



International  
Energy Agency

Secure  
Sustainable  
Together

Energy Policies of IEA Countries

Turkey

2016 Review



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## INTERNATIONAL ENERGY AGENCY

The International Energy Agency (IEA), an autonomous agency, was established in November 1974. Its primary mandate was – and is – two-fold: to promote energy security amongst its member countries through collective response to physical disruptions in oil supply, and provide authoritative research and analysis on ways to ensure reliable, affordable and clean energy for its 29 member countries and beyond. The IEA carries out a comprehensive programme of energy co-operation among its member countries, each of which is obliged to hold oil stocks equivalent to 90 days of its net imports. The Agency's aims include the following objectives:

- Secure member countries' access to reliable and ample supplies of all forms of energy; in particular, through maintaining effective emergency response capabilities in case of oil supply disruptions.
- Promote sustainable energy policies that spur economic growth and environmental protection in a global context – particularly in terms of reducing greenhouse-gas emissions that contribute to climate change.
- Improve transparency of international markets through collection and analysis of energy data.
- Support global collaboration on energy technology to secure future energy supplies and mitigate their environmental impact, including through improved energy efficiency and development and deployment of low-carbon technologies.
- Find solutions to global energy challenges through engagement and dialogue with non-member countries, industry, international organisations and other stakeholders.

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## 1. EXECUTIVE SUMMARY AND KEY RECOMMENDATIONS

### EXECUTIVE SUMMARY

As a founding member of the Organisation for Economic Co-operation and Development (OECD) and International Energy Agency (IEA), Turkey's energy policy has continuously evolved to serve a growing economy and population, mitigate rising import dependence and meet the country's environmental goals, including at international level.

Over the past decade, the Turkish economy grew at an average rate of 5%, which in turn has been a major driver of energy demand and investment in the Turkish energy market. Over ten years (2004-14), electricity demand almost doubled to reach 207 terawatt-hours (TWh) in 2015, while gas demand grew even faster, rising from 22 billion cubic metres (bcm) to 49 bcm. Since 2013-14, economic growth has slowed down; while foreign debt, inflation and exchange rate volatility have increased. The Turkish export industry is exposed to the global economic slowdown in key emerging and industrialised markets, notably in the European Union. Foreign direct investment in the Turkish economy fell to USD 12 billion in 2014, from USD 22 billion in 2007 (OECD, 2015).

Since the last IEA in-depth review in 2009, Turkey has made significant progress in reforming the energy (electricity) sector, following the liberalisation and privatisation of electricity generation and distribution, which triggered a private investment boom (generating capacity doubled during 2007-14) and secured energy access for its population. The IEA welcomes Turkey's efforts towards sustainable economic growth and meeting its energy targets for 2023, presented in 2009, as well as the new 2030 climate pledge submitted to the Paris 21st Conference of the Parties (COP21) in 2015.

The government has accelerated actions to address its growing dependence on imports by diversifying energy supplies. Turkey is progressing with its plans to deploy three nuclear power plants in the next decade, and has accelerated the deployment of renewable energy. Regional integration is advancing, as Turkey and the European Union (EU) will gain access to new gas sources from Azerbaijan by 2018-19 through the Trans-Anatolian Natural Gas Pipeline (TANAP) and from other sources in the Eastern Mediterranean and Middle East in the future. For the first time, the Turkish electricity system was interconnected with the Continental European system through the European Network of Transmission System Operators for electricity (ENTSO-E) in 2015. In this context, Turkey's contribution is increasingly crucial for the regional energy security.

Turkey is an active international energy partner and has long-standing ambitions of becoming an energy trading hub in the region. Since 2005, Turkey is negotiating to become a full member of the European Union, having been an associated member since 1963. In 2015, Turkey chaired the Group of Twenty (G20) and made a significant contribution to deepening the G20 energy agenda on energy access (G20 Action Plan on Energy Access), renewable energy (G20 Toolkit for Renewable Energy Deployment) and energy collaboration across both emerging economies and industrialised countries.

## CHALLENGES REMAIN

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The Turkish energy sector and energy policies need to evolve in step with the requirements to meet rising energy demand, foster sustainable economic growth for its cities and industries, and ensure the energy security needs of an emerging market located at the crossroads between Europe, Asia, and the Middle East in a period of significant geopolitical turmoil.

Important energy market reforms were introduced since the last IEA in-depth review in 2009, which mark progress towards liberalising the energy market, notably the New Electricity Market Law (No. 6446) and the Turkish Petroleum Law (No. 6491) of 2013.

In the electricity sector, the distribution sector and most of generation assets have been privatised (except hydro and some coal assets). The creation of the day-ahead and balancing market (PMUM), organised by the system operator TEİAŞ, led to a boom in private investment, boosting capacity margins and supporting growing electricity demand. The Energy Market Regulatory Authority (EMRA) has continuously supported market opening (85% in 2015); however, most households are not able to choose their supplier (threshold of 4000 kWh annual electricity consumption). Under Law No. 6446, the electricity wholesale market was reorganised, TEİAŞ PMUM was moved to the new energy market operating company (EPİAŞ) which was created in March 2015 as wholesale electricity exchange. However, the pace of liberalisation and privatisation has slowed down and electricity wholesale prices have fallen in recent years.

Progress has been more difficult in the gas sector. The Gas Market Law of 2001 (No. 4646) has not been fully implemented, notably with regard to the full unbundling of gas activities (supply, trade and storage) and transmission. Despite the efforts made to liberalise gas imports (since 2013, only 20% or 10 bcm have been purchased by private companies), the system operator BOTAŞ dominates gas imports, trade and wholesale. BOTAŞ imports 78% of all the natural gas consumed in Turkey, operates the gas network and one of two liquefied natural gas (LNG) import terminals, and has investments in a gas storage facility and the first gas transit pipeline (TANAP). The reform of the natural gas market has been ongoing with an Amendment of the Natural Gas Market Law pending adoption in Parliament since 2014. Progress in the gas market reform has also an impact on the electricity market, as natural gas is the first fuel in power generation (38.6% in 2015). A transparent and cost-based pricing mechanism for electricity and gas remains to be properly implemented.

As part of the 2009 Electricity Market and Security of Supply Strategy, and the Vision 2023, the government adopted energy targets for 2023, followed up in a number of strategies and action plans on energy efficiency (EE), renewable energy (RE) and climate change. Progress is being made towards the targets: Turkey is building the first two nuclear power plants in its history, but creating the legal framework, including the establishment of an independent regulatory authority, and bringing them online by 2023 is ambitious. In one decade, installed RE capacity has almost doubled, thanks to the support scheme which offers generators the choice between direct marketing on the day-ahead market and a feed-in tariff with local content support. The share of RE is fluctuating depending on hydro and coal/gas use and stood at 32.3% in 2015, above the envisaged RE target of 30% for 2023. When it comes to technology-specific RE targets, several deployment targets are included in different regulations and strategy documents, creating uncertainty about the future ambitions.

No doubt, Turkey has a strong RE potential, including hydro, wind and solar, but grid integration rules, notably for wind power and solar PV as distributed generation, and electricity network upgrades/connections are not adequate to satisfy the strong interest in RE licences by the private sector.

Energy intensity increased by 7.1% during 2005-15, while the IEA countries' average intensity was falling by 16.3%. Turkey's target to reduce energy intensity by 20% to 2023 (from 2011) is ambitious. In 2014, carbon dioxide (CO<sub>2</sub>) emissions from fuel combustion were up by 141.6% since 1990, with local air pollution in the large cities being a concern.

Geopolitical challenges remain significant in the region. Turkey is dependent on gas pipeline imports from the Russian Federation (hereafter "Russia") (55.1%), Iran (16.2%) and Azerbaijan (12.8%), but also on LNG imports from Algeria (8.1%) and Nigeria (2.9%). The gas system has a low capacity margin and has difficulties to cope with demand peaks or major transports, impacting the country's electricity security, as almost 50% of all natural gas is consumed in the power sector. Imports and transits of oil products from the Middle East increased. While Turkey is compliant with its oil stock obligations under the IEA, security of oil transit infrastructure has become a concern amid regional instability.

## SHAPING PROGRESS

### FOSTERING ENERGY SECURITY

Since the last IEA in-depth review in 2009, Turkey's gas demand has increased from 35.1 bcm to 48.7 bcm in 2014, driven by the gasification of the country with rising gas use in the residential, power and industry sectors. Gas imports have increased in step. Reforms towards full unbundling, as required under the 2001 Natural Gas Law, going beyond account unbundling of the system operator BOTAŞ, and the creation of a gas hub with liberalised imports and cost-reflective pricing have hardly advanced since 2009.

To date, the gas network has a maximum entry-point capacity of 196.5 million cubic metres per day (mcm/d), but peak demand in winter can reach over 230 mcm/d. The gas system cannot deal with gas supply interruptions during the winter peak period, and has to introduce load shedding in the power generation sector. Turkey has two LNG terminals, in Aliğa and Marmara, but lacks gas storage capacity. It is commendable that the government set a target of increasing gas storage to 5.3 bcm by 2019, and work has been completed to reinforce compressor power (Erzurum) and extend the underground gas storage capacity. The IEA encourages the government to create the investment conditions for upgrading the gas network, and constructing LNG and storage capacity as the best guarantee for security of gas supply. Gas is to maintain its important role in the power and the heating sectors over the medium term. The government will need to ensure that needed investments are made in the physical infrastructure and that competitive gas imports can reach Turkey.

Global LNG supplies will be ample over the medium term up to 2020, with lower LNG prices in Europe of USD 4-5 MMBtu. Turkey has a window of opportunity to attract competitive LNG. To seize this opportunity, the government will need to ensure the main prerequisites for a functioning gas market are in place, including a gas trading platform, supported by an independent system operator, which separates the trade and transmission, ensures compliance with third-party access and offers transparent tariffs

for gas transportation and storage. An independent system operator can facilitate transparent gas trade, the availability of short-term gas contracts, and market-based balancing capacity and can foster security of supply.

Since 2009, electricity supply security has improved with good capacity margins (69% in 2014) and a government plan for a coal-led expansion of its power generation based on domestic lignite. However, Turkey's electricity security is compromised by the fact that its electricity system has to deal with rising electricity consumption, in the absence of nuclear baseload capacity and in the presence of old (lignite) coal plants. In March 2015, Turkey experienced a 10-hour-long power failure, the first in 15 years. It was the most severe disturbance in the Turkish power system since 1999, when a large-scale earthquake caused a blackout. The 2015 blackout originated from the tripping of a heavily loaded 400 kilovolts (kV) transmission line, leading to the disconnection of the Turkish power system from the ENTSO-E Continental European grid. This illustrated the crucial importance of the east-west electricity transmission corridor, which needs to cope with imbalances between hydropower in the east and consumption centres in the west (Ankara, Istanbul and Izmir). The system operation has to deal with lower actual power availability which can greatly differ from installed capacity, notably during peaks of demand (and peaks are increasing), and with a lower contribution from hydropower amid droughts. Investment in the electricity networks and generation are needed to support the reliability and resilience of the power system with growing shares of variable renewable electricity, notably, if electricity demand accelerates in the future.

Since 2009, Turkey has been advancing in developing a nuclear programme with two nuclear projects going ahead on the basis of intergovernmental agreements, which were ratified by the Parliament. Turkey is developing the Akkuyu project, a Rosatom plant (VVER 4 800 megawatts electric [MW<sub>e</sub>]), with Russia, and the Sinop plant with Japan (ATMEA 4480 MW<sub>e</sub>) by the project company JAPCO (ENGIE, MHI, Itochu) and the Electricity Generation Corporation (EÜAŞ) as the operator. Turkey never had nuclear power and is creating the legal framework to obtain nuclear permits and approvals for different designs. The draft Law on Nuclear Energy covers basic principles of nuclear safety, authorisation and enforcement responsibilities, establishment of the independent regulatory body, separation of the non-regulatory function of the Turkish Atomic Energy Authority (TAEK), radioactive waste management policy, decommissioning and radioactive waste disposal policy. Before construction starts, the government should adopt the new Law and urgently proceed towards the full administrative independence of the Nuclear Regulatory Authority (outside TAEK), supported by adequate human resources to assess, monitor and evaluate the projects, and increase the collaboration with international competent organisations (Peer Safety Authorities and/or technical support organisations from the supplier or elsewhere).

The IEA commends Turkey for consistently meeting its stockholding obligations to the IEA by placing a minimum stockholding obligation on industry. The current emergency oil reserves mostly rely on the 20 days of stocks in refineries, given the absence of plans to release compulsory industry stocks held by distributors and eligible consumers. Turkey held some 66 million barrels (mb) of oil stocks at the end of November 2015, equating to 105 days of 2014 net imports, and well above the IEA 90-day requirement. Around 55% of total oil stocks are held in the form of crude oil. The use of emergency oil stocks is central to Turkey's emergency response policy, which can be complemented by demand restraint measures. The IEA notes the proposed changes to this policy in the draft Law on Complementary Oil Stocks.

## COMPLETING ENERGY MARKET REFORMS

After fast growth in the electricity sector, the Turkish electricity market entered a period of consolidation in 2014. Turkey's day-ahead and balancing electricity market (PMUM) was a major achievement. In 2015, the regulator EMRA set up the structures for the creation of the wholesale electricity trading platform, EPIAŞ, which was established in March 2015. Moving ahead, the government should complete the liberalisation and the privatisation of remaining state-owned generation assets (hydro and coal assets) and foster the functioning of the wholesale electricity market at EPIAŞ (day-ahead, intraday and financial markets), including the integration of regional trade, to promote long-term investment and competition in the market. The Prime Minister's Privatisation Administration's plans to continue privatising generation is a welcome step.

Competition in the gas market cannot be improved unless third-party access is implemented by effective application of the network code of BOTAŞ, and unbundling of trade and transmission activities is carried out (which is currently on account-unbundling level) and restrictions on import and export fully removed; an urgent evolution towards an independent system operator is needed in this respect. The gas market reform should be adopted without delay, in line with EU requirements and the government should set out an action plan for the creation of a fully functioning gas market. The government is working on an electricity market strategy and a natural gas strategy in 2016.

## INVESTING IN THE ENERGY HUB

Turkey has set out ambitions to become a regional energy trading hub to serve energy markets at the crossroads between Asia, the Middle East and Europe. Since the last IEA review in 2009, regional integration has advanced. Conversely, current regional instability makes Turkey's integration with its regional trade partners even more important. Turkey's and the European Union's energy security are strongly linked to each other and market integration has become more relevant. In a highly volatile energy region, Turkey's role for securing energy trade and transit to the European Union is significant.

Since 2015, the Turkish electricity system is formally synchronised with ENTSO-E Continental European system and trade flows are expected to grow in the future. Moving forward, the government and the regulator need to ensure the swift finalisation of EPIAŞ's trading rules, and support the development of the financial markets for electricity and gas, as well as the adoption of the necessary rules for the integration with ENTSO-E markets in the coming years. Turkey has a strong opportunity to increase its integration with regional electricity markets, which can foster security of electricity supply and system operation.

In the gas sector, Turkey is set to become an anchor of the Southern Gas Corridor, transporting natural gas from Azerbaijan (Azeri Shah Deniz 2) to Turkey and the European Union by 2018/19 through the Trans-Anatolian Gas Pipeline (TANAP) and the Trans-Adriatic Pipeline (TAP), from Turkey across Greece and Albania to Italy. Besides transporting 10 billion cubic metres/year to the EU market, BOTAŞ will import another 6 bcm/y of Shah Deniz 2 gas in addition to the current 6.6 bcm/y imports from Shah Deniz 1 (which expires in 2021). Turkey has diversified long-term gas contracts with Azerbaijan, Iran, Algeria and Nigeria. However, by volume, it remains 87% dependent on supplies by pipeline, mostly from Russia which supplied 55.1% of its total gas imports in

2015. The contracts with Nigeria (LNG) and Russia (west pipeline) expire in 2021, and the one with Algeria (LNG) runs until 2024.

Gas consumption growth has outpaced electricity consumption and is forecast to reach 50 bcm in 2016. Imports are set to remain important, as indigenous natural gas production is very small (0.4 bcm in 2015) but gas use in the residential and commercial sector is on the rise. Turkey is an important gas market and its geographical location is favourable to access the large resource base in the region. The opening of the Southern Gas Corridor is positive. However, its importance depends on the availability of gas beyond Azerbaijan from the Caspian region (Turkmenistan), and supplies from Iran and Iraq or Israel. The Eastern Mediterranean offers promising new gas supplies over the medium-term from Leviathan, with additions from Tamar or neighbouring fields, from Aphrodite, and also from Zohr in Egypt. In the medium term to 2020, global LNG supplies will be plentiful and cheap. Benefitting from well-supplied LNG markets and the diverse resources within its neighbourhood, Turkey has a considerable opportunity along with EU markets to diversify sources and routes, and to enhance the collective gas security.

For Turkey to become a regional energy hub, the government will need to diversify its long-term supply contracts and routes to increase competitive supplies in the market. The key prerequisite is the creation of a gas trading platform. This will require the separation of trade/supply, import and transmission, and the creation of an entry-exit regime which obliges all importers to sell to the platform. Only an independent system operator can ensure transparent balancing and congestion management and the compliance with third-party access to the gas storage and transmission capacity. This will attract private investments, including in new LNG terminals, natural gas storages and pipelines. Last but not least, the government should maintain incentives for upstream activities and encourage unconventional production, which seems to be promising in the Black Sea and in the East Anatolian Basin and the Diyarbakir Basin.

## SUSTAINABLE GROWTH TOWARDS 2030

Turkey is implementing new energy targets under the Vision 2023, its economic development strategy to 2023, the year that marks the 100th anniversary of the Republic of Turkey. The energy goals to 2023 include the promotion of indigenous energy resources, such as coal (lignite) and a 30% share of renewable energy in the electricity mix; the reduction of energy intensity by 20% below 2010 levels through improved efficiency and the launch of two to three nuclear power plants.

For the implementation of these goals, Turkey put forward a National Climate Change Strategy in 2010 and a related Action Plan for 2012, the 2012 Energy Efficiency Strategy and the 2009 Electricity Market and Security of Supply Strategy, in addition to the Ministry of Energy and Natural Resources (MENR)'s Strategic Plan (2015-19). Turkey has attracted support from the international donor community to the preparation of a Renewable Energy Action Plan and Energy Efficiency Action Plan in 2015. However, the Climate Action Plan outlines many actions, without prioritising their importance or evaluating their actual carbon-mitigation contribution and cost-effectiveness. Overlaps and inconsistencies between the different strategies and action plans hinder the assessment of progress and the identification of gaps in the progress towards the targets and priorities.

A commendable milestone is that Turkey, for the first time, set a quantitative greenhouse gas (GHG) emissions reduction target for 2030, in the context of the United

Nations Framework Convention on Climate Change (UNFCCC) 21st Conference of the Parties (COP21) in Paris in 2015. As a rapidly developing economy with low emissions per capita, Turkey's first-ever Nationally Determined Contribution (NDC) seeks to cap GHG emissions growth at 21% below the business-as-usual (BAU) increase expected for 2030.

However, this will not be enough to implement the global climate goals. The Paris Agreement 2015 aims to limit the global average temperature rise to well below 2 °C and to pursue efforts towards 1.5 °C. However, to date, the INDC lacks ambitions to support such a pathway, notably in the areas of renewable energy and energy efficiency and in the power sector where Turkey supports a large coal development programme.

IEA analysis for COP21 shows that, globally, measures to boost energy efficiency and renewable energy investment account for around 70% of emission reductions required under a 2°C scenario (IEA, 2015). Turkey will need to considerably increase ambitions in the areas of renewable energy (hydro, wind and solar) and energy efficiency.

Energy efficiency (EE) will make the largest contribution to achieving emission reductions to 2030. Turkey should have significant potential to save energy in several key sectors, but that potential remains unknown as monitoring and evaluation have not been pursued. Oil prices are expected to grow in the medium term with an increasing reliance on the Middle East. Energy efficiency will be a major tool for boosting economic productivity and energy security. The government should evaluate the benefits from setting a cap on consumption (not on energy intensity) to drive investment, similar to the new policies adopted in the People's Republic of China (hereafter "China"). Over the past ten years, the energy intensity of the Turkish economy saw a 7.1% increase, compared to a 16.3% average decline in IEA members. In Turkey, energy use has boomed in the transport, industry and buildings sectors. Turkey still has the lowest total primary energy supply (TPES) per capita, which indicates an expected steep future growth of energy consumption.

Turkey made strong progress in setting up the legal framework on EE in buildings and labelling. The government needs to prioritise EE at a horizontal level; currently the dossier is split between several ministries and carried out by a unit in the General Directorate for Renewable Energy. Better EE data collection and reporting is also essential in this context. MENR's Strategic Plan 2015-19 makes energy savings a priority. As many international institutions have pointed out, the institutional and governance structure of EE policies needs to be reinforced. In that respect, an effective dedicated Energy Efficiency National Agency (as in many IEA member states) with a clear co-ordination function and leading role can be useful with a view to enhancing and facilitating efforts in this policy area across several sectors of the economy, including transport and industry. The government should swiftly adopt the National Energy Efficiency Action Plan, which is being prepared in 2016, and set out clear priorities for action in transport, buildings and industry, quantitative productivity targets and milestones, and regularly evaluate the outcomes, assess progress towards the targets, and identify gaps over time.

A second priority area is renewable energy (RE). After a first phase and rapid take-off in the deployment of RE, the capacity has nearly doubled from 15.6 gigawatts (GW) to 28 GW during the period 2009 to 2014. However, the share of RE in total energy supply remained stable, as electricity demand accelerated and natural gas use saw a major boom. The government has set out a plethora of technology-specific RE targets in different strategies and plans for 2023 and 2030 which are not consistent. INDC targets



for RE decrease after 2023, below NREAP's ambitions and Turkey's potentials. Investors have a strong interest and the country a large potential of hydro, wind and solar power. Solar photovoltaic technology has been growing in recent years. In the second phase of renewable energy development, the government will need to ensure that clear and long-term targets (consistent with the longer-term 2030 goals) are established for all renewable energy technologies, and the necessary grid investments are proceeding swiftly with more streamlined environmental assessments, improved spatial planning and one-stop-shop permits. The government needs to set the rules for the use of distributed generation (net metering) and adapt the electricity system and the network operation rules to allow the integration of higher shares of variable renewable energies.

Turkey has one of the largest coal plant developments in the world, outside China and India, taking into account coal plants announced, proposed and under construction. However, the country imports most of the coal it uses in power generation (international hard coal prices have been falling for several years), as Turkey's large lignite reserves are of low quality and local air pollutants are high. In addition, security and mining safety concerns have increased in the past years, following severe accidents. The goal of fostering lignite production in Turkey is not consistent with climate goals. The INDC BAU sees GHG emissions rise by 512% of 1990 levels. The energy sector made a key contribution (72.5%) to Turkey's total GHG emissions in 2014, driven mainly by transport and power generation sectors, followed by industrial processes (13.4%), agriculture (10.6%) and waste (3.4%). If Turkey can mitigate GHG emissions in the energy sector, it will be able to achieve about 70% of its INDC. The power sector is the only area where mitigation can be achieved in the medium term; transport is likely to see a strong increase in GHG emissions given continuous population growth. The use of coal will need to be more sustainable with highly efficient and clean coal technology, and old plants will need to be refurbished or closed down. Turkey transposed the EU Large Combustion Plant Directive and invested in clean coal research and development, but the existing coal plant fleet is not yet refurbished.

Air quality is a concern, notably in the large cities of Ankara, Izmir and Istanbul. While the government has scrapped the oldest passenger cars and encourages public transportation, the population is still growing fast and so are its needs for housing and transportation. Sustainable energy use and air quality in the large cities should become a key priority. Energy production and use are the largest sources of air pollutants, notably from coal-fired power generation, cooking stoves and industry. The government should focus on improving air quality through the reduction of polluting road transportation, by stimulating the modal shift from road to public transportation, using integrated urban planning, and promoting alternative fuels and the renewal of the truck fleet. As outlined in the *World Energy Outlook Special Report on Energy and Air Quality* (IEA, 2016), governments can manage air pollution by adopting a long-term air quality goal, monitoring and reporting, and clean air policies for the energy sector. These include emission standards and air pollutant limits, standards for vehicle fuel economy and tax incentives for the promotion of cleaner private passenger vehicles, among others. The government should evaluate opportunities from joining the EU Emissions Trading System (ETS), using carbon taxation or emission performance standards, promoting district heating and cooling from renewable energy and waste, as means to encourage investments in a low-carbon economy.

To ensure Turkey can maintain a sustainable growth model, the government should prepare an integrated, long-term energy and climate strategy, in line with the Paris

Agreement. In the strategy, the government should identify the urgent measures needed to achieve its goals and set up a monitoring system to track the impact of policies, and integrate climate change with energy policy actions.

## KEY RECOMMENDATIONS

*The government of Turkey should:*

- *Complete the liberalisation of Turkey's electricity and natural gas markets towards market pricing and a competitive, transparent and liquid market place in support of Turkey's ambitions to become a regional energy trading centre.*
- *Foster energy security by ensuring investment in resilient gas and electricity networks and regional market integration, by raising ambitions in energy efficiency and renewable energy, and ensuring high levels of nuclear safety and security through a legal framework for nuclear energy.*
- *Set out an integrated long-term energy and climate strategy for 2030 as basis for a sustainable economic growth model, including a tracking and monitoring system, building upon the Vision 2023 and the climate pledge to COP21.*
- *As part of the strategy, prioritise short-term actions on energy efficiency and renewable energy by:*
  - *Adopting a government-owned National Energy Efficiency Action Plan with quantitative sectoral targets and milestones, notably for mobilising demand-side management and energy efficiency services, investing in energy-efficient buildings, and promoting energy efficiency in industry, power and heat and transport sectors. Regularly evaluate the outcomes, assess progress on the targets, and saving potentials and identify gaps.*
  - *Clarifying subsector targets for the use of renewable energy sources in electricity, transport and heat sectors up to 2023 and 2030 in order to provide long-term visibility for investors.*
  - *Promoting a clean transport sector and sustainable cities by encouraging the modal shift to public transportation, integrated urban planning, cleaner freight and passenger vehicles, adopting monitoring and reporting of air quality and air quality standards and objectives.*

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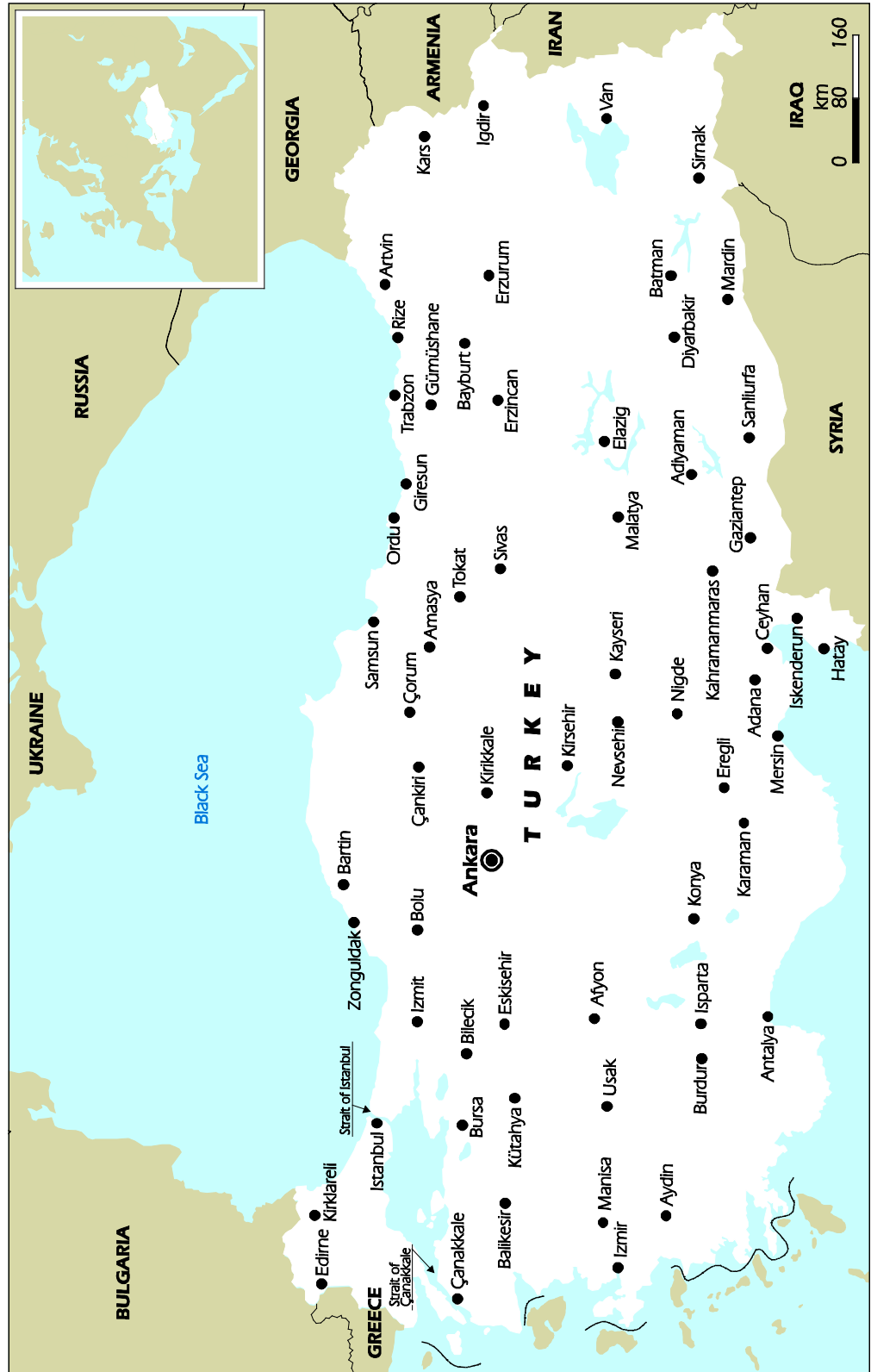
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**PART I**  
**POLICY ANALYSIS**

Figure 2.1 Map of Turkey



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area.

## 2. GENERAL ENERGY POLICY

### Key data (2015 estimated)

**Energy production:** 32.2 Mtoe (coal 41.8%, geothermal 14.8%, biofuels and waste 10.1%, hydro 17.9 %, oil 8.3%, solar 3%, wind 3.1%, natural gas 1%), +34.3 % since 2005

**TPES:** 129.7 Mtoe (coal 27.3%, natural gas 30.2%, oil 30.1%, biofuels and waste 2.5%, hydro 4.4%, geothermal 3.7%, solar 0.7%, wind 0.8%, electricity 0.3%), +54% since 2005

**TPES per capita:** 1.7 toe (IEA average: 4.5 toe)

**TPES per GDP:** 0.09 toe/USD 1 000 PPP (IEA average: 0.11 toe/USD 1 000 PPP)

**Electricity generation:** 259.7 TWh (natural gas 38.6%, coal 28.3%, hydro 25.8%, wind 4.4%, geothermal 1.3%, oil 0.8%, biofuels and waste 0.6%, solar 0.2%), +60.3% since 2005

**Power generation per capita:** 3.3 MWh (IEA average: 9.9 MWh)

## COUNTRY OVERVIEW

Turkey is situated at the crossroads of Asia and Europe, with most of its territory located in south-west Asia and a small part in south-east Europe (Eastern Thrace). The country borders the Mediterranean, Aegean and Black Seas and eight countries: Syria and Iraq to the south; Iran, Armenia and Azerbaijan to the east; Georgia to the north-east; Bulgaria to the north-west; and Greece to the west.

With a population of 77.5 million (2015) and a territory of 783 562 square kilometres (km<sup>2</sup>), Turkey has a rather low population density with the exception of the key cities, Izmir, Ankara and Istanbul, the latter being today the largest city in Turkey and in Europe with approximately 14 million inhabitants. Turkey has the fourth-largest territory among IEA members and 7% of the population. Strong differences exist across the country – consumption centres are in the north-west (Ankara, Istanbul and Izmir), and domestic energy resources concentrated in the east (hydropower) and in the west and central parts (coal mines and wind power). Turkey has a young and urbanising population and expanding energy needs. Total primary energy supply (TPES) per capita and power generation per capita are still low in comparison to many other IEA countries. However, TPES has risen considerably over the past 40 years from 24.4 Mtoe in 1973 to 129.7 Mtoe in 2015 and is set to continue this trend in the coming decades. Electricity consumption grows at a pace comparable to the industrial boom phases of large economies. In only 12 years, Turkey's electricity consumption doubled.

Given its proximity to the world's largest proven oil and gas reserves, Turkey is of strategic importance and has the long-standing ambition to become a major hub for the energy trade between Central Asia, the Russian Federation (hereafter "Russia"), the Middle East, Europe and other markets. Turkey is well positioned to reap the benefits of diverse supply sources and routes for its development and to support the diversification and security of supply of the European Union and the region. The country's geographical

conditions and climate bring about substantial potential for renewable energy, particularly hydro, wind, solar and geothermal energy.

The Turkish economy had a 4.7% average annual real growth rate of the gross domestic product (GDP) over the period of 2002 to 2014. GDP increased to over USD 800 billion in 2014, up from USD 305 billion in 2003. Over the last decade, GDP per capita in has nearly doubled to USD 19 917 in 2015, up from USD 10 165 in 2004 (OECD). The OECD expects Turkey to reach a projected growth rate of 3.7% in 2017 (OECD, 2016). Turkey has a rapidly growing private industrial sector, in basic industry, construction, banking, transport, and communication; the textile and clothing industry is the largest exporter. However, the country does not export high value-added products.

The 2008/09 financial and economic crisis hit Turkey very hard, but the economy rebounded. External demand depends on economic performance of the key export markets, notably the European Union. Competitiveness and productivity remain fragile, as foreign debt, inflation and exchange rate volatility increase (OECD, 2016).

The Turkish Republic has a parliamentary system of government. The Parliament, the Turkish Grand National Assembly (Türkiye Büyük Millet Meclisi) has 550 deputies, nationally elected by popular vote to serve a four-year term. The government is formed by the Justice and Development Party (AKP), led by Prime Minister Binali Yıldırım. The Head of State is President Recep Tayyip Erdoğan who was elected President in 2014.

Turkey has been a member of 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 as well as in international energy affairs. Since 2005, Turkey has been in negotiations to enter the European Union as a full member, having been an associated member since 1963. In 2015, Turkey chaired the G20 and made a significant contribution to deepening the G20 energy agenda on energy access, renewable energy and energy efficiency, and to establishing new priorities, including the G20 Action Plan on Energy Access and a G20 Toolkit for Renewable Energy Deployment.

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## SUPPLY AND DEMAND

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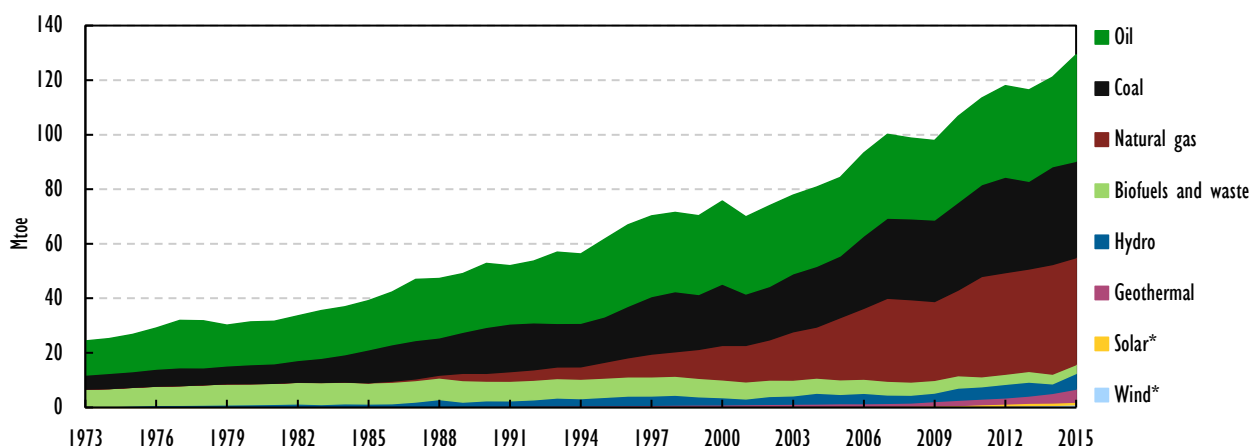
### SUPPLY

Energy supply in Turkey has been on an upward trend for the last four decades to meet the rapidly increasing energy needs of the fast growing economy. Turkey's TPES<sup>1</sup> was 129.7 million tonnes of oil-equivalent (Mtoe) in 2015, representing an increase of 54% from 84.2 Mtoe in 2005 (Figure 2.2). Turkey is highly dependent on oil and gas imports as only 24.8% of energy supply is met by domestic production. TPES per capita is the lowest among IEA members with 1.7 tonnes of oil-equivalent (toe) per capita in 2015, in comparison to the IEA average of 4.5 toe per capita. In relation to GDP, the energy intensity is much higher and Turkey is ranked around the IEA average.

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1. TPES is made up of production *plus* imports *minus* exports *minus* international marine bunkers *minus* international aviation bunkers *plus/minus* stock changes. This equals the total supply of energy that is consumed domestically, either in transformation (for example refining) or in final use.

Figure 2.2 TPES, 1973-2015



Note: Data are estimated for 2015.

\* Negligible.

Source: IEA (2016), *Energy Balances of OECD Countries 2016*, [www.iea.org/statistics/](http://www.iea.org/statistics/).

Fossil fuels totalled 113.6 Mtoe in 2015, an increase of 53.2% from 74.2 Mtoe in 2005. Natural gas, coal and oil each covered a third of TPES in 2015: natural gas (30.2% or 39.2 Mtoe) was followed by oil (30.1% or 39 Mtoe) and coal (27.3% or 35.3 Mtoe). Over the past decade, natural gas and coal supply increased by 72.1% and 56.2%, respectively, while oil supply increased by 35.8% during that period, stood at 39 Mtoe, rising from 28.7 Mtoe in 2005, mainly because of a 68.7% increase of consumption in transport.

Conversely, in 2015, Turkey's domestic energy production only covered 32.2 Mtoe or 24.8% of TPES; 51.1% of domestic energy was produced from fossil fuels, notably coal (41.8%, mostly lignite), oil (8.3%) and natural gas (1%) (Figure 2.4). Renewable sources constituted 48.9% of all domestic energy production, with biomass providing 10.1%, hydro 17.9%, geothermal 14.8%, solar 3% and wind 3.1%. According to the government, it is estimated that TPES will double to reach 222.4 Mtoe by 2020.

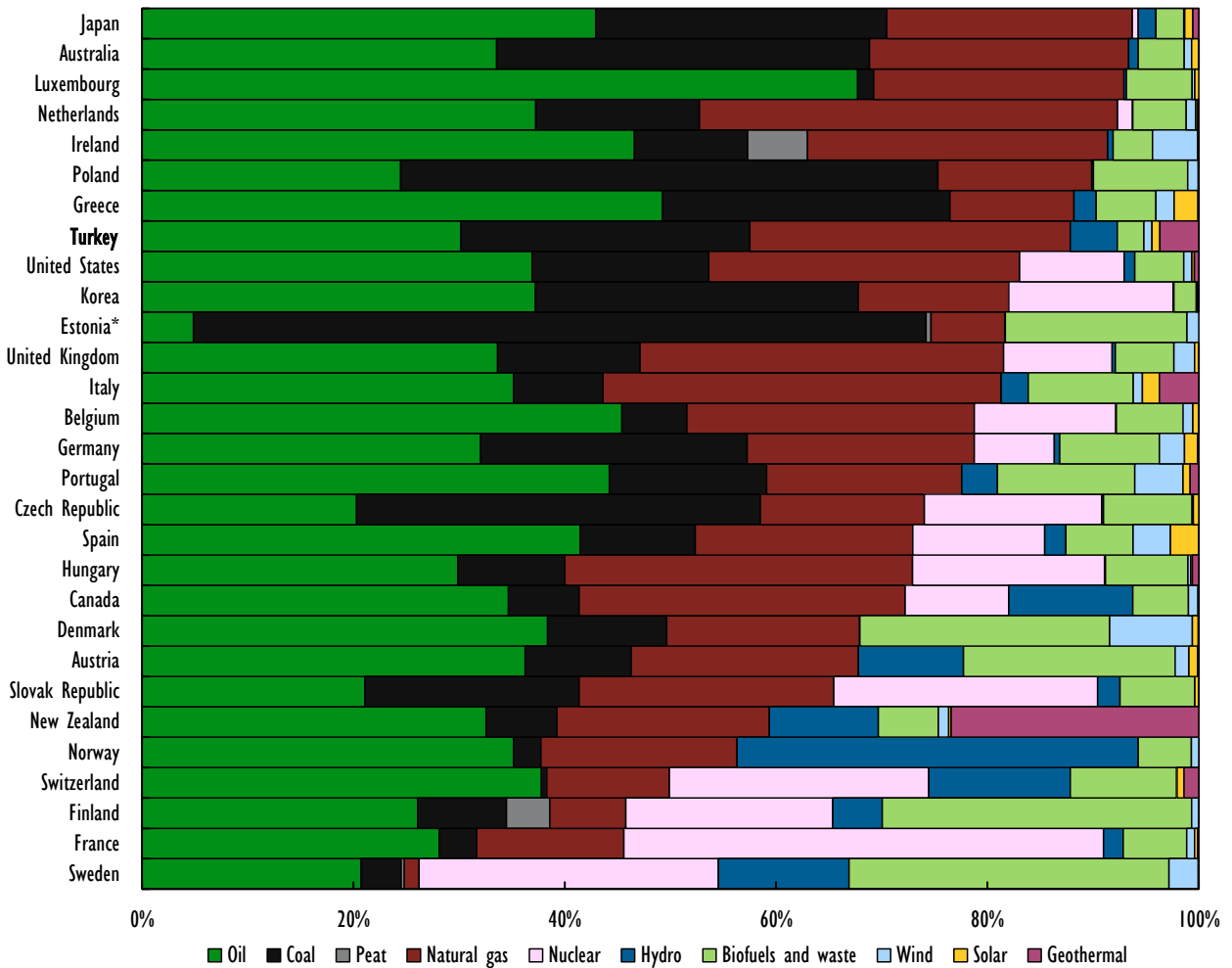
Energy from renewable sources represented 12.1% of TPES, and came from biofuels and waste (2.5%), hydro (4.4%), geothermal (3.7%), solar (0.7%) and wind (0.8%). The share of renewable energy has been volatile over the past ten years, largely reflecting varying levels of hydro basins. Most of the increase in energy demand was met by conventional energy sources.

Turkey has experienced strong growth in its total installed renewable power capacity (increasing from 15.5 gigawatts [GW]) to 28 GW from 2009 to 2014). Turkey has no production or consumption of nuclear energy. Growing energy needs have been met by a higher use of natural gas and oil. Given their limited domestic availability, oil and natural gas supply is almost entirely covered by imports.

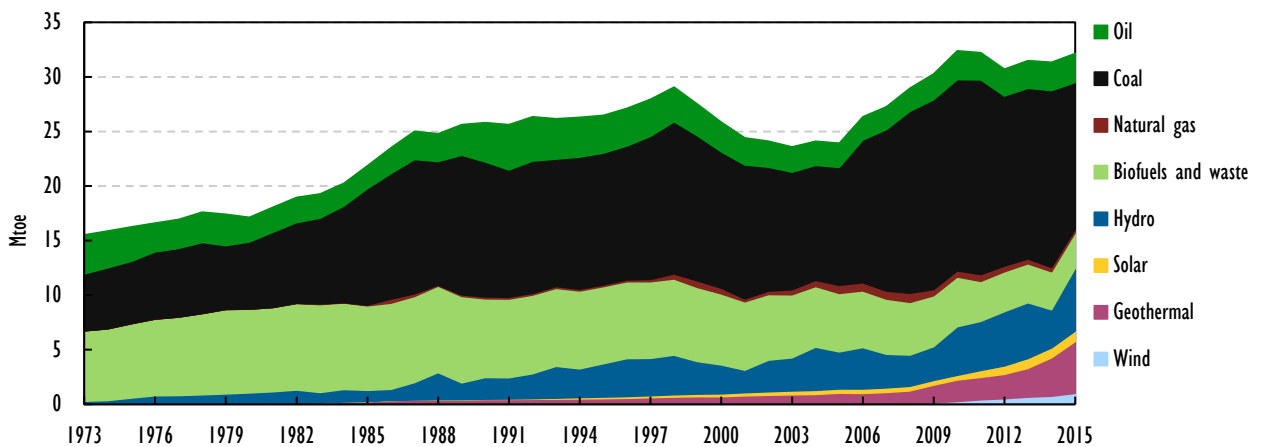
Turkey's energy mix is dominated by fossil fuels which represent 87.6% of TPES in 2015, slightly lowered from the share of 88.1% in 2005. Among IEA member countries, Turkey ranks eighth-highest with regard to the share of fossil fuels in TPES (Figure 2.3), behind Japan (93.7%), Australia (93.4%), Luxembourg (92.9%), the Netherlands (92.3%), Ireland (91.4%), Poland (89.9%) and Greece (88.2%).



