4 mcm/day, the total 2019 entry flow capacity of the gas transmission network was 314 mcm/day.

Every year, a seasonal Risk Management Report is prepared by BOTAŞ and the Turkish Electricity Transmission Corporation in co-ordination with the General Directorate of Energy Affairs in order to carry out network management and risk assessments. This report considers preventive actions in case of a gas disruption.

At times when peak demand exceeds supply, BOTAŞ prioritises residential gas consumption by directing power generators to temporarily lower their consumption by up to half of their contracted levels. However, an interruption has not been applied since March 2017.

Assessment

Natural gas remains an important fuel in Turkey's energy mix along with coal and oil. In 2019, it accounted for 25% of total primary energy supply. Gas demand has increased steadily since the early 2000s, with 45% growth in the last decade. However, in 2019, total gas supply dropped from a previous peak in 2017. Power generation is the largest gas-consuming sector. Gas power plants are typically flexible power sources, and electricity generation fluctuates to accommodate variations in demand and supply from other sources (hydro, in particular – which explains the drop in gas demand in 2018). Reflecting this, gas consumption in the power sector has varied. Industry and residential consumption has seen more stable growth. In 2018, industry consumed the largest share of total gas consumption followed by households.

Given its heavy dependence on imports for natural gas, along with the balance of payments and energy security vulnerabilities they create, Turkey's overarching priority with respect to natural gas is to reduce the share of imported gas and increase the share of domestically produced energy resources, including hydro, coal, lignite, nuclear and renewables (especially in power generation). Specifically, as part of its Eleventh Development Plan, the government targets a reduction in the share of natural gas in electricity generation to 20.7% by 2023, compared to 29.8% in 2018. As a consequence, Turkey's booming gas market should slow down in the coming years. However, an expected increase in gas demand from household consumers for heating purposes could offset this reduction in total consumption, resulting in annual growth in gas consumption, albeit at lower rates than in the past.

Gas production in Turkey has historically been low, meeting less than 2% of demand. Annual output peaked in 2008 and by 2019 covered less than 1% of total gas demand. Turkey is pursuing exploration of natural gas deposits to determine the domestic potential of natural gas, including shale gas. Shale gas exploration shows that it has some potential in a number of basins across Turkey. Current activities in shale exploration are focusing on understanding the unconventional hydrocarbons potential throughout the country. Exploration studies are underway in the Thrace Basin and Southeastern Anatolia Basin. However, further discoveries in the area and success from hydraulic fracturing are not expected to increase production in the long term.

The president's announcement in August 2020 of the Sakarya Gas Field discovery could represent a major development for Turkey's natural gas supply security and import bill. Considering the size of the field and the announced production target date (2023, which is ambitious), it has the potential to significantly reduce Turkey's gas import dependency (-36%) and energy import bill (-10%) through the medium term, and improve the negotiating position of Turkish importers at a time when the majority of Turkey's long-term gas import contracts are set to expire. The ramp-up of domestic gas production could also benefit the cost-competitiveness of natural gas, which has been recently losing market shares to coal in the power sector.

Presently, most natural gas supply has to be imported. In 2019, Turkey received almost half of total imports from Russia, 16% from Iran and 15% from Azerbaijan. Given the dependence on imports, Turkey adopted a strategy of diversification of import sources and routes as a cornerstone of its gas security policy. In recent years, Turkey has continued to diversify its gas supplies. Even though its gas demand has been rising over the past decade, it reduced overall demand in 2018 as well as lowered the share of natural gas from one source (Russia) in 2019. The IEA notes that Turkey significantly increased spot LNG imports, which has greatly added to security of supply.

As of the end of 2019, Turkey's gas transmission network approached 16 000 km and 17 entry points, with a total supply capacity of over 300 mcm/day (relative to a peak demand of 245 mcm/day in 2018-19). There are seven international pipeline import points, five LNG entry points and five domestic entry points (two from storage facilities and three from production fields). Turkey has been expanding its gas import infrastructure. Two recently completed gas pipelines – TANAP and TurkStream – will transit huge volumes of gas to Turkey and potentially onwards to Europe from Azerbaijan and Russia, respectively. The investments – both those completed and those still underway – will allow Turkey to mitigate the effect of potential supply disruptions and to ensure the country's position as a regional energy trade centre. Import capacity to Turkey grew from 190 mcm/day at the end of 2015 to 318 mcm/day at the end of 2019. Furthermore, according to BOTAŞ plans, they will be further expanded and targeted to exceed 400 mcm/day in 2021. New FSRU terminals are being constructed and new entry points are being connected to the network to ensure supply diversification. Underground storage facilities expansion is foreseen to increase total storage capacity from 3.4 bcm in 2019 to 10 bcm in 2023 at the latest, which will correspond to approximately 20% of total annual gas demand. The IEA notes that such an increase in import capacity and boost to storage and regasification capacity will also improve Turkey's negotiating position after existing long-term gas supply contracts expire.

In order to ensure security of supply for Turkish consumers, infrastructure development is accompanied by emergency planning. Every year, BOTAŞ and TEIAŞ together prepare a seasonal Risk Management Report, in which risks of uninterrupted supply are identified and preventive actions are provided in case of a gas disruption. The process is co-ordinated by the General Directorate for Energy Affairs.

Much effort has been put into establishing a short-term spot market, e.g. trading in natural gas on the Turkish Continuous Trade Platform, operated by EXIST, which introduced a new balancing regime and new rules for import capacity allocation. The market facilitates day-ahead, intraday, week, weekdays and weekend products. The market design for the gas exchange, put in place by EMRA, aims to let market players trade gas anonymously, and allows the transmission system operator to balance the system by entering the market when needed. The spot market, operating with continuous trade principles as of 1 September

2018, is not only providing the much-needed price signals for the market, but is also acting as an additional tool for flexibility for the market and promoting source and price diversity. The new balancing regime promotes competition and transparency in the Turkish gas market by introducing more transparent rules for supply and pricing of balancing gas. As of 2020, booking of available short-term capacity was conducted via an auction mechanism. Thirty per cent of available capacity is offered as annual products, 40% as quarterly products and the remaining 30% as monthly products. EMRA is also investigating how longer term forward gas contracts (monthly, quarterly, yearly) can be traded on the Turkish Continuous Trade Platform, so that the market can also be used to hedge risks.

To reduce existing information asymmetries between market players, more operational data could be published on a daily basis, including: flows by entry-exit points; storage inventory levels and flows; and technical, booked and available capacity levels.

The IEA notes that many positive changes have been made to the gas market regulatory framework. However, the dominant position on the gas market of BOTAŞ (based on sales to end users and DSOs) remained, and in 2019 BOTAŞ even increased its market share to 95% compared to 77% in 2017. This stands in sharp contrast with the Natural Gas Market Law, which in 2001 introduced an obligation to reduce BOTAŞ' market share to 20% by 2009.

In addition, all consumers are eligible consumers, with the exception of residential consumers whose annual consumption is below 75 000 m^3. Almost 600 000 eligible customers can purchase natural gas through bilateral contracts with any producer, importer, distribution company or wholesaler at a negotiated price. Still, 15.2 million so-called non-eligible customers do not have the option to choose their supplier and have to purchase natural gas from their default local distribution company at a price regulated by EMRA. The continued regulation of the retail market can effectively discourage alternative suppliers from entering the market and further limit competition.

Furthermore, the goal of establishing an independent transmission system operator that is fully separated from trading activities has not yet been fully achieved. The 2001 Natural Gas Market Law was supposed to fully unbundle BOTAŞ; currently, the accounting and functional unbundling of BOTAŞ is complete. Still, BOTAŞ retained its position as a major supplier on the market, as operator of the gas transmission system and storage system, as operator of two out of four LNG terminals, and has priority access to transmission capacity as the sole holder of long-term supply contracts. Moreover, with no secondary market for long-term transmission capacity, ensuring full non-discriminatory access of alternative suppliers to capacity seems to be impossible to reach. Further market development and liberalisation seems inconceivable without the unbundling of BOTAŞ.

The privileged market position of BOTAŞ, combined with the fact that export capacity is allocated on a first-come, first-served basis, limits the possibility for Turkey to implement its plans to ensure its position as a regional energy trade centre.

Recommendations

The government of the Turkey should:

- Fully unbundle the transmission system operator from commercial activities to enhance third-party access to transmission network capacity.
- Further boost transparency in gas markets by increasing the availability of daily operational data (such as flows by entry-exit points; storage inventory levels and flows; and technical, booked and available capacity levels).
- Reduce the dominant position of BOTAŞ and foster competition in the Turkish gas market.
- Extend freedom of supplier choice for all customers (including currently non-eligible customers), fully deregulate retail prices while continuing direct support to vulnerable customers, and encourage switching suppliers.

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10. Nuclear

Key data

Current nuclear power generation: 0

Planned capacity: 4.8 GWe by 2026

Overview

Turkey has made efforts toward developing nuclear energy since the 1960s. Studies to build a nuclear power plant were started in 1965. Since 2009, decisive steps have been taken to proceed toward the construction of two nuclear power plants (NPPs) on the basis of intergovernmental agreements (IGAs) signed with the Russian Federation in 2010 and Japan in 2013, for the construction of NPPs on the sites of Akkuyu and Sinop, respectively.

The first nuclear power plant (Akkuyu NPP) is planned to comprise four units of WWER-1200 type reactors. The construction of the first unit of Akkuyu NPP formally started in April 2018 and the government expects it to be completed by 2023. The other three units are to be completed at subsequent one-year intervals until the end of 2026. The applications for construction licenses for Units 2 and 3 were submitted in June 2018 and March 2019, respectively; the construction license for Unit 2 was granted in August 2019.

On the other hand, regarding the Sinop project, based on a feasibility study conducted by Mitsubishi Heavy Industries, the Ministry of Energy and Natural Resources (MENR) decided not to move forward with the project with Japan. Site selection for the third NPP project is ongoing.

As a major step in developing the legal framework toward Turkey's first nuclear power plant, Statutory Decree Law No. 702 was enacted in July 2018. It prescribed the establishment of an independent nuclear regulatory body, the Nuclear Regulatory Authority (NDK), as well as a national nuclear technical support organisation, the Nuclear Technical Support Co. (NÜTED). It also contains comprehensive provisions and requirements for safety, security, safeguards and radiation protection, and other related subjects of nuclear activities.

History of nuclear power development in Turkey

Background

Turkey established its first nuclear research reactor in 1962, and the second one in 1982, and has continuously conducted research activities using them. Turkey has also made several attempts to develop commercial NPPs since the 1960s. Its first attempt at NPP construction in the late 1960s did not succeed due to site selection and other issues. Following that, although several NPP projects were proposed from the 1970s to the 1990s, none of them were ultimately realised for various reasons, including disagreements on the partnership framework and on financial arrangements. In the process of these attempts, the Akkuyu site and the Sinop site were selected as candidate sites for NPP construction.

Efforts toward the NPP projects currently underway began in the 2000s. The Law on Construction and Operation of Nuclear Power Plants and Energy Sale (Law No. 5710) was ratified and enacted in 2007. In 2008, the Regulation Regarding the Principles, Procedures and Incentives for the Contracts and the Contest for the Implementation of Law No. 5710 (the Regulation on Implementing Law No. 5710) was published, which sets out the procedures and principles regarding the construction and operation of NPPs for electricity production, and regulates their energy sales.