**Figure 2.3** Breakdown of TPES in IEA member countries, 2015



**Figure 2.4** Energy production by source, 1973-2015



## DEMAND

Total final consumption (TFC)<sup>2</sup> of Turkey amounted to 85.8 Mtoe in 2014. It represented around 70.6% of TPES, the remainder being power generation and other energy industries (Figure 2.5). Driven by economic growth, final consumption of energy has also increased in all sectors, by 35.8% since 2004.

Oil consumption accounted for 35.6% of TFC in 2014, followed by natural gas (22.6%), electricity (20.6%) and coal (12.3%). Natural gas has been replacing oil use in heating and electricity generation, while geothermal and solar increased marginally, and biofuel use contracted. The initial growth of natural gas consumption was led by the power sector, but residential consumption increased with the expansion of the domestic gas distribution network. In addition, geothermal energy is used in all sectors as direct-use heating, mostly for district heating and partially for individual space heating, domestic hot water supply, greenhouse heating, industrial processes and electricity generation.

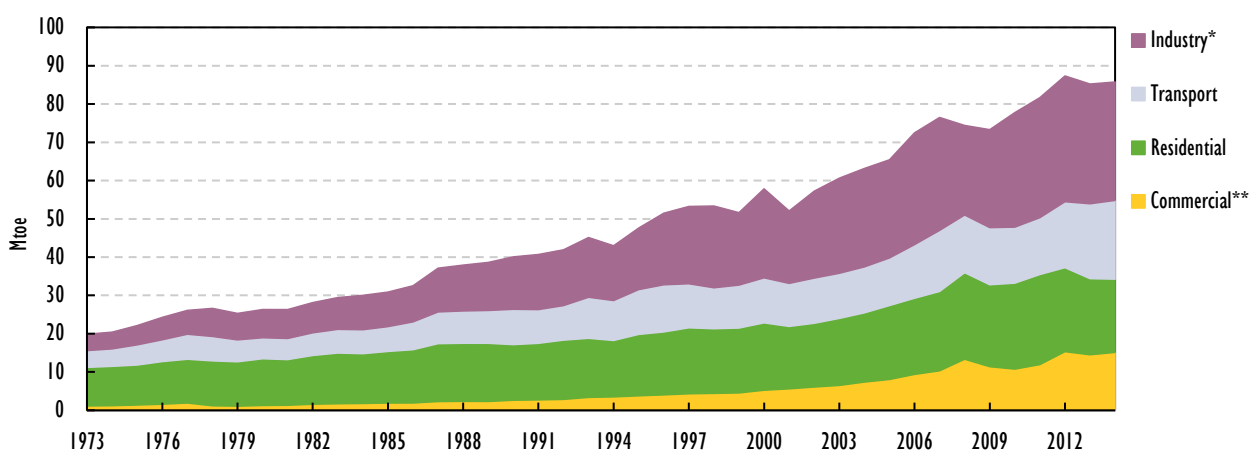
The industry sector is the largest consumer of energy in Turkey, with 36.1% of TFC in 2014, or 30.9 Mtoe, and its energy use has increased by 20.3% since 2004. Coal use dropped by 38.5% and has been replaced mainly by gas, which increased by 207.1%.

Households accounted for 22.3% of TFC, with 19.1 Mtoe, while energy use in the commercial and public services (including agriculture) amounted to 15.1 Mtoe or 17.6% of TFC. While energy demand in households has increased by 5.8% since 2004, demand in the commercial sector grew by 105.4%, more than in any other sector.

Energy use in transport accounts for 24% of TFC or 20.6 Mtoe. Energy use in this sector has contracted since 2008-10.

Turkey will likely see the fastest medium- to long-term growth in energy demand among IEA member countries. According to the government projections, it is estimated that TFC will more than double and reach 170.3 Mtoe by 2020.

Figure 2.5 TFC by sector, 1973-2014



\* Industry includes non-energy use.

\*\* Commercial includes commercial and public services, agriculture, fishing and forestry.

Source: IEA (2016), *Energy Balances of OECD Countries 2016*, [www.iea.org/statistics/](http://www.iea.org/statistics/).

2. TFC is the final consumption by end-users, i.e. in the form of electricity, heat, gas, oil products, etc. TFC excludes fuels used in electricity and heat generation, and other energy industries (transformations) such as refining.

## INSTITUTIONS

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The **Ministry of Energy and Natural Resources (MENR)** has the lead responsibility for formulating and implementing energy policies and programmes, in co-ordination with its attached, related and affiliated institutions and other public and private entities, on the basis of the five-year strategic plan for 2015-19.

MENR's **General Directorate of Energy Affairs (GDEA)** is in charge of the legal framework for the energy markets and reform programmes. The **General Directorate for Foreign Relations and EU (GDFREU)** oversees international energy relations. The **General Directorate for Renewable Energy** is responsible for energy efficiency and renewable energy, as successor of the former Electrical Power Resources Survey and Development Administration (EIE). The **General Directorate for Petroleum Affairs** has the lead on oil exploration and production, including upstream licensing and oil stockholding arrangements. The **General Directorate for Mining Affairs (GDMA)** is responsible for permits and activities in the mining sector. The **Transit Petroleum Pipeline Department (TPPD)** implements the project agreements made for oil and gas transit pipelines. The **Nuclear Energy Project Implementation Organisation (NEPIO)** carries out studies related to the implementation of nuclear energy projects and is responsible for the coordination of relevant organisations to prepare the framework, including the legislation, human resources, education, industry and technology. The **Strategy Development Directorate** is responsible for the preparation of the Strategic Plan of MENR.

MENR has two subordinated, so-called affiliated institutions: the **General Directorate of Mineral Research and Exploration (MTA)**, a research institution, and the **Turkish Atomic Energy Authority (TAEK)** which deals with nuclear policy, the nuclear regulatory framework, nuclear research and development, and nuclear safety.

In co-operation with the **Ministry of Development (MoD)** and the **High Planning Council (YPK)**, MENR is involved in the preparation of the national development plans.

The **Ministry of Environment and Urbanisation (MEU)** is the lead department for domestic and international climate change policies and the implementation of the government's National Climate Change Strategy and Climate Change Action Plan. MEU was created in 2011 by merging the environment departments of the Ministry of Public Works and Settlement with the Ministry of Environment and Forestry. The inter-ministerial **Coordination Committee on Climate Change and Air Management** is the body which co-ordinates the preparation of the national communication to the United Nations Framework Convention on Climate Change (UNFCCC). MENR is responsible for the co-ordination of actions to reduce GHG emissions in the electricity sector. In 2010, the Climate Change Coordination Committee had been established and was restructured to the **Climate Change and Air Management Coordination Committee** in 2013 to open up to the participation of private organisations, such as the Union of Chambers and Commodity Exchanges and the Industry and Business Association.

The **Under-Secretariat of Treasury** carries out the ownership function for the state-owned energy enterprises and prepares their annual financing programmes. The **Ministry of Development (MoD)** prepares the annual investment programmes. **Prime Ministry Privatisation Administration (PA)** had a leading role in liberalising the Turkish electricity market, reducing the state involvement in the economy and attracting private investment.

Following privatisation, several **public companies** remain under the ownership of the Treasury and the direct authority and regulatory oversight of MENR. These public companies are:

- Electricity Group consisting of EÜAŞ (the Electricity Generating Company which owns the remaining non-privatised generation plants); the Turkish Electricity Trade and Contracting Company TETAŞ, TEDAŞ as holding structure of the 21 distribution companies, the energy market operating company EPIAŞ, and the Turkish Electricity Transmission Company TEİAŞ.
- Petroleum Pipeline Corporation (BOTAŞ) – the state-owned crude oil and natural gas pipeline operator and gas trader. It also owns the LNG terminal facility.
- Turkish Petroleum Corporation (TPAO) – the state-owned oil company involved in upstream (exploration, drilling, well completion and production).
- Turkish Hard Coal Enterprises (TTK, for hard coal), the Turkish Coal Enterprises (TKİ, for lignite) and the Electricity Generation Company EÜAŞ together mine about 90% of Turkish coal.
- ETİ Mine Works General Directorate performs the production, exploitation and marketing of Turkey’s boron minerals within the framework of applicable laws.
- General Directorate of Turkish Electromechanics Industry (TEMSAN) is responsible for manufacturing, supplying, installing, operating and trading electric power plants and all equipment related with electricity generation, transmission and distribution.

**The Energy Market Regulatory Authority (EMRA)** is the regulator of the electricity, natural gas, downstream petroleum and liquefied petroleum gas (LPG) products markets. EMRA is responsible for granting licences for activities in the gas and electricity markets for generation (including electricity generated from renewable sources), transmission, distribution, wholesale, retail, import and export.

As the energy regulator, EMRA supervises and monitors the performance of the energy markets, and can impose fines and sanctions, where needed, in addition to its task of ensuring non-discriminatory third-party access at regulated tariffs to the monopoly networks of TEİAŞ, the 21 distribution companies, and BOTAŞ. EMRA’s main decision-making body is the board composed of nine members appointed by the Council of Ministers for a six-year term. EMRA is a public corporation with administrative and financial autonomy. It has also set up the new electricity wholesale exchange EPIAŞ (Enerji Piyasaları İşletme A.Ş.) in Istanbul by presenting the Regulation on the Organisational Structure and Working Principles of EPIAŞ on 1 April 2015 and appointing the Chairman and the Board of Directors.

The **Competition Authority** supports the process of market opening, privatisation and liberalisation, through its decisions and opinions with regard to the authorisation of mergers or acquisitions, scrutiny of market abuse, notably for the distribution of privatisation tenders, and the general monitoring of competition in the electricity and gas markets. It advised in favour of the legal separation of distribution and retail activities as part of the privatisation of distribution companies.

## KEY POLICIES

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### ENERGY STRATEGIES

The objective of Turkey's energy policies is to ensure secure, sustainable and affordable energy by diversifying energy supply routes and source countries, promoting indigenous energy production and energy efficiency to moderate growth of total final consumption.

These energy ambitions are enshrined in the **Vision 2023**, Turkey's economic development strategy to 2023, the year that marks the 100th anniversary of the Republic of Turkey. Vision 2023 comprises a number of energy targets which aim to make Turkey one of the ten largest economies in the world with annual exports of USD 500 billion. In the area of energy, Vision 2023 aims at promoting indigenous energy resources, including coal (lignite), raising the share of wind and geothermal energy in the electricity mix to reach 30%; reducing energy consumption by 20% below 2010 levels, through improved efficiency and starting up two or three nuclear power plants.

The **2009 Electricity Market and Security of Supply Strategy** set in motion the opening of the electricity market, phasing out cross-subsidisation and increasing competition and natural resource utilisation. Security of supply will be improved by increasing regional integration and by ensuring adequate generating capacity through well-functioning electricity wholesale markets, including the creation of the day-ahead, balancing and financial markets. A revision of Electricity Market and Security of Supply Strategy is under way.

In 2012, the High Planning Commission presented the **Energy Efficiency Strategy Paper** which built on the indicative target of the Vision 2023 – reducing Turkey's energy intensity by at least 20% by 2023 – and detailed energy saving targets and actions for every subsector.

Turkey bases policy actions in the energy sector on five-year economic development and strategic sectoral plans to guide investments and government actions across several ministries. In 2013, the government set out the key energy policy objectives in the **10th National Development Plan (2014-18)** (published in the *Official Gazette No. 28699*) which include ambitions to:

- increase domestic supply sources
- decrease import dependence
- diversify supply sources and routes
- realise oil and natural gas pipeline projects
- increase energy efficiency and renewable energy
- decrease consumption of fossil fuels
- improve competitiveness on electricity and natural gas markets
- expand and construct natural gas storage facilities and
- start up the operation of nuclear power plants.

The MENR **Strategic Plan 2015-19** presents the policy actions for the medium term, including 16 goals and 62 objectives. Security of supply is at the forefront with three key objectives: *i)* to ensure strong and reliable energy infrastructure, including supply/demand adequacy planning and investment in reliable natural gas storage facilities (at least 10% of domestic gas consumption or 5.3 bcm in 2019), transmission and distribution networks, and strong electricity transmission and distribution grids meeting N-1<sup>3</sup> rules; *ii)* to ensure the diversity of the fuel mix by limiting the use of imported natural gas in power generation to a share of 38%, by increasing the use of domestic coal (60 TWh by 2019) and renewable energy sources, by fostering indigenous oil and gas production and starting up two nuclear power plants; and *iii)* to manage demand peaks effectively, including market-based demand-side participation mechanisms in the electricity market. Another key priority is energy savings with actions to develop the regulatory framework for energy efficiency, to improve the monitoring capacity of government's energy efficiency policies, and to increase energy efficiency incentives, leading to the creation of an energy efficiency sector.

## ENERGY MARKET REFORMS

Turkey has pursued the reform of the electricity market under the New Electricity Market Law No. 6446 (14 March 2013) and secondary legislation. The Electricity Market Law No. 6446 introduced pre-licensing, which allows companies to obtain permits, approvals, licences from EMRA before starting their investment. The duration of pre-license period is 24 months. In addition, generation facilities using renewable resources with an installed capacity of maximum 1 MW are exempted from the licensing process altogether. The Council of Ministers is authorised to increase this upper limit to 5 MW. Law No. 6446 also created the new concept of market operator, which is a company separate from the system operator TEİAŞ to operate the energy exchange EPIAŞ.

On the retail side, Law No. 6446 includes provisions for the last-resort supplier and for possible special tariffs for vulnerable customers. The electricity market in Turkey does not have free prices, but maintains price regulation. The Law grants the Council of Ministers the right to extend the implementation of the price equalisation system (and thus to allow derogation from cost-reflective pricing) for another five years, which the Council did in 2015. This means that the move to cost-reflective pricing will only be considered after 2020.

Unlike in the electricity market, reforms in the gas market are pending. The Natural Gas Market Law and the Amendment to the Natural Gas Market Law (No. 4646) have only partly been implemented while a new draft Natural Gas Market Law was prepared by the government to contribute to the liberalisation of the natural gas market, and was sent to the Parliament in 2014.

Turkey restructured the oil/gas upstream regime to attract investment in indigenous production. The new Turkish Petroleum Law No. 6491 (of 30 May 2013) was enacted on 11 June 2013, paving the way for the liberalisation of the oil/gas exploration and production activities and for ensuring a more transparent investment environment and audit compulsory oil stocks which will be held by industry.

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**3. N-1** is an indicator for the security of electricity or gas supplies describing a situation where although the largest infrastructure (1) is down, the system can still work.

### SUSTAINABILITY POLICIES

Turkey became a party to the UN Framework Convention on Climate Change (UNFCCC) in 2004 and to the Kyoto Protocol in 2009. Along with other OECD countries, Turkey is an Annex I Party of the UNFCCC. However, since it did not take part in the Annex B of the Protocol because of its special circumstances recognised by the Conference of the Parties (COP), Turkey has been exempted from setting quantitative emission mitigation targets and did not have any mitigation or limitation commitments in the first period (2008-12) of the Kyoto Protocol. Turkey has suffered from being an Annex I party as it could not benefit from Kyoto's flexibility mechanisms, such as the clean development mechanism (CDM), and support from developed countries, including finance, capacity building and technology development despite being a developing country.

In 2010, the Higher Planning Council presented a National Climate Change Strategy for Turkey and, building on this, in 2012, the National Climate Change Action Plan of Turkey (NCCAP) for the period 2011-23. The 5th national communication on climate change was submitted to the UNFCCC in 2013, after the first one in 2007.

On the basis of the NCCAP, Turkey submitted its intended nationally determined contribution (INDC) in October 2015 to the UNFCCC, ahead of the 21st Conference of the Parties (COP21) meeting in Paris. Under its COP21 pledge, Turkey aims to cap GHG emissions from BAU scenario by up to 21% during 2020-30. The 2030 pathway includes renewable energy targets for the transformation sector, such as increasing the solar generating capacity to 10 GW and wind capacity to 16 GW and utilising the full hydroelectric potential. However, ambitions are lower for wind than indicated in previous plans and solar and wind targets remain both behind potentials.

Turkey has experienced the first phase of the deployment of renewable energy, notably wind power, with the creation of the Renewable Energy Resources Support Mechanism (YEKDEM). The mechanism gives the choice between direct marketing and resource- and technology-specific feed-in tariffs (with local content) under the Law Amending the Utilisation of RES in Electricity Generation (Law No. 6094). In recent years, wholesale electricity prices have come down, making YEKDEM the preferred choice of investors. Despite the boom in private investment and the attractive support mechanism, licensing, and grid integration of renewable energy at the transmission and distribution levels remain a challenge, and so do the needed system operation management and network rules, and permitting and spatial planning processes are lengthy.

### ASSESSMENT

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Since the last IEA in-depth review, Turkey has continued its industrialisation and has experienced dynamic population and economic growth. Since the global financial and economic crisis of 2008-09, the country has been impacted by weaker economic demand in its export markets, notably the Euro zone, and despite a good recovery, growth rates have remained moderate. In the medium and longer term, however, energy demand is set to see the fastest growth among IEA countries, and industry production is expected to rebound thanks to lower global oil, coal and gas prices.

Despite valuable indigenous coal and renewable energy resources, the country has low self-sufficiency and the pace of resource development has been behind demand growth. Turkey imports around 80% of its energy needs, nearly all of its oil and gas demand, which keeps increasing its energy import bill (around 60% of the foreign trade deficit).

This represents a significant financial burden and leads to an increase in electricity intensity and CO<sub>2</sub> emissions.

Since the last IEA review in 2009 the Turkish government has been working towards reducing the levels of its import dependence and diversifying the energy mix by introducing nuclear energy and further developing renewable energies, and by improving energy efficiency and making better use of its indigenous resources, in particular hydro, coal, geothermal and unconventional gas. Boosting energy security and economic growth remain the government's main energy policy priorities. Given its position as energy importer, security of supply has prevailed over environmental concerns in the past.

Turkey needs large investments in energy infrastructure, especially in electricity and natural gas, to be able to supply affordable energy to its citizens and to sustain economic growth. Turkey's demand growth and energy-intensive manufacturing industry will require competitive energy supplies. Even under a moderate growth of energy demand, large investments will be needed in gas and electricity infrastructure, notably in generation and transportation. The Turkish electricity grid faces challenges from fast demand growth as the main centres of consumption are located around Ankara, Istanbul and Izmir, far away from the resources - coal mines (west) and hydro generation areas (east). The Observatory of the Mediterranean estimates that more than USD 260 billion is needed in the energy sector by 2030, around two-thirds before 2023 (OME, 2014). The electricity sector alone is expected to account for more than 65%. In order to attract investment, competitive energy markets are a prerequisite and the government should go further to improve and implement the legal framework.

Major improvements of the legal framework were achieved in the energy sector since 2009. Despite several attempts to introduce new reforms, the transition to full market price mechanisms has not been completed and parts of the markets maintain regulated prices. Since 2014, Turkey's reforms are at the crossroads and the pace of energy market reforms has slowed down. All of this makes investment planning increasingly uncertain and difficult for the private sector. In 2016, the government announced its commitment to the reform agenda. In this context, the IEA encourages the government to implement a market approach and complete the privatisation process in the electricity sector (hydropower, thermal power plants) and the gas market reforms. To attract the necessary investment, the country needs to continue its energy market reforms.

After their collapse in 2014, oil prices have risen slightly since April 2016. Turkey has significant potential to make energy savings in several key sectors, but the exact potential remains unquantified. In February 2012, the government adopted an energy efficiency strategy with the objective to reduce energy intensity by 20% by 2023. Turkey has harmonised its legal framework with the EU framework on energy efficiency in buildings and labelling, but has not fully implemented the EU Energy Efficiency Directive. The IEA considers that improvements in implementing energy efficiency policy actions are vital to achieve the longer-term climate goals and energy savings in buildings, industry and the transport sectors. MENR Strategic Plan rightly focuses on creating the institutional capacities and market framework for energy efficiency services to take off. Energy efficiency is a key policy for the mitigation of climate change impacts and the reduction of GHG emissions.

Turkey is an Annex I Party of the UNFCCC, but has been exempt from setting quantitative emission mitigation targets given its special circumstances. The government presented a



National Climate Change Strategy in 2010, followed by the National Climate Change Action Plan in July 2011. The Action Plan includes short and long-term objectives with 541 actions for mitigating GHG emissions, without setting quantitative subsector targets, priorities for action or specific milestones for review and evaluation. Commendably, Turkey presented in October 2015 a quantitative emissions reduction target which aims to cap the rise in GHG emissions from Business-As-Usual levels by 21% by 2030 as its climate pledge to COP21. At the same time, the government envisages an increase in domestic coal-fired power generation, reaching 60 TWh by 2019.

Since 2009, Turkey has focused all efforts on the implementation of the 2023 targets and the 2009 Electricity Market and Security Strategy. In addition, the government set out new policy and fuel targets in several sectoral plans, including targets for the share of coal, natural gas and renewable energy in the electricity mix, which are not aligned, do not build on market fundamentals and are not consistent with the long-term goals. In order to devise mechanisms for GHG mitigation and avoid carbon “lock-in” in the mid-term future, the government will need to ring-fence energy policies against market trends, notably lower energy prices, and commit to secure and sustainable pathways.

Turkish energy policies could benefit from an integrated energy and climate strategy which would set out longer-term targets beyond 2023, consistent with the COP21 pledge for 2030. Therefore, in a first phase, priorities should be defined for achieving 2023 targets in a way that is consistent with the 2030 longer-term GHG emissions reduction goal. Such a strategy shall be based on energy demand/supply scenarios, and the cost-effectiveness of policies and measures. Secondly, progress towards the targets should be regularly tracked, through performance-based intermediate targets and energy and climate indicators, and resources should be allocated accordingly.

### RECOMMENDATIONS

*The government of Turkey should:*

- *Building upon the COP21 pledge and the Vision 2023, adopt an integrated long-term energy and climate strategy for 2030, based on energy demand/supply scenarios, performance-based targets, energy and climate policy indicators, and the cost-effectiveness of policies and measures, complemented by a mechanism for the monitoring and tracking of progress.*
- *Allocate adequate financial and human resources to the main institutions in order to implement policy reforms and ensure energy data and statistics collection and evaluation.*

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### References

IEA (International Energy Agency), (2016), *Energy Balances of OECD Countries 2016*, OECD/IEA, Paris, [www.iea.org/statistics/](http://www.iea.org/statistics/).

OME (Observatory of the Mediterranean), (2014), *Mediterranean Energy Perspectives – Turkey*, Paris.

OECD (2016), *Economic Survey of Turkey*, OECD/IEA, Paris.

### 3. CLIMATE CHANGE

#### Key data (2014)

**GHG emissions without LULUCF\***: 467.6 MtCO<sub>2</sub>-eq, +125% since 1990

**GHG emissions with LULUCF\***: 407.7 MtCO<sub>2</sub>-eq, +129% since 1990

**CO<sub>2</sub> emissions from fuel combustion**: 307.1 MtCO<sub>2</sub>, +141.6% since 1990

**CO<sub>2</sub> emissions by fuel**: coal 43%, natural gas 30.5%, oil 26.5%, other 0.1%

**CO<sub>2</sub> emissions by sector**: power generation 43%, transport 19.8%, manufacturing and construction 14.6%, residential 9.1%, commercial and other services 9.7%, other energy industries 3.7%

\* UNFCCC, 2016.

#### GREENHOUSE GAS EMISSIONS

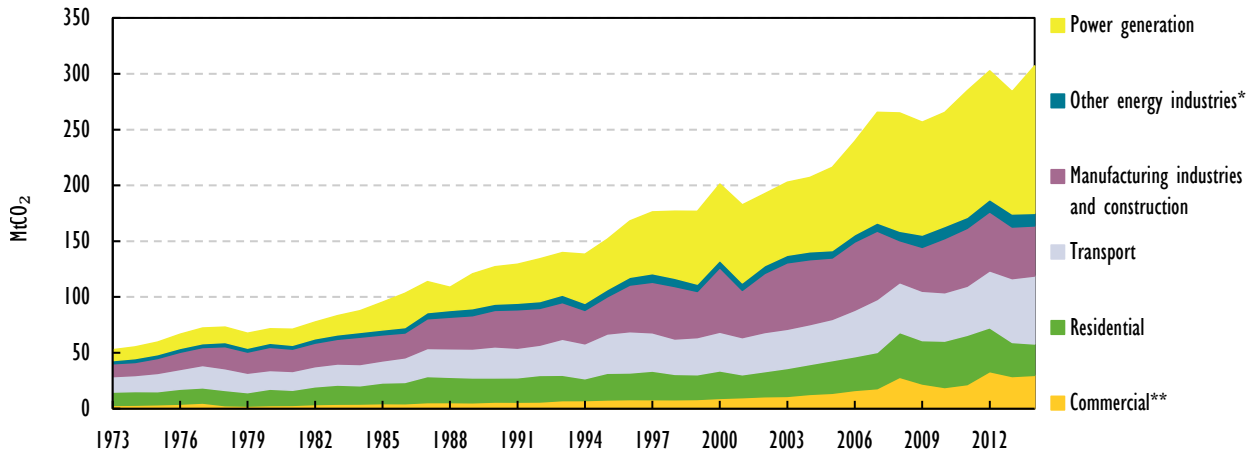
Carbon dioxide (CO<sub>2</sub>) accounted for 81.7% of total greenhouse gas (GHG) emissions in 2014, followed by methane (CH<sub>4</sub>) for 12.2%, nitrous oxide (N<sub>2</sub>O) for 5%, hydrofluorocarbons (HFCs) for 1.1%, according to Turkey's National Greenhouse Gas Inventory Report (UNFCCC, 2016). CO<sub>2</sub> emissions from fuel combustion are driven by transport and power generation sector emissions, followed by industrial processes and agriculture.

#### ENERGY-RELATED CO<sub>2</sub> EMISSIONS

Turkey's energy-related CO<sub>2</sub> emissions have been increasing steadily, and were 141.6% higher in 2014 than in 1990 (Figure 3.1). CO<sub>2</sub> emissions from fuel combustion were 307.1 Mt in 2014, 8.1% above the record high in 2013 (284 Mt). The largest CO<sub>2</sub> emitter in Turkey is power generation, accounting for 43% of the total. Transport and industry account for 19.8% and 14.6%, respectively, while households and the commercial and public services sector (including agriculture) emit 9.1% and 9.7% of the total, in that order. Other energy industries (including refining) account for the remaining 3.7%. Much of the increase in total emissions is driven by the power generation sector. Compared to 1990, emissions were 294.8% higher in 2014, with the share of total emissions increasing from 26.3%.

Compared to 2008, the strongest rise in emissions has been in transport (by 36.4%), other energy industries (by 32.3%) and power generation (by 24.8%), while emissions from manufacturing and the commercial and services sector increased by 19.4% and 6.2%, respectively. Conversely, households reduced their emissions by 30% during 2008-14. Compared to 1990, emissions from commercial and public services (including agriculture) have risen rapidly, up by 405.6% from a share of 4.6% of the total. Emissions in transport and other energy industries doubled during 1990 to 2014, while industry and household emissions only grew by 37.3% and 30%.

**Figure 3.1** CO<sub>2</sub> emissions by sector, 1973-2014



\* Other energy industries includes other transformations and energy own-use.

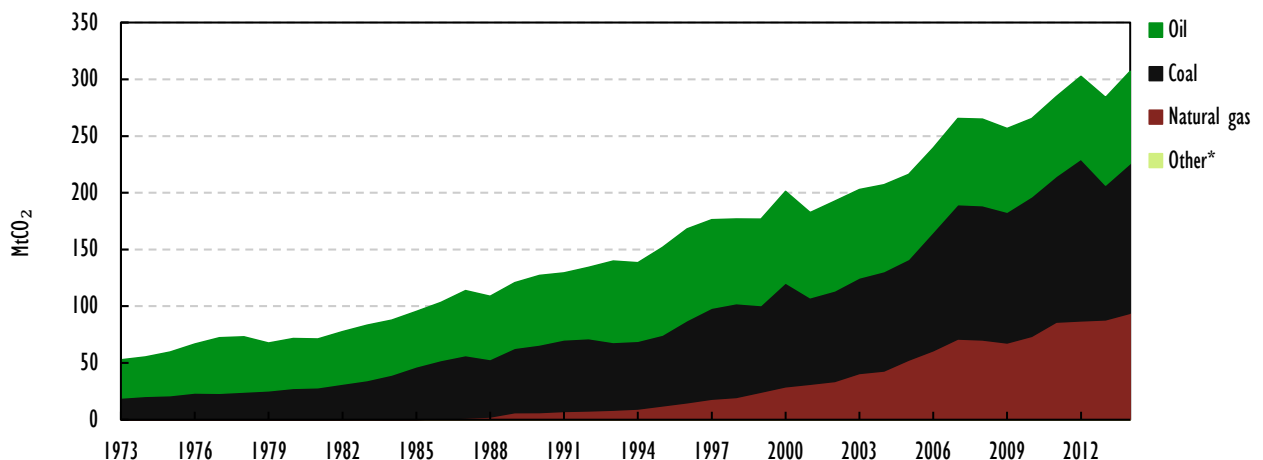
\*\* Commercial includes commercial and public services, agriculture/forestry and fishing.

Source: IEA (forthcoming), *CO<sub>2</sub> Emissions from Fuel Combustion 2016*, [www.iea.org/statistics/](http://www.iea.org/statistics/).

Most of the CO<sub>2</sub> emissions from fuel combustion relate to coal use, namely 43%. Coal is used across the economy, mainly in power generation and industry, both being large emitting sectors. Emissions from natural gas represent 30.5%, mainly from power generation. Those from oil, mainly used in the transport sector, account for 26.5%.

Compared to 1990, emissions from natural gas grew by 1 388.3%, increasing from a low share of 4.9% of the total. Emissions from coal doubled, while emissions from oil were up by 32.8%. In 1990, oil was the dominant fuel with 48.2% of total emissions, while emissions from coal accounted for 46.9%. In many ways, natural gas has helped to reduce emissions from coal.

**Figure 3.2** CO<sub>2</sub> emissions by fuel, 1973-2014



\* Other includes industrial waste and non-renewable municipal waste (negligible).

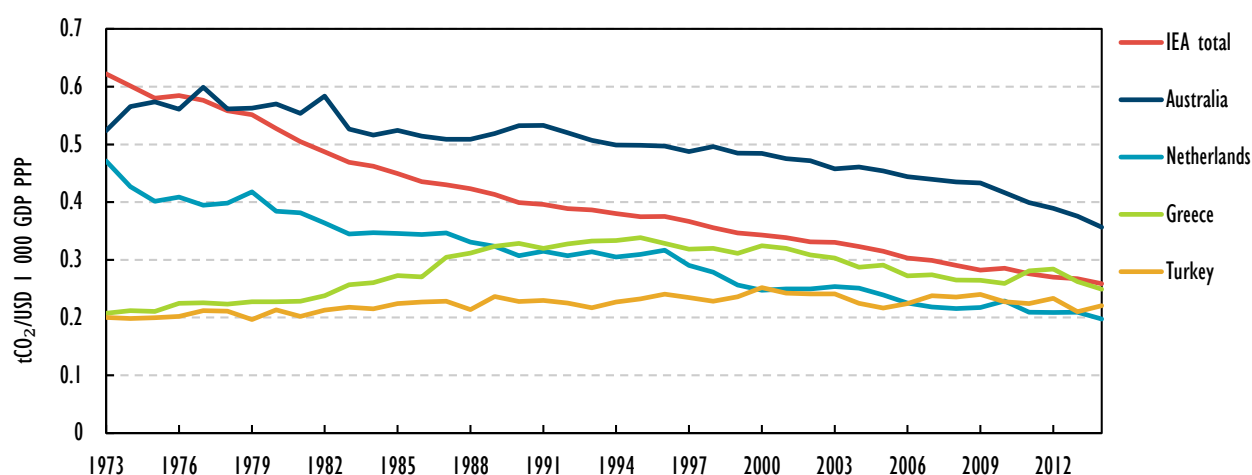
Source: IEA (forthcoming), *CO<sub>2</sub> Emissions from Fuel Combustion 2016*, [www.iea.org/statistics/](http://www.iea.org/statistics/).

## CARBON INTENSITY

Turkey's carbon intensity, measured as CO<sub>2</sub> emissions by real gross domestic product adjusted for purchasing power parity (GDP PPP), amounted to 0.2 tonnes of CO<sub>2</sub> per USD 1 000 PPP (tCO<sub>2</sub>/USD 1 000 PPP) in 2014. Turkey's carbon intensity is at the IEA average but higher than the IEA Europe average of 0.18 tCO<sub>2</sub>/USD 1 000 PPP and has been relatively stable, whereas the IEA average has dropped considerably (Figure 3.3).

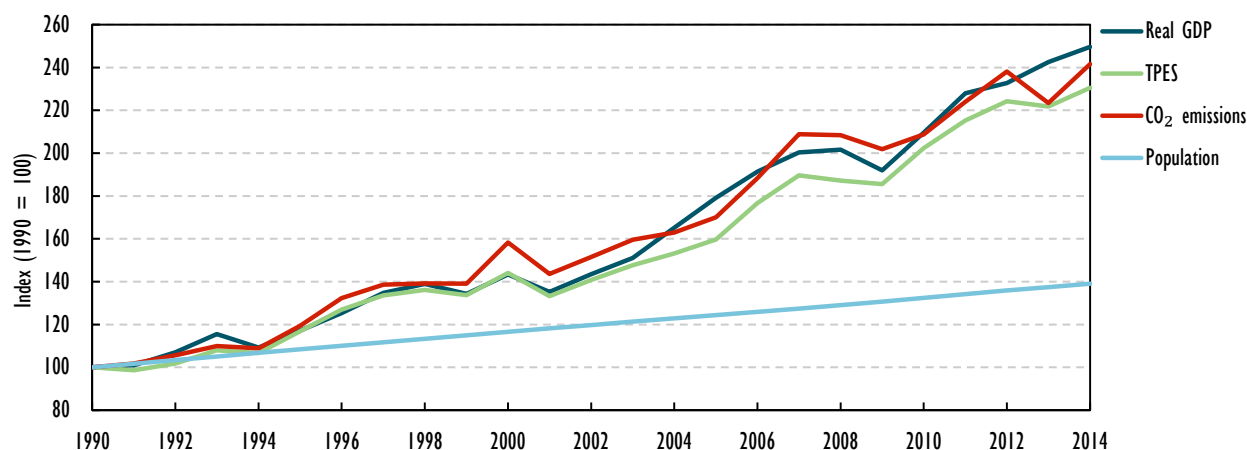
In 2014, Turkey's per capita greenhouse gas (GHG) emissions were 4 tonnes of CO<sub>2</sub>-equivalent (tCO<sub>2</sub>-eq), much lower than the IEA (10.1 tCO<sub>2</sub>-eq). Per capita emissions are growing fast (while the IEA average is falling) and the electricity sector is the most carbon-intensive segment with around 478 gCO<sub>2</sub>/kWh.

**Figure 3.3** Energy-related CO<sub>2</sub> emissions per unit of GDP in Turkey and in other selected IEA member countries, 1973-2014



Source: IEA (forthcoming), *CO<sub>2</sub> Emissions from Fuel Combustion 2016*, [www.iea.org/statistics/](http://www.iea.org/statistics/).

**Figure 3.4** CO<sub>2</sub> emissions and main drivers in Turkey, 1990-2014



Sources: IEA (forthcoming), *CO<sub>2</sub> Emissions from Fuel Combustion 2016*, [www.iea.org/statistics/](http://www.iea.org/statistics/).

## INSTITUTIONS

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The **Ministry of Environment and Urbanisation** (MEU) supervises and co-ordinates national and international activities related to climate change mitigation and adaptation. The **Climate Change Department** within the **General Directorate of Environmental Management** is the focal point of the implementation of the national climate change policies. The department's four divisions deal with climate change-related international obligations, including GHG monitoring, ozone layer protection, adaptation, and preparing national communications for the UNFCCC. MEU is responsible for the enforcement of climate change policies and their co-ordination.

Since 2004, an inter-ministerial **Coordination Board on Climate Change and Air Management** leads the preparation of the national UNFCCC communication, a process which is co-ordinated by MEU. The Board operates through seven thematic working groups whose members are from the government and industry, with observers from non-governmental organisations (NGOs), academia and business associations, including the Turkish Union of Chambers and Commodity Exchanges (TOBB), the Turkish Industry and Business Association (TUSIAD), the Independent Industrialists and Businessmen's Association (MUSIAD).

## POLICIES AND MEASURES

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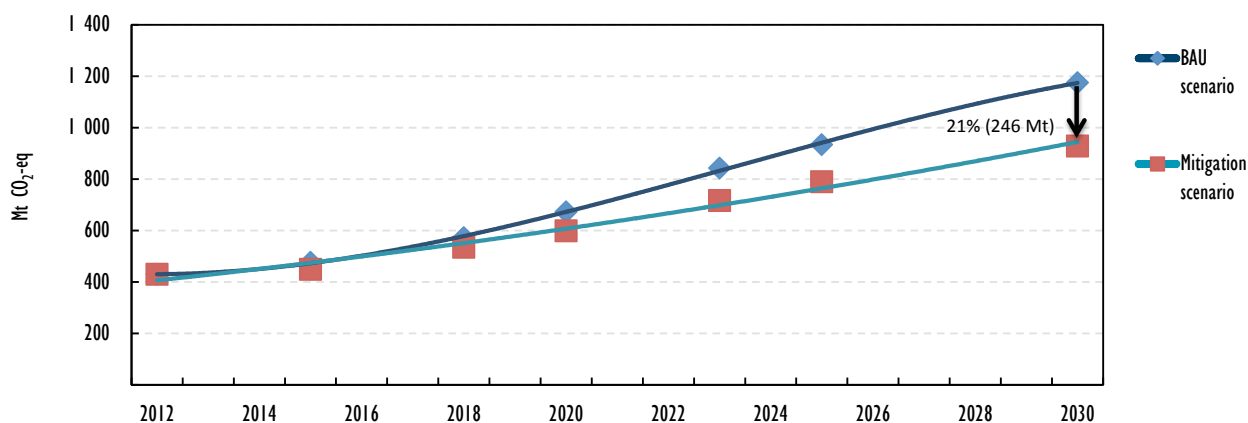
### TARGETS

Turkey became a party to the UNFCCC in 2004 and to the Kyoto Protocol in 2009. Along with other OECD countries, Turkey is an Annex I Party of the UNFCCC. However, since it did not take part in the Annex B of the Protocol because of its special circumstances as a developing country, recognised by the Conference of the Parties, Turkey was exempted from setting quantitative emission mitigation targets and did not have any mitigation or limitation commitments in the first period (2008-2012) of the Kyoto Protocol.

Turkey has suffered from being on the Annex I list as it could not benefit from Kyoto's flexibility mechanisms such as the clean development mechanism (CDM) and support such as finance, capacity building and technology development from developed countries despite being a developing country. At the 20th Conference of the Parties (COP20), held in Peru in 2014, it was decided that Turkey could access the technology, capacity building and financial support while attempting to mitigate climate change and its adverse effects at least up to 2020.

In 2015, Turkey submitted its first-ever nationally determined contribution (NDC) to the UNFCCC 21st Conference of the Parties (COP21) meeting in Paris.

Under its COP21 pledge, Turkey envisages a reduction of its GHG emissions of up to 21% below the BAU scenario during 2021 to 2030 (see Figure 3.5). During this period, GHG emission mitigation is expected to come from significant development of renewable energy, especially in the power sector, such as increasing solar generating capacity up to 10 000 megawatts (MW) and wind capacity up to 16 000 MW and utilising the full hydroelectric potential capacity by 2030.

**Figure 3.5** Total GHG emissions under BAU and mitigation scenarios, 2010-30

Sources: Republic of Turkey (2015), *Intended Nationally Determined Contribution (INDC)*, October 2015.

## MEASURES

In 2010, the Higher Planning Council presented a National Climate Change Strategy for Turkey. Building upon the strategy, the National Climate Change Action Plan of Turkey (NCCAP) for the period 2011-23 was published in 2012. The government prepared, in the framework of the United Nations Development Programme (UNDP), its first national communication under the UNFCCC in 2013. A monitoring system for the NCCAP was established in 2011 and NCCAP Monitoring Reports are being prepared. However, there are no indicators or quantitative benchmarks for assessing progress in the 541 actions of the NCCAP. Turkey is seeking to improve its evaluation tools and assessments with a view to revise the NCCAP in the coming years, including through capacity building and the legal approximation to the EU legislation (*EU acquis*).

A capacity-building project in the field of climate change will be funded in the context of the Instrument for the Pre-Accession Assistance (IPA-1) programme. It will help take into account climate change concerns about buildings, waste, transport and agriculture sectors by determining the costs and emission mitigation potentials and the development of an analytical basis for the long-term green growth strategy that will reconcile climate change, growth and energy security objectives and contribute to sustainability of these sectors. The IPA activities are ongoing in this regard so that the revised NCCAP will be completed at the end of 2017. The review of existing strategies, legislative gap analysis and preparation of regulatory and sectoral impact assessment of the EU climate *acquis* will be an important requirement to comply with EU legislation.

## AIR POLLUTION

Reducing harmful emissions and air pollutants (notably nitrogen oxides, sulphur dioxide and particulate matters) from coal-fired power plants and industrial installations as well as from road transportation (trucks and passenger cars) has been included among the goals and measures set out in the National Climate Action Plan of Turkey. The harmonisation of Turkish legislation with EU *acquis* on emission controls is under way. Turkey is transposing the Environmental Impact Assessment Directive and the Sulphur in Fuels Directive into national legislation. All new power plants must comply with the EU Large Combustion Plant Directive (LCPD) Industrial Emission Directive and existing ones

by 2019. The government largely privatised its coal-fired capacity, and so private companies will need to decide on closing or upgrading their old coal plants to comply with EU provisions. The preferred technology for new lignite and asphaltite-fuelled power plants is the circulating fluidized bed (CFB) technology. Over the past decade Turkey has developed clean coal solutions. There are a number of new coal-based power plants which have adopted supercritical technology. However, there are still many sub-critical thermal plants which emit heavy metals, such as mercury, and persistent organic pollutants (POPs), dioxins and polycyclic aromatic hydrocarbons. Air quality is an increasing concern in Turkey, notably in the large cities, stemming from emissions in the energy sector, coal combustion in residential, industrial heating and power generation, maritime and road transport and industrial processing. Around 97% of the urban population in Turkey is exposed to levels of particulate matter (PM<sub>10</sub>, PM<sub>2.5</sub>) which are the highest in Europe, higher than the limits set by the European Union and the World Health Organization (EEA, 2013). Ankara has PM yearly average concentrations of 58 ug/m<sup>3</sup>, and Istanbul 48 ug/m<sup>3</sup> (because of its sea-side location). The OECD estimated in 2010, 28 924 people in Turkey died prematurely from ambient PM and ozone exposure (OECD, 2014). The Ministry of Environment and Urbanisation set up an air quality monitoring system on its website ([www.havaizleme.gov.tr](http://www.havaizleme.gov.tr)) based on data from the local monitoring stations for sulphur dioxide (SO<sub>2</sub>), nitrous dioxide (NO<sub>2</sub>) and PM<sub>10</sub>. Recorded air pollutants are the highest in Eastern Turkey.

### Box 3.1 Energy and air pollution

Each year an estimated 6.5 million deaths are linked to air pollution with the number set to increase significantly in coming decades unless the energy sector takes greater action to curb emissions. No country is immune as a staggering 80% of the population living in cities that monitor pollution levels are breathing air that fails to meet the air quality standards set by the World Health Organization. Energy production and use – mostly from unregulated, poorly regulated or inefficient fuel combustion – are the most important man-made sources of key air pollutant emissions: 85% of particulate matter and almost all of the sulfur oxides and nitrogen oxides. They are released into the atmosphere from factories, power plants, cars, trucks, as well as the 2.7 billion people still relying on polluting stoves and fuels for cooking (mainly wood, charcoal and other biomass). The IEA calls for government action in three key areas:

- Setting an ambitious long-term air quality goal, to which all stakeholders can subscribe and against which the efficacy of the various pollution mitigation options can be assessed.
- Putting in place a package of clean air policies for the energy sector to achieve the long-term goal, drawing on a cost-effective mix of direct emissions controls, regulation and other measures, giving due weight to the co-benefits for other energy policy objectives.
- Ensuring effective monitoring, enforcement, evaluation and communication: keeping a strategy on course requires reliable data, a continuous focus on compliance and on policy improvement, and timely and transparent public information.

Source: IEA (2016), *World Energy Outlook, Special Report on Energy and Air Quality*, OECD/IEA, Paris.

**Table 3.1** Measures planned to implement Turkey's intended nationally determined contribution (INDC)

Sector	Measures
<b>Energy / power sector</b>	<ul style="list-style-type: none"> <li>▪ Increasing capacity of production of electricity from solar power to 10 GW until 2030.</li> <li>▪ Increasing capacity of production of electricity from wind power to 16 GW until 2030.</li> <li>▪ Tapping the full hydroelectric potential.</li> <li>▪ Commissioning of a nuclear power plant until 2030.</li> <li>▪ Reducing electricity transmission and distribution losses to 15% by 2030.</li> <li>▪ Rehabilitation of public power plants.</li> <li>▪ Establishment of micro-generation, co-generation systems and production on site at electricity production.</li> </ul>
<b>Industry</b>	<ul style="list-style-type: none"> <li>▪ Implementing the National Strategy and Action Plan on Energy Efficiency.</li> <li>▪ Increasing energy efficiency in industrial installations and financial support to energy efficiency projects.</li> <li>▪ Studying ways to increase the use of waste as an alternative fuel in appropriate sectors.</li> </ul>
<b>Transport</b>	<ul style="list-style-type: none"> <li>▪ Ensuring balanced utilisation of transport modes in freight and passenger transport by reducing the share of road transport and increasing the share of maritime and rail transport.</li> <li>▪ Enhancing combined transport.</li> <li>▪ Implementing sustainable transport approaches in urban areas.</li> <li>▪ Promoting alternative fuels and clean vehicles.</li> <li>▪ Reducing fuel consumption and emissions of road transport thanks to the National Intelligent Transport Systems Strategy Document (2014-23) and its Action Plan (2014-16).</li> <li>▪ Realising high-speed railway projects.</li> <li>▪ Increasing urban railway systems.</li> <li>▪ Achieving fuel savings by tunnel projects.</li> <li>▪ Scrapping old vehicles from circulation.</li> <li>▪ Implementing green port and green airport projects to ensure energy efficiency.</li> <li>▪ Implementing special consumption tax exemptions for maritime transport.</li> </ul>
<b>Buildings and urban transformation</b>	<ul style="list-style-type: none"> <li>▪ Constructing new energy-efficient residential buildings and service buildings as in accordance with the Energy Performance of Buildings Regulations.</li> <li>▪ Creating energy performance certificates for new and existing buildings so as to control energy consumption and GHG emissions and to reduce energy consumption per square metre.</li> <li>▪ Reducing the consumption of primary energy sources in new and existing buildings by means of design, technological equipment, building materials, development of channels that promote the use of renewable energy sources (through loans, tax reduction, etc.).</li> <li>▪ Disseminating "green" buildings, passive energy, zero-energy house design in order to minimise the energy demand and to ensure local production of energy.</li> </ul>
<b>Agriculture</b>	<ul style="list-style-type: none"> <li>▪ Saving fuel by land consolidation in agricultural areas.</li> <li>▪ Rehabilitation of grazing lands.</li> <li>▪ Controlling the use of fertilisers and implementing modern agricultural practices.</li> <li>▪ Supporting the minimum tillage method.</li> </ul>
<b>Waste</b>	<ul style="list-style-type: none"> <li>▪ Sending solid wastes to managed landfill sites.</li> <li>▪ Fostering the reuse, recycle and use of processes to recover secondary raw materials, to utilise as energy source or to remove wastes.</li> <li>▪ Recovering energy from waste by using processes such as material recycling of wastes, bio-drying, bio-methanisation, composting, advanced thermal processes or incineration.</li> <li>▪ Recovering methane from landfill gas or from managed and unmanaged landfill sites.</li> <li>▪ Utilising industrial wastes as an alternative raw material or alternative fuel in other industrial sectors, through industrial symbiosis approach.</li> <li>▪ Conducting relevant studies to utilise wastes generated from breeding farms and poultry farms.</li> <li>▪ Rehabilitating unmanaged waste sites and ensuring that wastes are deposited at managed landfill sites.</li> </ul>
<b>Forestry</b>	<ul style="list-style-type: none"> <li>▪ Increasing sink areas and preventing land degradation.</li> <li>▪ Implementing the Action Plan on Forestry Rehabilitation and the National Afforestation Campaign.</li> <li>▪ The National Action Plan for Combating Desertification.</li> <li>▪ The National Action Plan for Combating Erosion.</li> <li>▪ The National Action Plan for Upper Catchment Flood Control.</li> <li>▪ The National Action Plan for Dam Catchments Green Belt Afforestation.</li> <li>▪ The land degradation neutrality (LDN) activities and lessons learnt from LDN pilot project.</li> <li>▪ Preparatory works on soil database and Turkey's carbon soil map.</li> </ul>



## CLIMATE CHANGE ADAPTATION

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In 2012, MEU presented a National Climate Change Adaptation Strategy and Action Plan (MEU, 2012), following co-operation with the United Nations Joint Programme on Enhancing the Capacity of Turkey to Adapt to Climate Change.

The Turkish State Meteorological Service (TSMS) started to produce long-term regional climate projections with high resolutions for Turkey on the basis of a regional climate model, encompassing Turkey. According to the results obtained in early 2015 and published the same year (TSMS, 2015) from three global climate/earth systems models or GCMs (HadGEM2-ES, MPI-ESM-MR, GFDL-ESM2M) and two scenarios (RCP4.5 and RCP8.5), the average rise in annual temperature for 2016-40 in Turkey is expected to vary between 1.0°C and 2°C. In the period 2041-70, the increase in surface temperature is expected to vary between 1.5°C and 4.0°C. In the last period (2071-99) the average annual temperature rise is expected to vary between 1.5°C and 5°C. In some scenarios, it is projected that the temperature will rise by 3.0°C in winter and 8.0°C in summer in the last 30 years of the 21st century (2071-2100). The increase will be higher in winter for the eastern and inner parts of the country, while it will be higher in summer for south-eastern Turkey and the coastal regions except the Black Sea region.

The TSMS noted an increase in winter precipitation in most of the country in all periods, a decrease in spring precipitation except in the coastal and north-eastern parts of the country in all periods a decrease in summer precipitation except in the western coastal and north-eastern parts of the country in all periods, and a decrease in autumn precipitation, except in some parts of the country in all periods. With regard to precipitation projections, a small quantitative decrease is visible. There is no regular decrease or increase trend throughout the projection period (2016-19); however, the irregularity of precipitation attracts attention.

Climate change scenarios for Turkey propose an increase in the average temperature and a decrease in rainfall except in winter. Turkey's power sector relies on large shares of hydropower. Because of natural disasters, drought periods and other impacts from climate change, Turkey is likely to face challenges with regard to adaptation in future decades. In the power sector, the periods of serious and extended droughts place serious challenges to electricity security. For instance, lack of precipitation in 2014 substantially reduced reservoir levels at hydropower dams, resulting in a 30% drop in hydroelectric production. Beyond absolute declines in precipitation, the projected shift of precipitation from winter to warmer months of the year will require seasonal adjustments in water management, including for hydroelectricity production.

Increases in water temperature will also pose risks for thermal power generation (natural gas, coal and nuclear) in Turkey by increasing demand for cooling water. Promoting more water-efficient cooling technologies such as wet cooling towers or dry cooling, as opposed to once-through cooling, can help reduce water requirements of thermal power plants. Pursuing measures to improve both water and energy efficiency can also provide co-benefits for reducing emissions.

Sea level rise, coastal flooding and extreme weather events can also threaten energy infrastructure. Supportive policies and standards to "harden" infrastructure and ensure robust emergency response measures can help reduce vulnerability and exposure to these hazards.

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**ASSESSMENT**

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Turkey's CO<sub>2</sub> emissions from fuel combustion stood at 307.1 MtCO<sub>2</sub> in 2014 which marks an increase by 50.4% since 2000 and by 141.6% since 1990. This was the highest increase among IEA member countries (IEA, 2015); by comparison, the People's Republic of China saw its CO<sub>2</sub> emissions rise by 307% since 1990. CO<sub>2</sub> emissions intensity of the Turkish economy is around the IEA average, but its carbon intensity per capita is much lower than in other IEA member countries. There should be no complacency based on per capita emissions, as the energy sector, notably the electricity generation is the most carbon-intensive sector with fossil fuels dominating the electricity mix. Coal use is also high in the residential sector and industry as well as in power generation. While natural gas use in power generation has replaced coal as the leading combustible, the government has plans to increase the use of coal in the coming decade to reach 60 TWh by 2019.

Since the previous IEA review in 2009, Turkey made progress in supporting global efforts against climate change.

The Turkish government's reorganisation of the Climate Change and Air Management Cooperation Committee in 2013 opened the participation of private organisations, including business associations, so as to ensure better co-ordination of climate and energy policies among stakeholders. In terms of the legal and political mandate and capacity, environmental institutions in Turkey have been strengthened with the creation of MEU in 2011.

Turkey had become a party to the UN Framework Convention on Climate Change (UNFCCC) in 2004 and to the Kyoto Protocol in 2009. Along with other OECD countries, Turkey is an Annex I Party of the UNFCCC. Since it did not take part in Annex B of the Protocol and given its special circumstances as an emerging economy, Turkey was exempted from setting quantitative emission mitigation targets under the Kyoto commitment period.

In May 2010, on the basis of the National Climate Change Strategy (NCCS) and relying on the UNFCCC principle of common but differentiated responsibility and respective capabilities, the government presented its Climate Change Action Plan 2011-23 (NCCAP) in 2012. The NCCAP is a roadmap which covers all sectors and identifies 541 short-, medium- and long-term actions for mitigating climate change. It focuses on promoting energy efficiency, renewable energy, clean technology and public awareness campaigns to limit GHG emissions. Under the Kyoto Protocol, Turkey has relied on being exempted from setting binding targets, arguing it had specific national circumstances.

Turkey does not have specific climate change legislation, outside of the NCCAP and the environmental law.

Based on the NCCAP, Turkey, for the first time in its history, submitted in 2015 to the UNFCCC its NDC which aims to cap the increase in GHG emissions to 21% from the business-as-usual increase between 2021 and 2030. With its new target, Turkey provides an important signal to other countries of its commitment and intent to contribute to the global efforts against climate change. Turkey is also better situated to access support for finance, technology and capacity building to enhance its ability to implement its Action Plan. The IEA commends Turkey for this progress.

As a rapidly developing economy with low emissions per capita, Turkey will now need to work on concrete measures towards the implementation of its mitigation target for the post-2021 period up to 2030. This also includes the evaluation of existing government targets and policy goals, notably the stated objective of using the country's domestic coal potential to foster energy security by 2023.

Under its current NDC, Turkey's emissions will still be rising in 2030, as current policy measures will not make GHG emissions peak. The IEA invites the government to consider devising a low-carbon development strategy, as the 2015 Paris Agreement demands from its signatories, with a view to peak and decline emissions. The IEA has identified five key actions in the Bridge Scenario (IEA, 2015) that can significantly reduce emissions between now and 2030 beyond the levels in the NDCs with zero impact on GDP growth and with co-benefits in terms of air quality and energy security. Turkey should consider whether more could be done in terms of such "win-win" actions to further strengthen its 2030 target. This could help ensure that energy needs are met without locking in infrastructure that is incompatible with longer-term goals. The IEA urges the government to adopt a long-term low-carbon strategy and action plan for 2030-50 for GHG emissions reductions, on the basis of an integrated energy and climate policy, in line with the lifetime of energy infrastructure assets.

One area is the use of coal in the Turkish energy mix, where the country risks a high lock-in into energy infrastructure development (mines and power plants) for decades. Turkey has large lignite reserves and aims to increase the use of domestic coal in power generation to 60 TWh. In 2010, Turkey has adapted its legal framework to the EU Directive on Large Combustion Plants, which it transposed and is going to apply to all coal plants. The use of coal will need to be highly efficient, and old plants will need to be refurbished or closed. The government may wish to evaluate options, such as joining the EU Emissions Trading System (ETS), adopting carbon taxation or stringent emission performance standards.

Work is ongoing to revise the NCCAP, as the government prepares the Monitoring and Evaluation Report. To date, the objectives and actions contained in the NCCAP are not measurable and performance indicators to measure the objectives are inadequate or absent. The monitoring of NCCAP involves many ministries and is not producing the required results for policy making. Turkey is seeking to improve the evaluation tools and assessments with a view to revise the NCCAP, including through capacity building and the legal approximation to the EU requirements. NCCAP is planned to be revised so as to achieve concrete results from implemented actions and objectives by the end of 2017. Ensuring stakeholders' participation during this process will contribute to enhanced public awareness and support which are essential for its successful implementation.

Apart from monitoring air quality, there is no policy in place to manage air pollution in the large cities of Turkey, the country with the EU record in air pollutants, which go well beyond the standards set by the European Union and the World Health Organization. Investment in alternative fuels and modes of transport and clean power generation did not keep up with economic and urban growth.

Turkey is highly vulnerable to climate change impacts, notably to water shortage and drought, impacts that are already occurring. The government would be well advised to pursue the actions set out in the National Climate Adaptation Strategy and take measures to ensure the resilience of the energy sector to climate change impacts.

## RECOMMENDATIONS

The government of Turkey should:

- Present a long-term low-carbon strategy to 2030 and 2050 and action plan to reduce GHG emissions, as part of an integrated energy and climate policy strategy, following up on the Paris Agreement and Turkey's nationally determined contribution. Prioritise short-term actions in an updated National Climate Change Action Plan to 2030, including air pollution and adaptation measures, and integrate it with the long-term goals to ensure cost-effective mitigation policies.
- Ensure the monitoring, tracking and evaluation of the GHG mitigation policy targets, in close co-ordination with all key stakeholders.
- Proactively engage in bilateral and multilateral co-operation and secure the necessary finance, technology and capacity building to implement actions on climate change mitigation and adaptation.

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## 4. ENERGY EFFICIENCY

### Key data (2015 estimated)

**Energy supply per capita:** 1.7 toe (IEA average: 4.5 toe), +36.3% since 2005

**Energy intensity:** 0.09 toe/USD 1 000 PPP (IEA average: 0.11 toe/USD 1 000 PPP), +7.1% since 2005

**TFC (2014):** 85.8 Mtoe (oil 35.6%, natural gas 22.6%, electricity 20.6%, coal 12.3%, biofuels and waste 3.8%, heat 2.4%, geothermal 1.7%, solar 0.9%), +35.8% since 2004

**Consumption by sector (2014):** industry (36.1%), residential (22.3%), transport (24%), commercial and other services, including agriculture (17.6%)

## FINAL ENERGY USE

### FINAL CONSUMPTION BY SECTOR

Turkey's total final consumption (TFC) was 85.8 million tonnes of oil-equivalent (Mtoe) in 2014. Energy demand has continued its growth path and was 35.8% higher in 2014 than ten years earlier. During the global financial and economic crisis in 2008-09, demand contracted by 4.2%, but rebounded strongly by 18% in the three following years to reach a record high in energy consumption of 87.3 Mtoe in 2012.

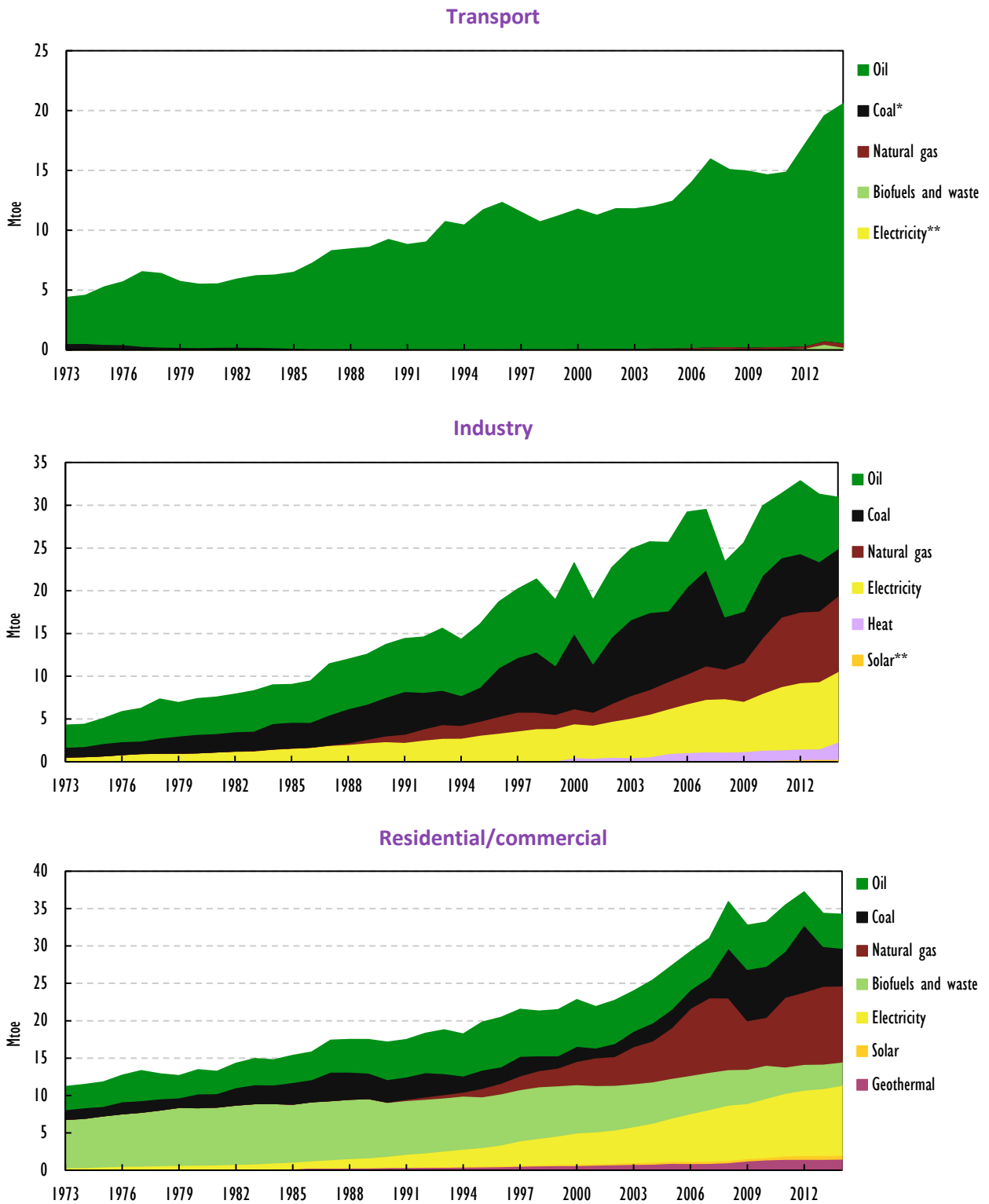
Industry is the largest consuming sector in Turkey, with 30.9 Mtoe in 2014 or 36.1% of TFC. Demand increased by 20.3% over the ten years to 2014, with its share in TFC falling from 40.7%. Growth in industry demand was slower than total TFC owing to a 20.7% plummet in 2008. From 2008 to 2014, demand grew by 32.2%.

The residential sector accounts for 22.3% or 19.1 Mtoe. Residential demand grew by 5.8% from 2004 to 2014, which is the slowest sector-specific rate of growth mainly due to a two-year contraction in demand during 2012-13 (16.1% in total). The share of the residential sector in TFC has fallen from 28.6% in 2004.

Turkey's transport sector represents 24% of TFC or 20.6 Mtoe. Demand grew by 71.4% in total over the period 2004-14, with its share in TFC increasing from 19% in 2004. Demand growth was strong in the first four years after 2003 (8% per year on average), followed by three years of decline from 2008 to 2010 (2.8% per year) and four years of strong growth (9.1% per year).

The strongest growth over ten years (105.4%) has been in the commercial and services sector (including commercial buildings, public services and agriculture). This sector accounted for 17.6% of TFC in 2014, a rise from 11.7% in 2004. Demand grew by 15.7% per annum from 2004 to 2008, had a 10.1% annual decline during 2009-10 and another period of strong growth – 11% in 2011 and 28.3% in 2012.

Figure 4.1 TFC by sector and by source, 1973-2014



\* Coal use in transport ceased in 2000.

\*\* Negligible.

Source: IEA (2016), *Energy Balances of OECD Countries 2016*, [www.iea.org/statistics/](http://www.iea.org/statistics/).

Transport is fuelled by oil (97.1% of total fuel demand), with the remainder made up of natural gas (1.8%), biofuels (0.7%) and electricity (0.4%). Biofuels were first introduced to the Turkish transport sector in 2006. Natural gas use grew by 256.2% from 2004 to 2014, increasing its share in transport TFC from 0.9% to 1.8%. The share of electricity has remained constant at 0.4%, while the share of oil has fallen from 98.6% in 2004.

Industrial fuel consumption is covered by natural gas (28.6% of the total), electricity (26.6%), oil (19.4%) and coal (17.9%). Heat accounts for 6.5% and solar power for the remainder (0.9%). Compared to 2004, coal and oil use have declined by 38.5% and 27.3%, respectively, while natural gas and electricity demand grew by 207.1% and 65.1%. In 2004, the leading fuels were coal (35%) and oil (32.2%) which both have decreased their share in total demand. Conversely, natural gas (11.2%) and electricity (19.4%) have increased their share. Heat demand grew by 350% in ten years, with its share rising from 1.7%, while solar power grew by 131.4%.

The residential and commercial sectors together consume mainly natural gas (29.8%) and electricity (27.3%). Coal, oil and biofuels and waste also play a significant role, with a share of 14.7%, 13.3% and 9.1%, respectively. Geothermal and solar make up 4.4% and 1.5%, respectively. In the ten years since 2004, demand for coal, natural gas and electricity in these two sectors has increased, while use of oil and biofuels and waste has fallen. Coal use was 109% higher, natural gas was up by 86.3% and electricity demand grew by 78.6%. Geothermal and solar also increased by 83.8% and 105.9%, respectively. Conversely, oil demand fell by 20.6% and the demand for biofuels and waste was down by 43.7%. The energy mix in the residential and commercial sectors has changed, moving away from oil and waste, previously the main fuels, which in 2004 accounted for 22.5% and 21.7% of total demand, respectively.

## ENERGY INTENSITY

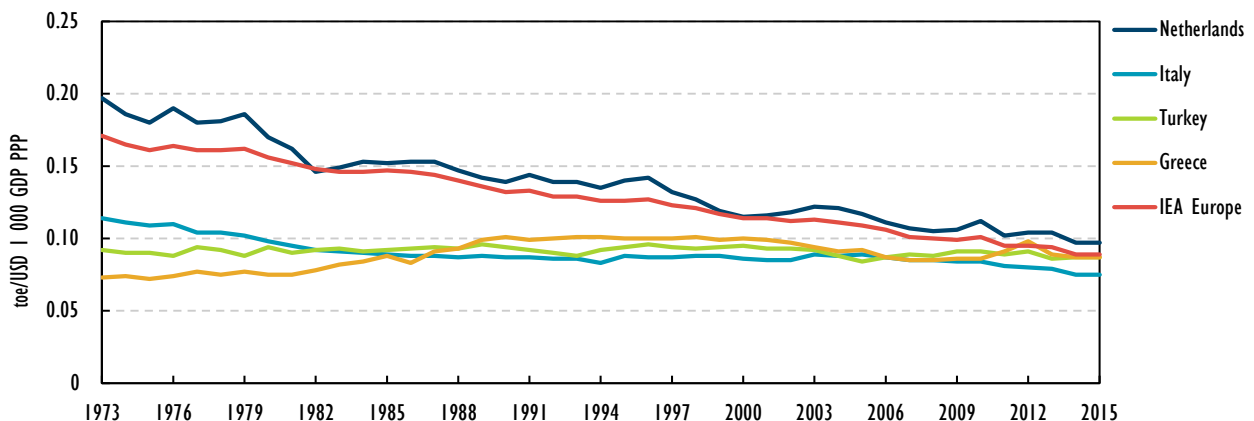
Energy use has grown in step with economic growth in Turkey. Energy intensity of the Turkish economy, measured as the ratio of total primary energy supply (TPES) per unit of real gross domestic product adjusted for purchasing power parity (GDP PPP), was 0.09 tonnes of oil-equivalent per USD 1 000 PPP (toe/USD 1 000) in 2015. The ratio is lower than the IEA average but in line with IEA Europe average of 0.09 toe/USD 1 000 PPP. Turkey's energy intensity is ranked twelfth-lowest. A further common indicator for international comparisons is energy consumption per capita (see Figure 4.3). Turkey's rate of 1.7 toe per capita per year is the lowest among IEA member countries.

Energy intensity increased by 7.1% during 2005 to 2015. Turkey was the only IEA member country to see its energy intensity rising, as the IEA average intensity was falling by 16.3% over the same period (Figure 4.2).

Turkey's energy efficiency potential has not yet been comprehensively assessed. The latest analysis from the World Bank considers saving potentials of 4.6 Mtoe in the manufacturing industry, 4.8 Mtoe in the transport sector, and 7.1 Mtoe in the household sector, leading to a total saving potential of 16.5 Mtoe relative to 2009.

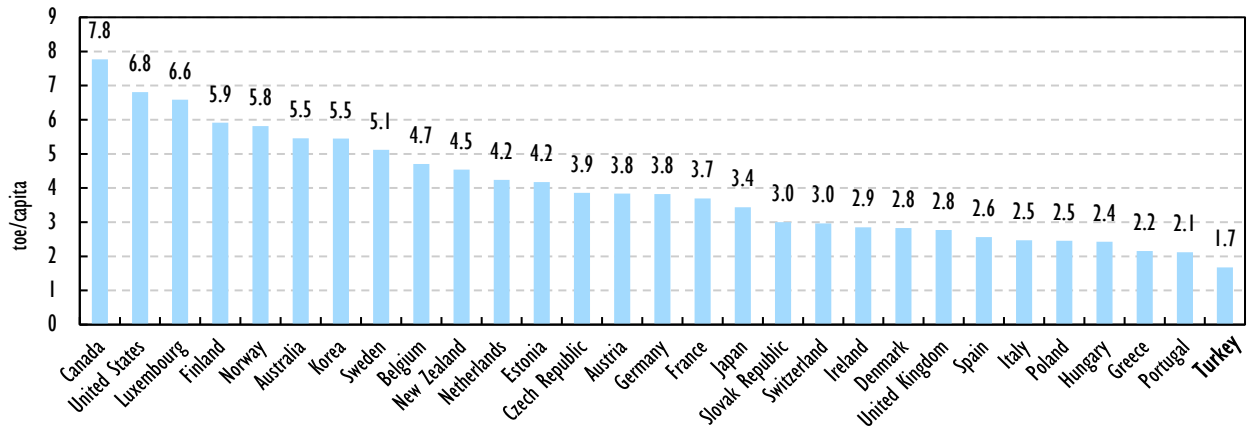
In terms of monetary value, energy efficiency savings could represent EUR 2.0 billion in the manufacturing industry, EUR 5.4 billion in the transport sector and EUR 5.8 billion in the household sector, adding up to a total saving potential of EUR 13.2 billion (World Bank, 2015).



**Figure 4.2** Energy intensity in Turkey and in other selected IEA member countries, 1973-2015

Note: Data are estimated for 2015.

Source: IEA (2016), *Energy Balances of OECD Countries 2016*, [www.iea.org/statistics/](http://www.iea.org/statistics/).

**Figure 4.3** TPES per capita in IEA member countries, 2015

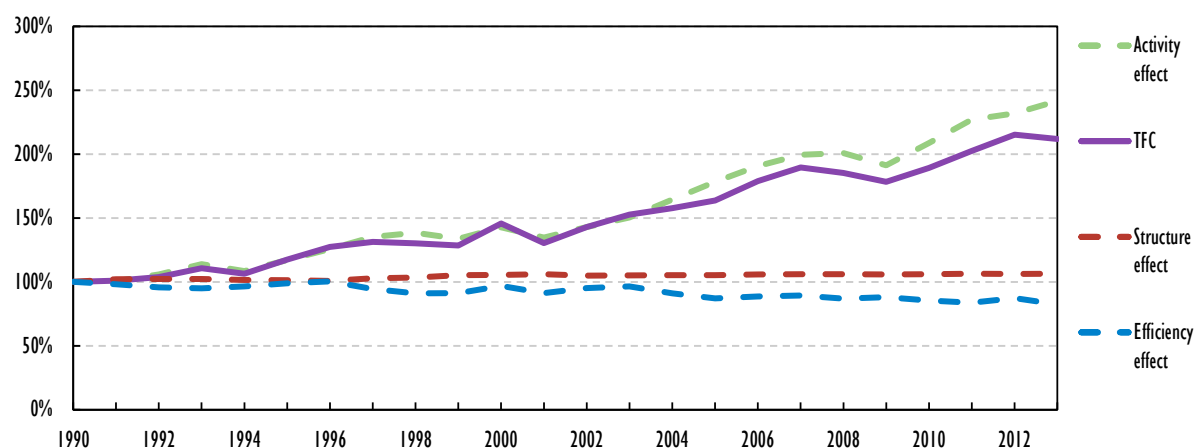
Note: Data are estimated for 2015.

Source: IEA (2016), *Energy Balances of OECD Countries 2016*, [www.iea.org/statistics/](http://www.iea.org/statistics/).

In the decomposition analysis presented in Figure 4.4, the energy consumption trends of Turkey's economy can be examined further. Most of the growth in energy consumption is attributed to the activity effect in Turkey, the key driver being GDP growth (value added). In addition, the structure of the economy during the period of accelerated industrialisation hardly changed (structure effect). Energy efficiency contributed only marginally to reducing energy consumption (energy intensity effect). Conversely, consumption was primarily driven by the activity effect. The energy intensity effect would have to offset the economic structure effect in the case of a developing country like Turkey for energy efficiency progress to be visible.

The economic structure is of key importance if Turkey aims to reduce energy consumption growth in the future. Energy intensity levels have remained relatively stable since 1990, with a marginal increase (0.7% per annum, since 2005 to 2015). If Turkey wants to meet its target of reducing energy intensity by 20% during 2011 to 2023, it has to effectively change the way energy is consumed in the Turkish economy.

**Figure 4.4** Decomposition analysis: Changes in TFC broken down by activity, structure and efficiency effects, 1990-2013



Note: Value-added data (GDP at market prices (constant 2005 US dollars) sourced from the World Bank and energy data from the IEA's energy balance for Turkey. Non-energy use is excluded from the total energy consumption as it does not reflect energy use efficiency.

Sources: IEA (2016), *Energy Balances of OECD Countries 2016*, [www.iea.org/statistics/](http://www.iea.org/statistics/); World Bank GDP data, 2016.

## INSTITUTIONS

The **Energy Efficiency Coordination Board (EECB)** has the mandate to prepare, revise, approve and co-ordinate the national energy efficiency strategies, plans and programmes, including energy efficiency and research and development (R&D) projects, and to monitor their implementation and assess their effectiveness. The EECB also approves the authorisation certificates given to universities and the union of chambers for the certification of energy managers. Created by the Energy Efficiency (EE) Law of 2007, the EECB includes senior members from MENR, from the Ministry of Finance, the Ministry of Transport, the Ministry of Science, Industry and Technology, the Ministry of Internal Affairs, the Ministry of Environment and Urbanisation, the Ministry of National Education, the Ministry of Development, the Turkish Treasury, the Energy Market Regulatory Authority (EMRA), the Turkish Standards Institution, the Scientific and Technological Research Council of Turkey (TÜBİTAK), the Union of Chambers of Turkish Engineers and Architects, the Union of Turkish Municipalities, and the Union of Chambers and Commodity Exchange of Turkey.

The **Ministry of Energy and Natural Resources (MENR)** and its **General Directorate of Renewable Energy** is responsible for carrying out studies on energy efficiency policy and programmes.

In 2011, the **General Directorate of Renewable Energy (GDRE)** was created as executive agency of MENR to continue the energy-related work of the General Directorate of Electrical Power Resources Survey and Development Administration (EIE), which was closed under Decree Law No 662. GDRE is mandated by ministerial decree to develop, implement and monitor national energy efficiency programmes and strategies throughout the country, next to renewable energy and new energy technologies programmes. This core task is to provide programme support. GDRE roles and responsibilities were confirmed by the 2007 EE Law and specified by the 2011 Regulation on Energy Efficiency for the Utilisation of Energy Resources and Energy.

The **Ministry of Transport, Maritime Affairs and Communication** is in charge of promoting energy efficiency in the transport sector. Directorate General for Safety and Inspection of Industrial Products under Turkish Ministry of Science, Technology and Industry is sole institution responsible for the energy efficiency legislation on appliances related product energy efficiency and labelling. 10th Development Plan of Turkey gives responsibilities to the Directorate General for Efficiency on market transformation of efficient electrical motors and enhancing the use of best available technologies through SMEs to increase industrial energy efficiency. The **Ministry of Environment and Urbanisation (MEU)** designs and implements legislation on energy performance in buildings.

A number of national non-governmental organisations (NGOs) are active in awareness-raising campaigns and implementing energy efficiency, including the Energy Efficiency Association (ENVERDER), the Association of Energy Management (EYODER) which brings together the energy managers or energy services companies (ESCOs), and the Turkish Co-generation and Clean Energy Technologies Association (TURKOTED).

## POLICIES AND MEASURES

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### LEGAL FRAMEWORK

Energy efficiency policies in Turkey are based on the legal framework of the Energy Efficiency Law No. 5627 of 2007 and several by-laws or regulations issued by the competent ministries. These include the 2008 Regulation on the energy performance of buildings (as amended in 2013); the 2010 Regulation for supporting energy efficiency in small and medium-sized enterprises, including training, audit and consultancy services (through the KOSGEB<sup>1</sup>); and the 2011 Regulation on energy efficiency of the utilisation of energy resources and energy. The latter contained subsector targets for industry and buildings. Turkey has also transposed the EU Eco-design and Labelling Directives (see the subsection on targets) through the Regulation on the indication of labelling and standard product information of the consumption of energy and other resources by products (EU/2010/30) and Regulation on the eco-design for energy-related products (EU/2009/125), which were published in the *Official Gazette* of 2 December 2011 and 7 October 2010, respectively, by MSIT. The transposition was carried out by MSIT by adopting ten product-related energy labels and 16 eco-design communiqués for implementation (secondary legislation).

Energy efficiency is considered central to the implementation of the 2010 National Climate Change Strategy (2010-20) and the 2011 National Climate Change Action Plan (2011-23). In 2012, the High Executive Committee adopted the Energy Efficiency Strategy (hereinafter the EE Strategy) with targets for all sectors and the actions required to achieve them. The 10th Development Plan of 2014-18 called for the strengthening of GDRE's institutional capacity, including its governance, independence and accountability. The MENR Strategic Plan 2015-19 makes energy savings and efficiency a key focus area. In 2014, the National Renewable Energy Action Plan (NREAP) was presented (MENR, 2014), and covers some energy efficiency policies and measures. In 2016, the National Energy Efficiency Action Plan (NEEAP) is being prepared by MENR, in co-operation with EBRD and Deloitte, in line with EU Energy Efficiency Directive 2012/27/EC.<sup>2</sup> The first NEEAP is to be released in 2016.

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1. KOSGEB is the Small and Medium-Sized Enterprises Development Organisation of the Republic of Turkey.

2. Directive 2012/27/EC of the European Parliament and of the Council of 25 October 2012 on Energy Efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC texts with EE relevance.

## TARGETS

Like many emerging economies, Turkey, given its economic growth, has based its energy savings on energy intensity. By contrast, EU countries have adopted absolute saving targets with regard to the reduction of final or primary energy consumption.

The government set out the goal of reducing Turkey's energy intensity by at least 20% during 2011-23 as part of the 2012 EE Strategy. The indicative target aims to reduce the amount of energy consumed per GDP (energy intensity) in the year 2023.

The EE Strategy sets out the following seven key objectives and subsector targets for 2023 with a view to:

- Reduce energy intensity and energy losses in the industry and services sectors by at least 10%.
- Decrease energy demand and carbon emissions of buildings, promote sustainable buildings using renewable energy sources and convert at least one-fourth of the existing (2010) building stock to sustainable buildings.
- Provide market transformation of energy-efficient products.
- Increase efficiency in production, transmission and distribution of electricity and decrease energy losses and harmful environmental emissions, notably decrease the electrical energy intensity by at least 20% and increase the total average cycle efficiency of the coal thermal power plants (and waste heat recovery) beyond 45%.
- Reduce unit fossil fuel consumption of motorised vehicles; increase the share of public transportation by road, sea and rail; and prevent unnecessary fuel consumption in urban transportation.
- Use energy effectively and efficiently in the public sector, including by decreasing annual energy consumption in public buildings and facilities in the order of 10% by 2015 and 20% up to 2023.
- Strengthen institutional capacities and collaboration, increase the use of state-of-the-art technology (increase domestic R&D results by at least 50 products/designs in the areas of energy efficiency and renewable energy resources) and awareness activities, and develop financial mechanisms (including carbon markets).
- Train at least 5 000 certified energy managers and create up to 50 energy efficiency consultancy companies in industry sectors by 2015.

Turkey has increasingly aligned its energy efficiency targets and policies to the EU 2020 framework. Over the past decade, the government has progressively implemented EU energy efficiency rules and regulations. (A brief overview of EU Energy Efficiency Policies is set out in Appendix 4.I.) To date, Turkey has transposed most of the Eco-Design Directive 2009/129/EC, with a view to ensure access of Turkish products to the EU appliances market, a requirement of the customs union agreement. In the field of energy efficiency in buildings, Turkey has transposed the 2002 Energy Performance in Buildings Directive 2002/91/EC, and recast as 2010/31/EU. Turkey has not yet transposed the Directive on Energy End-Use Efficiency and Energy Services (2006/32/EC) nor the Energy Efficiency Directive 2012/27/EC (EED).

## ENERGY EFFICIENCY FINANCING

Between 2009 and 2013, Turkey contributed to the Clean Technology Fund (CTF), jointly set up by the World Bank Group (IBRD, International Finance Corporation [IFC] and the EBRD. CTF provided loans totalling around USD 250 million, soft loans and technical assistance to promote private sector investments in energy efficiency and renewable energy projects in Turkey. Since 2009, the EBRD provided USD 285 million and IFC USD 255 million for financing renewable energy and energy efficiency projects through Turkish financial institutions. Turkey is the top investment destination of the EBRD and the bank also supports the technical capacity of MENR by designing Turkey's first NREAP and first NEEAP.

### Box 4.1 Energy efficiency awareness campaigns

- **Energy Efficiency Week:** Since the 1980s, the Energy Efficiency Week is being organised in Turkey each year in January and the Energy Efficiency Forum and Fair has been organised in Istanbul since 2010.
- **Third Country Training Programme:** Since 2002, International Energy Efficiency and Management Training has been organised in Turkey. Energy managers from more than 25 countries in the region have been trained as part of this programme, including experts from Asian, Balkan and Middle-Eastern countries.
- **Database on end-use energy efficiency:** Since the 1980s, Turkey has been collecting historic data series on energy end use. The former Development Administration EIE, now GDRE, collect through the ENVER Portal the energy use of industrial plants and buildings which have to report annually on energy consumption to the government under the EE Law (see below section on industry). To date, 1 365 industrial establishments are recorded in the database. In addition to the large industrial consumers (those consuming 1 000 toe of energy per year), commercial and service buildings consuming more than 500 toe of energy and public buildings consuming more than 250 toe are recorded every year. The database cannot be accessed by the public, as information is reported plant by plant. This database provides statistics per subsector on fuel use, CO<sub>2</sub> emissions and energy intensity, allowing comparisons of sectors and regions.
- **Turkish Cement Industry Benchmarking:** Benchmarking studies have been conducted in the cement sector in co-operation with the Turkish Cement Manufacturers' Association since 2001, and with a 100% participation of all plants since 2009. This allows plants to compare their specific energy consumption, to be aware of their performance and to improve their energy efficiency. This has led other sectors to start similar benchmarking studies, for instance the iron and steel, textile, and ceramic sectors. Both the government and sector associations promote the use of energy-efficient equipment and processes in all sectors.

Under the United Nations Development Programme (UNDP) Global Environment Facility (GEF) and the EU Pre-Accession Assistance (IPA), Turkey is carrying out projects improving the energy efficiency in buildings through legislative assistance and awareness-raising campaigns. The GEF supports projects that foster the implementation of the climate action plan under the United Nations Framework Convention on Climate Change (UNFCCC).

The “Energy Efficiency in SMEs [small and medium-sized enterprises] project”, established by MENR, World Bank and EBRD through EU financial assistance (the EU granted around EUR 50 million to be used in the fields of energy efficiency and renewable energy), aims to increase energy efficiency in SMEs through public commercial banks loans and is in place since 2012. The World Bank provided USD 201 million in loans and USD 2.82 million in grants to three public commercial banks in equal amounts. These banks will use loans to increase energy efficiency in SMEs. The technical assistance granted to MENR represents USD 0.94 million.

Bilateral training and capacity-building co-operation projects involved the Dutch NL Agency (Project on Improving EE Monitoring and Evaluation), Japan (Third Country Training Programme since 2002), the United States (Near-Zero Zone Project) and the French Development Agency AFD – KOSGEB Energy Efficiency in the SMEs Project. Within the framework of the “Energy Efficiency in the SMEs project”, the provinces of Bursa, Ankara, Kocaeli and Antalya provinces have been selected as four pilot areas; 50 pre-audits and 7 detailed audits in total were planned to be implemented. By now, 46 pre-audits and 4 detailed audits have been finalised.

In addition to multilateral and bilateral financial support, financial incentives are in place, including the support scheme for energy efficiency in industry, the Voluntary Energy Efficiency Agreement Scheme, incentives to improve the energy efficiency rate in the urban transformation plan, mandatory payment established for obligated parties, mandatory payment established for final clients of obligated parties, mandatory electricity tax, applied to all electricity consumers and a mandatory climate change levy (tax on energy delivered to users other than domestic), which are explained in the following sections.

## ENERGY EFFICIENCY POLICIES BY SECTOR

### Power sector

Turkey promotes efficient co-generation (combined heat and power, CHP), notably in industry, through an exemption from licensing and permitting requirements and a guaranteed tariff for micro co-generation under the Regulation regarding unlicensed electricity generation in the electricity market. Previously, Law No. 3096 Regulation for autoproduction of electricity supported CHP, but was superseded by the new Electricity Law No. 6446 and replaced with Independent Power Producer (IPP) system. The contracts of existing autoproducers were preserved as part of the legacy contracts. CHP accounts for 14% of installed capacity or 8 300 MW in 2013.

Since 2009, the state-owned electricity generator EÜAŞ has been carrying out a rehabilitation programme to upgrade and retrofit publicly owned thermal and hydropower plants and to phase out inefficient ones. The Ambarlı power plant has been converted from fuel oil to natural gas (ECT, 2014).

Reform of the distribution sector led to its privatisation, to the introduction of regulations based on targets for the reduction of theft and losses, and the installation of meter devices. Distribution losses have been declining since privatisation thanks to these reduction targets set by the regulatory authority EMRA as part of the tariff regulation of distribution companies. Since 2008, losses in the distribution sector have been reduced in most regions to under 10% (see Chapter 8 on electricity). Incentives are in place for the system and grid operators (transmission and distribution) in the regulated revenues

to reduce losses when managing the grids. Operators can obtain 30% of the avoided energy system costs (or 30% of the losses) as profit.

At the same time, the government and regulator EMRA work on a regulatory framework for the integration of demand response in the balancing power market and day-ahead market through an aggregation process.

### Industry

The EE Law of 2007 introduced energy audits, energy management services and voluntary agreements. Energy management is an obligation in buildings and industrial plants above a certain size. The Regulation on energy efficiency for the utilisation of energy resources and energy, which was published in the *Official Gazette No. 28097* of 27 October 2011, obliges the following installations to conduct energy audits: *i)* industrial plants with a consumption of more than 5 000 toe per year, *ii)* buildings in the services sector with a total built area over 20 000 m<sup>2</sup>, and *iii)* public buildings with a total construction area over 10 000 m<sup>2</sup> or with an annual energy consumption above 250 toe. The audits need to be renewed every four years and every ten years for public buildings.

The 2012 EE Strategy requires the reduction of energy intensities in each industry subsector by at least 10% at a level determined in collaboration with the sectors.

Certification programmes for energy managers in the industry and building sectors have been organised respectively since 1997, first by the former EIE, and later by its successor GDRE. These programmes authorised institutions and firms, including the Osmaniye Korkut Ata University and the Chamber of Mechanical Engineers, to provide EE services such as authorising consultancy companies and giving practical training. There are already over 7 000 certified energy managers in Turkey. Energy managers have been assigned in more than 700 industrial establishments and in more than 600 commercial buildings. As of January 2016, 35 certified ESCO companies operate in Turkey, providing services to the industry, the building sector or both.

By the end of 2015, 100 out of 1 200 industrial companies in Turkey have implemented the international energy industry management standard ISO 50001. The ISO 50001 certificate became compulsory in 2014 if the company wanted to obtain funding from the GDRE for voluntary agreements and efficiency improvement projects. These companies under this scheme are obliged to create an energy management unit or nominate an energy manager.

Three main incentive schemes foster energy efficiency projects in the Turkish industry:

- The Efficiency Improvement Project (EIP) funds 30% of a project and a maximum of TRY 1 million of the project cost with a five-year payback period for industrial users consuming at least 1 000 toe per year.
- The Voluntary Agreements Support programme pays 20% of energy expenditures to industrial energy users who agree to reduce their energy intensity by a minimum of 10% within three years.
- The incentives programmes support investment projects for up to five years in some regions and industrial facilities with an annual energy consumption of more than 500 toe and an objective to save at least 20% of their energy. The incentive scheme concerns underdeveloped regions in mostly eastern and south-eastern provinces.