Law No. 5710 and its implementation regulation aimed at facilitating the investment and operation of NPPs by the private sector, supported by power purchase agreements (PPAs). Law No. 5710 allows the state to take part in nuclear power projects by means of public-private partnerships. The Turkish Atomic Energy Authority (TAEK)[11] issued a set of criteria establishing general principles that investors must meet.

A tender for the construction and operation of NPPs and energy sale was held in 2008 by the Turkish Electricity Trading and Contracting Company (TETAŞ)[12], for the construction of four units at the Akkuyu site. Although one consortium bid in the auction, the competition was cancelled by TETAŞ as the result of an assessment on the energy sale unit price.

The Akkuyu project

Direct government-to-government discussions on the Akkuyu project as part of wider energy co-operation resulted in the signing of an IGA between Turkey and Russia for the construction and operation of the Akkuyu NPP in 2010. The IGA was ratified in the same year, providing the legal framework for the realisation of the project.

[11] TAEK, which undertakes studies and R&D to support nuclear activities, was restructured as a "subsidiary organisation" under the MENR to carry out nuclear research, waste management, training and any other related activities; it was merged with the Turkish Energy, Nuclear and Mining Research Authority (TENMAK), established by Presidential Decree No. 57 in March 2020.

[12] Within the context of Decree Law No. 703 published in the Official Gazette No. 30473 (bis) of 9 July 2018, TETAŞ and EÜAŞ unified under the structure of EÜAŞ and duties, authorities and responsibilities of former TETAŞ are now being performed by EÜAŞ.

Fundamental aspects of the Akkuyu project include the following (IAEA 2019 and WNA 2020):

- The Joint Stock Company, the Akkuyu Project Company (APC), is implementing the project on a build-own-operate model, and is responsible for the construction and operation of four units of the Russian WWER design, each with a capacity of 1 200 megawatt electrical (MWe) power.
- Russia's Rosatom initially holds a 100% share of APC, a share that will not drop below 51% at any time. The government of Russia will be the guarantor of the project.
- Roughly half of the electricity generated by the Akkuyu NPP will be bought by Electricity Generation Joint Stock Company (EÜAŞ), the Turkish state-owned company, through a 15-year PPA (70% of the electricity generated by Units 1 and 2, 30% of Units 3 and 4). The weighted average price during the PPA period is USD 0.1235/kWh (no escalation). The remainder of the output will be sold by APC on the open market. After the PPA period, all the electricity generated will be sold on the open market, and APC will pay 20% of the profits to the Turkish government.
- In case of less production than the volume stipulated in the PPA, APC shall fulfil its obligations by providing the balance of electricity.
- Nuclear fuel shall be sourced from Russian suppliers. The Rosatom agreement for Akkuyu includes provisions for a fuel fabrication plant in Turkey.
- Subject to separate agreements, spent nuclear fuel of Russian origin may be reprocessed in Russia.
- APC is responsible for decommissioning and waste management for the NPP. Within this framework, APC is to pay USD 0.0015/kWh to each of the special funds for the management of spent nuclear fuel and radioactive waste and for the decommissioning of plants during the PPA period. After the duration of the PPA, this contribution can be adjusted according to a decision by a Special Fund Board that will be established to manage the revenues of special funds and to approve expenses to be paid from special funds.
- Russia's Atomstroyexport is the general contractor for the construction of the Akkuyu NPP, and Titan2-IC İçtaş JV, jointly established by Russian company Titan2 and Turkish company IC İçtaş, is the main energy performance certificate contractor for the project. Turkish companies are expected to undertake a minimum of 40% of the work.
- Turkish engineers are expected to account for about 30% of the technical staff of the Akkuyu NPP at initial stage of the operation.

The construction of the first unit of the Akkuyu NPP formally commenced in April 2018 and is planned to be completed by 2023. The other units are planned to be put into operation at subsequent one-year intervals until the end of 2026.

The Sinop project

The IGA for the Sinop projects was signed between Turkey and Japan in 2013 and entered into force in 2015. According to this IGA, the share of the government of Turkey would be up to 49% in the Sinop Project Company, with EÜAŞ serving as the Turkish shareholder, together with a consortium led by Mitsubishi Heavy Industry, ITOCHU and ENGIE (former GDF-SUEZ).

The Sinop project was planned to consist of four ATMEA-1 model nuclear reactors, each with 1 120 MWe installed capacity and TETAŞ was to buy 100% of the generated

electricity for a period of 20 years according to the IGA. The operation of Unit 1 was expected in 2023.

However, as a result of the evaluation of the Feasibility Report submitted by Mitsubishi Heavy Industry in June 2018, the Turkish government decided not to move forward with the project with Japan in June 2019, based on unsatisfactory outcomes in terms of the PPA tariffs and project schedule. Currently, the government of Turkey is looking for other possible partners for the Sinop project. In the meantime, while site evaluation studies to obtain a site license are ongoing in Sinop, the Ministry of Environment and Urbanization has approved the final environmental impact assessment (EIA) report, giving a positive EIA decision for the Sinop project.

Site selection activities for the third NPP project are ongoing.

Legal framework and institutional oversight

Turkey's general energy legal framework is set by the Electricity Market Law and its implementing rules and regulations. Additional mechanisms have been devised for the financing of capital-intensive nuclear projects. For the Akkuyu project as well as for the other projects, the IGAs, once ratified by parliament, constitute the legal basis for a given project. PPAs fix the conditions (prices, fraction of electricity production covered and duration).

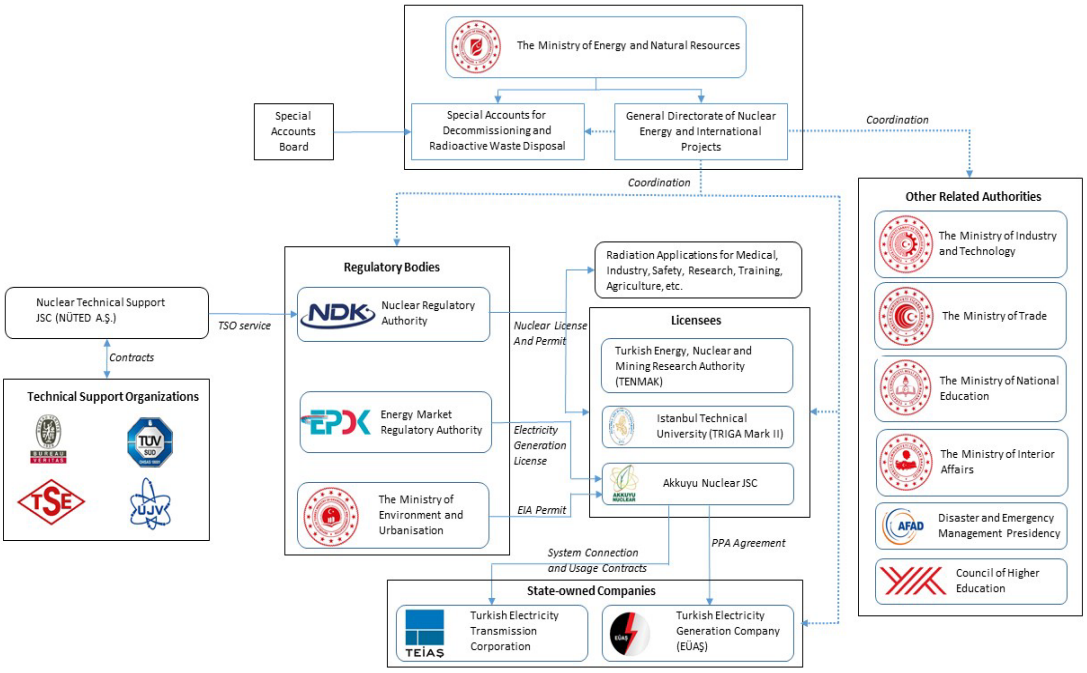
The Law concerning the Construction and Operation of Nuclear Power Plants and Energy Sale established in 2007 provided for TAEK[13] to set the criteria for building and operating nuclear power plants. The Atomic Energy Commission oversees all nuclear activities, submits budget requests to the prime minister and sets TAEK's programmes. An advisory council assists the commission. The Advisory Committee on Nuclear Safety is involved with licensing matters and gives advice to TAEK, which takes the final decisions.

Statutory Decree Law No. 702 was issued in July 2018. It is a comprehensive nuclear law regulating safety, security, safeguards, radiation protection and other related subjects. According to the law, the NDK was established as an independent nuclear regulatory body, and NÜTED A.Ş. as a nuclear technology support organisation. The law lists the general principles for nuclear-related activities in Turkey and the responsibilities of all organisations taking part in the Turkish nuclear energy programme. The institutional structure of organisations is represented in Figure 10.1.

In terms of international relationships, Turkey participates in a full range of international instruments related to nuclear safety, security and safeguards. It is active in the International Atomic Energy Agency (IAEA) and the Organisation for Economic Co-operation and Development's (OECD) Nuclear Energy Agency (NEA). Bilateral co-operation agreements in the field of peaceful use of nuclear energy are in force with a number of countries and dedicated co-operation agreements exist with the regulatory bodies of a number of countries.

[13] Merged with TENMAK, per Presidential Decree No. 57 from March 2020.

Figure 10.1 Organisations participating in the Turkish nuclear energy programme (as of January 2020)



Source: Turkish response to the IEA questionnaire.

Nuclear safety regulation

Establishment of the regulatory body

Historically, the function of safety authority in Turkey has been performed by TAEK that was established in 1956 as the Atomic Energy Commission and restructured in 1982. Since the NDK was established by Statutory Decree Law No. 702, it took over the responsibilities and activities as the nuclear regulatory authority from TAEK. (TAEK was transformed into a research and development organisation and also given the responsibility for disposing radioactive waste, managing orphan sources and preparing the draft national waste management plan.) TAEK, which undertakes studies and R&D to support nuclear activities, was restructured as a "subsidiary organisation" under the MENR to carry out nuclear research, waste management, training and any other related activities, and merged with the Turkish Energy, Nuclear and Mining Research Authority (TENMAK) established by Presidential Decree No. 57 in March 2020. The NDK undertakes regulatory activities, including establishing safety requirements as well as conducting safety reviews and inspections concerning nuclear facilities and activities related to nuclear energy and ionising radiation.

The NDK is associated with the MENR but has administrative and financial autonomy. Under the Turkish legal system, ministries have no administrative authority over associated organisations nor is there any hierarchical relation. Association only serves the purpose of integrity of administration and facilitation of co-ordination.

Organisational structure of the regulatory body

The NDK is composed of a Nuclear Regulatory Board and Presidency. Its decision-making organ is the Nuclear Regulatory Board, which consists of five members including the president of the NDK (who also chairs the Board) and a second chairman. All Board members are assigned by the President of the Republic, who also appoints the president of the NDK and its second chairman.