Since 2009, 25 industrial establishments applied for voluntary agreements and only 7 of them reduced their energy intensity commitment, resulting in a total grant of TRY 700 000 and a saving of 4 607 toe and TRY 4.1 million annually. Three more industrial establishments have been monitored: when these reduce their committed energy intensity, the total saving will be 1 340 toe at a cost of TRY 2.5 million plus a grant of TRY 600 000 annually. Since 2009, 35 EIP projects have been supported for a total investment of TRY 22 million and a grant of TRY 2.8 million with a total saving of 25 702 toe; 139 EIP applications are under evaluation with an estimated total grant of TRY 16 million and an estimated total saving of 33 177 toe and a total investment of TRY 43 million annually.

Turkey provides a large number of investment incentives (including VAT exemption, customs duty exemption, tax allowances, insurance premium employer support, interest support, land allocation), depending on the size, importance and the regional aspects of the investment, including for EE investment projects. Investments in manufacturing industrial plants need to be of a value of at least one million Turkish liras for the regions I and II, over TRY 500 000 for the regions III, IV, V and VI, and consume at least 500 toe per year. Incentives depend on whether investment is of strategic interest (large), general or regional importance.<sup>3</sup>

Support to SMEs is managed through the SME association KOSGEB. As part of the 10th Development Plan, an Action Plan for Improving Energy Efficiency in Industry under the general Programme for Improving Energy Efficiency was prepared in tandem with the Ministry of Science, Industry and Technology. Within this programme, support is provided to improve access to energy efficiency-related training, survey and consultancy services to SMEs, and technologies and good practices in the field of energy efficiency are shared among SMEs.

The Resource Efficiency-Energy Efficiency Project on Competition in Industry (SENVET) is arranged every year to demonstrate, introduce and promote energy-efficient and environment-friendly projects and technologies used by industrial establishments. The competition encourages industries to exchange knowledge on energy efficiency technologies, and promotes new studies on energy efficiency.

## Buildings

In January 2016, the building stock in Turkey reached 9 million units; out of which around 90%, or a total of 22 million, are residential dwellings. According to UNDP, between 2000 and 2012, the building stock grew by about 11.5% and the dwelling stock by 23.2%.

Turkey's building codes are based on the 2008 Regulation regarding the energy performance of buildings (BEP-TR) as amended in 2013. BEP-TR introduced a common methodology for calculating the energy performance in buildings and set minimum energy performance standards (MEPS) for new buildings and buildings subject to major renovation. An energy performance certificate (EPC) was introduced as of January 2011 in order to give information on primary energy demand and CO<sub>2</sub> emissions of new buildings and buildings that have been purchased or are rented. The requirements cover energy needs for space- and water-heating, cooling and lighting. The EPC is valid for ten

3. As per Decree 2002/3305 of 19 June 2012, four schemes are available: General Investment Incentive Scheme, Regional Investment Incentive Scheme, Large Scale Investment Incentive Scheme, and Strategic Investment Incentive Scheme.



years and is mandatory for all new buildings. Existing buildings were exempted from the EPC obligation for the first ten years; this exemption ends by May 2017. Building licences will not be granted to new buildings rated less than class “C”. As of January 2016, the number of buildings with an EPC totalled 350 018.

As mentioned in the industry section above, energy audits have to be carried out in buildings in the services sector with a total built area above 20 000 m<sup>2</sup>, and in public buildings with a total constructed area above 10 000 m<sup>2</sup>.

Turkey’s ambition is to turn at least a quarter of its 2010 building stock into sustainable buildings by 2023 and install heat insulation and energy-efficient heating systems in all commercial and service buildings (having total area of more than 10 000 m<sup>2</sup> with the dwellings). Furthermore, central heating is compulsory for new buildings having an area of more than 2 000 m<sup>2</sup> (since 1 April 2010). The installation of individual metering and control systems for central heating and hot water has been mandatory since 4 May 2012. Individual metering systems must be installed in all buildings with central heating systems.

The government has taken steps to promote the construction of sustainable buildings with industry. The Regulation on certification of sustainable green buildings and sustainable settlements, prepared by MEU, entered into force on 8 December 2014. MEU is developing a Green Building Certification System, including buildings and settlements.

The Regulation on improving energy efficiency of the utilisation of energy resources and energy (*Official Gazette No. 28097* of 27 October 2011) establishes that the energy consumption in government buildings and enterprises has to be reduced by at least 20% in 2023, below 2010 levels. Public enterprises shall make energy audits in buildings and facilities according to the Energy Performance Agreement with energy audit companies (EVD). GDRE has started energy audits in public buildings under the EE Regulation of 27 October 2011. Energy efficiency audits and energy identity certificates of 166 public buildings were tendered by GDRE in April 2014. Detailed audits were completed in October 2014, and evaluations of the results were carried out by GDRE. Further energy audits in other public buildings will be planned by GDRE. Amendments to the Energy Efficiency Regulations on Energy Performance Contracting model have been presented to Parliament to improve the energy performance of public buildings by decreasing their energy consumption and CO<sub>2</sub> emissions.

### **Transport**

Turkey’s transport system is dominated by road transportation which accounts for 90% of all passenger transport and 89% of all freight. Railway is hardly used for freight (4.4%) or passenger transportation (1%), but maritime routes are important for freight (6%).

The share of diesel cars has strongly increased over the past decade and reached 60% of newly registered vehicles in 2013. In recent years, the passenger car fleet has been renewed. On the basis of Law No. 5838, 291 805 old vehicles were scrapped. In the coming years, according to Communiqué No. 66 regarding the withdrawal of certain motor vehicles from the market, old freight and passenger transport vehicles licensed before 1990 will be scrapped.

Vehicle taxes are set on the basis of motor engine capacity and the age of the vehicle under the 2004 Motor Vehicles Tax Law, and not in relation to their particulates exhaust or emission performance.

Turkey has legal obligations to blend petrol (not diesel) with up to 3% of bioethanol. Bioethanol and biodiesel produced from domestic crops are exempted from excise duty when incorporated in petrol or diesel fuel up to 2%.

The legal framework is set out in the 2008 Regulation on the reduction of the unit fuel consumption and the increase of the efficiency standards. Regulation on the labelling of tyres is covered and enforced under the Regulation on fuel efficiency and other main parameters (1222/2009/AT) published in the *Official Gazette No. 38370* of 31 July 2012 and the amended labelling regulation (*Official Gazette No. 28575* of 2 March 2013).

The Ministry of Finance supports the purchase of low-emission cars through taxation incentives, including a lower special consumption tax applied to electrical vehicles. When purchasing a vehicle in Turkey for the first time, excise duty (SCT) is applied. The SCT rate is higher for high-speed vehicles. However, there are some exceptions. Lower SCT rates are applied to vans with a carrying capacity of nine passengers (including driver) under Customs Tariff Statistics Position No. 87.03.

The Ministry of Transport, Maritime Affairs and Communication aims to increase high-speed railway capacity, with high-speed trains and the electrification and rehabilitation of existing railways. Government efforts focus on strengthening transportation plans in urban areas and developing and promoting seaways and railways for both public local and long-distance transportation. The 2012 EE Strategy put forward actions in favour of a modal shift: for passenger transportation the goal is 10% by 2023 and for freight, 15% by 2023. Local urban transport plans are implemented by several metropolitan municipalities and cities: the metropolitan municipalities of Bursa, Eskişehir, and Sakarya published transportation master plans and the cities of Gaziantep, Manisa, İzmir and Rize are in the process of creating their own plans. One of the main features of the plans is the development and promotion of bicycle paths.

### **Appliances, equipment and lighting**

Turkey has largely harmonised its product efficiency standards with the EU Eco-design Directive 2009/125/EC. The government published the transposed directive in the *Official Gazette* of 7 October 2010. The Energy Labelling Framework Directive 2010/30/EU and its implementing measures are also harmonised and being implemented. The Regulation on labelling and standard product information of the consumption on energy and other resources by energy-related product was published in the *Official Gazette* of 2 December 2011, in compliance with the Framework Directive. Under this regulation, 10 of the 12 communiqués regulate the energy labelling of household appliances, such as washing machines, dish washers, TV sets, refrigerators, air conditioners, driers, lamps, among others.

By end of 2015, Turkey completed a five-year project for the market transformation of energy-efficient household appliances with the financial support of the GEF. In co-ordination with MSIT, the White Goods Manufacturers' Association of Turkey, company Arçelik A.S, and MENR-GDRE implemented the information and awareness-raising project aimed at informing the public about the use of energy-efficient household appliances, at improving the related legislation, raising awareness in the public and among producers and retailers of white goods, and accelerating market transformation.

## IEA 25 ENERGY EFFICIENCY RECOMMENDATIONS

The IEA 25 Energy Efficiency Recommendations offer a framework for a comprehensive portfolio of policies. Table 4.1 summarises the recommendations and reports Turkish energy efficiency policy priorities against this framework.

**Table 4.1** IEA 25 energy efficiency recommendations

Recommendation	Implementation and progress
<b>Energy efficiency across all sectors</b>	
1. Energy efficiency data collection and indicators	<i>ENVER portal and MENR-GDRE collect end-use energy data from large industrial facilities whose annual energy consumption is equal or higher than 1 000 toe.</i> This data collection effort should be improved and efforts made to address data gaps, identify new data priorities, including through international co-operation. Continue to develop statistics on sector-specific energy end-use data and energy efficiency indicators to develop and evaluate energy policies, targets and measures over time.
2. Strategies and action plans, institutional structure (resources)	<i>The first NEEAP will be issued in 2016. A dedicated strategy with energy efficiency targets and subsector targets already exists since 2012.</i> However, the energy efficiency target is not legally binding and the current targets for subsectors lack action plans for implementation. The NEEAP should regularly evaluate progress towards the targets and adjust actions. The institutional framework for energy efficiency is weak as competence is split among several ministries. The EE department in MENR is part of the GDRE, which deals primarily with the execution of campaigns and programmes.
3. Competitive energy markets, with appropriate regulation	<i>The energy retail and wholesale market reforms are being implemented with different levels of progress in gas and electricity markets.</i> Turkey still has to fully implement cost-reflective marginal retail pricing as a priority to send effective price signals to motivate investment in efficient supply and demand-side management options. The completion of envisaged privatisations, the gas market reform and the use of cost-reflective market pricing are vital.
4. Measures for increasing investment in energy efficiency (private/public)	<i>Efforts to develop and catalyse private sector funding for energy efficiency improvements in buildings, industry and transport are being made, for example under SME support, tax incentives and energy audit companies (not ESCOs).</i> <i>Studies are under way on how to create an ESCO market.</i> Such efforts could be expanded and mainstreamed and barrier to ESCO market development identified and removed, notably in the areas of green procurement and the public sector. Government-sponsored economic instruments for energy efficiency include loans from international financial institutions, tax relief to industry for voluntary EE measures and direct grants as well as awareness-raising campaigns. Turkey is not part of the EU-ETS and has no white certificates. Some direct investment includes public procurement, public investment in R&D, public infrastructure and technology replacement programmes.
5. Monitoring, enforcement and evaluation of policies and measures	<i>The implementation of the EE Strategy and the Climate Change Action Plan has not been reviewed. Commendably, a NEEAP has been prepared by EBRD/Deloitte with MENR, and this should form the basis for future evaluation.</i> Priorities for evaluation should include an accounting framework for energy efficiency investment, and financing and evaluation of social and economic impacts from all energy efficiency policies.
<b>Buildings</b>	
6. Mandatory building energy codes and MEPS requirements	<i>Turkey has building energy codes and MEPS as well as EPCs.</i> Regularly reviewing and strengthening MEPS is critical, as is ensuring that regulations do not place barriers on innovation.
7. Aiming for net-zero energy consumption buildings	<i>Several awareness-raising campaigns were carried out since 2007 to foster green buildings but no legislative measures are in place.</i>  Promote the emerging market for energy-neutral, low-energy buildings by researching how market leaders are creating new cost-effective construction options. Evaluate social and economic impacts.
8. Improving energy	<i>Implementing the EE Law including the EE Strategy target for the renovation of one-quarter of the</i>

efficiency of existing buildings	<i>building stock should increase private sector investments.</i> It is important to integrate building efforts with district heating and cooling (DHC) policies, address the needs of vulnerable groups and evaluate the social benefits of energy efficiency improvements.
9. Building energy labels and certificates	<i>A building labelling scheme is in place.</i> It is important to undertake an evaluation of the existing certification scheme to verify accuracy, and ensure effectiveness in motivating consumers.
10. Energy performance of building components and systems	Maintain and develop emerging low-energy building techniques. Align with EU standards and, where possible, with global technical standards to enable Turkish industry to access to EU and world markets for efficient technologies.
11. Mandatory energy performance standards and labels for appliances and equipment	Ensure MEPS and labelling policies are updated in line with future revisions of the EU Eco-design Framework. Work with EU and international standardisation bodies to apply world-best regulatory practice so as to enable global access for Turkish manufacturers.
<b>Appliances, equipment and lighting</b>	
12. Test standards and measurement protocols for appliances and equipment	Develop consumer and supplier confidence with an integrated European compliance system with high levels of information-sharing, co-ordinated check testing, and equitable non-compliance management.
13. Market transformation policies	Develop private sector energy efficiency market investments.
14. Phase-out of inefficient lighting products and systems	<i>Only medium efficiency halogen variants of GLS incandescent light bulbs are legal for sale.</i>
15. Energy-efficient lighting systems	Promote industry delivery of LED lamps / luminaires.
<b>Transport</b>	
16. Mandatory vehicle fuel efficiency standards	<i>Progress is driven by EU standards for light-duty vehicles (LDV) gCO<sub>2</sub>/km. These are currently in step with other global leaders in fuel economy standards.</i>
17. Measures to improve vehicle fuel efficiency	Two new LDV vehicle regulations that include air conditioning are currently under development. More attention should be paid to heavy-duty vehicles (HDV). There is also a need to consider supporting policies that address usage practices.
18. Fuel-efficient non-engine components	
19. Improving operational efficiency through eco-driving and other measures;	Implement recognised eco-driving policies from international best practices. These provide highly cost-effective energy and safety outcomes.
20. Improve transport system efficiency	Develop a framework of low-energy intensity in intercity and urban transport strategies that enable cities to develop effective mobility plans and implement investment in low-energy transport modes.
<b>Industry, energy utilities and end use</b>	
21. Energy management in industry	<i>Turkey carried out a benchmarking exercise in the cement and iron and steel industries. Voluntary agreements exist for large industrial facilities.</i> Explore capacity-building opportunities with international energy management associations to develop best practice in energy management. Create and expand networks of industries (ENVER) to share expertise across sectors. Expand benchmarking exercises across energy-intensive industries on the basis of international experience.
22. Highly efficient industrial equipment and systems	Update MEPS for generic industrial equipment such as motor fans and pumps. Consider reporting of energy consumption and audit information.
23. Energy efficiency services for small and medium-sized enterprises	<i>Support scheme for SMEs is in place by law.</i> Continue engaging with stakeholders, including financial institutions, industry associations and energy service provider associations, to design financial and support mechanisms appropriate to scaling up implementation of energy efficiency in SMEs.

24. Complementary policies to support industrial energy efficiency	<i>EE Strategy contains sector sub-targets and a number of grants and tax incentives are in place. There is a clear need to co-ordinate and deepen energy productivity efforts with sector-specific strategies, building on the NEEAP and EE Strategy.</i>
25. Governments should establish regulatory and other policies to ensure that energy utilities support cost-effective, verifiable end-use energy efficiency improvements	<i>Turkey aims to encourage the development of demand-side management/participation as part of the electricity market reform. Identify high-performing utilities and other industry energy efficiency initiatives through a benchmarking effort with the industry and encourage innovative demand-side management delivery. Assess the potential from solar PV and hydropower to contribute to peak shaving and demand-side participation programmes.</i>

## ASSESSMENT

Turkey's economy continued its strong growth path, which drove high energy consumption in the industry, commercial and transport sectors. As such, Turkey has more in common with emerging economies than with the IEA/OECD members. During 2005 to 2015, Turkey's energy intensity increased by 7.1%, Turkey was the only country with increasing energy intensity among IEA member countries, which on average saw intensity levels falling by 16.3% over the same period.

Energy use is high in industry, commercial (including public and commercial services) and transport sectors. Out of the total final consumption of 85.8 Mtoe, industry accounted for the lion's share (36.1%) followed by transport (24%), residential (22.3%), commercial and other services, including agriculture (17.6%). Turkey's energy intensity stood at 1.7 toe per capita per year and is the lowest among IEA member countries.

Since the last IEA review in 2009, many energy efficiency legislative measures, non-legislative actions and internationally funded programmes were carried out. Energy efficiency policies are comprehensive and Turkey has a strong policy framework, progressively aligned to the EU EE framework, based on the EE Law of 2007, the 2012 EE Strategy and related regulations. Turkey has harmonised its legal framework with the EU framework on energy efficiency in buildings and appliances and products, as part of the European custom requirements to access the EU market. However, the country has yet to start transposition of the EU Energy Efficiency Directive (EED), notably with regard to the role of energy services companies, the lead of the public sector or the energy saving obligations of energy utilities, and to transpose the 2010 Directive on the Energy Performance of Buildings (EPBD) as well as the EU vehicle efficiency into legislation. Turkey technically meets some of the obligations because it already has mandatory audits for large industry and in 2016. Currently, the government is working towards presenting the first NEEAP, a requirement of the EED.

Turkey stands out with several best practices: it has over 6 000 energy managers; it has carried out a benchmarking of the cement industry and has a large number of energy awareness projects. Turkey's certified training programmes and energy audit companies (universities/associations) are authorised as specific entities to deliver energy efficiency services, provide support to SMEs and sign voluntary agreements with large industries. The country benefits from a multitude of EE programmes, loans and technical assistance financed by international donors, notably the European Union, the World Bank Group and the EBRD. However, the institutional structure has not been able to make the most of the assistance and project management support.

Despite the progress made in the legal framework, the government has yet to consolidate the governance structure for EE policies and programmes. Competence in

energy efficiency remains divided across several ministries, while MENR has the responsibility for energy policy in all sectors. The EECB has not been able to align the various policies or create structured co-operation among ministries, despite its mandate. Replacing the previous administration in 2011, MENR's GDRE has now the mandate under the 2011 Regulation on Energy Efficiency for the Utilisation of Energy Resources and Energy, but has to deal with both policies for renewable energy and energy efficiency, and manages energy efficiency only as an executive agency in a subordinated department. Other ministries are in charge of legislation for transport, buildings and industry and appliances. The government should ensure that all the institutions, active in energy efficiency policies are well co-ordinated, for instance through the EECB. The institutional structure required to implement the EE legal framework should be a key priority for the government. Several international institutions have reviewed the institutional framework for energy efficiency policies in Turkey and provided recommendations to the government. They all agree to the need for a dedicated energy efficiency agency (EC Progress Report, 2013; ECT, 2014, Energy Community Secretariat, 2015), either in the form of a public-private partnership or an independent statutory agency with an EE policy committee under the authority of the Prime Minister (World Bank, 2015) with a clear co-ordination function.

In terms of targets, Turkey has aligned its ambitions with the EU 2020 framework and set out an indicative objective in the 2012 EE Strategy of reducing the relative energy intensity by 20% (below 2011 levels) for the period up to 2023 with several targets and objectives and actions for each subsector, including power, industry, buildings and transport. As an emerging economy, Turkey could compare its energy efficiency approach to other emerging markets, like the People's Republic of China. The latter has recently decided to adopt a cap on energy consumption, walking away from relative, energy intensity-based targets. After the outcome of a detailed gap analysis, Turkey may wish to review the mid-term progress in each sector and decide for target revisions in the period beyond 2023, also in line with EU requirements which stipulate an absolute reduction in energy consumption. The MENR Strategic Plan 2015-19 does not contain any new energy efficiency targets.

There is also a need to evaluate progress. In this regard, work towards initiating a first NEEAP is a key milestone. Meeting the medium-term efficiency target for 2023 will require continuous implementation, monitoring and evaluation of progress and stepping up efforts through new ambitious energy efficiency programmes. Achieving progress in a relatively short time requires accurate data collection, evaluation and formulation of actions to meet measurable, cost-effective and reliable sector targets for energy savings. To date, there has been no assessment of the actual energy savings achieved from the many measures presented by the government. Judging by consumption and emission trends, energy efficiency measures have not had a major impact on energy use or on mitigating CO<sub>2</sub> emissions. In 2014, emissions from fuel combustion grew by 8.1%, notably from power generation (20.6%). Overall GHG emissions increased by 141.6% between 1990 and 2014 (see Chapter 3 on climate change). A detailed assessment of the gap between the targets set out in each sector and the actions taken is still missing. Despite collecting end-use data, the government has not developed a methodology for the definition of energy efficiency indicators to measure trends. An assessment of energy saving potentials and modelling is yet to be developed to integrate energy efficiency into forecasting energy use.

On the basis of the NEEAP, the government should evaluate progress of the EE programmes and focus implementation on the most cost-effective energy efficiency policies to reach the 2023 targets. An adequate evaluation methodology for reaching the targets should be adopted and conducted in a transparent way. Assessment of progress should also include the comprehensive assessment of the remaining energy saving potential across the Turkish economy. To that end, energy end-use data collection and analysis will have to be expanded and improved if Turkey wants to make use of its historic data collection. In that context, there is an opportunity to improve energy statistics and collaborate at international level, including with the IEA on energy efficiency indicators.

It must be recognised that the economic conditions of Turkey and its strong growth in energy demand determine its emission profile; notably, the energy demand side will require the attention of the government, as it needs to reduce the environmental impacts of increasing economic activity and to secure high standards of living.

### POWER SECTOR

In the power sector, the 2012 EE Strategy requires an increase in total average efficiency of coal-fired thermal power plants, including waste heat recovery, to over 45% by 2023. The electrical energy intensity should decrease by at least 20% by 2023. However, there are yet no concrete steps taken for the implementation of these targets. Some progress has been made in modernising Turkey's power generation fleet and electricity grids thanks to private and public/private investment. However, no data are available on how many plants have actually been refurbished. A large number of old and inefficient thermal plants exists.

Energy demand-side measures are not yet used. The MENR 2015-19 Strategic Plan sets out the objective to foster demand-side participation in the energy wholesale and balancing markets, and the creation of an energy efficiency market. The role of energy utilities to deliver energy savings should not be underestimated in Turkey. The new EPIAŞ wholesale market should allow energy efficiency services, like demand-side management, to be bid into the electricity market on an equal basis with energy supply.

### INDUSTRY SECTOR

With its large, energy-intensive and trade-oriented industrial base the country has a good potential for energy savings from energy management. Industry is the largest consuming sector in Turkey, with 30.9 Mtoe in 2014 or 36.1% of TFC.

In industry, progress has been less visible but important steps have been taken, including the implementation of the ISO 50001 Energy Management Standard, which has been adopted in July 2011. In 2016, around 100 out of 1 200 large industrial installations apply ISO 50001. The EE Strategy requires each industry sector to define an energy intensity reduction of at least 10% of the current energy intensity for the next ten years. So far, implementation relies on voluntary measures with grants and tax incentives.

There are around 25 voluntary agreements to reduce energy intensity of industrial production. Industrial plants that agree with GDRE to reduce their energy intensity by at least 10% within three years can receive a grant from GDRE. If they fulfil their commitments in time, they can receive public support of up to 20% of the energy expenditure of the year in which the agreement entered into force.

While various incentive schemes exist, including grants and tax incentives, there is no public evaluation carried out and there are no data available to assess industry's performance with regard to energy efficiency improvements. GDRE developed a database on large industrial enterprises and private and public buildings. However, that database is not public and Turkey does not report energy end-use data to national or international organisations. Energy-intensive industries are globally competitive companies and require international benchmarks. The benchmarking exercises made in the Turkish cement and iron and steel industry are best practice and should be expanded to other energy-intensive sectors.

## BUILDINGS SECTOR

Turkey's legal framework for buildings is well aligned with the EU energy efficiency requirements. The government strengthened the EE legislation, notably with MEPS and EPCs. By January 2016, 350 000 EPCs had already been issued. In addition, sustainable buildings are given special attention by the government. To achieve the required energy efficiency improvement in the buildings sector, the government should co-operate closely with all the stakeholders to ensure that best practices are adopted; financing is made available on the basis of an evaluation of audits and EPCs.

In order to improve EE financial mechanisms for residential dwellings, several financial incentives are being developed by GDRE in the fields of buildings insulation, window replacement, boiler replacement, extending usage of heat and temperature controller, and market transformation of energy-efficient appliances.

The EE Strategy set out a target of decreasing annual energy consumption in public enterprises (buildings and facilities) by 10% in 2015 and 20% by 2023. Building on the leadership of the public sector, the government should amend the legal framework so that the public sector can sign procurement contracts for longer than 3 years; the inability to do this currently constrains the ESCO market, where the public sector would be the prime client target and a kick-starter for the development of an energy efficiency service market in Turkey.

## APPLIANCES AND PRODUCTS

Progress has been strong in the area of appliances and products. Turkey has largely harmonised its implementing directives with the EU Framework Directive on the Requirement of Energy-related Products (Eco-design Directive) and transposed it in October 2010. Similar approximation was enacted with regard to the EU Energy Labelling Framework Directive for Products and Appliances in December 2011.

A GEF-financed project on market transformation of energy-efficient household appliances was carried out during 2010-15 and helped to improve related legislation and raise awareness among the public, producers and retailers. Several training activities on eco-design and energy labelling were promoted. However, guidelines for monitoring and evaluating progress are still needed in this area.

## TRANSPORT SECTOR

The transport sector is an area demanding more attention. After the renewal of the Turkish passenger car fleet, thanks to legislation that required the scrapping of old



vehicles, the replacement of the old truck and van fleet (which dates back to 1990) is subject to future legislation.

In the EE Strategy, the government announced an action plan to promote vehicles with smaller engines and lower emissions (fuel cell or hybrid), notably in cities; to develop efficient transport systems and car-parking facilities; and to increase the share of maritime and rail transportation. To date, Turkey has blending obligations only for petrol (up to 3%) and not for diesel and does not have vehicle efficiency standards. The share of diesel cars is much higher than petrol cars in Turkey, and most vans and trucks use diesel for freight transportation. Tax incentives are given for electric vehicles and vans. Fuel taxation (including vehicle registration fees) could be used to favour the purchase and use of more efficient and lower emission vehicles through carbon content-based taxation. As demand in transport grew by 71.4% in total during 2004-14, the government should consider further tax incentives to encourage fuel economy and efficiency of new cars with a view to reduce fuel (and in particular diesel) consumption and related air pollution in large cities.

### RECOMMENDATIONS

*The government of Turkey should:*

- *Adopt the National Energy Efficiency Action Plan as government policy, and set out clear priorities, with quantitative sectoral targets and milestones in order to regularly evaluate the outcomes, assess progress on the savings potential and identify gaps.*
- *Strengthen the institutional structure for energy efficiency policies to reflect a high and horizontal energy efficiency priority; improve co-operation and co-ordination between the different ministries for the implementation of energy efficiency policies.*
- *Strengthen collection and evaluation of energy end-use data and energy efficiency indicators, including through international collaboration. Ensure the regular monitoring, evaluation and enforcement of voluntary and mandatory energy efficiency measures with special attention to the cost-effectiveness of the actions.*
- *Implement energy efficiency policies in the public sector at national and municipal levels, including in public buildings, lighting, heating and cooling systems and vehicle fleets. Amend the legal framework for green and energy-efficient procurement with a wide range of institutions and longer-term contracts to build a market of energy services companies.*
- *Foster energy demand-side management, e.g. utility-scale energy efficiency programmes, highly efficient household appliances and consumer behaviour as instruments to moderate total energy consumption while the population continues to seek better living standards.*
- *Continue to use taxation to favour the purchase of more efficient vehicles and reduce the growing share of diesel.*

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## APPENDIX 4.I

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### EU ENERGY EFFICIENCY POLICIES

European policies have been designed to help reach two indicative (non-binding) EU targets for energy efficiency for 2016 and 2020. The 2016 target is to reduce final energy use in the sectors outside the EU-ETS by 9% below the levels of the early 2000s. The 2020 target, agreed upon in 2007, is to reduce primary energy use in the Union by 20% from baseline projections.

The 2016 target was embedded in the Directive on Energy End-Use Efficiency and Energy Services (2006/32/EC). The directive encourages energy efficiency through the development of a market for energy services and the delivery of energy efficiency programmes and measures to end-users. It requires member states to create National Energy Efficiency Action Plans for meeting the target. The directive also sets the framework for measures such as financing, metering, billing, promotion of energy services, and obligations for the public sector. In addition, it requires member states to oblige energy distributors or retailers to offer either competitively priced energy services, audits or other measures to improve energy efficiency.

The Energy Efficiency Directive 2012/27/EC (EED) was developed and adopted out of concern that the European Union was unlikely to reach the 20% energy efficiency target for 2020. The EED replaces the previous directive (2006/32/EC) and strengthens many of its elements. The EED comprises a series of binding measures and requires each member state to:

- Set an indicative national energy savings target for the period 1 January 2014 to 31 December 2020 in line with the EU-wide 20% by 2020 target.
- Oblige energy providers to achieve cumulative end-use energy savings by 2020 equivalent to 1.5% of annual energy sales over the seven years from 2014 to 2020. Member states may pursue alternative ways to achieve equivalent energy savings.
- Carry out a comprehensive assessment of national heating and cooling systems to identify and implement the cost-effective potential for deploying highly efficient co-generation, efficient district heating and cooling, and other efficient heating and cooling solutions by the end of 2015.
- Assess the energy efficiency potential of its gas and electricity infrastructure, in particular regarding transmission, distribution, load management and interoperability, and identify measures and investments for the introduction of cost-effective energy-efficient improvements in the network infrastructure by 30 June 2015.
- Ensure that the metering and billing of actual energy consumption in all sectors occur at a frequency that enables end-users to take informed decisions about their energy consumption; and that meters are installed for all energy sources at end-users' premises, if technically possible and economically feasible.
- Develop public procurement rules ensuring that central governments purchase only highly efficient products.
- Facilitate the development of national financing facilities for energy efficiency measures.

In addition to the horizontal EED, several sectoral EU regulations and directives to increase energy efficiency are in force.

The Directive on the Energy Performance of Buildings (EPBD, 2002/91/EC, recast as 2010/31/EU) sets requirements for energy efficiency in building codes, including minimum energy performance requirements and energy certificates. The 2010 recast requires all new public buildings to be at least “near-zero energy” by the end of 2020, and all new buildings to reach this target by the end of 2020.

The recast Directive Establishing a Framework for Setting Eco-design Requirements for Energy-related Products (Eco-design, 2009/125/EC) aims to improve energy efficiency throughout a product’s life cycle. It applies to products that use energy and to products that have an impact on energy use, such as building components. Product-specific standards are set by EU regulations based on the directive.

Requirements for energy labelling of household appliances are based on several directives adopted since 1992. The recast of the Energy Labelling Directive (2010/30/EU) expands the mandatory labelling requirement to cover commercial and industrial appliances and also energy-related appliances; product-specific labelling standards are set up under this directive.

Current EU transport policies aim to reduce CO<sub>2</sub> emissions from new passenger cars, which in practice will lead to efficiency improvements in the car fleet. Under Regulation 443/2009, car manufacturers and importers are obliged to limit CO<sub>2</sub> emissions from new passenger cars to a weight-based fleet-wide average of 130 grammes of CO<sub>2</sub> per kilometre (gCO<sub>2</sub>/km) by 2015 and to 95 gCO<sub>2</sub>/km by 2020. In terms of fuel consumption, the 2015 target roughly corresponds to 5.6 litres per 100 km (L/100 km) of petrol or 4.9 L/100 km of diesel. The 2020 target equates to around 4.1 L/100 km of petrol or 3.6 L/100 km of diesel. A similar regulation for new vans was introduced in 2011 (Regulation 510/2011), with a limit of 175 gCO<sub>2</sub>/km by 2017 and 147 gCO<sub>2</sub>/km by 2020.



**PART II**  
**SECTOR ANALYSIS**



## 5. OIL

### Key data (2015 estimated)

**Crude oil production:** 2.5 Mt

**Crude oil net imports:** 25.1 Mt, +7.2% since 2005

**Oil products net imports:** 16.2 Mt, +259.5% since 2005 (imports 23.6 Mt, exports 7.4 Mt)

**Share of oil:** 30.1% of TPES and 0.8% of electricity generation

**TFC by sector (2014):** 32.8 Mtoe (transport 60.9%, industry 18.3%, commercial/public services and agriculture 11%, other energy 4.9%, residential 2.9%, power generation 2%)

## OVERVIEW

Turkey's crude oil imports are on the rise; indigenous oil production is small and in decline. In 2013, the reformed upstream oil licensing regime under the Turkish Petroleum Law entered into force and is expected to attract investment in oil exploration activities.

Over the past decade, net crude oil imports have increased by 7.2%, while net imports of oil products have grown by 260%. Turkey has become a major export market for oil products from the Middle East, while crude oil supplies from the Russian Federation (hereafter "Russia"), Iran and Libya collapsed.

The geopolitical situation in neighbouring Syria and northern Iraq poses challenges to the security of oil transportation, but supplies to Turkey have been uninterrupted to date.

## SUPPLY AND DEMAND

### SUPPLY

In 2015, oil was the second-largest energy source (30.1%) in Turkey, just behind natural gas (30.2%) and followed by coal (27.3%). Total oil supply amounted to 39 million tonnes of oil-equivalent (Mtoe) or 30.1% of total primary energy supply (TPES) in 2015.

Oil supply has been on an upward trend since 1990. Supply peaked at 33.5 Mtoe in 2012 and contracted slightly over the following two years followed by a 19% rebound in 2015. Overall, supply was 34% higher in 2015 than in 2009, when the last International Energy Agency (IEA) in-depth review was published, and 35.8% higher than in 2005. The main reason behind this trend is growing oil product imports to satisfy oil consumption in the fast growing industry and transport sectors.



## Oil production

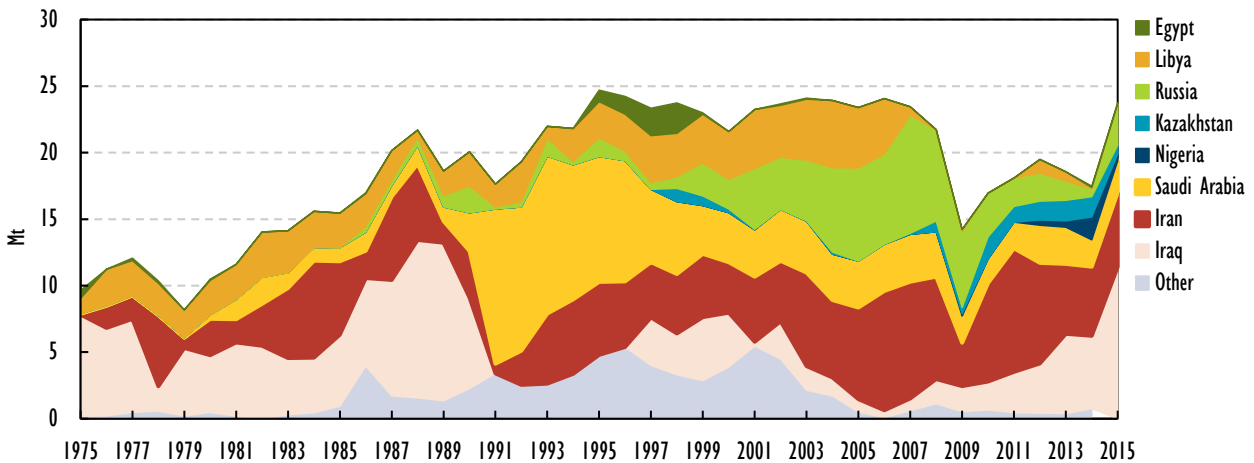
Domestic oil production has been declining. In 2015, Turkey produced 2.5 million tonnes (Mt) of crude oil, less than half the peak production of 4.4 Mt in 1991, mainly in the regions of south-east Anatolia, in the Batman and Adiyaman provinces. Around 75% of this amount was produced by the Turkish Petroleum Corporation (TPAO), the country's dominant oil and gas exploration and production company.

Most of Turkey's estimated proven oil reserves of around 376 million barrels (mb) are located in south-east Anatolia (total reserves are 378 mb). Exploratory drilling for unconventional oil is taking place in the Diyarbakir Basin, in the Dadaş formation, where shale oil and gas deposits have been identified, with expectations of unconventional oil reserves of 4.7 billion barrels (bbl). In January 2015, exploratory drilling by the joint venture Shell and TPAO began in the Black Sea and in the Dadaş formation.

## Crude oil imports

Turkey relies on imported crude oil as indigenous production accounts for only 9.4% of domestic supply (or 2.5 Mt in 2015). Turkey imported 25.1 Mt of crude oil during 2015, sourced mainly from the Middle East – Iraq (45.5%), Iran (22.3%) and Saudi Arabia (9.5%) – as well as from Nigeria (2.1%), Kazakhstan (2.6%), Russia (12.4%) and smaller quantities from other countries (Figure 5.1).

Figure 5.1 Crude oil imports by source, 1974-2015



Source: IEA (2016a), *Oil Information 2016*, [www.iea.org/statistics/](http://www.iea.org/statistics/).

Oil imports have seen some volatility, in line with economic growth and regional production curves. Crude oil imports were growing in the years up to 1994, when they began to plateau for more than a decade – imports were around 22 Mt. During 2009, imports plummeted by 34.6%, without a full recovery but higher volatility in the following years. During 2010-12 imports were 33.7% up from the 2009 low, but in 2013-14, they declined by more than 10% but rebounded by 4.3% in 2015.

Iraq, Iran and Saudi Arabia have been the largest sources of crude oil imports to Turkey for decades. The share of Russian crude oil imports has declined dramatically from a high of 37.9% of total imports in 2007 to 12.4% in 2015. Imports from Libya have nearly

ceased, compared to 4.2 Mt in 2006. Iranian oil gained importance. Crude oil pipeline imports from Iraq have increased significantly.

### Oil products

Turkey produced around 29.4 Mt of refined oil products in 2015, up by 57.7% since 2009. Following the trend of crude oil imports, oil products saw a 23.6% decline in output during 2009, but recovered by 26.3% from 2010-13. Unlike crude oil imports, however, refinery output has been less volatile because oil stocks have been used.

In 2015, Turkey's oil products output consisted of gas and diesel oil (29.4%), fuel oil (12.4%), gasoline (17.4%), kerosene-type jet fuel (17.1%), refinery gases<sup>1</sup> (4.7%), liquefied petroleum gas (LPG) (3.1%) and others. Over the past decade, the product mix has changed towards higher production of gasoline and kerosene-type jet fuel and lower production of naphtha and fuel oil.

At the same time, Turkey is also a net importer of oil products with 16.2 Mt of net imports in 2015 (imports of 23.6 Mt minus exports of 7.4 Mt). Net oil product imports have risen considerably over the past decade. Net imports were 259.5% higher in 2015 than in 2005, and 20.9% higher than in 2009 when net imports surged by 79.2% owing to low crude oil imports. The top five countries from which Turkey imported oil products in 2015 were Russia (22.9% of the total), United States (14.1%), India (11.4%), Israel (9.2%) and Greece (6.8%).

## DEMAND

Oil is mainly used in transport and industry. Transport accounted for 60.9% of total demand in 2014, while industry represented 18.3% of consumption (Figure 5.2). The remaining 20.8% is made up of commercial and public services and agriculture (11%), households (2.9%), energy own-use and further refining (4.9%, and a small share of 2% that is used in power generation).

Demand for oil has declined in each sector of the economy aside from transport and commercial and public services. Since 2009, transport has been the only sector pushing up demand for oil in Turkey, which was 36% higher in 2014, while total demand was only 12.6% higher. Demand from commercial services has been on the rise, but was 15.8% lower than in 2009. Industry demand has contracted by 24.9% below the level in 2009.

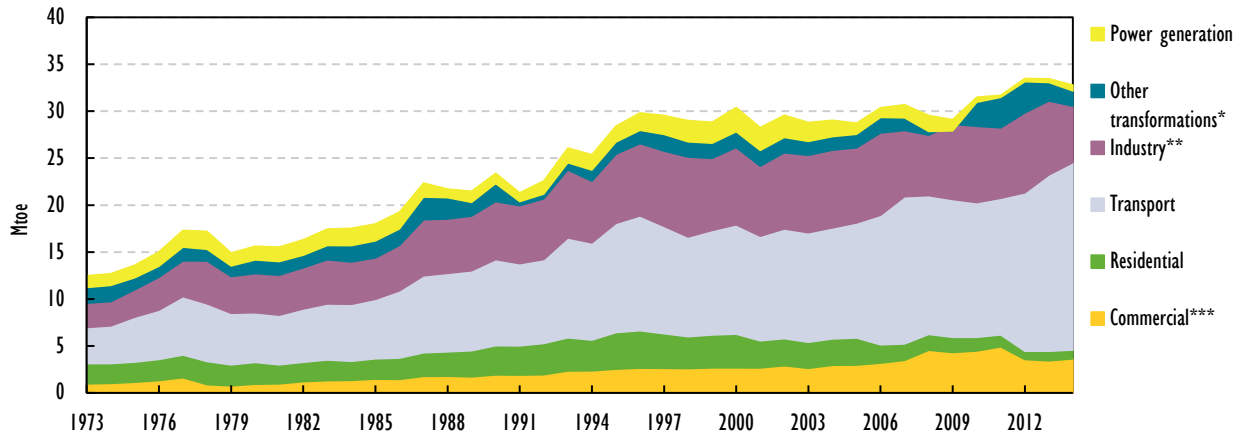
The sector-specific share of oil consumption has changed significantly over the last ten years. The transport share has increased from 40.7% in 2004 to 61% in 2014, while the shares in other sectors have fallen.

The largest contraction has been in the use of oil in power generation, households and industry. These sectors reduced demand by 63.3%, 66.5% and 27.3% below 2004 levels, respectively, as natural gas has replaced oil use.

The Ministry of Energy and Natural Resources (MENR) projects that the share of oil in Turkey's energy mix will remain unchanged in the medium term to 2020.

1. Refinery gases include butane, butylene, methane, ethane, and ethylene.

**Figure 5.2** Oil supply (TPES) by consuming sector, 1973-2014



\* *Other transformations* includes refineries and energy own-use.

\*\* *Industry* includes non-energy use.

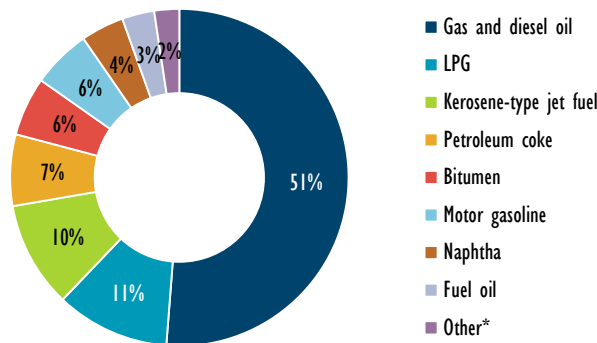
\*\*\* *Commercial* includes commercial and public services, agriculture/fishing and forestry.

Source: IEA (2016b), *Energy Balances of OECD Countries 2016*, [www.iea.org/statistics/](http://www.iea.org/statistics/).

Consumption of gas and diesel oil is growing in Turkey, accounting for 51.2% of total oil products consumption, notably in transport (Figure 5.3). Liquefied petroleum gas (LPG), bitumen and petroleum coke account for another 27.9%, while the remainder is made up of motor gasoline, naphtha and kerosene-type jet fuel oil.

Over the ten-year horizon, because of sector-specific changes in demand, the product mix consumed in Turkey has also changed. The largest change has been in the share of gas and diesel oil which has increased from 35.9% of total demand while the share of fuel oil has fallen from 21.1% in 2004 to 3.1% in 2014.

**Figure 5.3** Oil consumption by product, 2014



\* *Other* includes lubricants, white spirit, paraffin waxes, aviation gasoline, gasoline-type jet fuel and other non-specified oil products.

Source: IEA (2016a), *Oil Information 2016*, [www.iea.org/statistics/](http://www.iea.org/statistics/).

## INSTITUTIONS AND REGULATION

The **Ministry for Energy and Natural Resources (MENR)** oversees the legal and regulatory framework for oil and gas upstream and transit activities through the **Transit Petroleum Pipelines Department** and the **General Directorate of Petroleum Affairs**.

The **Turkish Energy Market Regulatory Authority (EMRA)** monitors the petroleum market activities, issues licences for oil transportation, storage and refining activities, and approves regulated tariffs for transport and storage facilities that are connected to the oil pipeline system. EMRA also monitors the competitive price formation in the refining and distribution sectors and can impose price caps under certain conditions.

**Under-Secretariat of Treasury (TT)** carries out the ownership function for the state-owned energy enterprises and prepares the annual general investment programmes.

The **Turkish Competition Authority (TCA)** ensures the enforcement of the Competition Law with regard to legal agreements, concerted practices and decisions limiting competition (Article 4), abuse of dominant position (Article 6) and mergers and acquisitions (Article 7). The Authority provides opinions to the government during the privatisation process and draft legislation, carries out market inquiries (e.g. the 2008 petroleum market inquiry) and issues fines.

## OIL MARKET STRUCTURE

During the 1970s and up to the 2000s, Turkey saw the emergence of state-owned enterprises. The Petroleum Reform Law of 1973 created several public companies: TPAO (exploration, and production), the Turkish Petroleum Refinery Corporation TÜPRAŞ (refining), the Petroleum Pipeline Corporation BOTAŞ (oil and gas pipeline activities), Petrol Ofisi A.S (POAŞ) (distribution activities) and DİTAŞ (crude oil and fuel transportation). Since 2003, Turkey has launched several market reforms which led to the separation of natural gas and oil market activities under the Petroleum Law (No. 6326, 1954-2013) with the adoption of the Natural Gas Market Law and Petroleum Market Law enacted in 2001 and 2003, respectively. State-owned companies maintain a stronghold over the upstream, transportation and refining sectors.

TPAO is the country's main domestic crude oil producer, covering about 70% of total domestic production in 2014 and holding 76% of exploration areas on its hand (including offshore under the new regime). In 2014, 49 companies were licensed to conduct exploration and production activities.

TÜPRAŞ is the country's largest industrial company and operates all four existing refineries. There is almost no competition in the refining segment. Following the petroleum market inquiry of 2008, the Turkish Competition Authority found that there is insufficient competition in the market, strong barriers to entry for non-incumbents, resulting in too high prices in comparison to the international levels. In 2014, the Competition Authority fined TÜPRAŞ when it found that the prices charged by TÜPRAŞ were about 15% higher than the Platts Italy CIF Med prices between 11 October 2008 and 1 January 2009. An administrative fine of about TRY 412 million (USD 130 million) was imposed on the company.

In 2015, 80 distributors operated 12 642 filling stations in the country, 29 more since the end of 2009. There are also 84 LPG distributing companies running 10 559 LPG autogas stations.

## REGULATORY FRAMEWORK

### UPSTREAM

Upstream oil and gas exploration and production operations are regulated under the reformed Turkish Petroleum Law (No. 6491) enacted in June 2013. The new law aims to put the Turkish oil market on the liberalisation track, to increase the efficiency of state-owned TPAO (reducing the idle licences that are maintained without drilling and exploration activities) and to attract foreign investors. In practice, companies rely on joint ventures with TPAO in order to secure licences and complete permit procedures.

The law divides the Turkish territory into two new petroleum regions, onshore and offshore. The offshore part is divided in areas which are within or outside territorial waters. Significant hydrocarbon potential areas can be opened to auctions for exploration licences which are granted by MENR to the applicant with the best investment programme.

The term of licences has been set at 5 years for onshore and 8 years for offshore licences in order to give sufficient time for exploration or drilling activities, while at the same time avoiding licence hoarding. Extension of the licences can be requested for onshore (2+2 years) and for offshore (3+3 years). The production licence is given for a period of 20 years with the possibility of extending it twice by 10 years. A royalty of 1/8, or 12.5%, is collected for both oil and natural gas production. As for petroleum activities, tax incentives are in place. No stamp tax on agreements and service contracts and no special consumption tax on equipment are imposed.

All licence owners have to submit a work and investment programmes for their exploration licence every year and provide 2% of the amount of investment as guarantee to MENR. The work and investment programme guarantee is 1% for offshore blocks. Companies that do not make investments in the areas in which they are committed, will be discharged from the petroleum field and their deposits will not be refunded. In 2015, 103 individual and 32 multiple new licence applications were submitted after the enactment of the new Petroleum Law.

Seismic mapping and technologies are not yet available in Turkey and considerable investment (foreign and domestic direct investment) is needed in large scale exploration to reach a high number of wells drilled, which is not conceivable in the current global low price environment. The 2015-2019 MENR Strategic Plan (MENR, 2014) outlines objectives to promote upstream activities, especially the development of Turkey's unconventional potential.

#### **Subsidies to domestic oil production**

Tax exemptions are implemented to encourage exploration and production activities: imported equipment for exploration activities is free of all tax, tariff, and fees. Materials imported for production are subject to value-added tax. Companies engaged in exploration and production activities in Turkey can use fuel exempted from the special consumption tax (under the Special Consumption Tax Law).

In order to diversify fuel supplies and restrain dependence on oil imports, under Turkish law refineries are obliged to buy domestically produced crude oil at a minimum price determined under Article 10 of the Petroleum Market Law, upon the proposal of domestic crude oil producers. Refining undertakings shall give a written response within

15 days to crude oil producers' offering crude oil with the minimum price set under Article 10, or higher. Refining undertakings shall not make any monetary demand or request about the delivery point and conditions which may adversely affect producers. Disputes on prices shall be settled within no more than 30 days by the arbitration of EMRA, the regulatory authority. EMRA is closely monitoring the nearest-accessible global free market prices and the Turkish petroleum market prices. In addition, the Council of Ministers can adopt other subsidies for specific regions and specific purposes upon the proposal of MENR.

Article 10 of the Law determines the acceptable market price formed in the nearest delivery port or refinery as follows: it is the applied crude oil sales price calculated from the free competitive price determined in accordance with the usual adjustments of quality and specific gravity of crude oil within Turkey or in the nearest world market plus half the expenses incurred for the transportation of the same quality of crude oil from world markets to the delivery point in Turkey, except for the Suez Channel crossing and Batman-Dörtyol pipeline fees, for the oil produced in and around Batman for the market price calculated at Batman Refinery, or the actual sales price applied at the delivery point in Turkey by the producer, excluding taxes, and where there is no accessible world market.

30-day term prices of Arab medium crude oil (31 American Petroleum Institute API index) for 26 API or lighter crude oil, and Ras Gharib crude oil (21.5 API) for crude oil heavier than 26 API shall be taken as basis for the domestically produced crude oil and in the evaluation of the gravity differences between the equivalent petroleum and domestic crude oil with respect to prices; USD 0.02 shall be 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. However, the price of the lower-gravity group shall not be higher than the price of the higher-gravity group. In the calculation of all expenses regarding the delivery of equivalent crude oil to Turkey, the nominal freight charge announced in the "world scale" shall be taken as basis. The transportation cost shall be calculated by applying average freight rate assessment (AFRA) percentage determined for long-range 2 product tanker (LR-2). Current insurance legislation and premium shall apply to the price cost plus freight calculated by adding gravity adjustment and transportation costs. Insurance premium implementation regarding hazardous and war situations is subject to the evaluation of MENR. The insurance premium amount, until revised, shall not exceed 0.075%. Market price of the domestic crude oil shall be calculated by adding taxes and levies taken for import. Transportation market value formed in the liquid fuel prices shall be taken for the domestic land transportation fees. Monthly foreign exchange average selling rate, as announced by The Turkish Central Bank; and barrel and metric tonne shall be used as petroleum unit and the US dollar as foreign currency in the market price proposals.

## DOWNSTREAM

Petroleum downstream activities are governed by the Petroleum Market Law No. 5015 and regulatory oversight is carried out by EMRA.

As described above, under Petroleum Market Law Article 10, oil prices are determined in free market conditions, but price caps can be used in certain cases. Prices set by refining and distribution licensees have to take into account global free market prices at the closest accessible point and have to be submitted to EMRA as price ceilings.

EMRA is monitoring the nearest-accessible global free market prices and Turkish petroleum market prices. Under Article 10, in case of risks that arise from agreements and activities that aim at or may result in hindering, disrupting or restricting the competitive environment and delivery in the petroleum market, EMRA is authorised to determine base and/or ceiling price(s) and take necessary measures to apply on a regional or national basis in all phases of activities not exceeding two months each time. In these cases, the price caps for consumer prices are determined by EMRA in line with global free market prices (see below the section on prices and taxes).

Refineries and distributor companies in Turkey are required to blend certain amounts of domestically produced ethanol into gasoline released to the domestic market. The blending obligation covers a maximum of 3% bioethanol content. Bioethanol and biodiesel are exempt from excise tax when incorporated into liquid fuels up to 2%.

In 2014, a Draft Fuel Market Law was prepared in order to harmonise oil and LPG activities under one law, as so-called fuel market activities. Emergency oil stocks and oil security issues were also regulated in this Draft Law (see below section on security of oil supply).

### TRANSPORTATION

EMRA regulates tariffs for storage and transportation activities. Tariffs for oil processing and licensed oil storage that is not connected to pipelines and transportation activities are set by the licensees after EMRA has been notified.

### TRANSIT

Oil transit is regulated under the 2001 Law Concerning the Transit Passage of Petroleum through Pipelines (Transit Law No. 4586). This law assumes the existence of Intergovernmental Agreements for the new built transit pipelines and sets out the rules for transit. Under the law, transit of oil and gas is not considered as internal market activity. Transit pipelines are governed by the Transit Law, the intergovernmental agreements (IGAs) and the project's commercial agreements. The government considers revising the Law by taking into account the developments in oil and gas transit over the past decade. A new Draft Transit Law is under preparation.

Turkey transits crude oil through the Baku-Tbilisi-Ceyhan (BTC) pipeline and the Iraq-Turkey pipeline (see below).

## OIL INFRASTRUCTURE

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### PORTS

Turkey has a large number of important oil ports, including Antalya, Ceyhan, Mersin-Ataş, Trabzon, Hopa, Izmir, Gemlik, Tekirdağ, Izmit, Iskenderun, Zonguldak and Istanbul. In 2011, the country's handling capacity at ports totalled 5.9 million barrels per day (mb/d).

Apart from pipelines, oil is also transported by truck and marine routes, serviced by 86 transportation companies (80 marine and 6 rail) and 64 bunker delivery companies.

## REFINERIES

Turkey has six refinery licences and four operating refineries in place. The Turkish Petroleum Refinery Corporation (TÜPRAŞ) the largest industrial and refining company, operates the country's four refineries (Izmit, Izmir, Batman and Kirikkale), the two largest being Izmir and Izmit with 11 million tonnes per year (Mt/y) processing capacity for oil imported by ship. Processing pipeline imports, Batman has only a small capacity (1.1 Mt/y), while Kirikkale (5 Mt/y) processes the lion's share of crude oil (see Table 5.1).

Construction of the residuum upgrading process (RUP) facility by TÜPRAŞ at Izmit Refinery was completed on 15 December 2014 and allows the production of high-value middle distillate for which demand is increasing. TÜPRAŞ will process about 4.2 Mt of high-sulphur fuel oil and related heavy products and 2.9 Mt of diesel and jet fuel.

There is one new refinery under construction which is set to come into operation in 2018. Azerbaijan's SOCAR is developing the Star refinery project at Aliaga, on Turkey's Aegean coast, close to its petrochemical plant. SOCAR will hold 81.5% equity in the project and Turkey's TURCAS 18.5%. The refinery will provide a processing capacity of 10 Mt per year, out of which 4.95 Mt of diesel oil will be produced when it starts to work at full capacity. Turkey's refineries produced 9 Mt of diesel oil at the end of 2015 and, thanks to upgrades and new capacity it expects to increase diesel oil production to 14 Mt in 2018 or 70% of Turkey's domestic demand for diesel oil.

In the past, the construction of an Eastern Mediterranean Refinery at Adana, near Ceyhan port, was envisaged. However, with decreasing domestic oil demand and refinery overcapacity in Europe and the Middle East, the investment environment for new refinery projects in Turkey has changed.

**Table 5.1** Refineries in Turkey, 2015

Refinery	Processing capacity (Mt/year)	Storage capacity (mcm)	Ownership
Izmit	11	2.91	TÜPRAŞ
Izmir	11	2.42	TÜPRAŞ
Kirikkale	5	1.38	TÜPRAŞ
Batman	1.1	0.253	TÜPRAŞ
<b>Total</b>	<b>28.1</b>	<b>6.96</b>	-

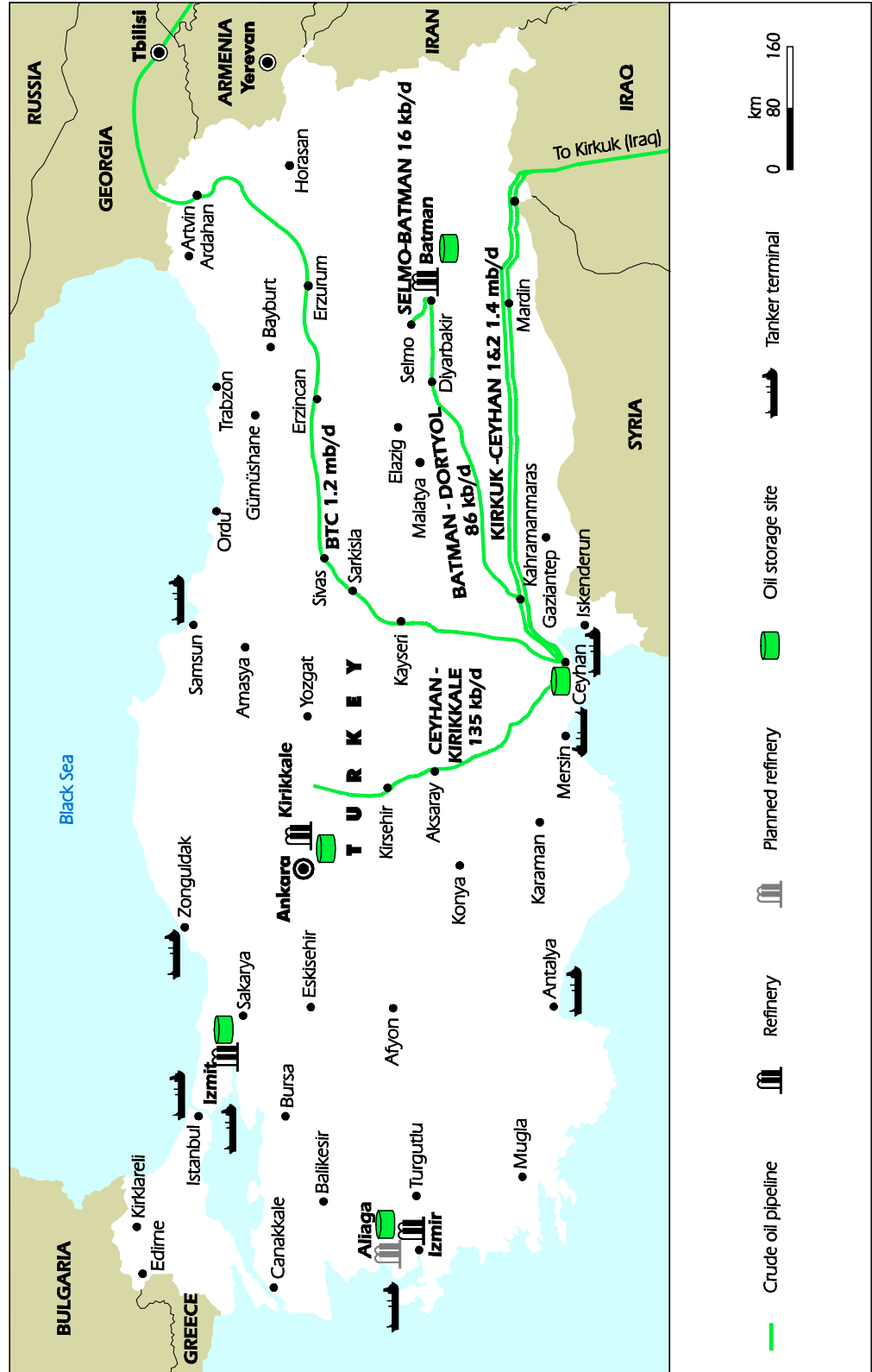
Note: mcm = million cubic meters.

## STORAGE

In 2014, total storage capacity in Turkey stood at 12.3 mcm, which marks an increase of 4 mcm since the end of 2009. Most storage facilities are located in the regions bordering the Sea of Marmara, the Aegean Sea and in Central Anatolia where the refineries are located, as well as in the region bordering the Mediterranean Sea which includes the Ceyhan Oil Terminal. Turkish refineries operate around 7 mcm and another 5.3 mcm is operated by 111 storage licence holders, which include fuel distributors BOTAŞ and TPAO. An increase of the storage capacity by 1.5 mcm is expected when the fifth refinery, the Star Refinery, starts operation.



Figure 5.4 Oil infrastructure in Turkey



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area.

## DOMESTIC PIPELINES

In the domestic network, 28 transmission companies were active in 2015. The main domestic crude oil pipelines are Batman-Dörtyol, the Selmo-Batman and the Ceyhan-Kırıkkale crude oil pipelines, in addition to 26 product lines serving refineries and distributors.

## TRANSIT PIPELINES

Turkey has an important role in bringing Eurasian and Middle East oil exports to global markets. Around 3% of global oil supply is shipped through the Turkish Straits. Apart from allowing oil tankers to transport Russian and Caspian oil from the Black Sea ports of Russia (Novorossiyk), Georgia (Supsa) through the Turkish Straits to the Mediterranean, Turkey is also a transit route for pipeline oil coming from the Caspian region, Azerbaijan, Kazakhstan, and Iraq to the Ceyhan oil terminal.

Turkey has two major oil transit pipelines: the BTC in operation since 2006 by BOTAŞ International Limited Company in Turkish territory and the IRAQ-Turkey Crude Oil Pipeline System (two parallel pipelines) which is operated by BOTAŞ in Turkish territory. BP owns 30.1% of BTC, while Azeri company Azerbaijan BTC Limited holds 25%. Other shareholders are TPAO, US Chevron and ConocoPhillip, Norway's StatoilHydro, Italy's Eni and France's TOTAL.

In 2010, Turkey's long-term oil transit contract with Iraq was extended for 15 years. In 2013, the Kurdistan Regional government (KRG) completed the Kirkuk-Ceyhan pipeline, connecting Kirkuk to Ceyhan oil port. A pipeline link completed by the KRG connects its oilfields to one of the two lines that make up the Iraq-Turkey Pipeline (ITP); this has boosted exports of Iraqi crude oil through Turkey since 2014. In December 2014, an interim agreement was reached between the Iraqi federal government and the KRG on several issues, including crude oil exports and revenue sharing.

**Table 5.2** Operating oil pipelines in Turkey

Pipeline	Capacity (Mt/year)	Start of operation	Length (km)	Supply origin	Ownership
<b>BTC</b>	50	2006	1.763	Caspian region (Azerbaijan and Kazakhstan)	BTC Consortium
<b>Iraq-Turkey Crude Oil Pipeline System</b>	71	1976/1987	641/656 = 1.297 (Turkey, plus Iraq 1.876)	Iraq	BOTAŞ in Turkish territory
<b>Ceyhan-Kırıkkale</b>	7.2	1986	448	Connecting Ceyhan port and oil refinery	BOTAŞ
<b>Batman-Dörtyol</b>	3.5		511	Transport of oil produced in south-east Anatolia to Dörtyol marine terminal	BOTAŞ
<b>Şelmo-Batman</b>	0.8	Out of operation 2008		Transport of oil produced in Selmo area to Batman Refinery	BOTAŞ

Source: MENR data provided 2014.

The Baku-Tbilisi-Ceyhan Crude Oil Pipeline (BTC) and ITP are transit pipelines. Almost all the crude oil reaching Ceyhan Port is delivered to the world market. So far Turkey has not purchased crude oil from BTC. Crude oil transported through ITP is occasionally supplied to the Turkish market. The two transit oil pipelines are significant for the oil supply security of third countries rather than Turkey's own energy supply security.

Volume transited through the Turkish Straits has reached the safety limit of maximum capacity for navigating cargo ships in a safe and secure manner. The Samsun-Ceyhan Crude Oil Pipeline project was proposed to mitigate the bottleneck in the Turkish Straits for oil deliveries from Samsun to Ceyhan. In 2010, Turkey and Russia initiated negotiations on the Intergovernmental Agreement but the project companies suspended the pipeline project, owing to the lack of oil throughput guarantee given by Russia.

## PRICES AND TAXES

Transport fuel prices are above the IEA average; in particular heating oil is expensive, with the tax component amounting to an average of 50% of the final retail price.

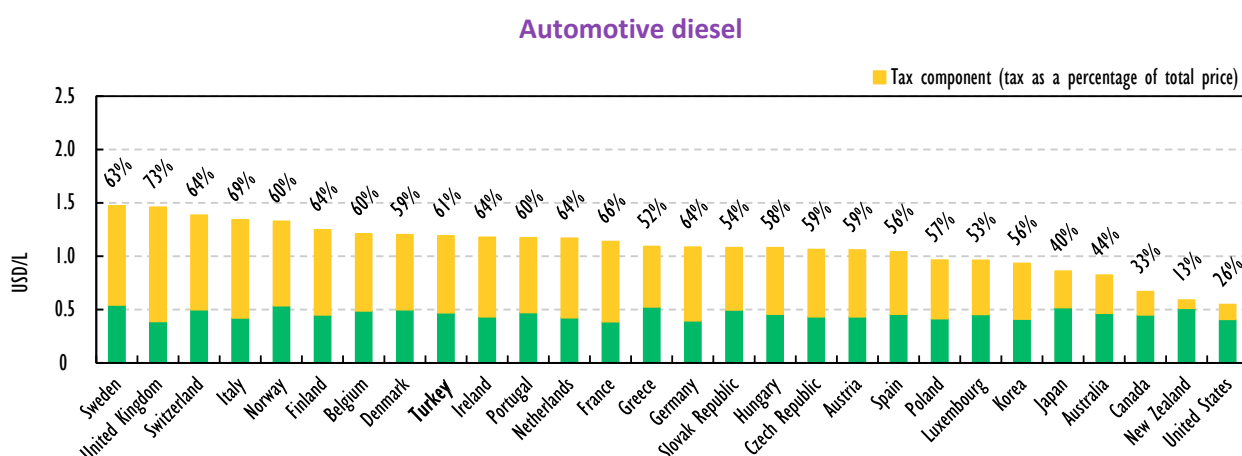
In the first quarter 2016, Turkish gasoline and heating oil prices were the eleventh-highest within the IEA member countries after United Kingdom and Korea. For diesel, the tax accounted for 61% of the fuel price.

Pursuant to the Special Consumption Tax (SCT) Law No. 6760, fuel oils and motor vehicles are taxed. SCT at varying rates is applied to motor vehicles in accordance with the vehicle type and its engine capacity, not the fuel. A tax of TRY 2.1765 is imposed per litre of gasoline, TRY 1.5945 per litre of diesel and TRY 1.5780 per kilo of LPG. Fuel used for marine and air transportation is exempted from SCT.

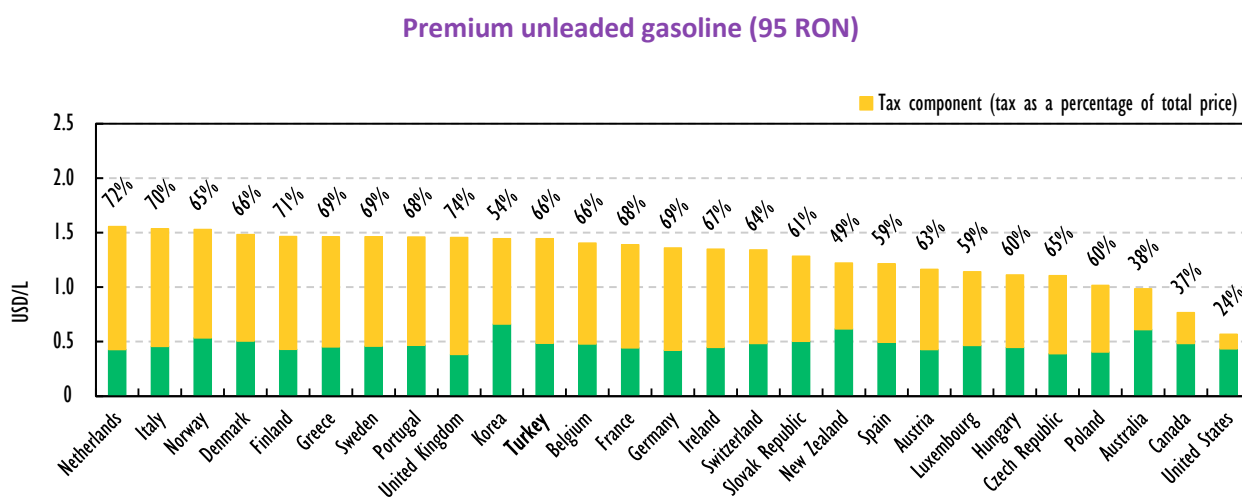
Turkey heavily relies on road transportation, and diesel is the fuel of choice, notably in the commercial and agriculture sectors. Around 70% of the vehicles running on diesel are trucks and transport vans. In 2013, 46% of vehicles ran on diesel against 32% on gasoline and 22% on LPG, continuing the steady rise in diesel use and the reduction in gasoline use witnessed since 2009. The percentage split of new registrations was 59 to 39 (diesel to gasoline) in 2013 (before the expected conversions of some gasoline vehicles to LPG).

Oil prices in Turkey are determined according to the Petroleum Market Law (Law No. 5015) Article 10. Refining and distribution prices are set by the licensees in line with global free market prices at the closest accessible point and are submitted to EMRA as ceiling prices. Under Law No. 5015 EMRA monitors the nearest-accessible global free market prices and Turkish petroleum market prices. EMRA can intervene in the free market price formation in case there is a risk to competition or to the delivery of oil supplies and can set base and/or maximum consumer prices during a temporary period of two months. To date, EMRA has applied a price cap on it twice so far, as there was lack of competition in the market. In such cases the maximum consumer price was determined by EMRA according to global free market prices.

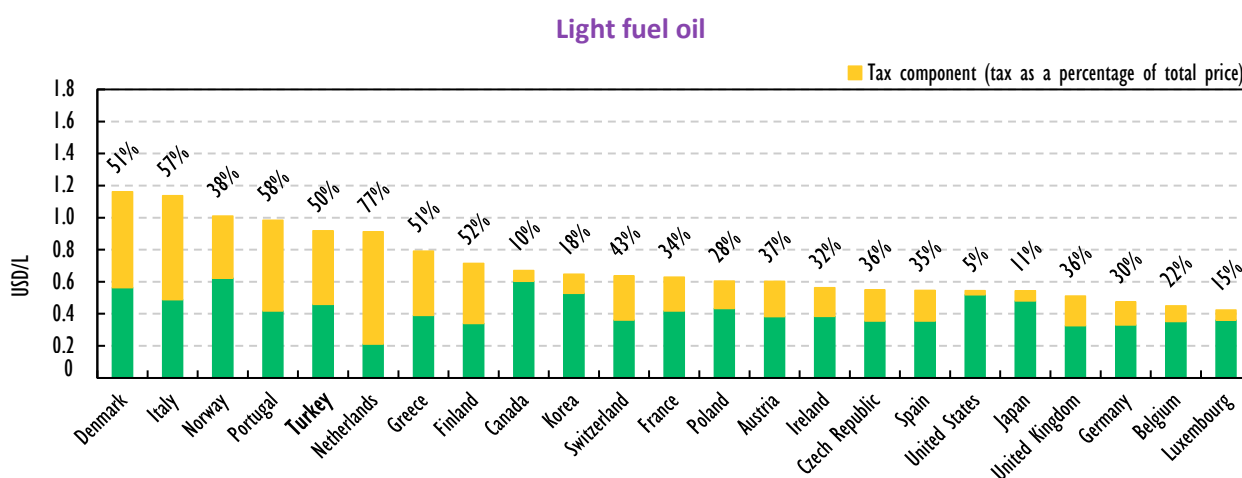
Figure 5.5 Fuel prices in IEA member countries, first quarter 2016



Note: Data not available for Estonia.



Note: Data not available for Estonia and Japan.



Note: Data not available for Australia, Estonia, Hungary, New Zealand, the Slovak Republic and Sweden.

Source: IEA (2016c), *Energy Prices and Taxes 2016*, Q1, [www.iea.org/statistics/](http://www.iea.org/statistics/).

## SECURITY OF OIL SUPPLY

Major oil transit pipeline, port and import infrastructure is located in the regions bordering Iraq and Syria (see Figure 5.4), including parts of the BTC, the Batman Refinery, with a small processing capacity, and the major Iraq-Turkey oil pipeline. The BTC has been providing secure oil transit since it started operations in 2006. Turkey's major refining capacity is located in western Turkey.

Concerns about security of oil transit infrastructure have come to the forefront in recent years and security of transit is regarded as a priority in Turkey. The extent of concern over security varies, depending on whether it concerns a supply interruption or the threat of terrorist attacks. Terrorist attacks are a major concern for Turkey. The war in Syria and neighbouring northern Iraq has brought about an increasing number of terrorist attacks and sabotage of oil infrastructure, notably in the south and east of Turkey. Given the current importance Iraq has gained in the crude oil import portfolio and the location of the oil import infrastructure, the requirements for the protection of critical oil infrastructure facilities have increased. Despite the war in northern Iraq and terrorist attacks against the Iraq-Turkey pipeline, Iraq and the Kurdistan Regional government have maintained crude exports through Turkey.

Domestic supply diversification and oil supply security in Turkey can be further increased by additional oil supplies available in the future from Iran, already a supplier of oil (and gas) to Turkey. Iran is able to raise exports, following the lifting of sanctions. In March 2015, Iran has ramped up production in preparation for its emergence from nuclear sanctions. The IEA estimates that Iran may be able to increase production to as much as 3.6 million barrels per day (mb/d) – its pre-sanctions capacity.

## EMERGENCY RESPONSE DECISION-MAKING

Stock release decisions are taken by the National Oil Stock Commission (NOSC) which is chaired by Under-Secretary of MENR. The commission acts as a National Emergency Strategy Organisation (NESO) and is composed of the Under-Secretary of the Treasury and the representatives of the Ministry of National Defence, the Ministry of Foreign Affairs, the Ministry of Finance, the Ministry of Interior, the EMRA and MENR's General Directorate for Petroleum Affairs (GDPA).

MENR renounced to establish a public stockholding agency because of the high economic costs of creating a new institution. Instead, the administrative capacity of GDPA was strengthened. A new Oil Stock Department was created within GDPA which is responsible for the co-ordination of oil stocks and the emergency response during oil supply disruptions. A decision by the NOSC is required to draw down compulsory industry stocks. Depending on the NOSC decision, and in close co-operation with EMRA, GDPA will request industry to release oil stocks when necessary. In practice, the stock release will be carried out by refineries in most cases.

## STOCKHOLDING STRUCTURE

As a member of the IEA, Turkey is responsible for building a stock of oil-equivalent to its 90-day net imports. As a requirement of national legislation, Turkey has an industry-oriented oil stockholding system, imposing stockholding mandates on refineries, distributors and eligible consumers.

Under the relevant acts, refineries and fuel distribution companies are obliged to hold at least 20 days of product stocks, based on the average daily sales of the previous year. Eligible consumers using more than 20 000 tonnes annually are required to hold 15 days' consumption of each type of liquid fuel.

The Draft Law on Complementary Oil Stocks aims to strengthen the oil stock system and introduce complementary oil stocks to be held by contract. It was combined with the new Draft Fuel Market Law which now contains provisions with regard to complementary oil stocks and oil security. After consultation of public and private institutions, the Draft Law is expected to be submitted to the Parliament in 2016.

### **Crude oil products**

Turkey held some 66 mb of oil stocks at the end of November 2015, equating to 105 days of 2014 net imports. All stocks are held by industry. Around 58.6% of total oil stocks are held in the form of crude oil, as refineries are allowed to hold crude oil in place of gasoline and diesel on the condition that they report the amount and the type of substitution. Middle distillates account for 24% of the country's total stocks, followed by motor gasoline (3%).

### **Location and availability**

All emergency oil stocks are held in the country. Since Turkish legislation does not allow emergency oil reserves to be held abroad, the country has no bilateral agreements or ticket arrangements with other countries.

Although compulsory stocks are commingled with commercial and operational stocks in storage, emergency oil stocks are considered to be held on top of the minimum operating requirements (MOR) of the industry.

### **Monitoring and non-compliance**

Under the Petroleum Market Law, EMRA is authorised to inspect all oil stocks and to convert the oil stocks to other products under the condition that their amounts are not reduced.

Stock levels are controlled by EMRA and monitored on a monthly basis via the Petroleum Market Information System. EMRA also conducts regular onsite audits and checks twice a year at randomly selected facilities to monitor the physical availability and the quality of the compulsory stocks. These audits are carried out in co-operation with the Ministry of Science, Industry and Technology. Technical requirements are also tested on site by individual experts. In cases of failure to comply with stock obligations in terms of quality, quantity and location of oil products, companies will have to pay fines, and, in case of serious infringement, the licence of the company may be cancelled.

### **Stock drawdown and timeframe**

The Petroleum Market Law requires a decision by the NOSC to draw down compulsory industry stocks during an oil supply disruption. According to the decision taken by the NOSC, the GDPA will request industry to release the necessary oil stocks in close co-operation with EMRA. Stock release will most likely be made by refineries. The government's decision could be taken in two days and the release of stock is estimated at three days.

### **Financing and fees**

The government does not provide financial support for building compulsory industry stocks. All refineries, distributors and eligible consumers must self-fund the operational costs of meeting their emergency requirements. These costs are implicitly passed on to final consumers in market prices.

### **Demand restraint**

Demand restraint is considered a secondary emergency response measure that could complement an oil stock release.

Turkey's demand restraint measures would range from light-handed measures (e.g. information and energy saving campaigns) on a recommendation basis, to heavy-handed measures (e.g. mandatory speed limits, a ban on weekend driving and short-distance driving, temporary restrictions on heating for houses and public buildings to under 15°C, restriction on the lighting of shop windows, prohibition of motor sports, introduction of delivery quotas of gasoline, tax increases and rationing) which would be deployed only in case light-handed measure are not enough to reduce oil consumption. The decision to implement demand restraint measures will be taken by the Crisis Coordination Board in provinces together with the prime minister's Disaster and Emergency Management Authority (AFAD). Approval by Parliament is required for the implementation of tax increase and rationing/allocation measures. Local governors are asked to implement demand restraint measures that the Coordination Board decides to apply according to the severity of the crisis.

### **Fuel switching**

Short-term fuel switching is not regarded as an emergency response measure in Turkey. The share of oil in power generation was 0.8% in 2014 and there is therefore little potential for fuel switching in this sector.

### **Other**

According to the Petroleum Law, the Administration can ask oil producers to increase their production. A domestic production surge is estimated to be a 5% to 10% increase of production for 10 days in time of crisis. However, it is insufficient to cover domestic oil demand since the country's annual crude oil production was around 2.5 Mt in 2015.

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## **ASSESSMENT**

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Over the past decade, Turkey's crude oil net imports have been volatile but increased by an average of 7.2% since 2005, reaching 25.1 Mt in 2005, while net imports of oil products increased fast to reach 16.2 Mt in 2015, up by +259.5% since 2005. Oil constitutes around 30.1% of TPES and the transport sector is the main driver of oil demand.

Turkey currently meets its consistent demand for oil by importing from several countries, as domestic production was only 2.5 Mt in 2015, and is in steady decline. The largest import source in 2015 was Iraq, followed by Iran, Russia and Saudi Arabia, with a significant decline in imports from Libya, Russia and Iran. However, geopolitical

uncertainties in the region place additional importance on Turkey's supply arrangements with producers further afield.

Since the last IEA in-depth review of 2009, Turkey has reformed its almost 60-year-old law governing oil and gas upstream exploration and production activities with the enactment of the new Petroleum Law in 2013. The government is keen to stimulate oil production by reforming its licensing regime and envisages a major increase in domestic oil and gas exploration and production in MENR Strategic Plan for the period 2015-19. The government should review the progress and results, notably with regard to foreign direct investment, including into technology and drilled wells, and ensure that the framework remains attractive, notably in changing global oil markets.

Most of the exploration activities were carried out in a period of high oil prices and as joint ventures with TPAO. The current low oil price environment will certainly impact the unconventional oil/gas activities in Turkey, limiting its outlook for reducing import dependence in the medium term. While ten years ago, oil majors were present in Turkey, exploration drilling is still at a low level and uncertainties remain with regard to the potential. The slow progress of oil exploration and production is largely the result of licence hoarding (without proceeding to production) under the previous Petroleum Law and lack of technology. Such innovative technologies are needed to improve assessments of the potential, to increase drilling activities and to manage financially and technically more challenging deep offshore exploration and hydraulic fracturing. Foreign investment will be crucial in this regard, but also the structure of the downstream sector determines the upstream activities.

Competition in the downstream sector remains weak with the Petroleum Refinery Corporation TÜPRAS owning and operating all four refineries, a situation which has resulted in a fine by the competition authority and in the application of two price caps by EMRA. At the same time, refineries have to purchase domestic oil at regulated prices. The entrance of Azerbaijan's SOCAR into the downstream market will be a welcome improvement to competition. The new refinery under construction in Aliaga is expected to produce 5 Mt per year of diesel from 2018 (out of a total production of 10 Mt).

Turning to the refined products market, as in many other countries, Turkey continues to fuel the high consumption of diesel, which is largely due to high freight transport, by maintaining a tax differential in the SCT, 61% for diesel and 66% for gasoline. Diesel use in marine and aviation transportation is exempted from the SCT.

Air pollution has become a growing concern in large cities, as standard diesel engines produce more harmful pollutants (nitric oxide and nitrogen dioxide), which is a public health hazard, than modern petrol engines, particularly in urban areas. Turkey also imports large amounts of diesel to service its growing diesel demand, while the country is exporting gasoline. The government should consider whether to adjust the tax approach to prevent further reliance on diesel, both to reduce the unnecessary expenditure and reliance on diesel imports and to reduce pollution. Alternatives worth considering include incentives for adapted "city diesel" vehicles, which produce fewer harmful particles, and low-emission zones in major urban areas. However, there is no strategic approach in place to evaluate domestic refining and domestic product demand. It would be advisable to design a strategy by involving all relevant ministries and industry stakeholders, to evaluate the oil demand and emissions in the different sectors and adapt taxation policies.



However, security concerns with regard to critical oil import and transportation infrastructure located in the south-east of Turkey are increasing amid the war in Syria and northern Iraq. Turkey has increasing Iraqi oil imports through the Iraq-Turkey oil pipeline and the Ceyhan port located in the south-east of Turkey. There have been some minor incidents related to the regional instability. The protection of critical infrastructure and the security of transit have become an issue for Turkey and should remain a key element in the oil security policy of Turkey as this could have also an impact on oil stockholding requirements.

In this respect, Turkey has chosen not to establish an oil stockholding agency, and decided instead to create a new unit within the ministry's General Directorate for Petroleum Affairs. GDPA has drafted a new Fuel Market Law including Complementary Oil Stocks provisions. The draft law requires contractors to hold, on behalf of the administration, complementary stocks or industry stocks, which complement the balance above the required 90 days of net oil imports. The costs of these stocks would be met by a levy. It is a matter for each country to determine how best to meet its oil stockholding obligations. However, it is critical that all stocks are additional to those required by the holders for their normal business and that clear procedures exist, and are tested, to ensure that stock drawdown can be made quickly and efficiently.

## RECOMMENDATIONS

*The government of Turkey should:*

- *Consider the development of a petroleum products strategy, in collaboration with the Ministries of Energy and Natural Resources, Economy and Transport, Maritime Affairs and Communication, to set a common approach for both taxation and transport policies and the development of domestic refining, in line with environmental, economic and energy security goals.*
- *Increase the efficient use of oil by strengthening demand-side policies, especially in the transport sector, and by adjusting fuel taxation in line with energy policy goals.*
- *Produce and test an operational handbook describing the procedures for the government and stockholders to implement a stock-draw in the event of an emergency and address critical infrastructure protection as part of the oil security policies.*

## References

IEA (International Energy Agency) (2016a), *Oil Information 2016*, OECD/IEA, Paris, [www.iea.org/statistics/](http://www.iea.org/statistics/).

IEA (2016b), *Energy Balances of OECD Countries 2016*, OECD/IEA, Paris, [www.iea.org/statistics/](http://www.iea.org/statistics/).

IEA (2016c), *Energy Prices and Taxes 2016*, Q1, OECD/IEA, Paris, [www.iea.org/statistics/](http://www.iea.org/statistics/).

MENR (Ministry of Energy and Natural Resources) (2014), *2015-2019 Strategic Plan*, Ankara.

## 6. COAL

### Key data (2015 estimated)

**Production:** 1.4 Mt of hard coal and 52 Mt of brown coal (50.4 Mt of lignite)

**Net imports:** 33.8 Mt of hard coal, +94.9% since 2005

**Share of coal:** 27.3% of TPES and 28.3% of electricity generation

**Inland consumption (2014):** 35.9 Mtoe (power generation 57.2%, industry 16.8%, other transformations 10.7%, commercial and public services and agriculture 9.7%, residential 5.6%)

## OVERVIEW

Turkey is endowed with large reserves of lignite and some hard coal, in sharp contrast to the scarcity of its oil and gas resources. Between 1990 and 2012, the energy demand increased by 127%, while indigenous energy production only rose by 25%, leading to an increased import dependence. Rising electricity consumption needs are met by an increased use of coal for power generation, which accounts for almost 30% of the electricity mix. However, most of the hard coal consumed in Turkey has to be imported, as domestic coal is low quality and lignite fields are only partially developed. Turkey has one of largest coal power plant development programmes, outside India and the People's Republic of China (hereafter "China").

Looking ahead, economic and population growth will give rise to an important increase in energy demand. Diversification is the cornerstone of the energy strategy of the government for the future. Lignite, the only indigenous fossil fuel with significant reserves, is considered the main component to meet future energy demand, in particular for power generation. The government expects coal, together with nuclear energy and renewable sources to play an important role. Given the price advantage of coal versus gas, imported hard coal and lignite are to play an important and growing role in securing energy supply in Turkey.

Coal use presents several challenges that must be considered and duly addressed. Its implications on climate change are obvious (see Chapter 3 on climate change). Safety in Turkish coal mines has become a major concern after the serious accidents that occurred in the last few years. Most of the planned investments in mining are still pending in spite of the urgently needed investment. On the other hand, the need for investment offers a good opportunity to apply the best technology throughout the process, building modern, safe mines and using coal with the most efficient and clean coal power plants.

## SUPPLY AND DEMAND

### SUPPLY

Turkey is endowed with large coal reserves, although the quality is generally poor. As part of the strategy of reducing import dependence, drilling and exploration activity has been intensified in the last ten years. Lignite reserves have almost doubled since 2004. However, coal production has been on the decline since 2007, as imports have grown.

#### Hard coal

Turkish hard coal reserves amount to 1.3 billion tonnes and are concentrated in the Zonguldak Basin, on the Black Sea coast in North Anatolia. The geological structure of the basin makes mining difficult because of steep seams, disturbed by frequent faults and containing a large amount of methane. Production can hardly be mechanised. In addition, Zonguldak coal is prone to self-combustion. On the other hand, this coal has coking properties. Although it does not produce coke suitable to be used in large blast furnaces, it can be blended with imported coking coal to produce high-quality coke. Virtually all hard coal reserves belong to the state-owned Turkish Hard Coal Enterprise (TTK), the main producer of hard coal in Turkey.

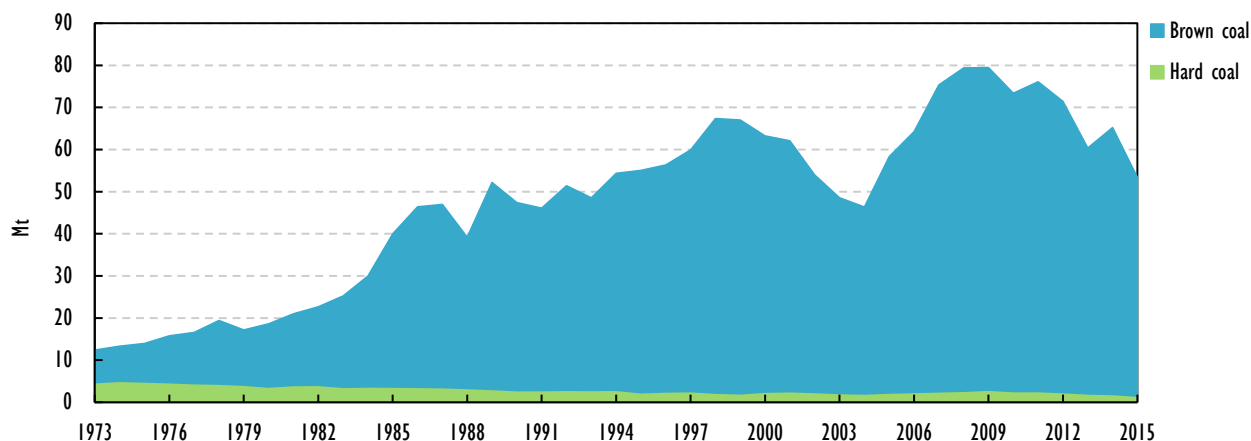
#### Brown coal

Known lignite reserves reached 15.6 billion tonnes, which ranks Turkey 20th among the largest lignite reserve holders in the world. They are scattered throughout the country, most of them in west Anatolia, although big basins like Afsin-Elbistan and Sivas-Kangal are located in central and east Anatolia (see Figure 6.5). Finally, there are some deposits of asphaltite in south-east Anatolia, near the Iraqi border. The quality of Turkish lignite varies a great deal, but most of it is low-calorific, and has a high content of ash, volatile matter, moisture and sulphur. More than half the lignite reserves have a calorific value between 1 000 and 1 500 kilocalories per kilogramme (kcal/kg); 17% of reserves are between 2 500 and 3 000 kcal/kg and only 8% are over 3 000 kcal/kg. Most coal requires washing to be usable. Thickness is variable, depending on deposits: in Afsin-Elbistan, some deposits can go up to 58 metres and a few deposits in central Anatolia are 40 metres thick. The state-owned Electricity Generation Corporation EÜAŞ (8.6 billion tonnes) and the Turkish Coal Enterprise TKİ (3.7 billion tonnes) own the majority of lignite reserves (see Figure 6.5).