Figure 10.2 shows the NDK's main organisational structure, which consists of six technical and five administrative units:

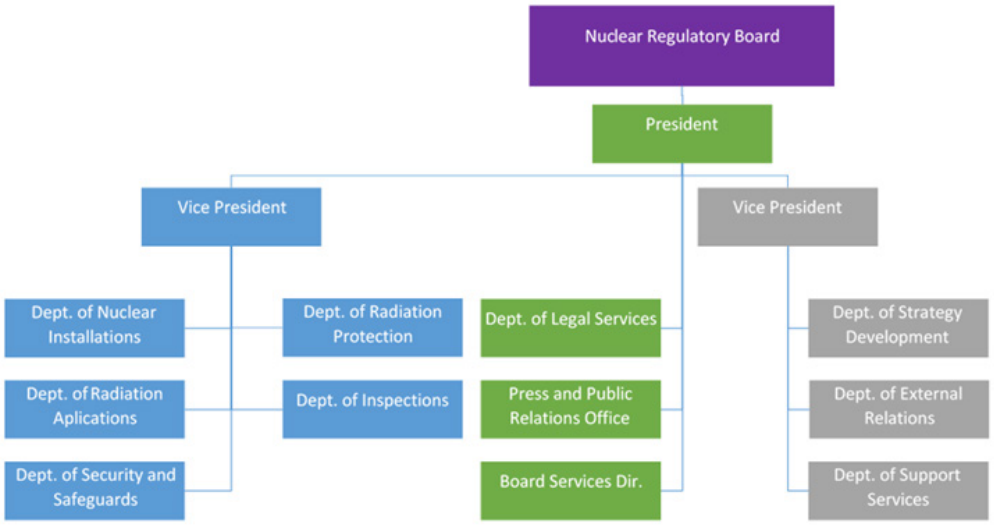
Technical units

- Department of Nuclear Installations (regulatory activities in nuclear safety)
- Department of Radiation Applications (regulatory activities in radiation applications and radiation facilities)
- Department of Security and Safeguards (regulatory activities in nuclear security and safeguards and transportation and import/export of radioactive materials, export control of nuclear dual use items)
- Department of Radiation Protection (regulatory activities in radiation protection, radioactive waste management safety as well as disaster and emergency management)
- Department of Inspection (nuclear and radiation safety inspections)
- Department of External Relations (national and international co-ordination on all activities within the scope of duties and responsibilities of the NDK)

Administrative units

- Department of Legal Services
- Department of Strategy Development (administrative and financial activities)
- Department of Support Services (human resources and other supporting services)
- Press and Public Relations Consultancy
- Directorate of Board Services (conducting secretarial work and operations of the Nuclear Regulatory Board)

Figure 10.2 Organisational structure of the Turkish Nuclear Regulatory Authority (as of January 2020)



Source: Turkish response to the IEA questionnaire.

Competence of the regulatory body

According to Statutory Decree Law No. 702, the NDK took over all regulatory personnel and technical bases from TAEK, the former regulatory body. The NDK has continued to increase its human resources. As of June 2019, it had a total of 121 staff, and will increase it to 169 in 2020. Further staff increases in the longer term are under consideration. All staff are subject to a training programme that covers all functions of the regulatory process and consists of internal, domestic and international training.

All existing nuclear regulations are being revised by the NDK for adoption to the new nuclear regulatory system. Their compliance with the latest IAEA and EU requirements and international applications are also being checked and improved, if necessary. Lessons learnt from the Fukushima Daiichi accident are also being introduced into new regulations.

For the successful licensing process of the Akkuyu NPPs, the regulatory authority also utilises IAEA support (peer reviews) and contracts with competent foreign technical support organisations in the field of regulating nuclear power plants, although the NDK's Department of Nuclear Installations had experience with the regulation of research reactors prior to the Akkuyu project. UJV Rez, a company from the Czech Republic, supported the review and assessment studies for the construction license process of Akkuyu NPP Unit 1 (NDK, 2019). The German engineering company TÜV SÜD is supporting the review and assessment for the licensing of Akkuyu NPP Unit 2 (NDK, 2019).

The Turkish technical support entity, NÜTED A.Ş., was established by Statutory Decree Law No. 702 to support the NDK and is in the process of hiring staff and building capacity.

Human resource development

APC is responsible for the education and training of the Turkish operating staff of the Akkuyu NPP, who will account for about 30% of the project's total technical staff (IAEA, 2019). According to the IGA, APC is to establish a training centre within the plant site equipped with full-scope control room simulators for the training of future Turkish operating staff (IAEA, 2019). The MENR is carrying out studies to establish additional educational programmes to train Turkish engineers in every field of NPP construction and operation.

A scholarship programme is provided by the Ministry of National Education for Turkish students (MEB-YLSY Scholarship Programme) to pursue graduate education in nuclear fields at foreign universities. As shown in Table 10.1, as of 2019, 413 Turkish students supported by this programme had studied or were studying at top foreign universities in countries with advanced nuclear technologies and experience such as Belgium, Canada, the People's Republic of China, Finland, France, Germany, India, Japan, Korea, the Netherlands, the Russian Federation, Sweden, the United Kingdom and the United States. All students are obliged to work in a public organisation related to nuclear energy in Turkey, such as the MENR, the NDK, TENMAK or EÜAŞ , for a period twice as long as their education period abroad after graduation. The education fields include those related to nuclear finance; nuclear law; public relations; nuclear fuel cycle; design, manufacturing and maintenance of mechanical and electrical nuclear instrumentation and control equipment, systems and components; spent nuclear fuel and radioactive waste management; nuclear safety, security and safeguards; site selection and evaluation; nuclear plant construction; nuclear material science; health physics; radiochemistry; radiobiology; radiation protection; and particle acceleration.

Table 10.1 Number of students selected for the MEB-YLSY Scholarship Programme

Institutions/organisations	2016	2017	2018	2019	Total
TENMAK (Turkish Energy, Nuclear and Mining Research Institution)	-	42	50	50	142
NDK (Nuclear Regulatory Authority)	-	36	40	61	137
EÜAŞ INTERNATIONAL ICC	-	30	31	43	104
Ministry of Energy and Natural Resources	4	7	10	9	30
Total	4	115	131	163	413

Source: Ministry of Energy and Natural Resources, Turkey.

Radioactive waste management

Statutory Decree Law No. 702 prescribes that the owners of nuclear facilities, including NPPs, are responsible for the storage of spent nuclear fuel and radioactive waste generated in their facilities until they are transferred to another authorised entity, and identifies TENMAK as the responsible organisation for final disposal. The law has an additional statement for spent nuclear fuel, which dictates spent nuclear fuel to be stored at the NPP site during the whole operation period in all cases. In addition, it requires that nuclear facilities be decommissioned and immediately dismantled at the end of their operational life. Not only nuclear facilities, but radioactive waste processing and storage facilities as well as radiation facilities are also to be immediately dismantled.

Following the preliminary site selection studies conducted by TAEK, a site selection report, entitled "Site Selection Report for a Near Surface Disposal Facility", was published in April 2019. The report ranks and lists candidate sites. Currently, LILW is stored in the Cekmece Nuclear Research and Training Center by TENMAK. TENMAK is preparing the draft National Radioactive Waste Management Plan, including a strategy for the establishment of needed facilities for the disposal of all types of radioactive waste, which is planned to be approved by the MENR by the end of 2020.

For the purpose of securing adequate financing for the long-term management of spent nuclear fuel and radioactive waste, Statutory Decree Law No. 702 established two special accounts funded by a percentage of the revenues of the sale of the electricity produced by the nuclear power plants. Payments to funds are determined by the Fund Management Board based on: the percentage per kWh electricity produced (for NPPs), the type of facility and activity, the waste class, the amount of waste and the radioactivity of waste (for other facilities and activities). One of the funds is to be dedicated to the disposal of spent nuclear fuel and radioactive waste and the other for the decommissioning of nuclear facilities, radioactive waste facilities, radiation facilities and radiation applications. A Fund Management Board is to be established to manage the revenues and to approve payments from the special funds.

Public communication

The MENR has developed public communication strategies related to nuclear power with three main objectives:

- provide information about nuclear energy, nuclear technology, nuclear safety, etc.
- raise public awareness about the advantages of nuclear technology, its safety and environmental friendliness, to develop public confidence in nuclear technologies
- build trust and a positive perception of nuclear energy, thus helping increase public support for the Akkuyu NPP project at the regional and national levels.

Public hearings among the local population were conducted for both the Akkuyu and Sinop projects, as part of the legal requirements of their environmental impact assessments.

In addition, the following public communication activities were performed (IAEA, 2019):

- Publicity spots were broadcast on national TV channels.
- Local representatives from the Mersin (where the Akkuyu project is located) and Sinop regions visited French nuclear installations in 2015 as part of a television documentary.
- Turkish journalists visited French nuclear installations in 2017.
- Conferences have been held in various universities.
- Information visits to schools were carried out in the Mersin region.
- Booklets and brochures have been distributed to tens of thousands of people.

APC established the Public Information Centre (PIC) in Mersin as a multifunctional communication platform. Among the visitors to the PIC are families, schoolchildren, students, government representatives, the media, tourists, etc. Visitors are informed of the history and development of the nuclear industry, achievements in physics, energy development prospects, the socio-economic development of Turkey associated with the

construction of the nuclear industry, as well as the basics of nuclear power plant operation and radioactive protection at the NPP. The PIC also implements educational programmes, including lectures, seminars and roundtables, as well as joint programmes with government agencies, local authorities, and social and political organisations.

According to the Turkish government, there is currently no serious public opposition to nuclear development.

Assessment

In an effort to diversify electricity generation capacity and promote local technical capabilities, Turkey decided about 15 years ago to develop its nuclear capacity. It envisages building three nuclear power plants, each with four reactors. As Turkey has no domestic nuclear industry, the government decided to enter into government-to-government agreements for the development of such capacity. The first such agreement was concluded with Russia in 2010 to build the Akkuyu NPP.

Construction of this first nuclear power plant is underway. The plant will consist of four units of Russian WWER-1200 reactors, each with 1 200 MWe capacity. Unit 1 began construction in 2018 and the government expects it to be completed by 2023. The other units are planned to be completed at subsequent one-year intervals until the end of 2026. The planned construction period for Akkuyu Unit 1 is around five years, which seems challenging compared to recent experiences for the construction of Russian pressurised water reactors, especially considering that this is the first nuclear power plant project in Turkey. In addition to building the plant on time, the regulatory authority should carefully prepare for regulatory inspections and must be ready to respond promptly to unexpected changes and delays so that Unit 1 is commissioned in 2023, which is the centennial anniversary of the establishment of the Republic of Turkey.

APC is implementing the project on a build-own-operate model and is responsible for the construction, operation and decommissioning of the four reactors. Russia's Rosatom initially holds a 100% share of APC, a share that will not drop below 51%. A Russian company is the general contractor for the construction of the Akkuyu NPP, and Turkish companies are expected to undertake a minimum of 40% of the work, mainly on non-nuclear products. The terms of the Akkuyu project are limited in terms of localisation and technology transfer. Therefore, it is important to make full use of the other nuclear projects as an opportunity to develop domestic capacity to build and operate nuclear power plants. However, the Sinop project has slowed down and the site for the third project has not yet been selected.

Roughly half of the electricity generated by the Akkuyu NPP will be bought by the state-owned company EÜAŞ through a 15-year PPA. The weighted average price during the PPA period is USD 0.1235/kWh (no escalation). The remainder of the output will be sold by APC on the open market. After the PPA period, all electricity generated will be sold on the open market and APC will pay 20% of its profits to the Turkish government. The average price in the PPA is much higher than the current market price in Turkey. However, the PPA price should be compared with market prices between 2023 and 2041 due to the fact that it will be valid for these years. Furthermore, when the technical lifetime of the power plant, post-PPA period and electricity production volume are considered together, the average unit price of electricity sold to the market is expected to be lower than the average purchasing price. When fully operational, the Akkuyu NPP may cover some 20 terwatt hours (TWh) per

year, 5% of the around 400 TWh in the market by that time. This can be a significant contribution to the Turkish electricity market.

An independent nuclear regulatory body and a national nuclear technical support organisation were established in 2019, based on Statutory Decree Law 702 enacted in 2018. The NDK is responsible for regulatory activities concerning nuclear facilities, devices, substances, and all activities related to nuclear energy and ionising radiation. Although the NDK is associated with the MENR, which is responsible for meeting energy needs, the MENR does not have any administrative authority over the NDK under the Turkish legal system.

In terms of the competency of the NDK, it took over the regulatory personnel and technology from the former regulatory authority and also receives wide support from outside organisations, including peer regulatory bodies and NÜTED A.Ş. to ensure high levels of competency. All existing nuclear regulations are being revised by the NDK for adoption to the new regulatory system and also to ensure their compliance with the latest IAEA and EU requirements. In addition to these efforts to maintain its competency, considering that the NDK has only recently been established as an independent organisation and so far has limited regulatory experience in commercial NPPs, it is beneficial to continue efforts to develop its competency and maintain its independence, including by receiving an IAEA and WENRA review of its regulatory activities.

Statutory Decree Law No. 702 prescribes operators of nuclear facilities, including NPPs, to be responsible for the long-term management of spent nuclear fuel and radioactive waste generated in their facilities and identifies TENMAK as the responsible party for final disposal. Despite the long history of nuclear and radioactive research activities in Turkey, a disposal site for LILW has not been developed and no candidate site has been identified. The lack of a disposal site and related policies and regulations could create or strengthen negative public sentiment for nuclear power. A national strategy for final disposal of all kinds of radioactive waste is planned to be established in a National Radioactive Waste Management Plan by the end of 2020. In terms of securing long-term funding, a Special Fund Board is to be established to manage the special funds for disposal of spent nuclear fuel and radioactive waste and for decommissioning of nuclear facilities that have already established by the law.

Education and training of operating staff at the Akkuyu NPP are taking place under the responsibility of APC, so that Turkish engineers will account for 30% of the technical staff in the NPP. Moreover, APC will establish a training centre within the plant site including a full scope control room simulator for the training of future Turkish operating staff. The MENR is also carrying out a study to establish an additional educational programme to develop Turkish engineers in every field of NPP construction and operation. In addition, more than 400 Turkish students are studying nuclear-related subjects at foreign universities under a national scholarship programme, who after graduation are obliged to work in a public organisation related to nuclear energy in Turkey.

The Turkish government is conducting a wide range of activities to increase public awareness and trust in nuclear energy in terms of its benefit and safety, both around the plant sites and at the national level. APC is also pursuing public communication efforts through the PIC as a multifunctional communication platform.

Overall, Turkish efforts on the regulatory framework and oversight, human resource development and public relations have been progressing steadily.

Recommendations

The government of Turkey should:

- Support the NDK and NUTED A.Ş. to ensure that they are fully prepared to complete all remaining inspection, licensing and regulatory procedures for the commissioning of the Akkuyu NPP within the planned time frame.
- Ensure continued domestic nuclear capacity building and technology transfer, including by exploring additional partnerships to effectively advance upcoming NPP projects.
- Request reviews of the Turkish regulatory system and activities in the country by external authorities, such as the IAEA and WENRA, to confirm and improve the adequacy and effectiveness of the NDK regulatory oversight model.
- Establish a clear and achievable strategy for the long-term management of spent nuclear fuel and radioactive waste and steadily implement planned activities.

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11. Coal

Key data

(2019 provisional)

Production: 90.0 Mt/17.7 Mtoe (96% lignite), +5% since 2009

Net imports: 38.1 Mt/24.3 Mtoe (38.1 Mt imports, 0.0 Mt exports), +87% since 2009

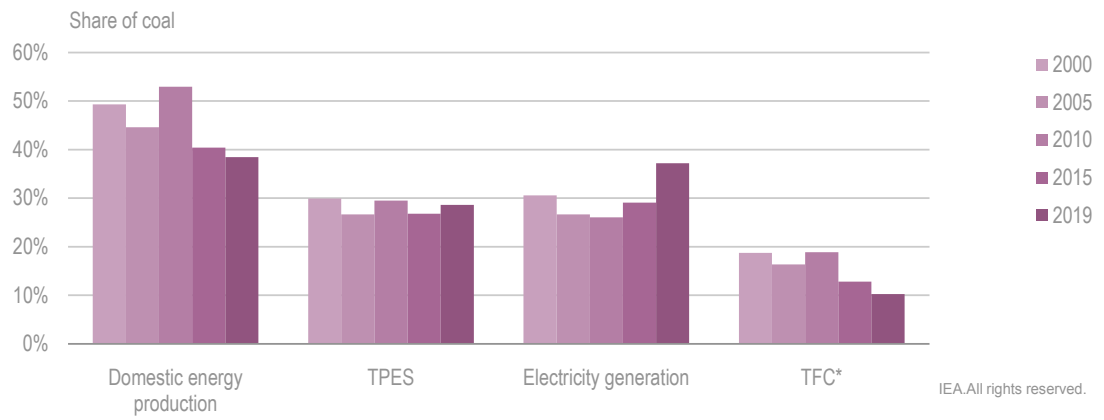
Share of coal: 28% of TPES and 38% of electricity generation

Consumption by sector (2018): 40.8 Mtoe (electricity and heat generation 64.7%, industry 26.4%, services 4.9%, residential 4.3%)

Overview

Coal is the third-largest primary energy source in Turkey, representing 28% of total primary energy supply (TPES) in 2019, just behind oil (29%) and natural gas (25%). The share of coal in TPES has been stable in recent decades, but its consumption in total final consumption (TFC) has declined, while the share in power generation has increased (Figure 11.1). Turkey has large domestic coal resources, mainly lignite, and coal production accounts for 42% of total domestic energy production.

Figure 11.1 Share of coal in different energy supplies, Turkey, 2000-19



Coal has long been an important fuel in Turkey's energy system, representing 28% of TPES and 38% of electricity generation in 2019 after a recent increase.

* *TFC* (total final consumption) data are from 2018.

Note: TPES = total primary energy supply.

IEA (2020a), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

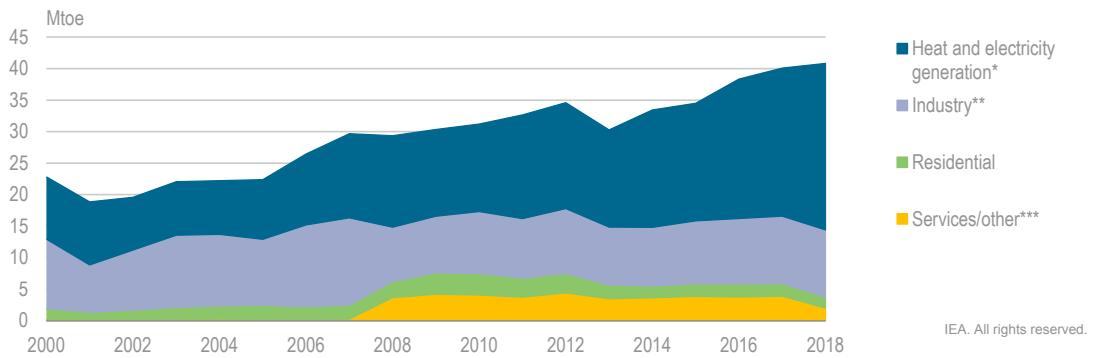
Coal imports have increased in the last decade to cover increasing demand. In mass terms, domestic coal production accounted for 71% of total coal supply in 2019, but in energy terms, domestic production covered 42% of TPES. The government wants to increase domestic coal production further to limit the country's dependence on energy imports, so it provides support for both mining and coal power generation from domestic coal.

The high share of coal in Turkey's energy system is a major cause of greenhouse gas emissions in the country. In 2018, coal combustion accounted for 43% of energy-related CO_2 emissions, and coal-related emissions have increased by nearly 32% in the last decade. Furthermore, domestic lignite production and consumption increases local air pollution, even with the stricter pollution controls recently implemented. Turkey should assess its current coal policy to evaluate both its cost-effectiveness as well as its environmental impacts.

Supply and demand

Coal demand is steadily increasing in Turkey (on an absolute basis). Total coal consumption (in energy terms) increased by 39% in a decade, from 29.4 Mtoe in 2008 to 40.8 Mtoe in 2018 (Figure 11.2). The trend was due to rapid growth in coal-fired power generation, which has nearly doubled in the last decade. As of May 2020, Turkey's total installed capacity of coal-fired power generation was 20.3 gigawatts (GW), equal to 22% of total installed capacity, and coal power accounted for 37% of total electricity generation. Sixty-five per cent of total coal demand in 2018 went to the electricity and heat generation sectors, followed by industry (26%), services (5%) and residential (4%). Coal demand in electricity and heat generation has increased rapidly, especially in recent years, growing by 71% from 2013 to 2018. Coal demand in services decreased by 49% in 2018, compared to the year before, whereas coal demand in other sectors has remained relatively stable over the last decade.

Figure 11.2 Coal demand by sector, Turkey, 2000-18



Coal consumption has increased by 39% in the last decade due to rapid growth in electricity and heat generation, which accounted for 65% of total coal demand in 2018.

* *Power generation* includes a minor share of district heat production.

** *Industry* includes energy use in industry sectors and transformation in coke ovens and blast furnaces.

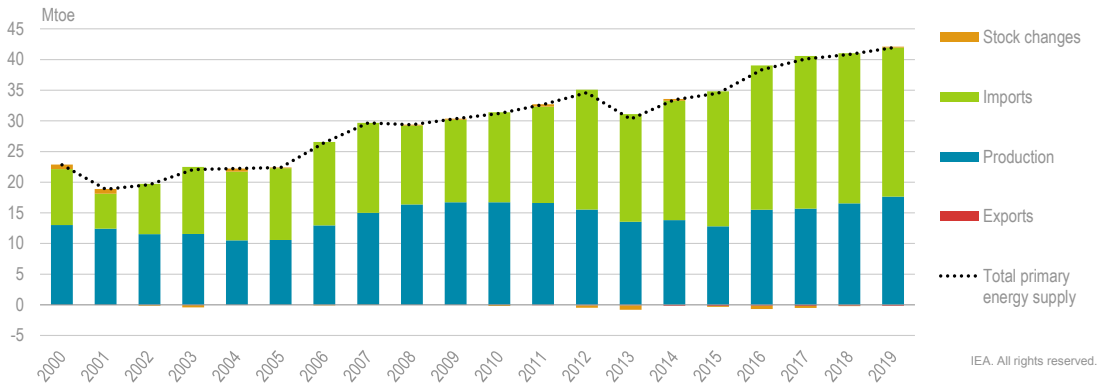
*** *Services/other* includes commercial and public services.

Notes: Mtoe = million tonnes of oil equivalent. The sudden increase of coal consumption in services in 2008 and corresponding drop in (unspecified) industry consumption are due to a change in data collection methodology.