Total supply of coal was 35.3 million tonnes of oil-equivalent (Mtoe) in 2015, or 27.3% of total primary energy supply (TPES). Coal supply was 18.3% higher in 2015 than in 2009 and 56.2% higher than in 2005. This growth has been driven by increasing use of coal in power generation.

Turkey's lignite production reached 50.4 million tonnes (Mt) in 2015 and has exhibited cyclical growth over the past few decades, with a downturn in the early 2000s followed by a record high of 76.2 Mt in 2008. From 2008 to 2015, production contracted by 33.8% in total, albeit with an 8.8% rise in 2014 (Figure 6.1). Overall, lignite production was 8.7% lower in 2015 than ten years earlier.

Hard coal production has remained relatively unchanged for decades to 2014, at around 2 Mt. In 2015, hard coal production was 1.4 Mt, 21.7% lower compared to the previous year. Amid very low global hard coal prices, imports have become more important.

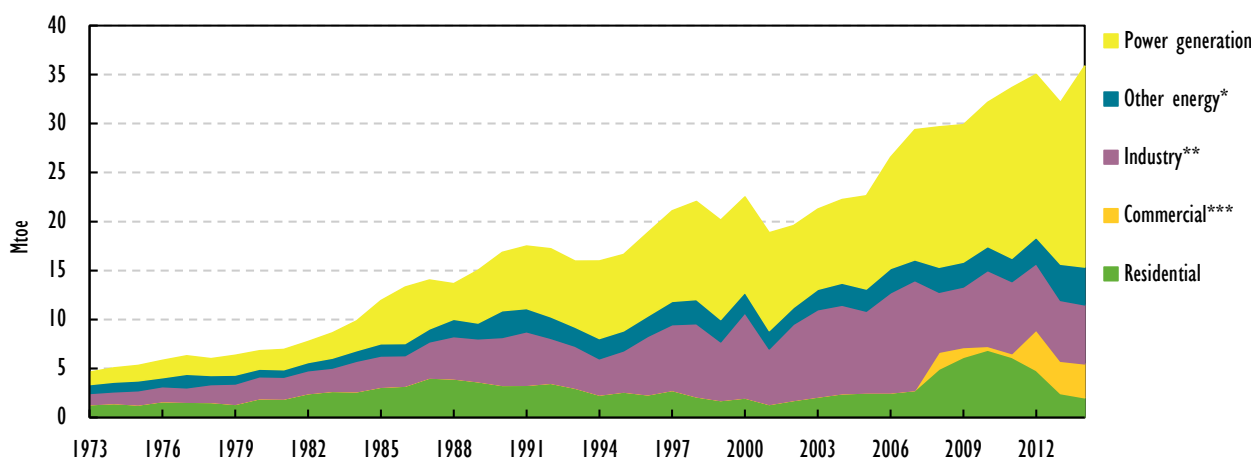
**Figure 6.1** Brown coal and hard coal production, 1973-2015

In IEA coal statistics, brown coal comprises sub-bituminous coal and lignite, while hard coal comprises anthracite, bituminous and other sub-bituminous coal. This is consistent with Turkish classification, in which lignite includes lignite and sub-bituminous coal.

Source: IEA (2016a), *Coal Information 2016*, [www.iea.org/statistics/](http://www.iea.org/statistics/).

## DEMAND

Around 68%<sup>1</sup> of coal consumed in Turkey is turned into electricity and heat by power generation facilities; 16.8% is consumed by industry, largely in autonomous power generation plants. The remainder goes to commercial and public services, including agriculture (9.7%) and households (5.6%) (see Figure 6.2). Over the past decade, coal demand has been driven by the power generation sector (along with the transformations sector where coal is refined into products and then used in power generation).

**Figure 6.2** Coal supply by sector, 1973-2014

Note: TPES by consuming sector. There is no coal use in the transport sector.

\* *Other energy* includes other transformations such as coke ovens and refining, and energy own-use.

\*\* *Industry* includes non-energy use.

\*\*\* *Commercial* includes commercial and public services, agriculture/forestry and fishing (negligible).

Source: IEA (2016b), *Energy Balances of OECD Countries 2016*, [www.iea.org/statistics](http://www.iea.org/statistics).

1. It includes both coal and coal products, such as recovered gases, coal tar, patent fuel and briquettes.

Consumption for power generation and other energy use has increased by 140.6% and 71.3% from 2004 to 2014, respectively. This trend has been consistent over the ten years. Conversely, industry demand was 33.4% down over the same period, losing its dominant share of 40.6% of total demand in 2004. Demand from the residential and commercial sectors peaked in 2012 and has contracted since.

More than 80% of domestically produced lignite is used in power generation. By the end of 2014, 8.6 gigawatts (GW) or 12.3% of total installed power generation capacity used domestic (lignite) coal and 6.2 GW or 9% used imported hard coal. Regarding volumes of electricity generated, domestic coal produced 33.6 terawatt-hours (TWh), or 14% of the total capacity and imported coal 29.5 TWh, representing 12.3%. Thermal power plants in Turkey work at load factors below 50%, much lower than in other countries.

**Table 6.1** Power plants under construction using domestic coal\*

Owner	Plant	Fuel	Capacity (MW)
Hema Elektrik	Amasra	Hard coal	1 100
Konya Ilgin	Ilgin	Lignite	500
TEYO Yatırım Dış Tic. A.Ş.	Tufanbeyli	Lignite	600**
Hidro-Gen	Soma	Lignite	510**
Adularya	Eskişehir-Mihalıccık	Lignite	290
Çelikler	Bursa-Keles	Lignite	270**
Çelikler	Kütahya-Domaniç	Lignite	300**
Silopi Elektrik	Silopi	Asphaltite	405***
Aksa Göynük Enerji	Bolu-Göynük	Lignite	270**
Sırnak Elektrik	Silopi	Asphaltite	135***
Tam Enerji	Etyemez Coal	Lignite	100

\* 300 MW of Tufanbeyli (Enerjisa), 270 MW of Silopi, and 135 MW of Bolu-Göynük started operation in 2015, 135 MW of Bolu-Göynük started operation in 2016.

\*\*TKI owned lignite deposits which were given to the private sector with leasing method by obligation to install a power plant within a 6-year-investment period.

\*\*\*TKI owned asphaltite deposits which were given to Silopi Elektrik and Province Şırnak with leasing method.

Low prices of international hard coal compared with high prices of imported natural gas have triggered investments in coal-fired power plants using imported coal. In 2014, Izdemir Enerji (350 MW), ICDAS Elektrik (600 MW) and Atlas Enerji (600 MW) coal power plants started operation.

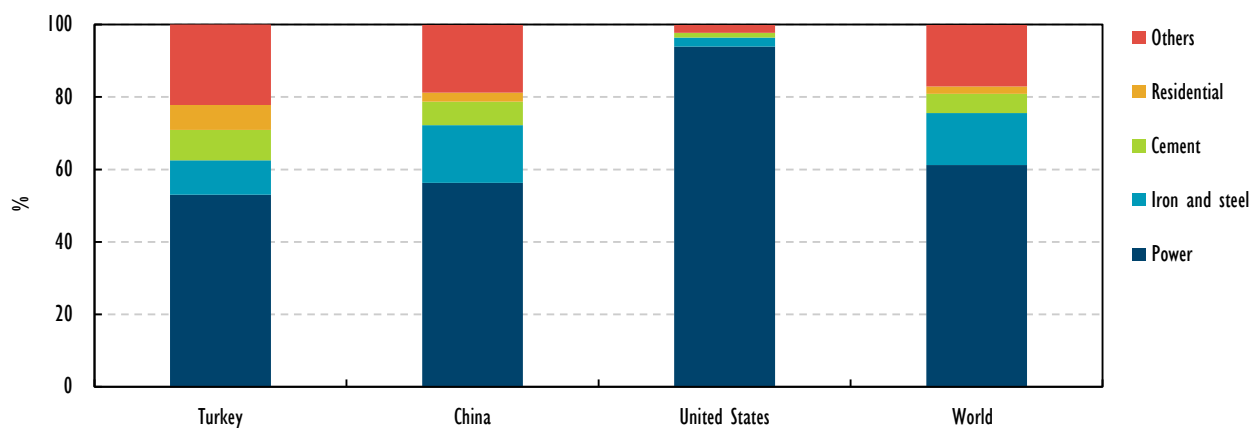
There are more than 30 GW of new projects planned at different stages, from pre-licence to construction. More than 7 GW are under construction, more than 13 GW under evaluation, another 3 GW proposed and the remainder only announced, but without significant progress.

A large share of coal is consumed in the residential and industry sectors, a rare case by international comparison (where most coal is used in power generation). Figure 6.3 shows coal use in Turkey, China, United States and the world. In Turkey,

coal use in industrial and residential applications is very high compared to international patterns. Even in China, where use for industrial and residential sectors is very high in absolute terms, the share of coal consumption in these sectors is lower than in Turkey. In Turkey, coal is still used as a base fuel in the residential sector for space heating.

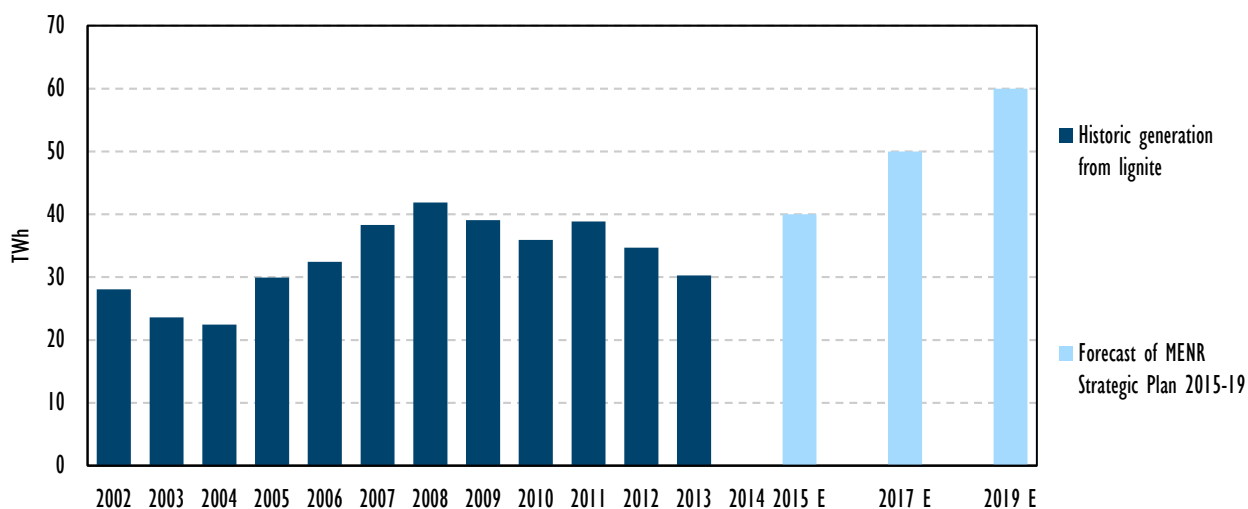
Turkey is the ninth largest steel producer in the world, after China, Japan, the United States, India, Korea, the Russian Federation (hereafter “Russia”), Germany and Brazil. Turkey is also one of the main producers and consumers of cement worldwide. In 2014, production was over 75 Mt with exports close to 8 Mt.

**Figure 6.3** Coal consumption by sector in Turkey and in other large economies (2013)



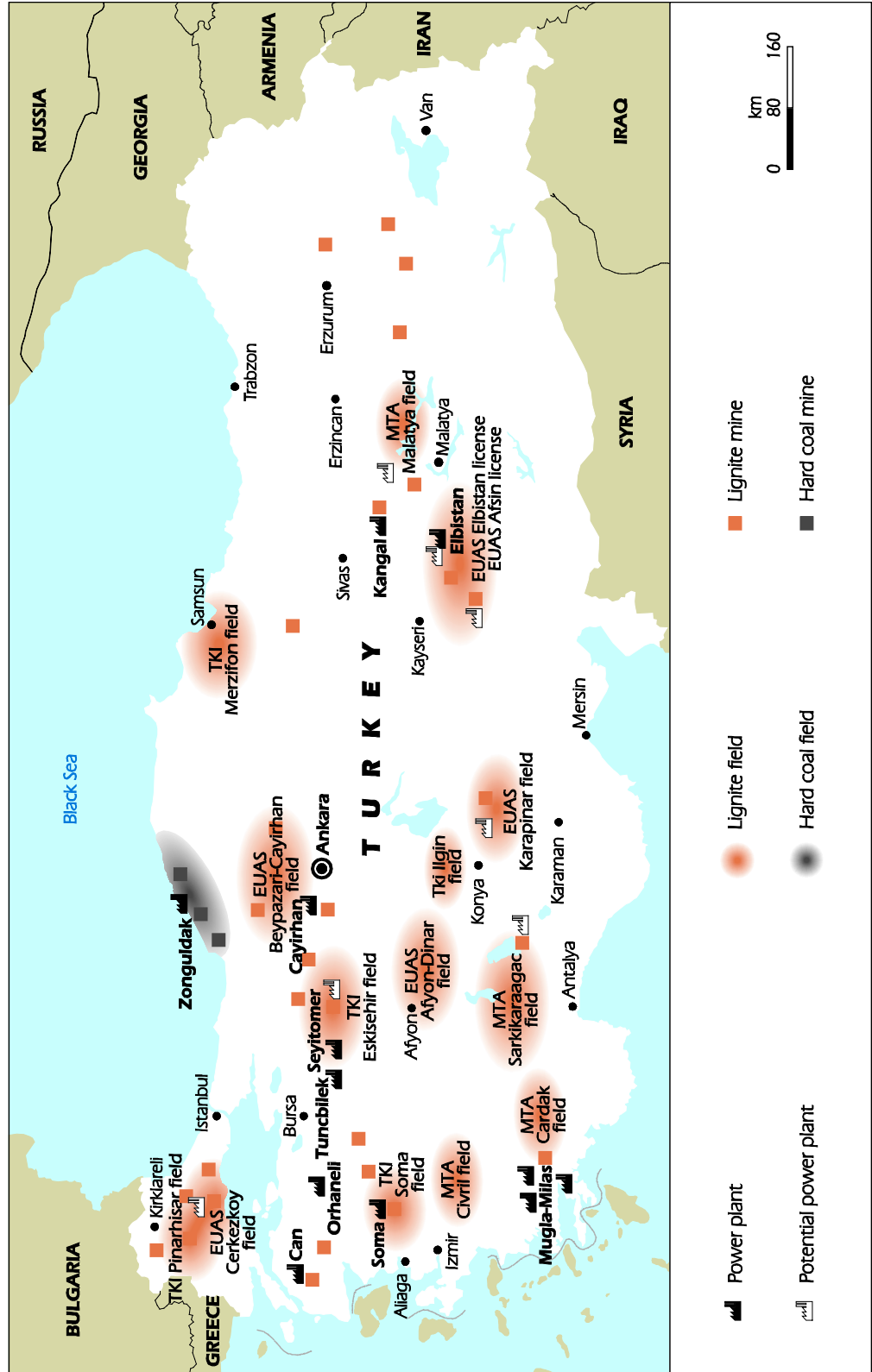
Source: IEA (2015b), *Energy Balances of OECD Countries*, OECD/IEA 2015, [www.iea.org/statistics/](http://www.iea.org/statistics/).

**Figure 6.4** Planned increase in the use of domestic coal in power generation



Sources: TEİAŞ; MENR (2014), *Strategic Plan 2015-19*, Ankara.

Figure 6.5 Turkey's coal mines and coal-fired power plants

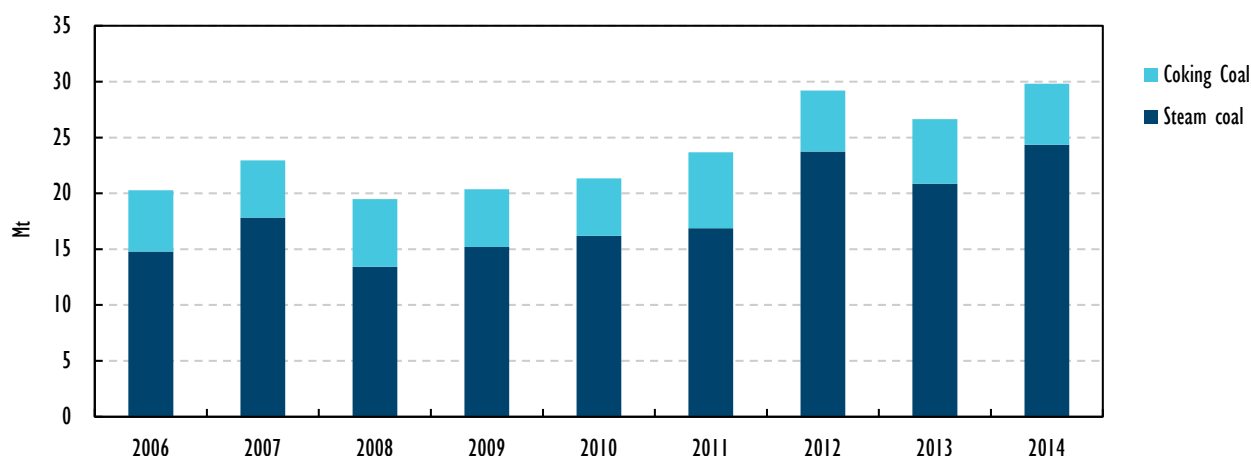


This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area.

## IMPORTS

Imports accounted for 96% of the total hard coal supply in 2015, when Turkey imported 34 Mt of hard coal from Colombia (33.1% of the total), Russia (33%), South Africa (14.6%), Australia (8.2%) and other countries. Hard coal imports have increased by 95.7% over the past ten years, because of growing demand and low prices. Anthracite is used mostly in residential heating and coking coal is for steel production.

**Figure 6.6** Imports to Turkey by coal type 2006 -15



Source: IEA (2016a), *Coal Information 2016*, [www.iea.org/statistics/](http://www.iea.org/statistics/).

## INSTITUTIONAL FRAMEWORK

The **General Directorate of Mineral Research and Exploration (MTA)** is responsible for coal exploration activities and focuses on research activities. It is an affiliated institution of the **Ministry of Energy and Natural Resources (MENR)**.

The role of the state in the coal industry is very important through two state-owned companies. The largest coal producers and reserve holders of lignite are the state-owned company **Turkish Coal Enterprises (TKI)** and the **Electricity Generation Corporation (EÜAŞ)**. State-owned company **Turkish Hard Coal Enterprises (TTK)** produces most of Turkey's hard coal and owns virtually all the reserves.

## COAL POLICY

The Turkish government's aim is to increase the use of domestic resources to reduce import dependence as a core policy objective of its 2009 Electricity Market and Security of Supply Strategy. It underlined the need to prioritise the use of domestic lignite, among other indigenous resources, and to accelerate the installation of power plants using clean coal technologies.

In the 2012 Energy Efficiency Strategy, the government set the target to increase plant efficiency above 45% by 2023, but no detail has been provided with regard to its implementation.

MENR Strategic Plans 2010-14 and 2015-19 set out the policy directions for the coal sector. The 2015-19 Plan includes the target of increasing the amount of electricity



generated from domestic coal to 60 TWh by 2019 (see Figure 6.4) and outlines plans for establishing a new governance in supervising operation and inspection of mines and for creating the conditions for efficient, effective and secure mining. Mining operations and oversight should be brought in line with international standards, and new partnerships with companies to increase foreign investments in exploration and international experience should be stimulated (MENR, 2010 and 2014).

Afsin-Elbistan, Karapinar, Eskisehir-Alpu and Afyon-Dinar are the most promising regions for coal exploration. In order to identify, assess and increase coal reserves, reinforced exploration activities would be required.

## PRIVATISATION

Privatisation in Turkey has been ongoing for several decades. TTK produces most hard coal and owns virtually all the reserves. Since 2002, 30% of its production has been privatised on the basis of a royalty tender scheme, which has increased coal production. TKI transferred some coal-mine management to private companies, which in turn pay royalties to the government and provide coal to EÜAŞ, industry and households. TKI and EÜAŞ production includes amounts produced by private companies acting as leaseholders or contractors of the state-owned companies.

Privatisation has led to the transfer of power plant ownership and the transfer of operating rights of their associated mines. State-owned lignite production decreased in 2013 and 2014, after the privatisation of two lignite-based power plants and their associated mines in 2013 and of three more in 2014. Following privatisation, state-owned companies' production has been declining: in the case of EÜAŞ, from 39 Mt in 2011 down to 25.6 Mt in 2012, and in the case of TKI, from 33.4 Mt in 2011 to 21.7 Mt in 2013 and 14.9 Mt in 2014.

Lignite-fired power plants that have been privatised include Seyitömer (600 MW, 2013), Kangal (457 MW, 2013), Yeniköy (420 MW, 2014), Kemerköy (630 MW, 2014), Yatagan (630 MW, 2014), Tunçbilek B (365 MW, 2015), Orhaneli (210 MW, 2015), and Soma B (990 MW, 2015).

Given the investments required in the coal sector, the completion of privatisation and the use of foreign and domestic direct investment are crucial for its future development. There are some joint ventures of Turkish and foreign companies, but mainly local players have been attracted. There are enough financial resources in the country and Turkish investors have trust in the domestic market. In many ways, the private sector can be more efficient in management and operations than the public sector, and investments can be mobilised swiftly. Some mines need large investments, once opencast mining is completed and underground operation starts. To develop lignite fields, large private, including foreign, investments are required in the format of private-public partnership, especially considering the financial, operational and technological risks involved. Safety standards and requirements should be added to cost considerations in the privatisation tenders.

## COAL SUBSIDIES

A large part of coal subsidies are directed to production. Given the dependence of the economy of the Zonguldak Province in the Black Sea region on the activities of TTK, the Turkish government supports TTK. To do so, the government transfers capital to the

company in order to pay its staff. These capital transfers are not meant to make TTK more competitive, but to improve the sustainability of the region. TTK sells coal close to market prices, which is not enough to cover its costs. The Treasury is transferring capital to sustain TTK's financial viability. Capital transfers from the budget amounted to USD 270 million in 2011, USD 255 million in 2012, USD 298 million in 2013 and USD 288 million in 2014 (G20 EMM, 2015). The MENR Strategic Plan 2010-14 stated that TTK invested TRY 32.4 million (or USD 15 million) in hard coal mining in 2009 (MENR, 2010). Since 2008, global coal prices saw sharp declines but the production costs of TTK have remained unchanged, so the level of subsidies increased.

The IEA definition of an energy subsidy is any government action directed primarily at the energy sector that lowers the cost of energy production, raises the price received by energy producers or lowers the price paid by energy consumers. In the case of TTK, the transfer of funds by the government to the company is a subsidy, as it lowers the cost of energy production which otherwise should include the funds received by the government to cover staff cost.

The rehabilitation of TTK should remove this inefficient producer-side subsidy in the medium term. MENR, which has the main responsibility for restructuring TTK, the Under-Secretariat of Treasury and the Ministry of Development have been working on a study plan under the G20 commitment to phase out inefficient fossil fuel subsidies (G20 EMM, 2015). This study is progressing in accordance with the annual programmes co-ordinated by the Ministry of Development. In the meantime, to increase productivity and reduce the losses, total TTK staff has been reduced by 13.8% between 2009 and 2014.

Next to production subsidies, the government offers various investment incentives, including special support for coal-fired power plants fuelled with domestic resources, a waiver of value-added tax, support to the investment location, interest and insurance premiums paid by employers and tax reductions. Since 2012, the New Investment Incentives Programme offers four different kinds of support structures:

- *A General Investment Incentive Plan* is available for all investment types which are on the programme list and have a minimum fixed investment amount. All electricity generating facilities using domestic coal are entitled to VAT and customs duty exemption.
- *A Regional Investment Incentive Plan* provides regional incentives with the objective to eliminate inter-regional imbalances across Turkey. Minimum amounts have been determined for different kinds of investments: the minimum investment amount is TRY 1 million for regions 1 and 2, and TRY 500 000 for regions 3, 4, 5 and 6. An additional labour cost deduction of 38% is available only for region 6.
- *A Large-Scale Investment Incentive Plan* aims to improve Turkey's technological abilities and supports research and development (R&D) capacity.
- *A Strategic Investment Incentive Plan* is available for the production of intermediate and final goods with high import dependence (more than 50%). Investments of TRY 50 million or above are eligible to benefit from this scheme.

The government also intends to maintain momentum of R&D in the coal sector, particularly with regard to fluidized bed combustion, coal gasification and liquid fuel production technologies. Considering the old age of Turkey's coal fleet and the resulting load factors and poor environmental performance, most of the existing fleet of coal-fired power plants need to be rehabilitated.

## MINING SAFETY

There have been several accidents in Turkish coal mines, like in 2011, when a landslide killed ten workers in the Elbistan-Collalar mine (one week later, another worker died in a smaller landslide). In 2014, the worst mining accident ever recorded in Turkey occurred on 13 May when 301 workers died in Soma (Manisa region), after an explosion and a subsequent fire. In 2015, 18 miners were trapped in a central Turkish coal mine which flooded when a water pipe exploded.

The regime of technical regulations and product safety and inspection in Turkey has been modified since 2004 in order to achieve harmonisation of the technical legislation in the European Union. Today, import controls of various product groups are carried out through the “Risk-Based Trade Control System (TAREKS)”. Within TAREKS, import controls are performed electronically and on a risk basis; in other words, only risky products are subjected to safety and conformity checks. The scope of the Communiqué of Product Safety and Inspection No. 9 (*Official Gazette No. 29579* of 31 December 2015) has been updated to ensure safe conditions for coal miners. As of 1 April 2016 safety lamps for mines will be subjected to safety and conformity checks.

Coal mining safety can be improved. Anywhere in the world, the development of a mine project must take into account rehabilitation of land affected by mining, waste facilities management, control of liquid and gas releases and, especially, the safety and health of workers. Every single aspect needs proper legislation, adequate investments and use of state-of-the-art technologies. However, what is more important is to infuse the whole sector with a safety culture. This requires that safety inspectors be independent, well prepared and have the capacity to fine any lack of compliance with the rules. This also requires managers that focus on workers’ safety and zero-accident, educated engineers and managers as well as trained workers, mindful of any risk in work and competent to report any weakness in safety.

## CLEAN COAL TECHNOLOGIES

Most coal plants in operation in Turkey use subcritical technologies. Exceptions are the recent Zetes 2, Bekirli Biga Izdemir Aliaga and Atlas Energy plants, using supercritical steam conditions, which represent around 4 GW of total capacity. Whereas electrostatic precipitators are common in many of the pulverised coal plants, many others do not have any system to prevent dust emissions. Likewise, desulphurisation stations are common, and atmospheric subcritical fluidized bed combustion has been used in some cases. Only few stations, like Afsin-Elbistan A (1 355 MW), Soma B (990 MW), Seyitömer (600 MW) and Tuncbilek (365 MW) are not equipped with flue gas desulphurisation (FGD). The control of nitrogen oxides (NO<sub>x</sub>) is almost inexistent in the Turkish fleet.

Considering the significant increase envisaged in coal capacity, clean coal technologies will have to play an important role. The preferred technology in the new plants is circulating fluidized bed (CFB) for lignite and asphaltite plants developed by the private sector. CFB is a versatile clean coal technology which can be important in a country like Turkey, where the solid fuels used for power generation include domestic hard coal, domestic lignite, imported hard coal, petcoke and asphaltite.

Harmonisation of Turkish legislation in the coal sector with EU legislation is under way. All new power plants must now comply with the EU Large Plant Combustion Directive (LCPD, 2001/80/EC). Upgrading most of the existing and old coal plants to comply with

LPCD provisions will however be a major challenge for private companies and the state. Although most of the old lignite power plants have been privatised; their rehabilitation is required.

Turkey maintains important R&D activities on clean coal, notably by TÜBİTAK, the Turkish Scientific and Technical Research Council, which has strong research projects on CFB combustion systems for coal, biomass and coal/biomass mixture. Lignite gasification has also attracted attention in Turkey, mainly from TKI, with several projects on gasification. TKI designed and built a 250 kg/h gasifier in addition to some other smaller projects. TKI is working in co-operation with other Turkish institutions, notably TÜBİTAK, as well as within international programmes, one of which is an EU Seventh Framework Project (FP7) on coal gasification in collaboration with India, France and the Netherlands.

## ASSESSMENT

Turkey is endowed with important lignite reserves (15.6 billion tonnes versus 1.3 billion tonnes of hard coal); the only fossil fuel with significant reserves in Turkey. Since 2009, the strategy of the government has been to decrease import dependence, notably on natural gas (needed for power generation) by relying on the development of domestic coal. The continuous rise in energy demand and the high energy import bill oblige Turkey to look at domestic resources, i.e. lignite reserves. Considering coal plants announced, proposed and under construction, Turkey has the largest coal power plant development programme in the world, outside China and India.

Conversely, domestic coal production has been in decline, and imported hard coal has become the key source to meet growing energy needs. Coal has a competitive advantage over natural gas in power generation in absence of carbon taxes or emissions trading schemes in Turkey. Hard coal imports increased by 95.7% between 2005 and 2015. Coal played a significant role in electricity generation with a share of 28.3% in 2015, and Turkey produced around 0.8 Mt of coking coal, 2.2 Mt of steam coal and 50.4 Mt of lignite, and imported 34 Mt of hard coal. In the medium term, the government expects production, consumption and imports of coal to increase significantly.

But a series of issues could hamper lignite fields' development and thus compromise the strategy of the government. First, low quality of domestic lignite adds to the high-moisture, generally high-ash and high-sulphur content of lignite. Turkish lignite fields are often deep underground and involve high production costs. The upfront investments required are significant and it is not clear how the necessary financing can be secured. Secondly, long procedures and delays for licensing and permitting worsen the financing and add to the other risks involved in this already high-capital and risky investment. Thirdly, large investments are needed in the coal sector development including research, development and technology deployment, such as clean coal technologies. Fourthly, delays in the privatisation process can create regulatory uncertainty for investors.

Coal mining is more risky than any other industrial activity, but many countries have been able to successfully reduce the death tolls in their mines. Recent accidents in Turkey (Soma and Ermenek) raised safety concerns. The government of Turkey is applying new regulation on mining safety. Experience in other countries suggests that strict regulation, while necessary, is often not sufficient. A safety culture involving regulators, owners, contractors, workers, regulators, inspectors and other stakeholders

is needed. Education and independent inspection by the competent authorities will ensure thorough monitoring and application of a disciplinary regime as to safety rules.

The government has committed to privatising a great part of the coal-fired power plants and mines of state-owned companies. This process will increase the economic efficiency of mines, attract investments and encourage competition. The privatisation process should be organised in a transparent and fair manner, ensuring equal opportunities to all local and foreign investors. To date, no foreign company has shown interest in the privatisation tenders of coal power plants and mines.

Afsin-Elbistan, Karapinar, Eskisehir-Alpu and Afyon-Dinar are the most promising regions. The development of the fields should be fostered by using best available technology for both mining and power generation. The state may play a supportive role, given the large financial resources and operational risks inherent to these investments, as well as other perceived risks related to biomass co-firing (that can reduce load factors of conventional plants or future CO<sub>2</sub> prices). In order to attract investments to some of those fields, the government has included power plants using domestic resources in the prioritised investments which can benefit from the so-called regional incentives. The government should monitor the progress of lignite mine development and be ready to adopt new measures, like private-public partnerships, while ensuring transparent processes, reducing subsidies and avoiding distortions in the electricity markets.

Complex procedures and lack of co-ordination between different administrative bodies have led to delays in the past. The government needs to further streamline licensing procedures, to reduce delays or unexpected hurdles, to continue to improve the governance and co-operation of all the institutions.

Turkish Hard Coal Enterprises (TTK), the state-owned company exploiting hard coal resources, receives subsidies to compensate the losses from uncompetitive production. The social and regional issues associated with the closure of domestic mines are common to many countries when facing competition from imported hard coal. The needs for subsidies grew when global hard coal prices fell sharply in the past decade. Production of TTK, less than 2 Mt, is not relevant for security of supply in Turkey. International coal markets are generally well supplied, with a diversity of providers and no geopolitical constraints. Therefore, subsidies are inefficient in economic terms. Despite the political difficulties around removing these subsidies, the government should complete its plans to stop supporting TTK in line with its G20 commitments. In order to gain credibility, a date for the full phase-out should be set.

The coal plant fleet in Turkey is a mix of new plants (and more are under construction) and old polluting plants. Whereas upgrading the old plants will be challenging, the Turkish government has adopted the emission limits set by the EU Large Combustion Plant Directive (LCPD) for new plants. This would ensure that sulphur, NO<sub>x</sub> and particulates emissions are kept at acceptable levels. While the LCPD implementation will reduce air pollution, it does not address the strong increase in CO<sub>2</sub> emissions or improve the plant efficiency. In the 2012 Energy Efficiency Strategy, the target of increasing plant efficiency above 45% by 2023 has been set but no detail has been provided with regard to its implementation. The rehabilitation of the oldest plants is cost-intensive and limited private sector appetite for privatisations has come forward. As set out in Chapter 3 on climate change, from an environmental point of view, the closure of the oldest and most inefficient plants and the rehabilitation of the system critical ones should be considered by the government to ensure GHG emissions peak by 2020.

Technology plays a very important role in developing clean energy solutions. Turkey is investing in this technology and should accelerate R&D efforts to achieve its efficiency targets. Versatility of CFB technology can play an important role in Turkey given the diversity of fuels available for consumption, like domestic lignite, hard coal and asphaltite, and imported hard coal. Whereas efficient lignite drying can help to reach higher efficiencies, in the longer term, lignite gasification with carbon capture and storage (CCS) would enable Turkey to use its domestic resources in a low-carbon manner. Turkey has successful R&D projects on lignite drying and gasification. Advanced development of CFB, lignite drying and gasification are witnessed around the world. Turkish R&D efforts should thus be built on international financial and technological co-operation.

Given the growing hard coal imports expected and the potential role of coal as price-setter for electricity, a transparent, liquid coal market can be beneficial for the country's competitiveness. The government can be proactive in fostering a competitive coal market, i.e. in the emergence of national price indices or, in the longer term, of a derivative market for those indices. Although, API-based derivatives are a very liquid market, Turkish futures and options would allow players to hedge and limit risks in a better way. Creating a National Reporting System could be a step to accelerate the coal market development in Turkey.

## RECOMMENDATIONS

*The government of Turkey should:*

- *Ensure safe conditions for coal miners, making best use of international experience and best practice. Reinforce monitoring, inspections and regulation, as well as promote a strong safety culture.*
- *Adopt appropriate support for the necessary investment in best available technology for both mining and power generation, without creating distortions in the electricity market. Stimulate the upgrade of coal plant efficiency by rehabilitation. Phase out old and inefficient coal-fired power plants.*
- *Accelerate the phase-out of subsidies to Turkish Hard Coal Enterprises and set a date to end the subsidies.*
- *Continue R&D efforts on clean coal technologies by building upon international co-operation and considering state-of-the-art technology.*

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## 7. NATURAL GAS

### Key data (2015 estimated)

**Natural gas production:** 0.393 bcm (negligible)

**Net imports:** 47.6 bcm, +79.2% since 2005

**Share of natural gas:** 30.2% of TPES and 38.6% of electricity generation

**Consumption by sector (2014):** 48.7 bcm (power generation 49.1%, industry 22%, residential 19.1%, commercial and public services 6.3%, other energy 2.5%, transport 0.9%)

## OVERVIEW

Natural gas is the main fuel in Turkey, accounting for 30.2% of total primary energy supply (TPES) and 38.6% of electricity generation in 2015. Natural gas supply is almost entirely provided by imports of 48.2 billion cubic metres (bcm), as domestic gas production is negligible (0.4 bcm). Since 2005, Turkey's natural gas net imports have grown by almost 80%, driven by higher gas consumption in the residential sector, following large-scale gasification, rising private investments in gas-fired power plants and growing consumption in the industry sector. Security of supply concerns have increased in step, while market reforms towards the creation of a gas hub with liberalised imports and cost-reflective pricing have only slowly advanced since 2009. The government amended the 2001 Natural Gas Market Law and presented to Parliament a Draft Natural Gas Market Law which is pending adoption in 2016.

## SUPPLY AND DEMAND

### SUPPLY

Natural gas supply amounted to 39.2 million tonnes of oil-equivalent (Mtoe) or 47.6 bcm in 2015. Supply is 2.4% lower than in the high gas demand year of 2014, but 35.7% higher than in 2009. Gas supply has been growing rapidly for decades since its first use in 1982. Natural gas is the main fuel in Turkey, with 30.2% of total TPES (the share of oil being 30.1%) and 38.6% of electricity generation in 2015.

### PRODUCTION AND RESERVES

Indigenous natural gas production has seen a sharp decline, down from 1.017 bcm in 2008, to 0.684 bcm in 2009 and 0.4 bcm in 2015, representing less than 1% of domestic gas demand. Most of the natural gas is produced by the incumbent gas producer TPAO in the Black Sea offshore shallow waters. Turkey's remaining gas reserves are small with a total of 5.4 bcm in 2013. The government estimates that around 551 bcm of recoverable shale gas potential is available in Turkey, notably, in the south-east, the Anatolian Basin and the Diyarbakir Basin (Dadas formation) and, in the north-west, the

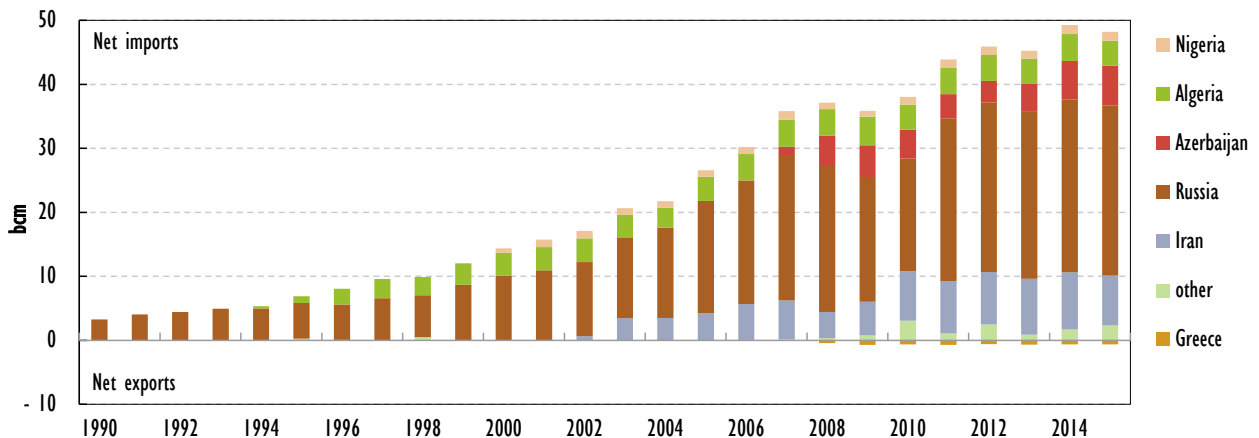


Thrace Basin (Hamitabat formation), and in the Siva and Salt Lake Basins (EIA, 2013). Deep water exploration activities in the Black Sea have been ongoing since the 1970s by the international oil company majors. TPAO and Shell have been investing in exploration since February 2013 and the ISTRANCA-1 offshore oil well was tested for natural gas. Since November 2011, TPAO and Shell have been conducting exploratory drilling in the Turkish parts of the Mediterranean Sea. However, gas reserves remain underexplored. There are expectations that the new Petroleum Law of 2013 and its new licensing regime will stimulate exploration. Companies began exploratory hydraulic fracturing in the promising Dadas shale formation in the Diyarbakir region in south-east Turkey in 2013. Operations have been interrupted following terrorist attacks in the region.

## IMPORTS AND EXPORTS

Total imports in 2015 were 48.2 bcm, originating mostly from the Russian Federation (hereafter “Russia”) (55.1% of the total), Iran (16.2%), Azerbaijan (12.3%), Algeria (8.1%), Nigeria (2.9%) and others. Pipeline gas is dominant in the import structure as liquefied natural gas (LNG) has only played a small role so far. Two LNG receiving terminals are in operation. Turkey received gas from five countries under long-term contracts and LNG supplies from the global spot market. By volume, Russian, Azeri and Iranian gas supplies have been on an upward trend since 2007. Turkey exports some natural gas to Greece, from 0.4 bcm in 2008 to 0.6 bcm in 2015.

**Figure 7.1** Turkey’s natural gas net trade by country, 1990-2015



Note: Other includes spot LNG.

Source: IEA (2016a), *Natural Gas Information 2016*, [www.iea.org/statistics/](http://www.iea.org/statistics/).

## DEMAND

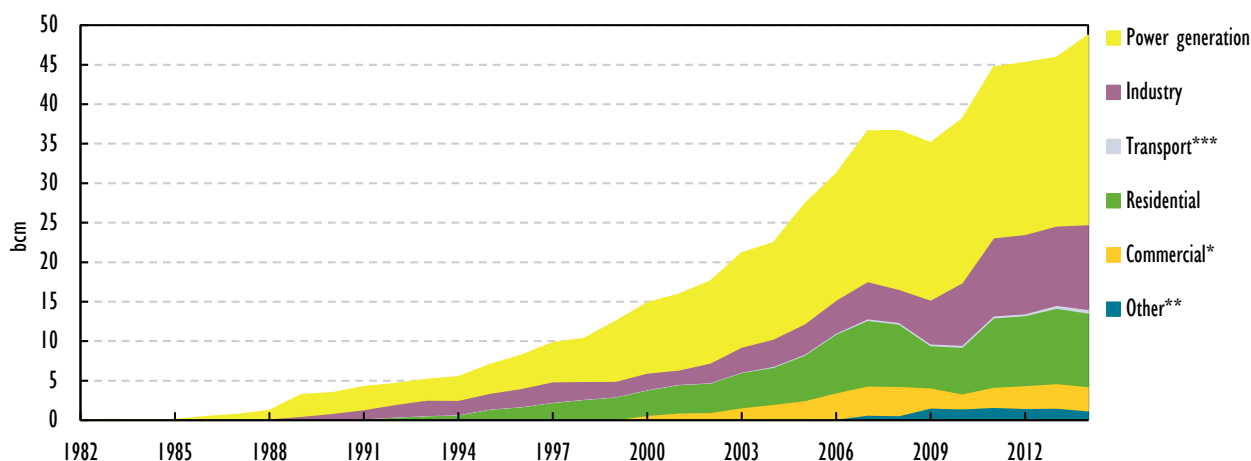
Natural gas demand (or total supply) amounted to 40.2 million tonnes of oil-equivalent (Mtoe), or 48.7 bcm, in 2014. Since gas was introduced in Turkey in 1982, demand had been on a steep-growing path until 2009, when it declined by 4.2% for the first time in 27 years. Demand recovered quickly by 8.6% in 2010, followed by a surge of 17.2% in 2011 and slower growth of around 1% in 2012-13, followed by a 6.1% rebound in 2014.

Gas is mainly used in the power generation sector which was the largest natural gas consumer in Turkey, with a share of 49.1% in 2014. Looking at the trends over the years, however, industry, which accounts for 22%, is the fastest-growing consuming sector. Its

share in total demand has grown from 15.4% in 2004, while the power generation share has fallen from 54.2% in 2004 and 60% in 2007. Demand from industry was 211.1% higher in 2014 than in 2004, while demand from power generation was 96.9% higher. Gas use in refining has increased sevenfold.

Households consumed 19.1% of natural gas in 2014, followed by commercial and other services (6.3%), refining and energy own-use (2.5%) and transport (0.9%). Demand from households and commercial services has almost doubled compared to 2004, rising from 6.6 Mtoe to 12.4 Mtoe, following the large-scale gasification of the country. Demand from transport has increased, starting at very low levels, growing its share fourfold from 0.6% to 0.9% during 2004 to 2014.

**Figure 7.2** Natural gas demand by sector, 1973-2014



Note: TPES by consuming sector.

\* *Commercial* includes commercial and public services, agriculture/fishing and forestry.

\*\* *Other* includes LNG plants, other refining and energy own-use.