Source: IEA (2020a), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Domestic coal production covers 71% of total coal supply in terms of mass, but around 42% in energy terms, as domestic production is mainly lignite with low calorific value compared to imported steam coal. Furthermore, domestic production has fluctuated in the last decade, while imports have steadily increased (Figure 11.3). After decreasing in 2009-15, coal production grew by 38% in the four years from 2015-19, reaching 90 million tonnes (Mt) or 17.7 Mtoe in 2019. The growth in coal production is supported by policy directed at both mining and power generation (see policy section below). Most domestic coal production is lignite used in power generation. In 2019, lignite accounted for 96% of total domestic coal production (in mass terms). Turkey's lignite resources are low in energy content; 79% of lignite has a calorific value below 2 500 kcal/kg.

Figure 11.3 Coal supply by source, Turkey, 2000-19



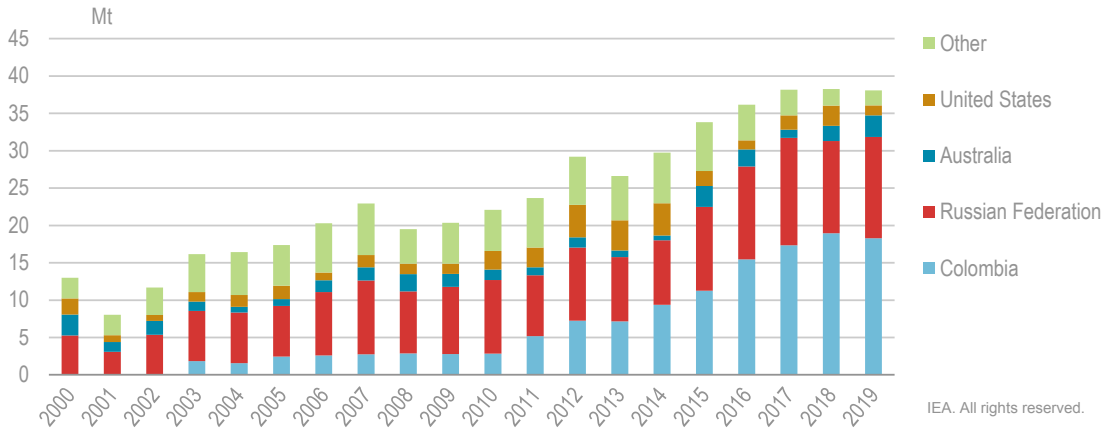
After previous fluctuations, domestic coal production has increased by 38% in the last four years and accounted for 42% of total coal supply (by energy content) in 2019.

Note: Mtoe = million tonnes of oil equivalent.

Source: IEA (2020b), *Coal Information 2020* (database), www.iea.org/statistics.

As domestic production has fluctuated, coal imports have become more important for Turkey to meet growing coal demand in power generation. Coal imports have nearly doubled in the last decade, but have remained relatively flat in recent years during the rapid increase in domestic production. In 2019, Turkey imported 38.1 Mt of coal, of which Colombia accounted for 48%, followed by Russia at 36% with smaller shares from Australia (8%) and the United States (3%) (Figure 11.4). Coal imports from Colombia began in 2003 and the country has been the largest source of imports since 2016. Most imported coal is steam coal used for power generation and industry (83% of total coal imports in 2019) and the rest is coking coal, mainly used in steel production.

Figure 11.4 Turkey's coal imports by country, 2000-19



Turkey's coal imports have doubled in the last decade, mostly increasing from Colombia, which, together with Russia, accounts for over 80% of total imports.

Notes: Mt = million tonnes. Includes both steam and coking coal.
Source: IEA (2020b), *Coal Information 2020* (database), www.iea.org/statistics.

Coal policies

Coal mining

Turkey's approach to coal mining and coal-fired generation is rooted in a strategy to reduce dependence on imported natural gas for economic and energy security purposes. The strategy to reduce gas consumption is focused on the power sector, where gas-to-coal fuel switching is easier compared to other sectors such as industry. As such, the government has pursued a plan to boost domestic production and consumption of Turkey's sizeable coal reserves. Lignite, in particular, is a priority area for development, mainly for use in power generation. Hard coal is intended to be used more heavily in the industrial sector. On the flip side, the government is trying to reduce the use of coal in household heating in favour of natural gas.

The two state-owned coal mining companies, Turkish Coal Enterprises (TKİ) and Turkish Hard Coal Enterprises (TTK), explore for and produce lignite and hard coal. TTK has a virtual monopoly in hard coal production, processing and distribution. TKİ and TTK set low domestic prices for hard coal and lignite. By way of example, the average selling price for TTK hard coal was TRY 309 (USD 46) per tonne in 2017, around half the level of Newcastle FOB prices that year (OECD, 2019).

The coal produced by TKİ is sold to industry, thermal power plants and households according to size and heating values. In 2019, TKİ's average selling prices for industry, thermal plants and households were TRY 363 (USD 64), TRY 114 (USD 20) and TRY 503 (USD 89) per tonne, respectively.

According to the Mineral Research & Exploration General Directorate, Turkey has 19.14 billion tonnes of lignite and 1.6 billion tonnes hard coal reserves (proven). With the aim of meeting energy demand in line with industrialisation and population growth, the government has stepped up efforts to find new coal fields and to speed up the development of existing mines.

The Institute of Mineral Research and Exploration, under the Ministry of Energy and Natural Resources' General Directorate of Mineral Research and Exploration, has been supporting exploration in Turkey since it was first created in 1935. Based on exploration activities started in 2005, 3.35 million m² had been explored by the institute by 2019. Eighteen new coal fields were discovered, 5 of which hold large reserves, while 3 existing fields achieved large reserve increases. Overall, between 2005 and 2019, 10.64 billion tonnes of lignite resources were added, taking total resources to 19.14 billion tonnes, an increase of 128%. The government expects that with additional exploration work, Turkey's coal resource estimate could double.

In an effort to boost production, Turkey has promoted more privatisation of the coal mining sector. The non-producing areas of TTK and TKİ were divided and relicensed. It is foreseen that coal production and consumption will increase with the commencing of operations in mine sites that were tendered to the private sector, on the condition that a thermal power plant be installed near the mine location.

The tenders for mining assets are based on feasibility studies, which cover technical specifications; the royalty ratio in all tenders is also based on the findings from feasibility studies. The government provides a purchasing guarantee (through the state-owned electricity company EÜAŞ) for 15 years on electricity at a fixed price, depending on the specific tender (with prices fixed in USD terms to minimise currency risk for investors). The agreed price for a 2017 tender was USD 6.04 cents per kilowatt hour (kWh), relative to prevailing market prices of around 4-5 cents. The tenders also include an obligation for mine reclamation.

The government and state-owned mining companies have stepped up efforts in recent years to improve occupational health and safety practices at mine sites in response to concerns about worker health and safety, as well as illegal mining. The government has also boosted its inspection capacity for mining operations. New legislation is underway to promote mechanisation in underground mining, which is mainly led by private companies.

The government offers production subsidies for private underground mining (though not for exploration), based on labour and production methods. Notably, after a 2014 disaster at one area of the SOMA mine (Turkey's largest mining area), as a result of the government's regulatory changes to improve health and safety standards, labour costs are estimated by the government to have doubled. However, the hard coal mining sector receives financial support from the government to pay for miners' wages, which are up to 100% higher than for comparable jobs in other sectors of the economy, to compensate for the hardship of the profession.

Given the importance of coal in Turkey's energy sector, the two state-owned mining companies, in collaboration with universities and other research institutes, are active in exploring the potential for clean coal technologies, notably through various RD&D projects to extract the energy content of domestic coal/lignite without mining it (underground coal gasification).

Coal-fired electricity

As part of its strategy to reduce dependence on imported energy sources, by 2027 Turkey wants to add new lignite power generation capacity of 7.5 GW, though this target may change based on reserve reports that will be prepared by internationally authorised institutions.

As of May 2020, the installed electricity capacity to use domestic coal was 11 313 megawatts (MW) (10 097 MW lignite, 811 MW hard coal, 405 MW asphaltite), which represents 12.3% of total installed capacity. Installed capacity for imported coal was 8 967 MW. Together they constitute 22% of total power generation capacity. Overall, the government expects that growth in coal-fired generation capacity will keep pace with total generation capacity expansions, keeping the share of coal in the power mix stable in the medium term.

Notwithstanding Turkey's efforts to promote the construction of coal-fired generators, the sector has seen a notable slowdown in recent years, in large part due to challenges securing loans for coal plants. Some local opposition to the siting of coal plants has also presented setbacks to plans, when Turkey's Council of State in 2019 cancelled an environmental impact assessment decision of a coal power plant in the Bartin Province's Amasra district, as cumulative effects were not reviewed in the report. The company has submitted a revised report to the Ministry of Environment and Urbanization.

The government is also keen to prevent the closure of existing power generators operated by the private sector, primarily for energy security reasons. To that end, in January 2018, a so-called electricity market capacity mechanism was introduced with the Regulation on Electricity Market Capacity Mechanism. It is meant to ensure sufficient installed and reserve generation capacity. TEİAŞ, the system operator, is the responsible entity for managing the capacity mechanism. Under this framework, power plants that meet the eligibility criteria receive monthly capacity payments. Qualified plants – domestic coal generators as well as natural gas and hydro power plants – can also participate in the energy market, unlike in capacity markets in some other jurisdictions where these plants are considered to be a separate, reserve capacity. In order to be able to receive capacity payments, participants are required to prove that certain thresholds have been satisfied; these are calculated by taking into account the weighted average capacity utilisation rates in the last four quarters. For the power plants utilising domestic resources, the threshold is 10%, for others it is 15%. The payment amounts are calculated according to a formula set out under the regulation by taking into account the unit-based generation costs, the costs necessary for the generators to stay within the system, and the hourly power sale and purchase rates. Payments are prioritised for generating facilities utilising domestic coal resources. In 2018, TRY 1.4 billion (USD 298 million) was paid out in capacity payments, while the budgeted amount in 2019 was TRY 2 billion (USD 352 million) and TRY 2.2 billion for 2020 (USD 333 million).

In addition to the capacity mechanism, the government is also keen to prevent the closure of existing coal-fired generating plants operated by the private sector. As such, in addition to the capacity mechanism described above, EÜAŞ purchases electrical energy from privately owned coal power plants that generate electricity using domestic coal with a guaranteed price between 5-5.5 US cents/kWh (USD 50-55/MWh, revised quarterly) until the end of 2027. A (domestically sourced) coal plant can claim both a capacity mechanism and this support.

At the same time, the government is moving forward with stricter enforcement of environmental limits on coal plants. Thermal power plants in Turkey are subject to the Industrial Air Pollution Control Regulation, which sets limit values for air pollutants such as SO_2, CO, NO_X and particulate matter. While limit values vary with fuel type and thermal capacity, they do not change with respect to plant age.

According to Temporary Article 8 of the Electricity Market Law, additional time was granted to existing privatised and public thermal power plants in order to realise investments related to the environmental regulation and to complete necessary permits until the end of 2019. By 1 January 2020, these existing privatised and public plants are also subject to the Industrial Air Pollution Control Regulation. Notably, the government proceeded with a requirement to install filters on existing privatised and public thermal power plants based on a December 2019 presidential veto of a law that would have delayed implementation for ten plants to 2022. New plants are required to have the filters already. The veto was based on public health concerns over air pollution. In accordance with the environmental requirements, the government ordered five coal plants to completely shut down due to failure to install filters in January 2020, while one was ordered to partially shut down; four other plants were granted temporary certificates of activity.

A project between Denmark and the Department of Energy Efficiency and Environment under the MENR is being carried out for heat recovery from coal-fired thermal plants and using it for heating in nearby dwellings.

Assessment

Coal remains one of the most important primary energy sources in Turkey. Coal consumption in 2018 was 40.8 Mtoe, 65% of which was consumed for electricity and heat generation. The remainder was used in the industry, services and residential sectors.

As of May 2020, installed electricity capacity to use domestic coal principally lignite, followed by small shares of hard coal and asphaltite, representing 12.4% of total installed capacity. Installed capacity for imported coal was 8 967 MW. Together they constituted 22% of total power generation capacity and 37.1% of electricity generation in 2019.

Turkey's coal demand has grown by 39% over the past decade, while indigenous coal production fell between 2009 and 2015, leading to increased import dependence. Since 2015, Turkey's domestic coal production has rebounded. Domestic production is mainly low-quality lignite, while imports consist of hard coal. Turkey imported 38 Mt of coal in 2019: 48% from Columbia, 36% from Russia, 8% from Australia and 3% from the United States.

The government and state-owned mining companies have stepped up efforts in recent years to improve occupational health and safety practices at mine sites, in response to concerns about worker health and safety as well as illegal mining. Recent mining accidents in the country have also been a driving force behind more stringent safety regulations. The government also boosted its audit capacity for mining operations. New legislation is underway to promote mechanisation in underground mining.

Given the importance of coal in Turkey's energy sector, the two state-owned mining companies are active in exploring the potential for clean coal technologies, notably through various RD&D projects to extract the energy content of the coal/lignite without mining it. The economic viability of the different technologies is uncertain at this stage, but if some of them prove to be successful, they could be game changers for making use of Turkey's large coal and lignite resources in a more environmentally friendly way over the longer term. There is no ongoing or proposed RD&D for carbon capture and storage. When reconsidering the option of carbon capture and storage, the government should also

investigate whether there are any legal and technical barriers to underground storage for CO_2 and prepare proposals to remove such barriers while creating a legal framework for underground storage at the same time. This can build upon the ongoing "Technical Assistance for Developed Analytical Basis for Formulating Strategies and Actions towards Low Carbon Development" conducted by Ministry of Environment and Urbanization, which includes the EU's preliminary regulatory assessment from the CCS Directive, scheduled for completion in May 2020.

Turkey's approach to coal mining and coal-fired generation is rooted in a strategy to reduce the share of imported natural gas and imported coal in electricity generation; the main driver behind this policy is a desire to reduce dependency on imported energy sources and lower the country's import bill. Consequently, the government has pursued a plan to boost the domestic production and consumption of Turkey's sizeable coal reserves. Lignite, in particular, is a priority area for development, mainly for use in power generation. Hard coal is intended to be used more heavily in the industrial sector. The government is also trying to reduce the use of coal in household heating in favour of natural gas.

The two state-owned coal mining companies explore for and produce lignite and hard coal. TTK has a virtual monopoly in hard coal production, processing and distribution. TKİ is mostly active in lignite mining.

According to the Mineral Research & Exploration General Directorate, Turkey has 19.14 billion tonnes of lignite resources and 1.6 billion tonnes of hard coal reserves (proven). To achieve the coal policy target to reduce import dependence, the government has stepped up efforts to find new coal fields and improve the productivity of existing mines.

In its effort to boost coal production, Turkey has promoted more privatisation of the coal mining sector. The non-producing areas of TTK and TKİ are being relicensed via a tendering system to private companies. Some of the tenders grant the right to mine coal/lignite on the condition that a thermal power plant be installed near the mine site. EÜAŞ will purchase the electricity generated by these plants for 15 years at a price established in the tender; a recent agreed price was USD 6.04 cents per kWh, relative to prevailing market prices of around 4-5 cents.

The government also promotes the use of domestic coal in other ways. Existing power plants running on domestic lignite are allowed to engage in a power purchase agreement with EÜAŞ at a price determined by the ministry – 60% of electricity from these plants is purchased at 5-5.5 USD cents per kWh, slightly above the prevailing market price (though below prices at previous periods in the recent past). The same support is given to power plants predominantly running on imported coal for the share of their output that is generated with domestic coal. Both categories of power plants can also receive a capacity remuneration.

In addition, coal mining itself receives financial support from the government, notably to pay for miners' wages, which are up to 100% higher than for comparable jobs in other sectors of the economy, to compensate for the hardship of the profession.

If the measures described above are taken together, then the financial support for the domestic coal sector can be substantial and distort competition with other domestic sources for electricity, like hydro, geothermal, solar and wind. In 2019, EÜAŞ purchased 24 TWh of electricity from coal-fired generators at a pre-determined price. Moreover, the

capacity payments to coal plants amounted to over USD 210 million in 2019. The wage subsidy for underground miners is hard to quantify, due to limited information on wages and the number of miners.

As stated above, EÜAŞ can buy some electricity produced with domestic coal at the indicated prices and sell it at market prices in the wholesale market or through bilateral contracts at regulated tariffs. EÜAŞ purchases electricity from power plants and also itself produces around 60 TWh of electricity (in 2019), mainly from its large hydro assets that can produce electricity at relatively low costs, well below the prevailing market price. By purchasing coal-fired electricity via the mechanisms described above and mixing it with its own cheap hydropower, the government assumes that EÜAŞ can sell its portfolio at either market prices in the wholesale market or to captive customers at above-market prices, without incurring losses.

On balance, the IEA understands the government's desire to boost domestic energy production to increase energy security, reduce the country's hefty energy import bill and diversify its sources of fuel. However, it should be noted that the energy security risks of imported coal are generally considered much lower than for imported gas and oil, as coal can be sourced from a diverse set of countries that have little geopolitical risk. Moreover, notwithstanding the job benefits in the mining sector from domestic coal production, the use of domestic coal is not always competitive and often requires subsidies. In addition, the environmental impact of domestic mining and the burning of coal should be taken more into account. As the costs for renewable electricity production continue to decline rapidly, and in some countries already match the PPA prices for coal-fired generation in Turkey, additional renewable energy can also be promoted with similar costs as coal, but with a much lower environmental impact.

Recommendations

The government of Turkey should:

- Notwithstanding energy security considerations, evaluate the effectiveness of its domestic coal policy, taking into account the widespread availability of imported coal, the environmental impact of lignite relative to other sources of generation, the costs of electricity produced from domestic coal and alternative options for power generation, including renewables.
- Gradually phase out support mechanisms for coal mining and coal-fired power generation to ensure a level playing field across fuels and technologies, while ensuring adequate transitional assistance to impacted regions and sectors.
- Enhance efforts on clean coal technologies, including those that limit the environmental impact of coal mining.
- Start a carbon capture and storage programme for coal-fired power generation with dedicated subsidies for research and deployment, while removing barriers for CO_2 storage.

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ANNEX A: Organisations visited

Review criteria

The Shared Goals, which were adopted by the IEA Ministers at their 4 June 1993 meeting in Paris, provide the evaluation criteria for the in-depth reviews (IDRs) conducted by the International Energy Agency (IEA). The Shared Goals are presented in Annex C.

Review team and preparation of the report

The IEA's in-depth review team visited Ankara 13-17 January 2020. The team met with government officials, energy companies, interest groups, research institutions, and other organisations and stakeholders. This report was drafted on the basis of the review team's preliminary assessment of the country's energy policy and information on subsequent policy developments from the government and private sector sources. The members of the team were:

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Mr. Guido Federer, Switzerland

Ms. Aleksandra Świderska, Poland

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Ms. Divya Reddy

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Organisations visited

During its visit to Ankara, the review team met with the following organisations:

Association of Distribution System Operators (ELDER)
Association of Electricity Producers (EUD)
Association of Thermal Insulation, Waterproofing, Sound Insulation and Fireproofing Material Producers, Suppliers and Applicators (İZODER)
Clean Energy Foundation (TEMEV)
Department for Energy Efficiency and Environment (DEEE)
Department for Strategy Development (SGB)
Energy Efficiency Association (ENVER)
Energy Efficiency and Management Association (EYODER)
Electricity Generation Company (EÜAŞ)
Energy Law Research Institute (EÜD)
Energy Market Regulatory Authority (EMRA)
European Bank for Reconstruction and Development
General Directorate for Energy Affairs
General Directorate of Mineral Research and Exploration (MTA)
General Directorate of Mining and Petroleum (MAPEG)
General Directorate for Nuclear Energy and International Projects
Geothermal Power Plant Investors Association of Turkey (JESDER)
International Solar Energy Society (GÜNDER)
Islamic Development Bank
Liquefied and Compressed Natural Gas Association (SSDGD)
Ministry of Agriculture and Forestry
Ministry of Energy and Natural Resources (MENR)

Ministry of Environment and Urbanization

Ministry of Foreign Affairs

Ministry of Industry and Technology

Ministry of Trade

Ministry of Transport and Infrastructure

Ministry of Treasury and Finance

Natural Gas Distribution Companies Association of Turkey (GAZBİR)

Nuclear Regulatory Authority (NDK)

Petroleum Industry Association (PETDER)

Petroleum and Natural Gas Platform Association (PETFORM)

Petroleum Pipeline Cooperation (BOTAŞ)

Presidency of Strategy and Budget (SBB)

Solar Energy Investors Association (GÜYAD)

Turkish Atomic Energy Authority (TAEK)

Turkish Coal Enterprises (TKİ)

Turkish Cogeneration Association (TÜRKOTED)

Turkish Electricity Distribution Company (TEDAŞ)

Turkish Electricity Transmission Company (TEİAŞ)

Energy Exchange Istanbul (EXIST)

Turkish Hard Coal Enterprise (TTK)

Turkish Miners Association (TMD)

Turkish Petroleum (TPAO)

Turkish Solar Energy Society (GENSED)

Turkish Wind Energy Association (TÜREB)