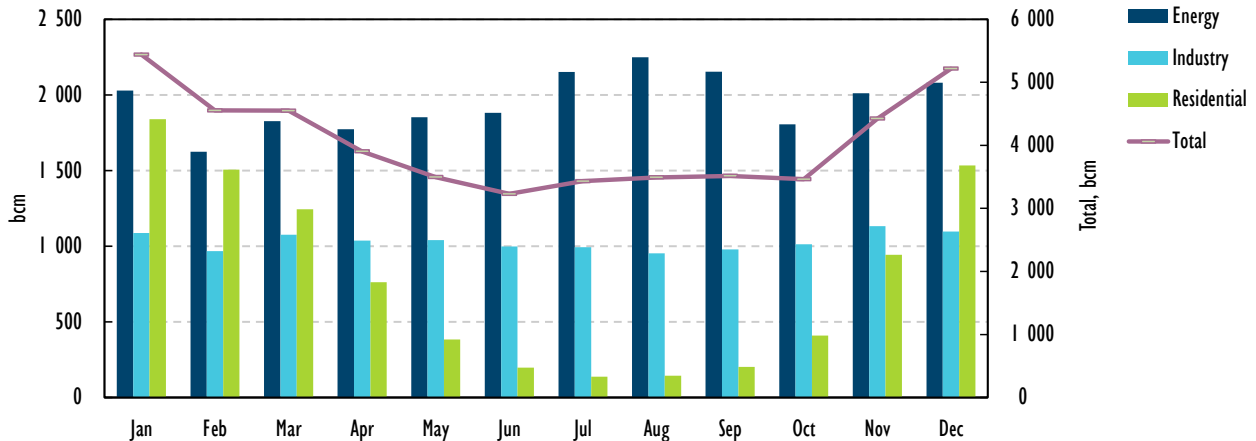
\*\*\*negligible

Source: IEA (2016a), *Natural Gas Information 2016*, [www.iea.org/statistics/](http://www.iea.org/statistics/).

Natural gas demand has a high seasonality with a winter/summer cycle: heating demand in the residential sector rises in winter and consumption peaks in the power sector to meet air-conditioning needs in the summer. Supply has to meet the constantly high level of consumption in Turkey's industry sectors all year round (see Figure 7.3).

Natural gas plays an important role in the Turkish economy and has been a driver of economic development. The 2009 Electricity Market and Security of Supply Strategy set out objectives to stabilise the share of natural gas in the electricity mix below 30% by 2023. MENR Strategic Plan 2015-19 targets a share below 38% by 2019. In 2015, natural gas had a share of 39% in the electricity mix, down from the peak of 60% in 2007.

The International Energy Agency (IEA) expects a moderate growth in gas demand as gasification of the distribution sector is almost completed. Next to the steady use of natural gas in the heating and industry sectors, future growth in the power sector will depend on the pace of renewable energy deployment, coal development and electricity demand growth. Coal to gas competition will be strong in the wholesale market in the absence of a carbon price or new environmental restrictions in Turkey, which gives coal an advantage over gas use in power generation.

**Figure 7.3** Natural gas demand seasonality, 2014

Source: MENR data provided 2014.

## INSTITUTIONAL FRAMEWORK

### INSTITUTIONS

Within the **Ministry of Energy and Natural Resources (MENR)**, the **General Directorate of Petroleum Affairs (GDPA)** is responsible for regulating the exploration and production activities in both oil and natural gas sectors. MENR's **Transit Petroleum Pipelines Department (TPPD/TPBH)** negotiates, on behalf of the state, the agreements related to the transit pipelines, ensures their implementation and performs the state's obligations arising from them and from the Transit Law No. 4586. TPPD is not involved in transmission and/or distribution activities in the gas and petroleum markets.

The **Energy Market Regulatory Authority (EMRA)** is the natural gas market regulator. It is in charge of the licensing of all gas market activities – import, export, transmission (not transit), storage/LNG, wholesale, distribution and sale of natural gas and compressed natural gas (CNG)). It is responsible for ensuring non-discriminatory third-party access to the natural gas networks by approving and/or determining tariffs where prescribed by legislation (connection tariffs, storage, transmission and distribution tariffs and tariffs for regulated household customers), and is tasked to ensure that market participants are in compliance with the rules and regulations.

The **Under-Secretariat of Treasury** carries out the ownership function for the state-owned energy enterprises and prepares the annual general investment and financing programmes.

The **Turkish Competition Authority (TCA)** ensures the enforcement of the Competition Law with regard to legal agreements, concerted practices and decisions limiting competition (Article 4), abuse of dominant position (Article 6) and mergers and acquisitions (Article 7). The Authority provides opinions to the government during the privatisation process and drafts legislation, carries out market inquiries and issues fines.

State-owned **Petroleum Pipeline Corporation BOTAŞ** owns and operates the gas pipeline network, is responsible for oil and natural gas transportation, for import-exports through pipelines and for operation of its own LNG terminal, marketing sales and

storage of natural gas, pipeline survey, engineering and construction works. BOTAŞ is also shareholder in the first gas transit pipeline (TANAP) that is under construction.

## GAS MARKET STRUCTURE

### UPSTREAM

Around 50% of natural gas production in Turkey is carried out by state-owned oil company Türkiye Petrolleri Anonim Ortaklığı (TPAO) or Turkish Petroleum Corporation, mostly from Black Sea offshore fields; the remainder is produced by private companies, such as Thrace Basin Nat. Gas Cor., Corporate Resources B.V. and Pinnacle Turkey Inc.

### MID- AND DOWNSTREAM

The Natural Gas Market Law (NGML 2001) requires the unbundling of all gas market activities. Thus, a legal entity engaging in wholesale natural gas trade may not perform transmission or distribution activities. Transmission companies must not perform any activity other than transmission (ownership unbundling). Import companies are subject to unbundling. Distribution companies cannot perform any activity other than distribution but can engage in retail. NGML requires all gas market participants to obtain a licence. EMRA has granted a large number of licences (as evidenced in Table 7.1).

**Table 7.1** Licences in the natural gas market (December 2014)

Licence type	Number of licences
<b>Import:</b>	<b>56</b>
- Import:	17
- Spot LNG:	39
<b>Export:</b>	<b>8</b>
<b>Wholesale:</b>	<b>45</b>
<b>Storage:</b>	<b>8</b>
<b>Transmission:</b>	<b>18</b>
- LNG:	17
- Pipeline:	1
<b>CNG:</b>	<b>103</b>
- CNG Transmission-Distribution:	39
- CNG Sales :	64
<b>Distribution:</b>	<b>69</b>
<b>Total:</b>	<b>307</b>

Source: EMRA, (2014), *Natural Gas Market 2014 Sector Report*, [www3.epdk.org.tr/documents/dogalgaz/rapor\\_yayin/DPD\\_RaporYayin2014.pdf](http://www3.epdk.org.tr/documents/dogalgaz/rapor_yayin/DPD_RaporYayin2014.pdf).

There are many private wholesale companies and importers; however, their market share is relatively small in comparison to state-owned BOTAŞ. The company dominates natural gas transport, imports, trade, transit and wholesale, as it imports 78% of all the natural gas consumed in Turkey (EMRA, 2013, and Table 7.2 below on imports) and owns and operates one of two LNG facilities and plans to invest in one new natural gas storage facility. BOTAŞ holds nine import and export licences, one transmission and two storage licences (one for LNG and one for underground storage), while TPAO holds one storage and one wholesale licence. BOTAŞ controls most of the wholesale supply, and most distribution companies purchase their gas from BOTAŞ. BOTAŞ's dominant position in LNG and pipeline imports has been maintained over time by the government with a view to securing natural gas supplies to Turkey through a national champion.

### LNG AND STORAGE

In 2014, there were 40 spot LNG import licences and 18 transmission LNG licences. In 2014, BOTAŞ and Algerian SONATRACH extended the LNG sale and purchase contract for another ten years (to 2024). Private importer EgeGaz operates the Aliaga LNG terminal in Izmir and imported natural gas from Qatar, Spain and Norway in 2014, but most of the capacity is taken by BOTAŞ. The LNG contract with Nigeria will expire in 2021.

By law (NGML 2001), LNG terminal operation has no separate licence and is treated as gas storage licence. The law lays down regulated third-party access (TPA) to LNG and storage facilities. On the other hand, tariffs are regulated by EMRA for the one activity of LNG storage, as there is no competition in this market segment. However, third-party access to the regulated LNG and storage facilities is not fully implemented in practice (see section below on market reform and regulation).

### IMPORT AND EXPORTS

Given the current import contract portfolio (see Table 7.2), the dominance of BOTAŞ in imports is unlikely to change before 2024-26. In 2011, BOTAŞ and Azerbaijan's SOCAR signed a natural gas sales and purchase contract for the delivery of 6 bcm per year of gas from Azerbaijan Phase II field to start at the end of 2018. In 2014, BOTAŞ extended its gas sales and purchase contracts with Algeria, as mentioned above.

As required under NGML 2001, BOTAŞ held a contract transfer tender in 2005, resulting in the transfer of 4 bcm/y of gas under the scope of the Natural Gas Sale and Purchase Contract between BOTAŞ and Gazprom Export LLC via the Western Route to alternative private importers (Enerco Enerji, Bosphorus Gaz, Avrasya Gaz and Shell Enerji) by 2009.

Besides, the natural gas sale and purchase contract between BOTAŞ and Gazprom Export LLC for the delivery of 6 bcm/y of gas from Russia along the Western Route through Bulgaria expired at the end of 2011 (remaining 4 bcm will expire in 2021). In conformity with the NGML, its term was not extended by BOTAŞ. This enabled the import of 6 bcm/y gas by private sector companies. In fact, in 2013, four private sector companies (Bosphorus Gaz, Akfel Enerji, Bati Hatti, Kibar Enerji) started to import this quantity from Russia via the Western Route. Currently, seven private companies, in addition to BOTAŞ, are importing a total of 10 bcm/y of pipeline gas to Turkey via the Western Route.

The EMRA Board adopted a decision to invite private sector applications for a natural gas import licence for supplies from Iraq. As a result, one company obtained an import licence in September 2013.

**Table 7.2** BOTAŞ current natural gas sale and purchase agreements (imports)

Current agreement	Volume (bcm/y)	Date of agreement	Status	End date
Algeria (LNG)	4.4	1988	In operation	October 2024
Nigeria (LNG)	1.3	1995	In operation	October 2021
Iran	9.6	1996	In operation	July 2026
Russia (Blue Stream)	16	1997	In operation	End of 2025
Russia (West)	4	1998	In operation	End of 2021
Turkmenistan	15.6	1999	Pending	
Azerbaijan (Phase I)	6.6	2001	In operation	April 2021
Azerbaijan (Phase II)	6	2011	2017/18	2032/33
Azerbaijan (BIL)	0.15	2011	In operation	2046

Source: BOTAŞ.

## NATURAL GAS INFRASTRUCTURE

### NATURAL GAS NETWORK

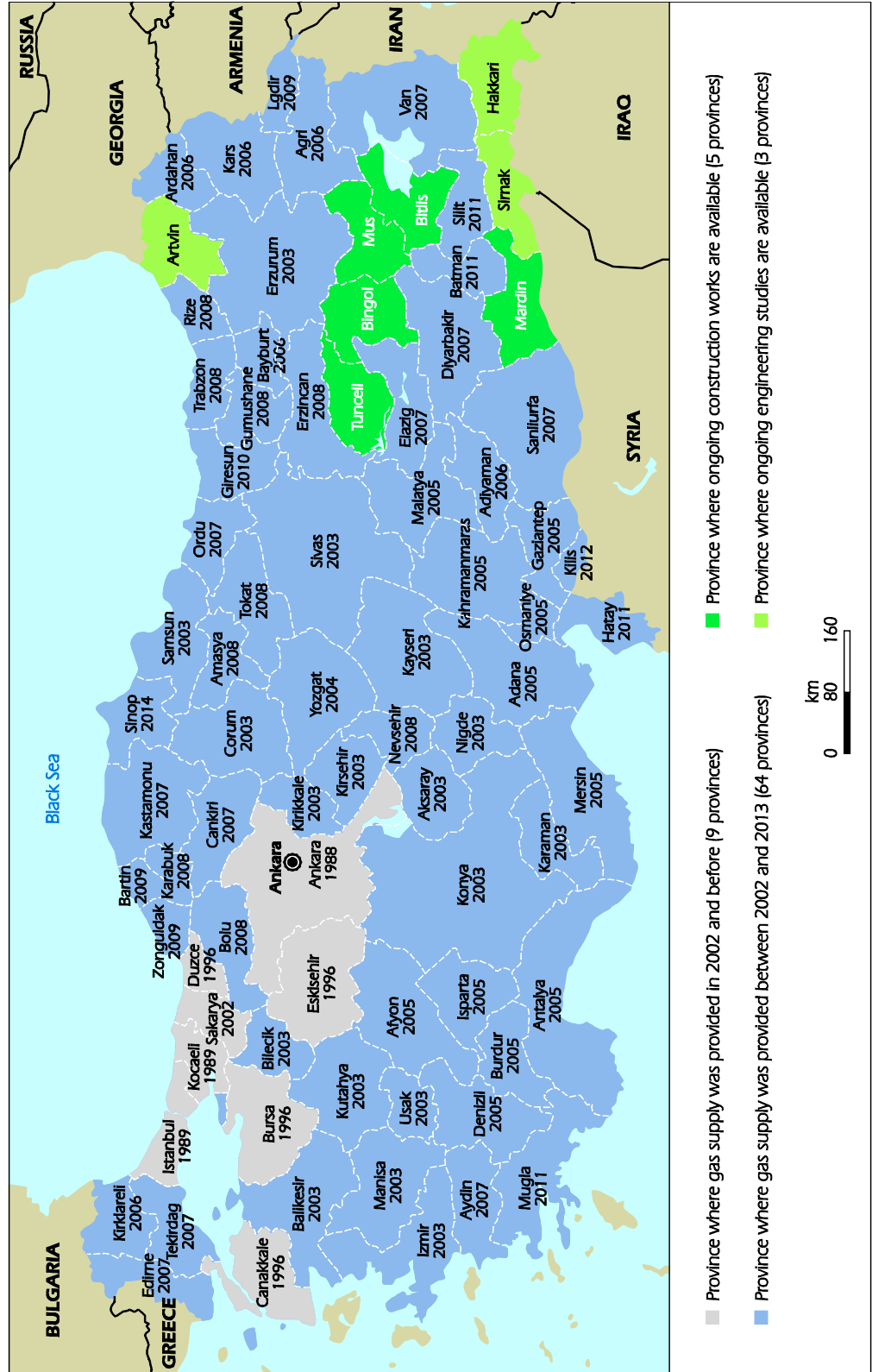
Turkey's gas transmission network comprises 12 812 kilometres (km) of pipelines and nine entry points: four international pipeline import points, two LNG entry points, two entries from production fields and one from the storage facility. The bulk of daily supplies comes from long-term gas pipeline imports; gas from storage is used when needed and spot LNG contracts and long-term LNG contracts are mainly used for peak shaving.

### DISTRIBUTION AND RETAIL

Over the past years, Turkey has completed the privatisation of the gas distribution sector and connected its population to natural gas in most cities of the country (see Figure 7.4) by a world-wide unique tender process. In total, 69 licences are held by private distribution companies that are both retailers and distribution network operators. By 2015, the gas distribution tenders were finalised for 76 out of Turkey's 81 cities, 71 of are using natural gas in their regions, while the tender processes for 5 cities is ongoing.

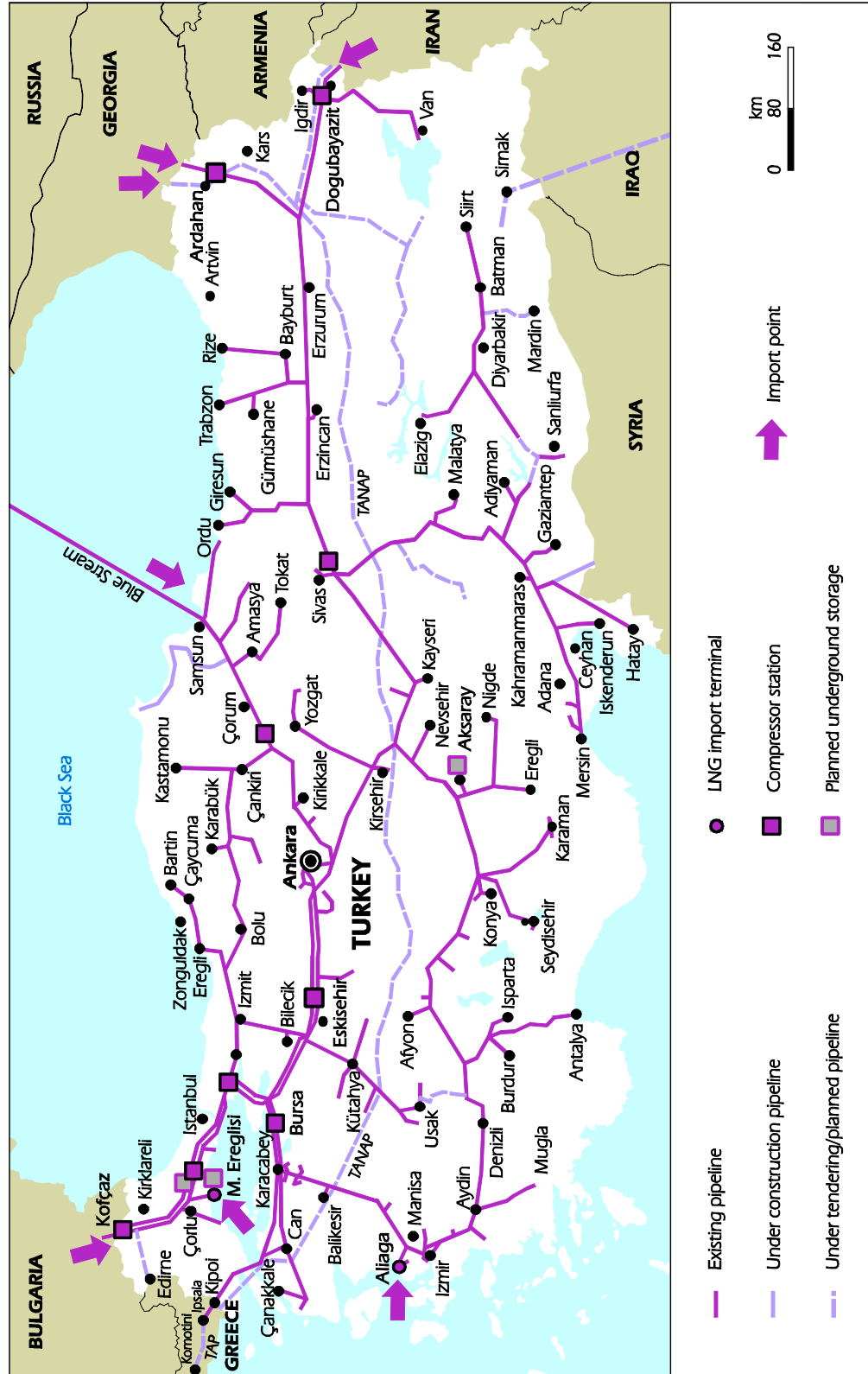
Gas suppliers have the legal obligation to purchase gas from a diversified supply basket with at least two supply sources and at the lowest margin (tenders are based on the unit service and depreciation charge (USDC) for supplying one kWh of natural gas to consumers (c/kwh)), plus a connection fee, as required under the tender process administered by EMRA (see section below on market reform and regulation). BOTAŞ' existing monopoly in the gas market does not allow distribution companies to purchase gas from competitive producers, wholesalers or importers, even though they have de jure right to do so under the NGML. Most distribution companies purchase their gas from BOTAŞ. Many companies submitted bids of 0 USCD, thus admitting that they would not recover their investment cost in the first eight years.

Figure 7.4 Natural gas distribution in cities, 2014



Source: BOTAŞ.

Figure 7.5 Natural gas infrastructure in Turkey



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area.



## INTERNATIONAL IMPORT/EXPORT PIPELINES

In 2015, Turkey had four operating international gas import pipelines with a total technical import capacity of 46.35 bcm: the Russia-Turkey Western Route (from Bulgaria), the Russia-Turkey Blue Stream (2003) at Samsun, the Iran-Turkey pipeline, and the Baku-Tbilisi-Erzurum (BTE) or South Caucasus natural gas pipeline (2007), bringing gas from Azerbaijan through Georgia to eastern Turkey. Turkey exports gas to Greece through the interconnector, the Turkey-Greece pipeline. All of these pipelines are for import, they are not considered as transit pipelines when they enter the gas network.

## TRANSIT PIPELINE PROJECTS

Turkey's first transit pipeline started construction in 2015 (see Figure 7.5). Turkey and Azerbaijan have developed the **Trans-Anatolian Natural Gas Pipeline (TANAP)** which will bring natural gas from Shah Deniz Phase II field in Azerbaijan to Turkey and Europe by linking the South Caucasus Pipeline at the border of Turkey and Georgia with the Trans-Adriatic Pipeline (TAP) at the border of Turkey and Greece. In a first phase, 6 bcm will be delivered to the Turkish domestic market in 2018/19 and 10 bcm to Europe in 2020, along the TAP through Greece and Albania to South Italy. The Intergovernmental Agreement for the development of TANAP was signed on 26 June 2012 between Turkey and Azerbaijan; and the host government agreement was signed between Turkey and the TANAP project company. On 17 December 2013, the final investment decisions on TANAP, TAP and Shah Deniz Phase II field development were taken. The shareholder agreement of the TANAP project company was finalised on 26 May 2014 with shareholdings by SOCAR (58%), BOTAŞ (30%) and BP (12%). On 17 March 2015, construction started. In December 2015, Turkey and Azerbaijan agreed to speed up the construction of TANAP and start the supplies to Turkey.

TANAP has a scalable capacity of 16 bcm/y to 32 bcm/y that could enable Turkey to enhance its security of gas supply. However, this increased capacity will require additional compressors in the TANAP system in order to transport additional volumes of gas. To this end, Turkey has been supporting the trilateral co-operation among Azerbaijan, Turkmenistan and the European Commission. Turkey notably supports the Trans-Caspian gas pipeline to transport Turkmen gas across the Caspian Sea to Azerbaijan and Turkey. The Ashgabat Declaration on the development of co-operation in the field of energy between Turkmenistan, the Republic of Azerbaijan, the Republic of Turkey and the European Union (May 2015) builds on the framework agreement signed between Turkey and Turkmenistan in 2013 and on the 1998 agreement on the Turkmenistan-Turkey-Europe natural gas pipeline to transport 30 bcm of Turkmen gas to Turkey (16 bcm) and Europe (14 bcm). Turkey had already signed a gas sale and purchase agreement for 15.6 bcm with Turkmenistan in 1999. Moreover, a Turkish private company signed a framework agreement with Turkmenistan for the supply of smaller volumes of gas which could be transported via Iran, directly or using swaps.

Turkey is also interested in Iraqi gas. The **Iraq-Turkey natural gas pipeline** project is planned to run in parallel with the existing Kirkuk-Ceyhan crude oil pipeline. In 2014, Azerbaijan invited Iraq to use TANAP's third-party capacity.

The Turkish Stream gas pipeline is considered to replace the South Stream project by Gazprom to reroute Ukraine gas transit after 2019. The project was initially planned for a total capacity of 63 bcm through a four-string pipeline to transport gas from Russia across an offshore section under the Black Sea to Turkey's western coast (Kiyıköy) and

onwards to the Turkey–Greece border and from there onto European markets. Making use of the advanced offshore development of the cancelled South Stream project, on 1 December 2014 BOTAŞ and Gazprom signed a memorandum of understanding (MoU) for initiating studies of the Turkish Stream. During 2015, Turkish Stream negotiations stalled, as BOTAŞ's gas price discount requests were not met by Gazprom. Therefore no clarity was provided on how the gas could be traded at the Turkey-Greece border and transported to European markets. In autumn 2015, Gazprom announced it would scale down the project to two lines totalling a capacity of 32 bcm/y; one line was meant to replace the West Balkan line so that Turkey would no longer depend on transit through Ukraine, and the other line was meant to supply gas to Europe through Greece. Within Europe, several options were considered for the transportation from the Turkey–Greece border on to Europe. In November 2015, the EU list of Projects of Common Interest included the Tesla and Eastring gas pipeline projects which, if built, could transport both Russian and Caspian gas from Turkey to Central Europe. In its planned form (for 32 bcm or 63 bcm), the Turkish Stream pipeline would first need to secure a large gas demand in European markets, beyond Turkey and Greece, and have substantial transmission capacity to transport the gas through Turkey and Eastern Europe to access key EU gas markets. None of those conditions is satisfied to date.

The feasibility study is ongoing for the project of an **Interconnector Turkey–Bulgaria (ITB)** to connect the Turkish and Bulgarian natural gas networks through a bidirectional pipeline with a capacity of up to 3 bcm/y. An MoU was signed by both governments on 28 March 2014, and a joint working group was established to prepare pre-feasibility studies for the technical and commercial aspects.

In addition to the Caspian and the Middle East, the Eastern Mediterranean has been attracting attention for many years, with new discoveries since 2009 (Zhor, Leviathan, Aphrodite, Tamar and Salamat fields) doubling the reserves. There are also discussions to develop an undersea gas pipeline from Israel to Turkey to bring gas from Israel's offshore reserves (Leviathan).

With a view to encourage the development of transit pipelines (other than TANAP), the government envisages to create a dedicated legal regime for these pipelines which should be governed by the forthcoming Transit Law.

## DISTRIBUTION

Turkey's natural gas distribution network is smaller than the transmission gas pipelines. It has 318 entry points, 47 being operated by BOTAŞ and 271 by private distribution companies. By the end of 2014, the length of pipelines constructed by companies holding distribution licences reached 9 486 km, the polyethylene pipelines totalled 63 967 km, and service lines were 25 160 km-long (EMRA, 2014).

## LNG

Turkey has two LNG import terminals, one in the west at Aliğa/İzmir, which is owned and operated by private company EgeGaz, but most of the capacity is booked by BOTAŞ. One terminal consists of two LNG tanks and a regasification and send-out capacity of 6 bcm/y. The second LNG terminal is located in the north-west at Marmara Ereğlisi/Tekirdağ, owned and operated by BOTAŞ with a send-out capacity of 8 bcm/y. A construction project for a new LNG terminal, which is expected to have a capacity of 18 mcm/d, is under evaluation.

## STORAGE

By the end of 2015, Turkey had a total of 2.84 bcm of gas storage capacity: it had one underground gas storage facility at Marmara Silivri close to Istanbul, operated by TPAO, with 2.84 bcm storage capacity in two depleted gas fields (Kuzey Marmara and Değirmenköy), next to several storage tanks located at the country's two LNG facilities.

Gas storage is needed to deal with seasonal balancing, peak shaving and gas supply shortages. Turkey's natural gas system does not have sufficient storage and flexibility, and all of the existing gas storage capacity is located in the north-west. The increase of the country's gas storage capacity from current levels is crucial to support the safe operation of the natural gas transmission system and to manage demand peaks. As part of Turkey's 2023 vision, the government has set an objective for raising the natural gas storage capacity to 5 bcm. MENR Strategic Plan 2015-20 includes targets to raise storage capacity to cover 10% of annual consumption by 2019 (5 bcm) and up to 20% thereafter.

**Table 7.3** Natural gas storage in Turkey

Company	Type	Location	Storage capacity (bcm)	Status
BOTAŞ	LNG 3 storage tanks	Marmara Ereğlisi/Tekirdağ	0.15 LNG	Operational
EgeGaz A.Ş.	LNG 2 storage tanks	Aliağa/İzmir	0.17 LNG	Operational
TPAO	Underground storage (two depleted gas fields)	Silivri/İstanbul	2.84 (4.3)	Operational (expansion by 2020)
BOTAŞ	Underground storage (12 salt caverns)	Sultanhanı/Aksaray	0.5/1.0	Under construction 2017/2019

Source: MENR data provided 2015.

Progress is under way with two ongoing extension projects by TPAO at the existing underground storage in Silivri, the Degirmenköy extension project, and the Kuzey Marmara extension project. At the end of 2015, the storage capacity of the Silivri facility was expanded to 2.84 bcm, the withdrawal capacity increased from 25 mcm/d to 75 mcm/d (injection will remain at 16 mcm/d). After completion of the extension projects, the total storage capacity of Kuzey Marmara and Silivri will be expanded to 4.3 bcm at the end of 2020.

A new BOTAŞ gas storage site, the Tuz Gölü natural gas underground storage (salt cavern) project, is under construction; the facility is located 150 km south-east of Ankara and planned to be commissioned by 2017. It should reach 0.5 bcm working gas capacity by 2017 (Phase I) and a total capacity of 1 bcm by 2019 (Phase II), with a maximum of 30 mcm/d injection and 40 mcm/d withdrawal capacity. BOTAŞ also plans to increase the storage and regasification capacity of Marmara Ereğlisi LNG terminal to 415 000 cubic metres (cm) by installing a fourth LNG storage tank and additional send-out equipment. Basic design engineering works for this project have been completed.

Three storage licences have been granted by EMRA to private companies (among them Tören Natural Gas Storage and Mining Company, part of Bendis Energy) and the Ministry of Economy granted an investment stimulus package to develop new underground storage projects in the Tarsus region for an additional 4 bcm by 2019.

## MARKET REFORM AND REGULATION

### UPSTREAM

Upstream activities, exploration and production of natural gas (and oil) are subject to the new Petroleum Law (No. 6491) which was enacted on 11 June 2013, amending the legal framework that had been in place for almost 60 years. Exploration and production of oil and natural gas are subject to licence and lease. A new licensing system is introduced by dividing Turkey into two districts – onshore and offshore – replacing the previous 18 petroleum districts. The main novelty of the new Petroleum Law is that incumbent TPAO has no longer the right to obtain licenses on behalf of the state. However, in practice TPAO holds substantial offshore licences (see Chapter 5 on oil). The new law aims to set the Turkish oil market on track for liberalisation and foreign investment and to reduce the possibility and time allowed to hold licences without starting exploration investment. Companies that do not make investments in the areas they are committed to will be discharged from the petroleum field and their deposits will not be refunded.

### MID- AND DOWNSTREAM

Mid- and downstream activities are regulated under NGML, No. 4646 of 2 May 2001 (2001 NGML) and the Natural Gas Market Licence Regulation.

The 2001 NGML still forms the backbone of the Turkish gas market regulation. It introduced the independent regulatory authority EMRA and a licensing regime for all gas market activities by EMRA, thereby abolishing the monopoly of BOTAŞ over import, transmission, distribution and sales of natural gas. The NGML also introduced the concept of eligible consumer and mandated EMRA to lead a gradual process of market opening by authorising it to decrease the eligibility limit until all consumers can choose their supplier.

The 2001 NGML aimed at reducing the role of the state in the gas sector and creating a competitive gas market. It required that, by 2009, no company should hold import contracts or operate gas sales equivalent to more than 20% of Turkey's gas consumption. BOTAŞ was required to tender at least 10% of its existing contractual obligations each year until it reaches the 20% share by 2009. NGML also introduced unbundling and third-party access. In addition, NGML required the subsequent ownership unbundling of BOTAŞ into separate companies dealing with transmission, trade and storage activities and its privatisation (except for transmission), within two years (from 2009 onwards).

The 2001 NGML was not fully implemented. Despite the stated goals of market liberalisation, the key role of BOTAŞ was maintained as a strategic player under the Council of Ministers' mandate of ensuring energy supply security in Turkey, with a view to avoid a breach of its existing contractual obligations. The NGML provided for a number of import/export restrictions during the transition time until full unbundling would be in place after 2009. First, the NGML does not allow private companies to enter into import contracts (with the exception of LNG contracts) with countries that have existing gas and sales agreements with BOTAŞ in order to sustain a strategy of diversification of natural gas sources and routes (temporary Clause 2 of NGML 2001). Secondly, an implementing decree by the Board of EMRA (No. 725) requires the opinion

of BOTAŞ if a new contract would impact its current import contract obligations or its ability to operate the gas transmission network with fully booked capacity in winter seasons. And thirdly, any new import or wholesale licence applicant would need to satisfy a storage requirement within five years. For importers, this amounts to an obligation to store up to 10% of its gas imports in Turkey.

The legal framework of the NGML 2001 has not been implemented. None of the stated market opening objectives had been achieved by 2015 and the transition has become the status quo, there was no ownership unbundling, but account unbundling and imports have been liberalised only to a very small extent.

BOTAŞ maintains low gas prices to households and its market share in the residential markets, despite the high import costs it is exposed to. This creates deficits at BOTAŞ and may lead to underinvestment. Since 2008, Turkey has been implementing gas market reforms to move gradually to full cost-reflective pricing through the so-called Automatic Pricing Mechanism. However, BOTAŞ household tariffs are set below the weighted average cost of imported gas in Turkey (see also CA, 2012; OIES, 2014; World Bank, 2015). IEA data on gas and electricity prices illustrate that Turkey has the fourth-lowest gas price to households among IEA member countries (just after the United States, Canada and Hungary), but electricity prices in industry are around the average (see Figure 7.7. and Figure 8.11 in Chapter 8 on electricity). The main reason is that Turkey maintains cross-subsidisation between gas and electricity wholesale and retail markets with an impact on gas prices (see also EC, 2014).

Non-discriminatory TPA to the transmission network, to storage and LNG facilities is provided for in the NGML – the Network Code of BOTAŞ (2004) – and three separate by-laws: the Basic Usage Principles and Procedures of Marmara Ereğlisi LNG Terminal (2010), the Basic Usage Principles and Procedures for Aliaga LNG Terminal (2010), and the Basic Usage Principles and Procedures of Silivri Underground Storage Facility (2012) which were approved by the EMRA Board. Access disputes are settled by EMRA. An Electronic Bulletin Board (EBB) which manages capacity allocation is required under the Network Code. TPAO operates its EBB to show the availability of gas in the underground storage. The modernised EBB of BOTAŞ was launched in January 2015.

Access to the transmission and distribution networks is a right for all parties. Transmission and storage companies prepare their rules for TPA for EMRA's approval. However, requests for capacity from third parties can be rejected on specific grounds, including when network capacity is insufficient or connection technically not feasible. Access shall be provided, however, if a third party is ready to pay for the costs of connection and expansion. To date, the implementation of TPA and storage obligations as requested under NGML cannot be implemented when network and storage capacity is limited. Owing to the lack of competition in storage, the activity remains regulated (in line with the temporary provision in the NGML) with tariffs set by EMRA, including for LNG.

In an attempt to progress with the gas market reform, the Draft Amendment of the Natural Gas Market Law (No. 4646) was submitted to the Parliament in August 2014. Its adoption is pending. The key changes of the draft law are as follows:

- The ownership unbundling of BOTAŞ into three separate legal entities for LNG terminals and storage, transmission, trade activities, is to be enacted one year after adoption. BOTAŞ will be nominated the national system operator to ensure the operation and co-ordination of the transmission network.

- Incentives for the construction of new LNG terminals and storage facilities are envisaged.
- Competitive private sector imports are enabled also for countries with which BOTAŞ has purchase contracts. Until BOTAŞ's import share decreases to 20%, it cannot arrange any new natural gas purchase contract (but can extend current ones).
- Security of supply provisions enable BOTAŞ to renew expired purchase contracts and the decision of the Council of Ministers allows new purchase contracts for the incumbent. MENR will have to provide an opinion to EMRA on new import/export licences and prepare a Natural Gas Security of Supply Report every year.
- An organised wholesale natural gas market is envisaged with the financial settlement transactions. As foreseen in the *Electricity Market Law No. 6446* of 2013, the Energy Market Operations Company (EPIAŞ) was set up in March 2015.

## DISTRIBUTION AND RETAIL

As part of the market reforms in the early 2000s, the privatisation of the distribution networks in the cities and granting of distribution licences (which include both distribution network services and gas supply licences to non-eligible consumers) were carried out. The right for distribution in a specified area is provided for 30 years following a tender process organised by EMRA.

There is competition for the distribution licence but not for the region after the licence is awarded. Distribution companies are required to carry out investments and build the gas network in their respective territories within five years and have to purchase natural gas at least from two different sources and most economical price. Distribution companies are obliged to connect all the customers demanding the service; for non-eligible consumers, the connection fees are determined by EMRA.

Tenders were designed as reverse auction, targeting the lowest margin for the first eight years of the licence. The bidding criterion was to offer the lowest unit service plus depreciation charge (USDC). (In some areas, the USDCs hit zero, and auction moved onto the underbidding of connection fee for the first eight years. This means that household gas prices equal the import, transmission storage cost and margin of BOTAŞ.) After the expiry of the first eight years, distribution tariffs are determined by EMRA according to a price cap methodology. EMRA Board Decision of 2011 adopted the Principles and Procedures of Tariff Calculation for Natural Gas Distribution Companies. This means that in the future an increase in gas prices to households can be expected, in particular, in the case when BOTAŞ loses its import monopoly, as companies will need to recover their investment cost.

## GAS TRANSIT

Gas and oil transit via the national transmission system and the construction of new pipelines for transit purposes are not considered as internal market activity within Turkey's legislation. The Law concerning Transit Passage of Petroleum through Pipelines (Transit Law No. 4586) of 2001 assumes the existence of Intergovernmental Agreements for the new built transit pipelines and sets out the rules for transit. To date, Turkey has no natural gas transit pipeline in operation. The government considers revising the Law by taking into account the developments in oil and gas transit over the past decade. A new Draft Transit Law is under preparation.

## GAS WHOLESALE MARKET AND THE ENERGY HUB

Turkey is geographically located in close proximity to more than 70% of the world's proven oil and gas reserves. It has the long-standing ambition to become a regional energy hub for energy trade flows from the Middle East, Central Asia and the Caucasus to European and Asian markets. Therefore, Turkey is a key country for ensuring energy security and providing diversified supply sources and routes, considerations that have gained increased significance in recent years.

In this respect, major pipeline projects, realised and proposed, will contribute to regional and Europe's energy supply security. Turkey plays a key role in the East–West transit along the Southern Gas Corridor with the South Caucasus Natural Gas Pipeline (SCP), the BTE Natural Gas Pipeline, and the Turkey-Greece Natural Gas Interconnector (ITG) which are in operation. The government has been active in supporting the work towards the TANAP and TAP projects which will become operational by 2018/20. Russia considers Turkey a key transit partner under recent South Stream or Turkish Stream projects as an alternative for Ukrainian gas transit after 2019.

Contrary to its ambitions, its key geographical position and major interest by supplier countries in building new pipelines, Turkey is not yet realising its full potential, for a number of different reasons, including regional instability, low transmission and storage capacity of the gas network and the confidence and trust in Turkey as a reliable transit corridor and as a competitive energy market. Turkey has an opportunity to foster international gas trade and investment co-operation in a geopolitically sensitive climate, if it can promote gas market reforms in support of a gas hub.

Several characteristics define a gas hub. In essence, a hub facilitates gas wholesale trading as a marketplace and defines a hub gas price marker. The network operation, availability of ample gas supplies and liquidity of products (short term and medium term), and the legal framework are central to the hub design. For the creation of a gas hub, the legal and regulatory framework for the gas market is therefore essential together with the facilitation of the wholesale trading rules and procedures (see Figure 7.6).

International experience in other IEA jurisdictions shows that the creation of a gas hub requires an independent and neutral player, a network operator to facilitate the market place for all market participants to book, allocate and transport capacity along the gas network. The network operator thus needs to be unbundled so it can guarantee independent management and access for market participants. This also requires transparent third-party access and transparent rules for capacity allocation, congestion management and balancing. The regulator and the competition authority will have to play a greater role to promote competitive suppliers, sufficient network capacity and flexible trading products.

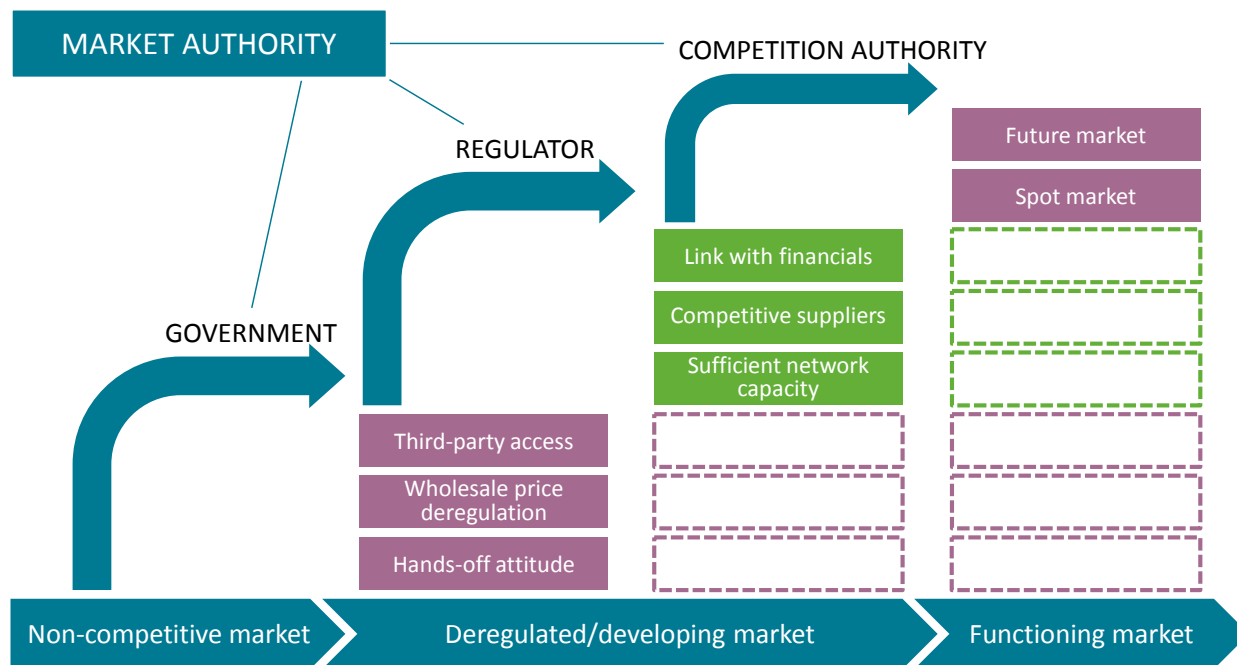
The dominant trend in Europe is the development of virtual trading hubs. The only physical hubs in Europe are Belgian Zeebrugge Hub and the Austrian Central European Gas Hub, where the pipeline and storage configuration allows a significant amount of physical gas sales and purchases, including gas storage. The European virtual hub model brings together all delivery points in one entry-exit zone. The network operator of the zone delivers the service of transportation between entry and exit points and balancing services. At the same time, European gas markets have developed from long-term contracts to short-term contracts and flexible spot market and futures products.

The Turkish government has taken steps towards the creation of an energy exchange. However, the structure of the gas market platform remains under discussion. The Energy Markets Operation Inc. (EPIAŞ – Enerji Piyasaları İşletme Anonim Şirketi) was established on 21 March 2015. At first, EPIAŞ will be responsible for power purchase and sale; in the future, it is expected to trade natural gas, oil and derivatives. In addition, the Ceyhan Port is set to become a major hub for oil export and trade, with a planned oil refinery, an LNG terminal and a petrochemical facility which should enable it to transport more than 1 million barrels of crude oil per day to the world markets.

The Turkish gas network in its current legal, operational and system design will need to be adapted towards a virtual gas hub. In line with BOTAŞ's Network Code (Network Operation Principles, amended in 2008), the Turkish gas system has a national balancing point and maintains four separate transfer points for imports from Azerbaijan (Georgia), Iran and Russia (Malkoclar, West Line and Durusu terminal at Samsun, Blue Stream), in addition to one exit zone for the whole network. However, the NGML 2001 and provisions for the ownership unbundling of BOTAŞ and its privatisation are pending. BOTAŞ is involved in trade, transit, storage, imports and transmission, and dominates the market place.

Discussions are ongoing in Turkey to create a single virtual trading point and to turn the system into a full entry-exit regime in the coming years in an effort to build a gas wholesale market in Turkey, linked to the energy wholesale electricity exchange EPIAŞ which was set up in March 2015. The notion of a gas hub builds on a system where gas can be traded freely across the gas system, where it would not be separated by contractual paths or trade/transit provisions. By implementing a full entry-exit system, Turkey would enable all importers to sell directly to the day-ahead market. This will create liquidity.

**Figure 7.6** Creating a competitive wholesale natural gas market



Source: Adapted from on IEA (2012), *Gas Pricing and Regulation, China's Challenges and IEA Experience*.



A full entry-exit system will require a new gas balancing mechanism to settle the imbalances across the entire system according to its value to the system. Up to now, in line with the existing BOTAŞ Network Code, title transfers between shippers are carried out over virtual transfer entry–exit points defined at each entry point. The virtual national balancing point is used for day-ahead gas exchanges between shippers or for minimising post-day imbalances. The balancing regime is published daily at the *ex ante* balancing gas price. The balancing gas price is determined on a monthly basis by taking the weighted average of the bids received the previous month. The main tool for managing capacity allocation and balancing is the EBB. In December 2013, EMRA prepared amendments to BOTAŞ’s Network Code by introducing the new market-based balancing regime for transmission where shippers can propose prices and quantities through the EBB. The new regime is currently simulated and has not been enacted.