World Bank

ANNEX B: Energy balances and key statistical data

Turkey

Energy balances and key statistical data

Unit: Mtoe

SUPPLY		1973	1990	2000	2010	2017	2018	2019p
TOTAL PRODUCTION		**15.53**	**24.83**	**26.40**	**31.63**	**36.88**	**40.37**	**45.91**
Coal		5.21	11.39	13.02	16.74	15.68	16.55	17.66
Peat		-	-	-	-	-	-	-
Oil		3.59	3.61	2.73	2.65	2.70	3.01	3.15
Natural gas		-	0.18	0.53	0.56	0.29	0.35	0.39
Biofuels and waste[1]		6.45	7.21	6.50	4.53	3.03	3.24	3.29
Nuclear		-	-	-	-	-	-	-
Hydro		0.22	1.99	2.66	4.45	5.01	5.15	7.64
Wind		-	-	0.00	0.25	1.54	1.72	1.87
Geothermal		0.05	0.43	0.68	1.97	7.13	8.34	9.71
Solar/other		-	0.03	0.28	0.48	1.50	2.01	2.20
TOTAL NET IMPORTS		**8.72**	**27.48**	**49.74**	**74.33**	**111.86**	**104.65**	**100.56**
Coal	Exports	-	0.02	0.04	0.01	0.17	0.15	0.16
	Imports	0.01	3.94	9.11	14.65	24.91	24.48	24.29
	Net imports	0.01	3.92	9.07	14.65	24.74	24.33	24.13
Oil	Exports	0.84	1.88	1.29	6.41	6.80	5.00	8.53
	Imports	9.68	23.13	30.54	36.96	53.38	49.23	53.51
	Int'l marine and aviation bunkers	-0.13	-0.30	-0.92	-1.59	-4.38	-4.70	-5.06
	Net imports	8.71	20.94	28.33	28.97	42.20	39.53	39.91
Natural gas	Exports	-	-	-	0.53	0.52	0.55	0.63
	Imports	-	2.68	12.05	31.32	45.49	41.40	37.19
	Net imports	-	2.68	12.05	30.79	44.97	40.85	36.56
Electricity	Exports	-	0.08	0.04	0.17	0.28	0.27	0.24
	Imports	-	0.02	0.33	0.10	0.24	0.21	0.19
	Net imports	-	-0.06	0.29	-0.07	-0.05	-0.06	-0.05
TOTAL STOCK CHANGES		**0.11**	**-0.88**	**0.14**	**-0.24**	**-1.92**	**-0.82**	**0.16**
TOTAL SUPPLY (TES)[2]		**24.36**	**51.44**	**76.29**	**105.72**	**146.81**	**144.20**	**146.62**
Coal		5.15	15.58	22.83	31.21	40.09	40.83	41.95
Peat		-	-	-	-	-	-	-
Oil		12.48	23.40	30.40	31.51	44.34	41.95	43.01
Natural gas		-	2.86	12.64	31.40	44.23	41.02	37.01
Biofuels and waste[1]		6.45	7.21	6.50	4.53	3.03	3.24	3.29
Nuclear		-	-	-	-	-	-	-
Hydro		0.22	1.99	2.66	4.45	5.01	5.15	7.64
Wind		-	-	0.00	0.25	1.54	1.72	1.87
Geothermal		0.05	0.43	0.68	1.97	7.13	8.34	9.71
Solar/other		-	0.03	0.28	0.48	1.50	2.01	2.20
Electricity trade[3]		-	-0.06	0.29	-0.07	-0.05	-0.06	-0.05
Shares in TES (%)								
Coal		*21.1*	*30.3*	*29.9*	*29.5*	*27.3*	*28.3*	*28.6*
Peat		-	-	-	-	-	-	-
Oil		*51.2*	*45.5*	*39.9*	*29.8*	*30.2*	*29.1*	*29.3*
Natural gas		-	*5.6*	*16.6*	*29.7*	*30.1*	*28.4*	*25.2*
Biofuels and waste[1]		*26.5*	*14.0*	*8.5*	*4.3*	*2.1*	*2.2*	*2.2*
Nuclear		-	-	-	-	-	-	-
Hydro		*0.9*	*3.9*	*3.5*	*4.2*	*3.4*	*3.6*	*5.2*
Wind		-	-	-	*0.2*	*1.0*	*1.2*	*1.3*
Geothermal		*0.2*	*0.8*	*0.9*	*1.9*	*4.9*	*5.8*	*6.6*
Solar/other		-	*0.1*	*0.4*	*0.5*	*1.0*	*1.4*	*1.5*
Electricity trade[3]		-	*-0.1*	*0.4*	*-0.1*	-	-	-

0 is negligible, - is nil, .. is not available, x is not applicable. Please note: rounding may cause totals to differ from the sum of the elements.

Unit: Mtoe

DEMAND						
FINAL CONSUMPTION	**1973**	**1990**	**2000**	**2010**	**2017**	**2018**
TFC	**19.87**	**40.39**	**57.84**	**78.46**	**105.04**	**102.96**
Coal	2.97	7.85	10.84	14.82	12.66	10.57
Peat	-	-	-	-	-	-
Oil	9.54	20.37	26.13	28.39	39.88	39.15
Natural gas	-	0.71	4.91	13.14	25.15	24.95
Biofuels and waste[1]	6.45	7.21	6.46	4.44	2.48	2.54
Geothermal	0.05	0.36	0.62	1.39	1.86	1.95
Solar/other	-	0.03	0.26	0.43	0.84	0.88
Electricity	0.85	3.87	8.24	14.62	21.13	21.92
Heat	-	-	0.39	1.23	1.03	0.99
Shares in TFC (%)						
Coal	*14.9*	*19.4*	*18.7*	*18.9*	*12.1*	*10.3*
Peat	-	-	-	-	-	-
Oil	*48.0*	*50.4*	*45.2*	*36.2*	*38.0*	*38.0*
Natural gas	-	*1.8*	*8.5*	*16.7*	*23.9*	*24.2*
Biofuels and waste[1]	*32.5*	*17.8*	*11.2*	*5.7*	*2.4*	*2.5*
Geothermal	*0.2*	*0.9*	*1.1*	*1.8*	*1.8*	*1.9*
Solar/other	-	*0.1*	*0.5*	*0.6*	*0.8*	*0.9*
Electricity	*4.3*	*9.6*	*14.3*	*18.6*	*20.1*	*21.3*
Heat	-	-	*0.7*	*1.6*	*1.0*	*1.0*
TOTAL INDUSTRY[4]	**4.28**	**13.74**	**23.33**	**30.00**	**37.35**	**37.38**
Coal	1.14	4.54	8.90	7.37	6.90	6.86
Peat	-	-	-	-	-	-
Oil	2.59	6.18	8.23	8.13	8.69	7.98
Natural gas	-	0.67	1.76	6.51	10.70	10.57
Biofuels and waste[1]	-	-	-	-	-	0.83
Geothermal	-	-	-	-	-	-
Solar/other	-	0.01	0.10	0.13	0.30	0.31
Electricity	0.55	2.35	3.96	6.65	9.74	9.84
Heat	-	-	0.39	1.23	1.03	0.99
Shares in total industry (%)						
Coal	*26.7*	*33.0*	*38.1*	*24.6*	*18.5*	*18.3*
Peat	-	-	-	-	-	-
Oil	*60.4*	*44.9*	*35.3*	*27.1*	*23.3*	*21.4*
Natural gas	-	*4.9*	*7.5*	*21.7*	*28.7*	*28.3*
Biofuels and waste[1]	-	-	-	-	-	*2.2*
Geothermal	-	-	-	-	-	-
Solar/other	-	*0.1*	*0.4*	*0.4*	*0.8*	*0.8*
Electricity	*12.9*	*17.1*	*17.0*	*22.2*	*26.1*	*26.3*
Heat	-	-	*1.7*	*4.1*	*2.8*	*2.7*
TRANSPORT[2]	**4.38**	**9.22**	**11.76**	**14.63**	**27.73**	**27.97**
OTHER[5]	**11.20**	**17.43**	**22.75**	**33.83**	**39.96**	**37.61**
Coal	1.30	3.30	1.94	7.46	5.77	3.71
Peat	-	-	-	-	-	-
Oil	3.11	5.02	6.25	5.91	4.12	3.93
Natural gas	-	0.04	3.11	6.41	14.01	13.92
Biofuels and waste[1]	6.45	7.21	6.46	4.44	2.36	1.56
Geothermal	0.05	0.36	0.62	1.39	1.86	1.95
Solar/other	-	0.02	0.17	0.30	0.55	0.57
Electricity	0.29	1.48	4.22	7.92	11.29	11.98
Heat	-	-	-	-	-	-
Shares in other (%)						
Coal	*11.6*	*18.9*	*8.5*	*22.0*	*14.4*	*9.9*
Peat	-	-	-	-	-	-
Oil	*27.7*	*28.8*	*27.4*	*17.5*	*10.3*	*10.4*
Natural gas	-	*0.2*	*13.7*	*19.0*	*35.1*	*37.0*
Biofuels and waste[1]	*57.6*	*41.4*	*28.4*	*13.1*	*5.9*	*4.1*
Geothermal	*0.4*	*2.1*	*2.7*	*4.1*	*4.7*	*5.2*
Solar/other	-	*0.1*	*0.7*	*0.9*	*1.4*	*1.5*
Electricity	*2.6*	*8.5*	*18.5*	*23.4*	*28.3*	*31.8*
Heat	-	-	-	-	-	-

Unit: Mtoe

DEMAND							
ENERGY TRANSFORMATION AND LOSSES	**1973**	**1990**	**2000**	**2010**	**2017**	**2018**	**2019p**
ELECTRICITY GENERATION[6]							
Input (Mtoe)	2.77	10.78	22.66	36.87	53.52	55.48	..
Output (Mtoe)	1.07	4.95	10.74	18.16	25.57	26.21	26.17
Output (TWh)	12.43	57.54	124.92	211.21	297.28	304.80	304.25
Output shares (%)							
Coal	*26.1*	*35.1*	*30.6*	*26.1*	*32.8*	*37.2*	*37.2*
Peat	-	-	-	-	-	-	-
Oil	*51.4*	*6.9*	*7.5*	*1.0*	*0.4*	*0.1*	*0.2*
Natural gas	-	*17.7*	*37.0*	*46.5*	*37.2*	*30.3*	*18.7*
Biofuels and waste[1]	*1.6*	-	*0.1*	*0.2*	*0.7*	*0.9*	*1.1*
Nuclear	-	-	-	-	-	-	-
Hydro	*20.9*	*40.2*	*24.7*	*24.5*	*19.6*	*19.7*	*29.2*
Wind	-	-	-	*1.4*	*6.0*	*6.5*	*7.2*
Geothermal	-	*0.1*	*0.1*	*0.3*	*2.1*	*2.4*	*2.9*
Solar/other	-	-	-	*0.1*	*1.3*	*2.9*	*3.5*
TOTAL LOSSES	**4.19**	**11.30**	**18.00**	**27.04**	**40.43**	**40.20**	**..**
of which:							
Electricity and heat generation[7]	1.70	5.83	11.52	17.45	26.59	27.89	..
Other transformation	1.50	2.80	1.69	3.05	4.16	4.15	..
Own use and transmission/distribution losses	1.00	2.66	4.79	6.54	9.68	8.16	..
Statistical differences	**0.30**	**-0.25**	**0.45**	**0.22**	**1.35**	**1.04**	**..**
INDICATORS	**1973**	**1990**	**2000**	**2010**	**2017**	**2018**	**2019p**
GDP (billion 2015 USD)	136.09	287.66	411.73	610.07	953.45	980.40	989.00
Population (millions)	38.07	55.12	64.27	73.14	80.31	81.41	82.27
TES/GDP (toe/1 000 USD)[8]	0.18	0.18	0.19	0.17	0.15	0.15	0.15
Energy production/TES	0.64	0.48	0.35	0.30	0.25	0.28	0.31
Per capita TES (toe/capita)	0.64	0.93	1.19	1.45	1.83	1.77	1.78
Oil supply/GDP (toe/1 000 USD)[8]	0.09	0.08	0.07	0.05	0.05	0.04	0.04
TFC/GDP (toe/1 000 USD)[8]	0.15	0.14	0.14	0.13	0.11	0.11	..
Per capita TFC (toe/capita)	0.52	0.73	0.90	1.07	1.31	1.26	..
CO_2 emissions from fuel combustion ($MtCO_2$)[9]	52.8	128.8	201.2	267.8	378.6	374.1	-
CO_2 emissions from bunkers ($MtCO_2$)[9]	0.4	0.9	2.8	4.8	13.3	14.3	-
GROWTH RATES (% per year)	**73-90**	**90-00**	**00-10**	**10-16**	**16-17**	**17-18**	**18-19**
TES	4.5	4.0	3.3	4.4	7.4	-1.8	1.7
Coal	6.7	3.9	3.2	3.5	4.5	1.9	2.7
Peat	-	-	-	-	-	-	-
Oil	3.8	2.7	0.4	5.0	5.3	-5.4	2.5
Natural gas	-	16.0	9.5	3.4	15.6	-7.3	-9.8
Biofuels and waste[1]	0.7	-1.0	-3.6	-6.0	-2.8	6.8	1.4
Nuclear	-	-	-	-	-	-	-
Hydro	13.7	2.9	5.3	4.4	-13.4	3.0	48.3
Wind	-	-	55.7	32.1	15.4	11.4	9.2
Geothermal	13.7	4.7	11.1	20.5	18.2	17.0	16.4
Solar/other	-	25.9	5.4	18.4	14.4	33.7	9.6
TFC	4.3	3.7	3.1	3.8	7.3	-2.0	..
Electricity consumption	9.3	7.9	5.9	5.0	7.8	3.7	..
Energy production	2.8	0.6	1.8	2.2	2.1	9.5	13.7
Net oil imports	5.3	3.1	0.2	5.5	5.6	-6.3	1.0
GDP	4.5	3.7	4.0	6.4	7.5	2.8	0.9
TES/GDP	-0.0	0.4	-0.7	-1.9	-0.1	-4.5	0.8
TFC/GDP	-0.2	0.0	-0.9	-2.5	-0.1	-4.7	..

0 is negligible, - is nil, .. is not available, x is not applicable. Please note: rounding may cause totals to differ from the sum of the elements.

TES = total energy supply, Mtoe = million tons of oil equivalent, TWh = terawatt hour, GDP = gross domestic product, toe = tons of oil equivalent

TFC = total final consumption, Mt CO2 = million tons of CO2

Footnotes to energy balances and key statistical data

1. Biofuels and waste comprise solid biofuels, liquid biofuels, biogases, industrial waste and municipal waste. Data are often based on partial surveys and may not be comparable between countries.
2. Excludes international marine bunkers and international aviation bunkers.
3. Total supply of electricity represents net trade. A negative number in the share of total energy supply (TES) indicates that exports are greater than imports.
4. Industry includes non-energy use.
5. Other includes residential, commercial and public services, agriculture/forestry, fishing, and other non-specified.
6. Inputs to electricity generation include inputs to electricity and co-generation plants. Output refers only to electricity generation.
7. Losses arising in the production of electricity and heat at main activity producer utilities and autoproducers. For non-fossil fuel electricity generation, theoretical losses are shown based on plant efficiencies of approximately 10% for geothermal and 100% for hydro, wind and solar photovoltaic.
8. Toe per thousand US dollars at 2015 prices and exchange rates.
9. "CO_2 emissions from fuel combustion" have been estimated using the IPCC Tier I Sectoral Approach methodology from the 2006 IPCC Guidelines. Emissions from international marine and aviation bunkers are not included in national totals.

ANNEX C: International Energy Agency "Shared Goals"

The member countries* of the International Energy Agency (IEA) seek to create conditions in which the energy sectors of their economies can make the fullest possible contribution to sustainable economic development and to the well-being of their people and of the environment. In formulating energy policies, the establishment of free and open markets is a fundamental point of departure, though energy security and environmental protection need to be given particular emphasis by governments. IEA countries recognise the significance of increasing global interdependence in energy. They therefore seek to promote the effective operation of international energy markets and encourage dialogue with all participants. In order to secure their objectives, member countries therefore aim to create a policy framework consistent with the following goals:

1. Diversity, efficiency and flexibility within the energy sector are basic conditions for longer term energy security: the fuels used within and across sectors and the sources of those fuels should be as diverse as practicable. Non-fossil fuels, particularly nuclear and hydropower, make a substantial contribution to the energy supply diversity of IEA countries as a group.

2. Energy systems should have **the ability to respond promptly and flexibly to energy emergencies.** In some cases this requires collective mechanisms and action: IEA countries co-operate through the Agency in responding jointly to oil supply emergencies.

3. The environmentally sustainable provision and use of energy are central to the achievement of these shared goals. Decision-makers should seek to minimise the adverse environmental impacts of energy activities, just as environmental decisions should take account of the energy consequences. Government interventions should respect the polluter pays principle where practicable.

4. More environmentally acceptable energy sources need to be encouraged and developed. Clean and efficient use of fossil fuels is essential. The development of economic non-fossil sources is also a priority. A number of IEA member countries wish to retain and improve the nuclear option for the future, at the highest available safety standards, because nuclear energy does not emit carbon dioxide. Renewable sources will also have an increasingly important contribution to make.

5. Improved energy efficiency can promote both environmental protection and energy security in a cost-effective manner. There are significant opportunities for greater energy efficiency at all stages of the energy cycle, from production to consumption. Strong efforts by governments and all energy users are needed to realise these opportunities.

6. Continued **research, development and market deployment of new and improved energy technologies** make a critical contribution to achieving the objectives outlined above. Energy technology policies should complement broader energy policies. International co-operation in the development and dissemination of energy technologies, including industry participation and co-operation with non-member countries, should be encouraged.

7. Undistorted energy prices enable markets to work efficiently. Energy prices should not be held artificially below the costs of supply to promote social or industrial goals. To the extent necessary and practicable, the environmental costs of energy production and use should be reflected in prices.

8. Free and open trade and a secure framework for investment contribute to efficient energy markets and energy security. Distortions to energy trade and investment should be avoided.

9. Co-operation among all energy market participants helps to improve information and understanding, and encourages the development of efficient, environmentally acceptable and flexible energy systems and markets worldwide. These are needed to help promote the investment, trade and confidence necessary to achieve global energy security and environmental objectives.

(The Shared Goals were adopted by IEA Ministers at the meeting of 4 June 1993 Paris, France.)

* Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, The Netherlands ,Turkey, the United Kingdom and the United States.

ANNEX D: Glossary and list of abbreviations

In this report, abbreviations and acronyms are substituted for a number of terms used within the International Energy Agency. While these terms generally have been written out on first mention, this glossary provides a quick and central reference for the abbreviations used.

Acronyms and abbreviations

APC	Akkuyu Project Company
BOTAŞ	Petroleum Pipeline Company
BTC	Baku-Tbilisi-Ceyhan
CAAP	clean air action plan
DEEE	Department of Energy Efficiency and Environment
DSO	distribution system operator
E&P	exploration and production
EEIP	energy efficiency improvement project
EIA	environmental impact assessment
EMRA	Energy Market Regulatory Authority
EPC	energy performance certificate
ESCO	energy service company
ETS	emissions trading scheme
EÜAŞ	state-owned electricity generation company
EV	electric vehicle
EXIST	Energy Exchange Istanbul
FiT	feed-in tariff
FSRU	floating storage and regasification unit
GDP	gross domestic product
GEF	Global Environment Facility
GHG	greenhouse gas
IAEA	International Atomic Energy Agency
IEA	International Energy Agency
IGA	intergovernmental agreement
INDC	Intended Nationally Determined Contribution
ITP	Iraq-Turkey Pipeline
KOSGEB	Small and Medium Enterprises Development Organization of Turkey
LNG	liquefied natural gas
LPG	liquefied petroleum gas
LULUCF	land use, land-use change and forestry
MAPEG	General Directorate of Mining and Petroleum
MENR	Ministry of Energy and Natural Resources

NASAP	National Climate Change Adaptation Strategy and Action Plan
NCCAP	National Climate Change Action Plan
NDK	Nuclear Regulatory Authority
NEA	Nuclear Energy Agency
NEEAP	National Energy Efficiency Action Plan
NOSC	National Oil Stock Commission
NPP	nuclear power plant
NÜTED	Nuclear Technical Support Co.
OECD	Organisation for Economic Co-operation and Development
PHES	pumped hydro energy storage
PIC	Public Information Centre
PMR	Partnership for Market Readiness
PPA	power purchase agreement
PPP	purchasing power parity
PV	photovoltaics
R&D	research and development
RD&D	research, development and demonstration
SAMOFAR	Safety Assessment of the Molten Salt Fast Reactor
SCT	special consumption tax
SME	small and medium-sized enterprise
SOCAR	State Oil Corporation of Azerbaijan
TAEK	Turkish Atomic Energy Authority (previous)
TAGEM	General Directorate of Agricultural Research and Policies
TANAP	Trans Anatolian Natural Gas Pipeline
TAP	Trans Adriatic Pipeline
TCP	technology collaboration programme
TEDAŞ	Turkish Electricity Distribution Corporation
TEİAŞ	Turkish Electricity Transmission Corporation
TENMAK	Turkish Energy, Nuclear and Mining Research Institution
TETAŞ	Turkish Electricity Trade & Contract Corporation
TEVMOT	Promoting Energy-Efficient Motors in Small and Medium Sized Enterprises in Turkey
TFC	total final consumption
TFEC	total final energy consumption
TKİ	Turkish Coal Enterprises
TPAO	Turkish Petroleum Corporation
TPES	total primary energy supply
TRY	Turkish lira (currency)
TSO	transmission system operator
TTK	Turkish Hardcoal Enterprises
TÜBİTAK	Scientific and Technological Research Council of Turkey
UNFCCC	United Nations Framework Convention on Climate Change

WACC	weighted average cost of capital
YEKA	renewable energy resource area
YEKDEM	Renewable Energy Support Mechanism

Units of measure

bcm	billion cubic metres
g CO_2	gramme of carbon dioxide
GJ	gigajoule
GW	gigawatt
GWe	gigawatt electrical
kb/d	thousand barrels per day
kg CO_2	kilogramme of carbon dioxide
km	kilometre
km^2	square kilometre
kWh	kilowatt hour
mb	million barrels
mcm	million cubic metres
Mt	million tonnes
Mt CO_2	million tonnes of carbon dioxide
Mt CO_2-eq	million tonnes of carbon dioxide-equivalent
Mtoe	million tonnes of oil-equivalent
MVA	mega-volt amperes
MW	megawatt
MWe	megawatt electrical
t CO_2	tonne of carbon dioxide
toe	tonne of oil equivalent
TWh	terawatt hour

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Energy Policy Review

The International Energy Agency (IEA) regularly conducts in-depth peer reviews of the energy policies of its member countries. This process supports energy policy development and encourages the exchange of international best practices and experiences.

The guiding principles of Turkish energy policy continue to be market reform and energy security. Rapid economic and population growth in the past two decades have not only driven strong growth in energy demand but also an associated increase in import dependency.

Turkey has prioritised security of energy supply as one of the central pillars of its energy strategy, including efforts to boost domestic oil and gas exploration and production, diversify oil and gas supply sources and associated infrastructure, and reduce energy consumption through increased energy efficiency.

Turkey has seen considerable diversification of its energy mix in the past decade, in particular through the growth of renewable electricity generation. The commissioning of Turkey's first nuclear power facility in 2023 will further diversify the country's fuel mix.

Notwithstanding many positive changes Turkey has made toward liberalising its energy markets and diversifying its energy sources, the government should ensure that policies in place to bolster energy security – including growth in coal-fired generation and support for various forms of electricity generation – do not impede the economic efficiency of markets and the country's longer-term decarbonisation efforts.

In this report, the IEA provides energy policy recommendations to help Turkey smoothly manage the evolution of its energy sector.