Turkey’s domestic gas system has a relatively small capacity to transport gas from east to north-west with the current compression levels. It cannot serve as a physical gas hub, given limited storage and transmission capacity. BOTAŞ has nine compressor stations with 397 megawatts (MW) of capacity. By further increasing the power of the compressor stations (existing and backup units) and by investing in new underground gas storage sites, BOTAŞ aims to reduce the bottlenecks in the transmission system and increase security of supply by 2017. The government’s target of doubling gas storage will need to be strengthened if Turkey is to achieve its goal of becoming a gas hub and ensuring a gas transit across its gas network.

Flexible trade also requires transparent congestion management and capacity allocation. BOTAŞ’s Network Code provides for capacity allocation to be made for each calendar year separately for each entry and exit point. The duration of an allocation can range from one month to one year. Nomination processes are completed one day ahead. Capacity allocations at the four transfer points and entry points of LNG terminals and storage facilities linked to the transmission network are made on a *pro rata* basis with separate capacity fees at each entry point, while capacity allocations for the exit point to the domestic transmission network are made on entry-exit system on a yearly basis with one capacity fee. Such a *pro rata* allocation of transport capacity across the whole system may be necessary in a system with congestion; it may, however, impede flexibility in the use of the transmission system as it does not allocate capacity according to its value for the system. Moving towards a flexible capacity allocation, including short-term capacity auctions, would help the transmission system operator (TSO) to better utilise the capacities, including at peak times.

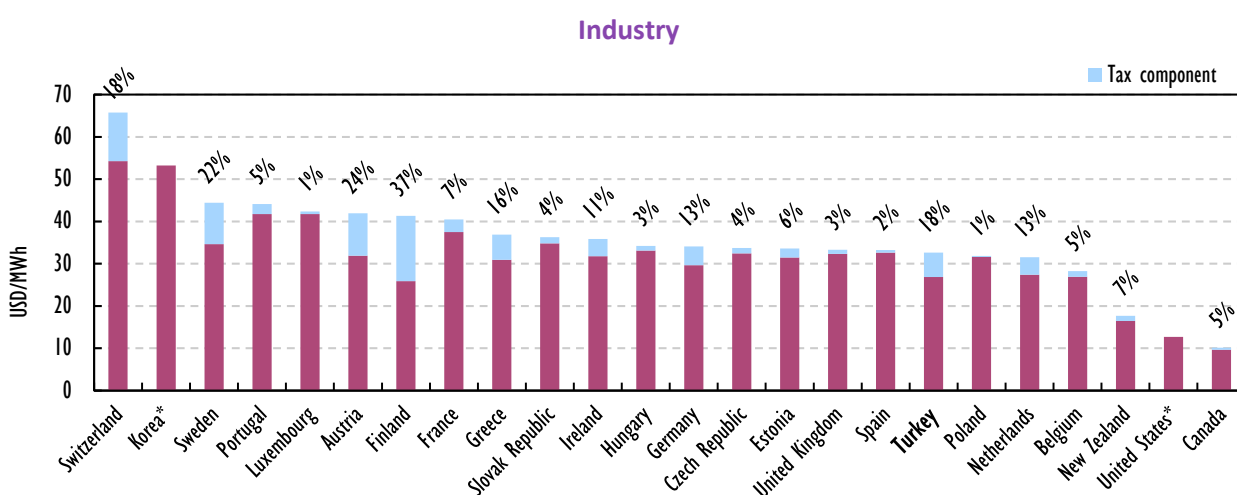
With major gas reserves in geographical proximity, Turkey is well placed to become a gas hub to bring supplies to Europe from Azerbaijan, Turkmenistan, Iraq and Iran, and from the Eastern Mediterranean. New gas supplies are critical for Turkey itself as a major gas importer to further diversify and expand its gas supply options, but they are also essential in creating a liquid gas market. Turkey plays a pivotal role for the security of oil and gas supplies in the region.

Turkey’s ability to deliver on its vision as energy hub could be become reality if the government supports swift progress in the creation of a transparent and liquid wholesale gas market, maintains a close engagement with regional partners on new supply developments, and fosters the upgrading of the natural gas infrastructure.

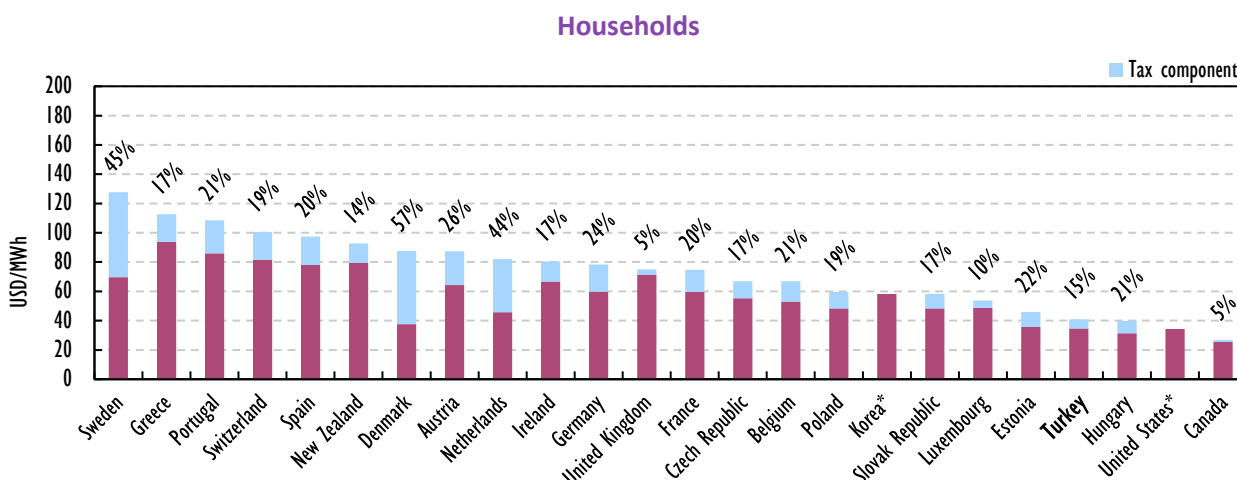
## PRICES AND TAXES

Market opening is in place for wholesale but not for household and larger retail consumers. As enshrined in the 2001 NGML, each year, EMRA determines the eligibility threshold and aims to move towards one objective: make all consumers eligible to freely choose their supplier. In December 2012, the EMRA Board took the decision to make all industry customers eligible as of 2013. Subsequently, the Board decided to decrease the eligibility threshold for gas customers to 100 000 cubic metres/year (cm/y) and in 2014, to 75 000 cm/y. The number of eligible consumers was around 440 000 in 2015.

Figure 7.7 Gas prices in IEA member countries, 2015



Note: Data not available for Australia, Denmark, Italy, Japan and Norway.



Note: Data not available for Australia, Finland, Italy, Japan and Norway.

\* Tax information not available.

Source: IEA (2016b), *Energy Prices and Taxes 2016 Q1*, [www.iea.org/statistics/](http://www.iea.org/statistics/).

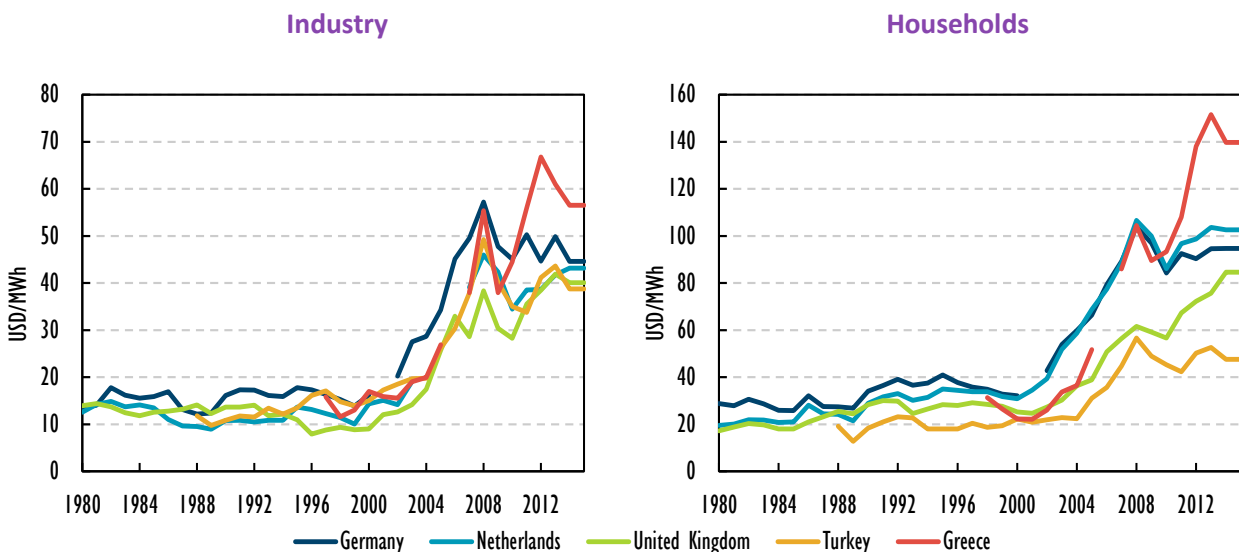
Wholesale prices are not regulated by EMRA but determined by the seller and buyers in the market. Retail prices differ according to retail group of eligible or non-eligible customers and across distribution regions. Not all gas consumption is metered. Eligible

consumers can choose their supplier but if they do not want to, they can take gas from the distribution company. Eligible end-users pay the gas wholesale purchase price of the distribution company (most of the time, BOTAŞ's sales price, as distribution companies have to purchase at the cheapest price) plus the unit service charge or the distribution tariff set by EMRA for network services.

By international comparison, natural gas prices in Turkey are low, for both industry and household customers. Households still benefit from very low gas prices, given that distribution companies are obliged to provide the cheapest offer and make no margins. Gas prices are below the level of liquid EU gas markets, such as the Netherlands or the United Kingdom (Figures 7.7 and 7.8) and closer to household gas prices in the United States and Canada.

Distribution licences are granted through a tender process in which companies compete to underbid their opponents for the margin they charge (unit service and depreciation charge (USDC) for supplying one kWh of natural gas to consumers) which is applicable for the first eight years of their licence period. Distribution tariffs for those regions are determined by EMRA only after the first eight years expire, therefore, the competitive bid price that won the tender is maintained for eight years. As a result, end-user prices for customers in approximately 70 distribution regions almost all equal BOTAŞ gas sales prices plus a margin (which is mostly 0 for many regions). Distribution tariffs differ among regions according to whether EMRA has determined them or when the lowest bid price is still in effect for that region. Next to the gas price companies can charge a connection fee. The connection fees of non-eligible consumers are about EUR 140 (including connection line plus meter). Connection fees of eligible consumers are freely determined by the parties within the framework of the principles.

**Figure 7.8** Gas prices in Turkey and in selected IEA member countries, 1980-2015



Notes: Data are not available for Turkey from 1980 to 1987. Data are not available for the Netherlands' industry price from 2004 to 2006. Data are not available for Greece from 1980 to 1996 and in 2006, and for Germany in 2001.

Source: IEA (2016b), *Energy Prices and Taxes 2016 Q1*, [www.iea.org/statistics/](http://www.iea.org/statistics/).

## SECURITY OF GAS SUPPLY

Turkey's gas system does not have a high capacity margin: natural gas demand was 48.7 bcm in 2015, which was met by net imports and some domestic production.

### NETWORK ADEQUACY (N-1)

The gas network has a maximum entry-point capacity of 196.5 mcm/d, but winter peak demand can reach over 230 mcm/d. The total of 196.5 mcm/d includes daily contracted pipeline imports (140), maximal send-out capacity from LNG (36), underground storage (20), and daily production (0.5). The east-west transportation capacity is limited because of lack of compressor stations; the Erzurum compressor station was upgraded in 2015.

Gas demand can quickly rise above supply, given the limited supply margin and the low delivery capacity of the Turkish gas network, which is caused by the east-west transmission bottlenecks and limited network flexibility, plus a lack of gas storage. Such a situation can occur during winter peak demand or when import flows are interrupted. During several winters, Turkey has also experienced cuts in supply, either from one or both of Turkey's pipeline suppliers, Azerbaijan and Iran. The gas system was not able to balance and the operator needed to introduce load shedding and forced cuts of power plants. For example, despite the mild winter of 2014, Turkey experienced a peak in winter gas demand in January 2015 and started introducing load shedding.

Any serious natural gas supply shortages have strong knock-on effects in the gas-consuming sectors, notably the power sector. As described in Chapter 8 on electricity, the actual availability of power supply can vary, depending on the hydro basin levels. A combination of a dry year and a gas supply shortage (disruption or extreme winter) could develop into a combined gas and power sectors crisis.

The tight security of gas supply situation is likely to persist until the end of 2018 when 6 bcm of Azeri gas starts flowing to Turkey through TANAP, and when new gas storage facilities are able to provide further flexibility to the gas network.

### SUPPLY/DEMAND BALANCE

On the supply side, any increase in gas supplies will be vital for Turkey to improve its security. For the winter 2015/16, Turkey was able to contract spot market LNG from several sources. Unlike LNG imports, the outlook for expanding Turkey's pipeline gas supply portfolio in the medium term remains challenging because of regional conflicts.

Efforts towards expanding TANAP to bring new sources in the Caspian or the Middle East to Turkey and Europe are ongoing. Despite the two governments signing a framework agreement in May 2013, no tangible progress has been made in developing a supply route to Turkey from Turkmenistan because of the lack of compromise among Caspian littoral states. In the past, Turkey supported the development of the Arab natural gas pipeline to bring Egyptian gas to Turkey and Europe through Jordan, Lebanon and Syria. The proposed extension of the Arab gas pipeline to Turkey was cancelled. However, imports of Iraqi gas are promising and could reach 20 bcm in 2020, but progress will depend on Iraq putting in place the gas infrastructure to capture and process the rising volumes of associated gas, mainly from the southern oilfields, and successfully developing non-associated gas fields. BOTAŞ announced a tender for the construction of a gas pipeline section to connect to the Iraqi border.

Gas supplies from Turkey's second-biggest supplier after Russia, Iran, are unlikely to increase beyond the current capacity of 10 bcm, even after sanctions are lifted. Supplies from Iran were subject to temporary fluctuations, particularly in winter. The *IEA World Energy Outlook 2015* considers that Iran will require substantial gas for its domestic economic development and possibly for larger oilfield reinjection to boost oil production output, once sanctions are lifted and economic growth recovers (IEA, 2015).

In the longer term, there are prospects for Turkey to tap into the potential of Iran's and Eastern Mediterranean gas fields, notably the Israeli offshore fields. Plans to increase Russian supplies to Turkey through Turkish Stream are under discussion.

### GAS EMERGENCY RESPONSE

The 2001 Natural Gas Market Law No. 4646 sets the standard of gas supply security for suppliers. Gas importers (except spot LNG importers) are obliged to hold gas in storage to a capacity corresponding to 10% of their annual gas imports, although they have a compliance period of five years.

In line with NGML 2001, the Transmission Network Operation Principles (network code) was approved by the EMRA to regulate the operation of the TSO and the companies involved, such as distributors and importers, in the event of a natural gas shortage. According to the code, BOTAŞ transmission division would take the lead in the event of a supply disruption under the supervision of EMRA.

In 2011, MENR approved an action plan on additional contingency measures. Under the action plan, the Commission for Enduring and Supervising Security of Natural Gas Supply, CESS-NGS, was established with the participation of the Under-Secretary of the MENR (chairperson), EMRA, the General Directorate of Energy Affairs of the MENR, the Turkish Electricity Transmission Corporation (TEİAŞ), the state-owned Electricity Generation Company (EÜAŞ), the Turkish Electricity Trading and Contracting Company (TETAŞ) and BOTAŞ. The CESS-NGS proposes to amend the National Gas Market Law in order to oblige all power plants with fuel-switching capacity to hold sufficient amounts of secondary fuel such as diesel. It is also planned that all periodic maintenance is to be kept at minimum levels during winter months.

Turkey lacks peak delivery flexibility, notably during situations of winter gas peak demand or gas import disruptions. The TSO uses an electronic bulletin board to announce "difficult days" when heavy imbalances in the system are about to occur, caused by excessive withdrawals or insufficient gas entries. Suppliers can be requested to implement disruption and interruption orders from the TSO within eight hours. When the gas importers concerned can be identified, gas supplies can be curtailed in accordance with the end-user priority list, which is submitted by gas importers every year. In case of a gas supply disruption in which the gas suppliers are not identified, the TSO will first endeavour to curb consumption by implementing interruptible contracts. However, the share of such contracts with BOTAŞ is limited to around 1.4% of its total sales, because prices between normal contracts and interruptible ones make no significant difference. The TSO will also reduce the contractual capacities of gas-fired power plants which can switch to alternative fuels, and then cut gas supplies to other power plants. The total amount of dual-fired power generation was around 3.5 GW (or some 8.4 mcm/d at net calorific value), with most generating electricity for their own facilities. When the above measures have been exhausted to mitigate the gas disruption, the TSO will reduce gas supplies to industry and eventually to households.

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## ASSESSMENT

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Since the last IEA in-depth review in 2009, Turkey has experienced a fast-growing natural gas consumption, increasing from 35.1 bcm in 2009 to 48.7 bcm in 2014, a historic peak. Natural gas has reached a strong position in power generation (49.1% of all gas is consumed for electricity generation) and an increasing role in the industry and residential sectors. Natural gas makes up 39% of the electricity mix. The country has seen a period of high investment, notably after the privatisation and expansion of the gas distribution grid across Turkey and the successful reforms in the electricity market, attracting investment in new gas-fired power plants. Natural gas is a key fuel in the Turkish economy. However, the country imports almost all of its gas needs.

Medium-term gas demand in the power sector will depend on the growth of renewable energy, the pace of coal development and the introduction of nuclear energy in power generation. In the MENR Strategic Plan 2015-19, the government has set a target to decrease the share of natural gas in the power mix to below 38% by 2019, as the government aims to increase the share of electricity produced from nuclear, renewable sources and domestic coal, mainly motivated by security of supply concerns. With increasing amounts of coal use in power generation and in the absence of a carbon price, coal will remain competitive over natural gas. There are several reasons that may compromise the fast growth of alternative sources, first and foremost the trends in future electricity sector's growth, but also delays in renewable, coal and nuclear deployment. Natural gas supply is likely to remain an important pillar in the short to medium term, notably for heating in the residential sector; therefore, it is critical to ensure its secure and competitive supply.

Progress towards the creation of a gas trading hub and the development of needed gas storage and transportation capacities is under way, but the pace has been much slower than expected. Turkish oil and gas pipeline operator and importer BOTAŞ dominates imports, wholesale trade and transmission activities, as well as supplies to distribution companies and thus to final consumers. The reform of the gas market lags behind the progressive approach taken in the electricity market.

First, the legal framework of the 2001 Natural Gas Market Law No. 4646 (NGML 2001) has not been implemented. Unbundling of BOTAŞ was done at accounting level, despite the provision that, by 2009, it should have been ownership-unbundled. And 15 years after the adoption of the law, the market barriers to competitive import of gas into Turkey still remain high with BOTAŞ managing around 80% of total gas imports. On the positive side, the energy regulator EMRA has gradually opened the market and achieved the liberalisation of about 20% of gas import contracts or 10 bcm in total since 2013, on the basis of provisions of the NGML 2001 to gradually transfer BOTAŞ import contracts until its market share decreases to 20% of annual consumption. However, only a small amount of import contracts (20%) has been actually transferred and current contracts of BOTAŞ extend well into 2025 and beyond. EMRA also developed the rules for access to the transmission and balancing services, including settling third-party access disputes, and continuously works on updating BOTAŞ Network Code.

The IEA review of 2009 had called for the effective unbundling of BOTAŞ, the creation of an independent transmission system operator and the reduction of BOTAŞ's market dominance. There has been an attempt in 2014 by the government to present a draft amendment to the NGML 2001 which would have required the legal unbundling of

BOTAŞ into separate entities (trading, transmission and LNG terminal and storage operations), further market opening, the creation of a gas wholesale exchange, and import competition. However, the draft amendment to the Natural Gas Law is pending adoption in the Parliament. The last years were marked as a period of uncertainty and gas business stakeholders have underlined the importance of completing the reforms. The IEA therefore urges the government to swiftly proceed with the long-awaited reforms and implement the provisions of NGML 2001. The competition authority should also play a more active role in the promotion of competitive gas supply, including a possible volume release programme. This situation can only be solved by structural remedies, such as ownership unbundling and the completion of full market opening towards competitive prices to all gas users.

Retail market opening has been the focus of the regulator EMRA. In December 2012, the EMRA Board rendered an important decision in order to boost competition in the natural gas retail market. In this framework, large industry customers became eligible to choose their supplier, with the exception of small and medium-sized enterprises (SMEs) and households. All non-household customers have been free to choose their suppliers since 2013. This decision was reinforced with a new EMRA Board decision in 2015 to decrease the eligibility threshold to SME customers with a consumption of up to 75 000 cm. For the year 2016, the EMRA Board took the decision to maintain the eligibility threshold for the gas customers at 75 000 cm, which translates into around 440 000 consumers who can choose their suppliers. However, BOTAŞ remains the dominant supplier to state-owned power companies and distribution companies, and gas prices to households remain low in international comparison, and high to industrial consumers. While EMRA has tendered the gas distribution licenses for all large cities, de-facto it has not been able to ensure competitive supply and regulates final prices. An action plan for market opening should be agreed with all stakeholders.

Gas market reforms are even more important if Turkey wants to continue EU accession negotiations. The legal regime of the gas market is non-compliant with EU legislation – EU Gas Directive 2009/73/EC and Gas Regulation (EC) No. 715/2009, EU Regulation 994/2010 – and substantial reforms will be required. These need to include the full unbundling of transmission, trade and storage and LNG activities, designation of distribution system operators, as well as ending the separation of transit and transportation, abolishment of gas storage obligations and the full implementation and compliance with third-party access. The government should step up initiatives to create a liquid and transparent gas wholesale market and ensure compliance of BOTAŞ with third-party access rules and its legal obligations under the Network Code.

Turkey wishes to become a major gas trading centre at the crossroads of the Middle East, the Caspian and Mediterranean region and Europe. However, progress in achieving a gas hub remains low. An independent gas network operator together with the established gas exchange will need to be created to support the creation of a gas hub. Turkey has no day-ahead or secondary gas market, no full entry-exit regime and the balancing regime does not value capacity for its contribution to balancing the system. Although the Natural Gas Market Tariff Regulation in Turkey allows transmission and distribution network operators to propose different tariffs for backhaul, interruptible, non-interruptible and similar types of transportation services, in reality there are no consumers, even eligible, with interruptible contracts, for trading and/or other purposes. Any gas supply shortage – in the event of interruptions during critical days and in winter times – places high stress on the system. The availability of flexible short-term gas

contracts, interruptible capacity and a flexible balancing regime, as well as new gas supplies, higher physical gas transmission and storage capacity are vital preconditions for security of supply and reliable transportation. The government should prioritise the implementation of the energy exchange EPIAŞ and/or a platform for gas trading, EMRA's plans to amend BOTAŞ's Network Code should lead to the implementation of a new market-based balancing regime and a full entry-exit regime which would abolish the split between the virtual trading point and the four import entry points and would introduce improved capacity allocation to reduce network congestion.

The Turkish gas network has a maximum entry-point capacity of 196.5 mcm/d, but winter peak demand can reach much above 230 mcm/d (see Figure 7.3), making gas supply security a challenge. Turkey has taken steps to address its lack of gas storage and some new facilities are being planned to achieve 5 bcm of gas storage by 2023. In 2015, Turkey had only one underground storage facility (TPAO's Silivri facility), and some peak shaving from two LNG facilities. The new BOTAŞ Sultanhani/Tuz Golu gas storage facility (capacity of 1.5 bcm by 2020) is under construction and three storage facilities are at the pre-investment phase after EMRA licensed them in 2014.

However, even if Turkey can reach its stated target of 5 bcm of gas storage, it will not be enough to service a competitive natural gas market and international transportation. To date, Turkey has two LNG facilities. But most gas supplies largely depend on Russian imports by pipeline. The draft amendment to the Natural Gas Market Law creates incentives for underground natural gas storage and LNG storage facilities. Turkey can also clarify expectations of new gas supplies and transportation routes if it can boost the volume of additional storage required to maintain a resilient system and if it can improve network planning. The new draft amendment law requires annual security of supply reports to be prepared by the Council of Ministers who decide also on the expansion of the gas infrastructure. However, it would be more desirable to improve network planning in a transparent manner by consulting publicly with private industry on the planned gas network investment. The network planning should be published to increase consultation and transparency with market participants and encourage investment decisions. To date, the Turkish legal framework regulates gas storage and LNG imports as one activity. With a view to stimulate investment critically needed, the government should separate LNG and storage activities and ensure full implementation of third-party access to regulated facilities.

Significant progress has been made in developing the Trans-Anatolia Gas Pipeline, which is the backbone of the Southern Gas Corridor to deliver Azeri gas to Europe. Following the intergovernmental agreement and final investment decision (FID) and shareholder agreements, land acquisition in Turkey is being completed and construction has begun. Turkey and Azerbaijan agreed in December 2015 to speed up the construction and start of supplies to Turkey ahead of 2018. TANAP is the first transit pipeline. Turkey continues its active participation in regional and international forums and working groups on energy, and the new transit regime is intended to stimulate further pipeline projects. MENR considers that a change in law is necessary in order to bring separate provisions in different laws together, and to set combined rules for the oil and gas transit in Turkey (thus repealing Transit Law 4586). However, there is no clarity provided to market participants as to what rules such a new transit regime would entail, given the fact that each transit pipeline project is governed by the bilateral rules agreed in the Intergovernmental and host government agreements, and shareholder agreements.



Turkey has secured new long-term agreements for new gas supplies with Azerbaijan, Algeria and private importers which started imports from Russia on the Western Route. EMRA has issued new import licences for imports from Iraq and has invited tenders for import licences from Kazakhstan. Beyond these, no short-term supply increases from Iran or Russia can be expected. Broader efforts to secure and diversify supply may be compromised by the geopolitical situation in the Caspian, Middle East and Eastern Mediterranean region. In the longer term, some diversification of gas supplies can be achieved with promising quantities coming from Iraq or Israel, in addition to the positive long-term outlook for Caspian and Iranian supplies, and some unconventional gas production in Turkey. MENR estimates that Turkey has 551 bcm of recoverable shale gas, principally in the Dadas formation in the south-east, and expects the new licensing regime of the Petroleum Law of 2013 to set the path for more exploration activities. However, most of the shale gas is located in the south-east Anatolian territory affected by the war in Syria. For production to prove commercially viable, best practice from international experience of unconventional development, including environmental management, community engagement, technology R&D and asset inspection are valuable for Turkey.

Natural gas is playing an increasingly important role in the residential, commercial and power generation sectors. The government should reassess its gas policy to ensure the long-term adequacy of the supply/demand balance and the protection of its critical gas infrastructure. It is working towards increasing the share of alternative energy sources in the power sector and energy efficiency in the domestic market. The government should continue to run robust risk assessments, adopt required short-term market-based measures - notably interruptible contracts - and design prevention and emergency plans which take into account related electricity supply security concerns and the protection of critical gas infrastructure.

## RECOMMENDATIONS

*The government of Turkey should:*

- *Continue efforts to bring diversified gas supplies to Turkey by stepping up negotiations with international partners to secure supplies for both domestic gas demand and gas trades for European gas markets.*
- *To this end, speed up the expansion of the gas transportation network, the construction of gas storage and LNG facilities, and develop a comprehensive gas network plan.*
- *Complete the gas market reform by setting out an action plan towards a fully competitive and transparent gas wholesale market with an independent transmission system operator that can ensure third-party access to transmission network capacity and fully separates trade and transmission activities.*
- *Explore all opportunities for the development of Turkey's unconventional resources, using international experience and standards.*
- *With a view to consolidate the security of gas supply policies, continue to carry out risk assessments and set out preventive actions and emergency plans; evaluate policies with regard to critical infrastructure and related electricity security issues; and consider the benefits of increased energy efficiency and renewable energy use.*

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## 8. ELECTRICITY

### Key data (2015 estimated)

**Total electricity generation:** 259.7 TWh, +60.3% since 2005

**Electricity generation mix:** natural gas 38.6%, coal 28.3%, hydro 25.8%, wind 4.4%, geothermal 1.3%, oil 0.8%, biofuels and waste 0.6%, solar 0.2%

**Installed capacity (2014):** 69.5 GW, +88.8% since 2004

**Peak demand (2014):** 41 GW

**Electricity consumption (2014):** 207.4 TWh (industry 46.2%, commercial and public services 30.1%, residential 22.3%, transport 0.4%, energy sector 0.03%)

## OVERVIEW

Since the last in-depth review of 2009, Turkey has continued to experience rising electricity demand in step with economic growth. Generation increased from 198.4 terawatt-hours (TWh) in 2008 to 259.7 TWh in 2015, while generating capacity nearly doubled in the ten-year period 2004-14 to reach 70 GW in 2014.

In the past five years, Turkey was able to lay the ground work for the electricity wholesale market. The successful restructuring and privatisation of the electricity distribution sector from 2008 to 2013 have attracted major private investments in power generation. Since 2014, the Turkish electricity system has been synchronised with the Continental European system.

After a period of high investment, with satisfactory capacity and profit margins and with accelerated growth in electricity demand, the Turkish electricity market has entered a period of consolidation. This creates an opportunity for the government to complete the creation of a well-functioning wholesale electricity market, the privatisation of the remaining state-owned generation assets and full market opening as well as strengthening regional integration of the electricity market.

## SUPPLY AND DEMAND

### SUPPLY

Turkey's electricity generation has been growing rapidly for decades and reached a record high in 2015 at 259.7 terawatt-hours (TWh). In 2015, it was 33.3% higher than in 2009 (Figure 8.1), when the IEA carried out the previous in-depth review. Electricity is generated mainly from fossil fuels, which made up 67.7% of total generation in 2015, 11.3 percent points lower than in 2014 thanks to the higher contribution from renewable sources. Natural gas is the major fuel in electricity generation (38.6%), followed by coal (28.3%), and some fuel oil (0.8%).

The electricity generation mix in Turkey can change year on year, owing to the seasonality of hydro supply and unavailability of old lignite plants. In 2015, hydropower production was at a record high of 66.9 TWh, 64.6% higher than in 2014. Hydropower production averaged 47.1 TWh for the period 2005-15, or 22% of total generation. The share of hydro and natural gas in total generation has been volatile. Since 2005, the use of coal in power generation has increased, while electricity production from oil declined by 60.1%. Natural gas has increased its share from 45.3% in 2005 to 47.9% in 2014. However, in 2015 the share of natural gas fell to 38.6% of total, while the share of coal in the electricity mix increased from 26.7% to 28.3%.

**Table 8.1** Installed generating capacity by fuel, 2004-14 (in MW)

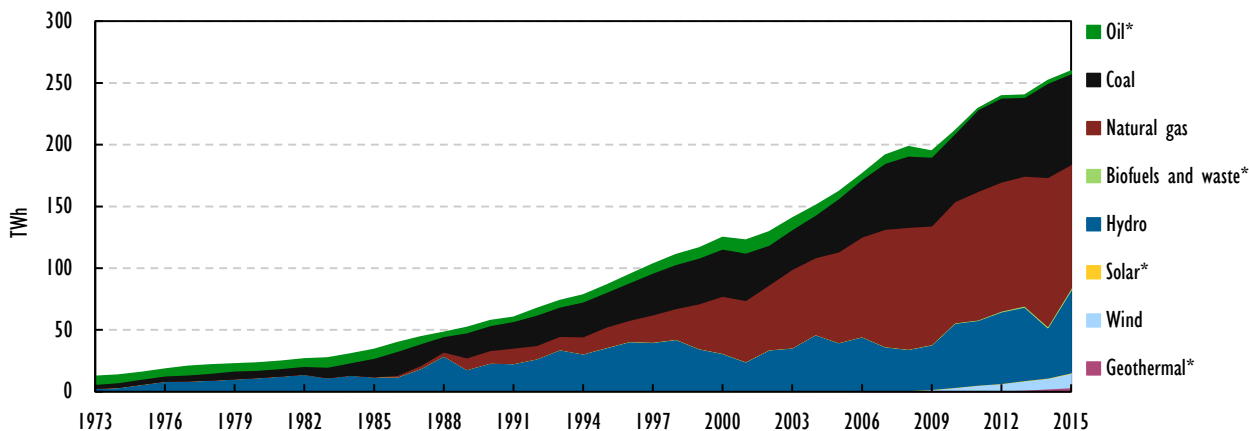
Turkey	2004	2007	2008	2009	2010	2011	2012	2013	2014
<b>Total capacity</b>	36 824	40 835	41 818	44 761	49 524	52 911	57 059	64 007	69 520
<b>Combustible fuels</b>	24 125	27 271	27 595	29 339	32 279	33 931	35 027	38 612	41 752
<b>Coal</b>	8 296	10 197	10 191	10 590	11 950	12 550	12 576	12 606	14 814
<b>Fuel oil</b>	2 596	1 999	1 819	1 699	1 593	1 300	1 285	616	595
<b>Natural gas</b>	10 158	11 648	10 657	11 825	13 303	13 144	14 116	17 170	18 724
<b>Multi-fuel-fired</b>	3 048	3 384	4 868	5 138	5 325	6 811	6 881	8 021	7 370
<b>Other combustible fuels</b>	27	43	60	87	108	126	169	199	249
<b>Renewable energy</b>									
<b>Hydro</b>	12 906	13 395	13 829	14 553	15 831	17 137	19 609	22 289	23 643
<b>Geothermal</b>	15	23	30	77	94	114	162	311	405
<b>Solar photovoltaic</b>	0	0	0	0	0	0	0	0	40
<b>Wind</b>	21	146	364	792	1 320	1 729	2 261	2 759	3 630
<b>Other (e.g. fuel cells)</b>	0	0	0	0	0	0	0	36	50

Source: IEA (2016a) *Electricity Information 2016*, [www.iea.org/statistics/](http://www.iea.org/statistics/).

Since Turkey has no nuclear energy to date, renewable energies are the third pillar in power generation, mainly hydro (25.8%), wind (4.4%), geothermal (1.3%), biofuels and waste (0.6%) and solar (0.2%). Hydroelectric plants are the major installed capacity source (Table 8.1), with 34%, followed by natural gas 26.9%, coal-fired power plants 21.3%, and wind 5.2%. Over the past decade, Turkey has seen considerable investment in renewable energy capacity besides hydropower. Installed capacity of wind was 173 times higher in 2014 than in 2004 while geothermal power was 27 times higher. Biofuels and waste use increased tenfold while solar power was first introduced in 2013. Solar power is still at a low level, but its shares have been increasing since 2013. The total share of non-hydro renewables in electricity generation was 6.5% in 2015, up from 0.2% in 2005.

In comparison to other IEA member countries, Turkey's share of fossil fuels in electricity generation was ninth-highest in 2015 (Figure 8.2), with a fifth-highest share of natural gas use. The geothermal share ranked third-highest behind New Zealand and Italy. The hydro share was seventh highest with record-high production in 2015.

Figure 8.1 Electricity generation by source, 1973-2015

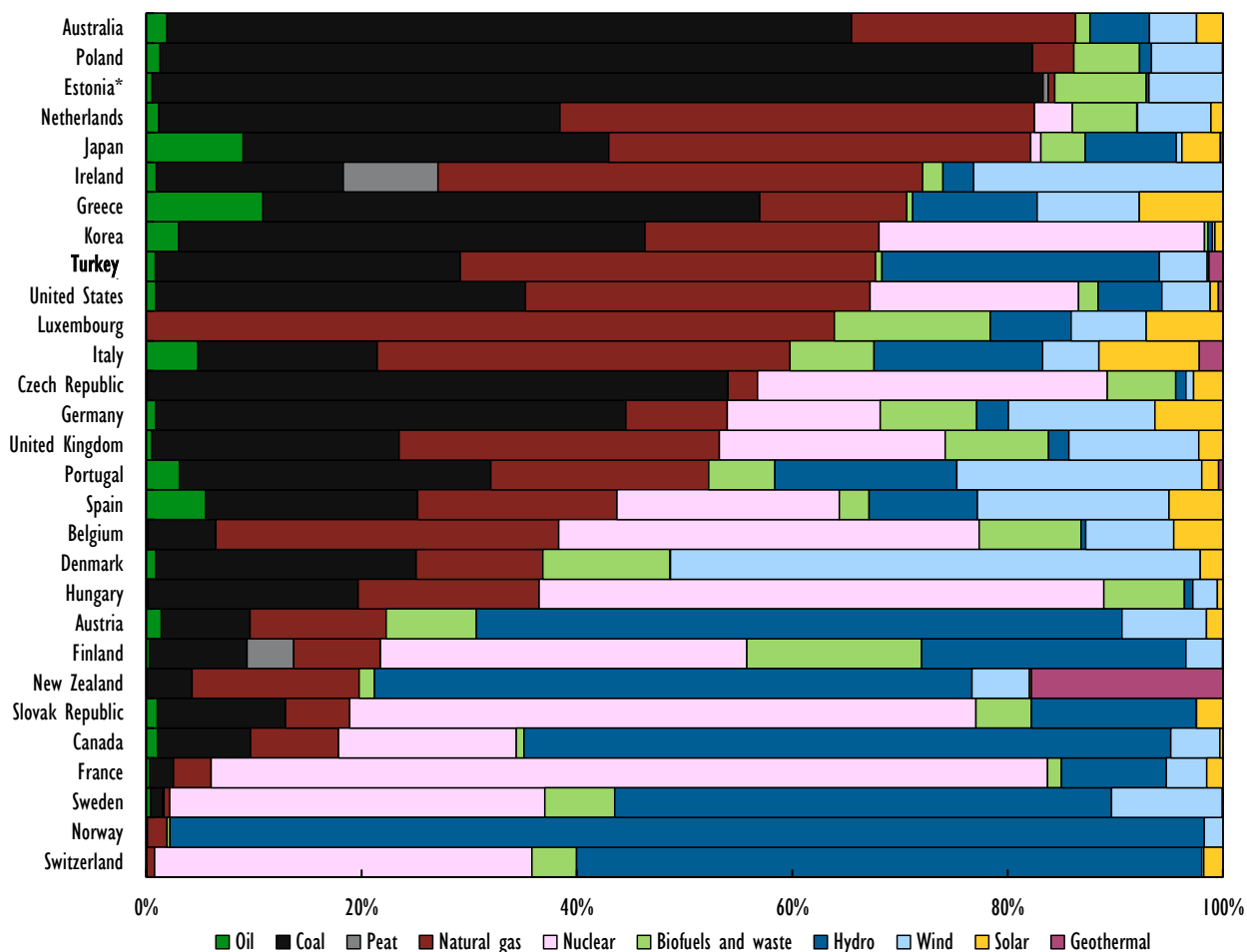


Note: Data are estimated for 2015.

\* Negligible.

Source: IEA (2016b), *Energy Balances of OECD Countries 2016*, [www.iea.org/statistics/](http://www.iea.org/statistics/).

Figure 8.2 Electricity generation by source in IEA member countries, 2015



Note: Data are estimated for 2015.

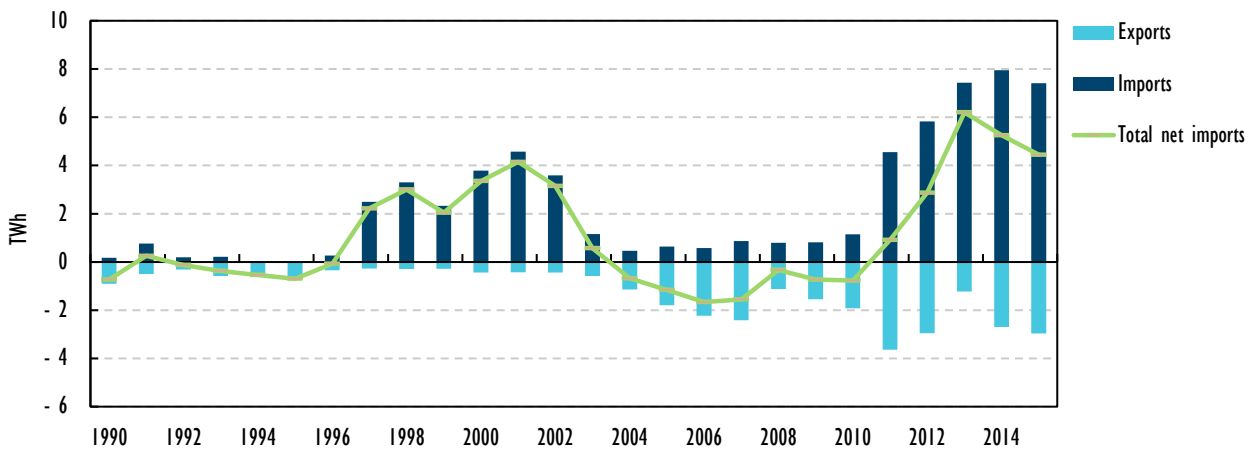
\* Estonia's coal represents oil shale.

Source: IEA (2016b), *Energy Balances of OECD Countries 2016*, [www.iea.org/statistics/](http://www.iea.org/statistics/).

## IMPORTS AND EXPORTS

Turkey has interconnections with all neighbouring countries; however the capacity and trade volumes are small. In 2015, Turkey's cross-border electricity net imports amounted to 4.4 TWh or 2.1% of the total electricity supply of the country. Imports have been on the rise since 2010 and totalled 7.4 TWh, with exports of 3 TWh in 2015. Net electricity trade is growing, ranging from net exports of almost 4 TWh in 2011 to net imports of almost 8 TWh in 2014. Both imports and exports have grown over the past decade. Most of the increase in imports has been since 2011 and the trial connection to the EU electricity grid (see Figure 8.3). Around 66.7% of total imports came from Bulgaria in 2014 and the remainder from Iran (28.3%), Georgia (3.7%), Azerbaijan (1.3%) and Greece (0.05%), while electricity is exported mainly to Greece (70.8%) and Iraq (29.1%).

**Figure 8.3** Net electricity imports to and exports from Turkey, 1990-2015



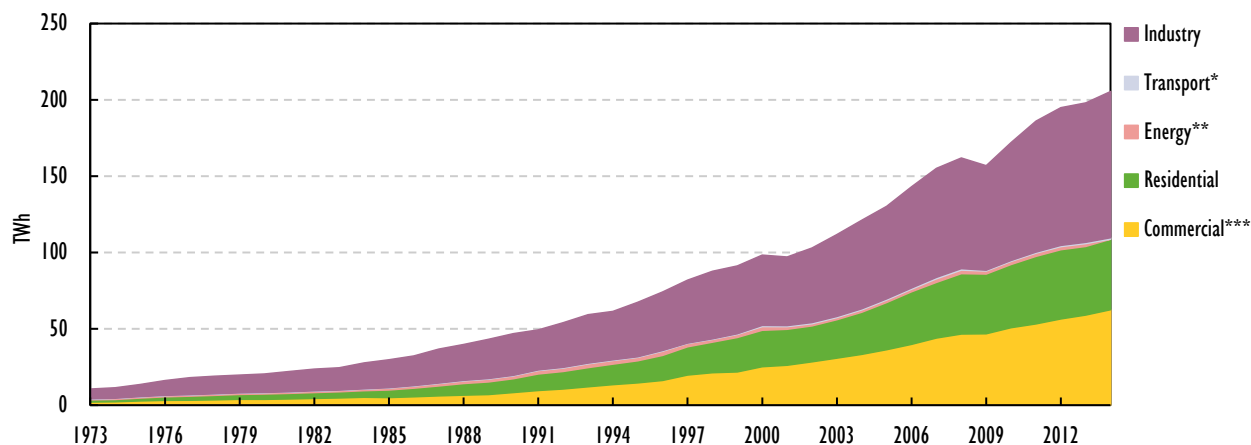
Source: IEA (2016a), *Electricity Information 2016*, [www.iea.org/statistics/](http://www.iea.org/statistics/).

## DEMAND

Turkey's electricity consumption reached 207.4 TWh in 2014, a record high. Since 2004, consumption only contracted once by 3.1% in 2009, after seven years of steady growth (see Figure 8.4). In 2014, consumption was 71.2% higher than in 2004. At the same time, annual instantaneous peak demand in 2014 reached a historic high of 41 gigawatts (GW), 198% up from in 2004, higher than in any previous year since 2009.

Industry is the largest final consumer of electricity, accounting for 46.2% of total consumption. Industry demand has experienced a 65% growth over the past decade. During the economic crisis, industry demand contracted by 5.6% during 2009 but rebounded in 2010 with a 12.8% jump. The industry share in total demand contracted slightly from 47.9% in 2004 as total demand grew slightly faster.

The sector of commercial and public services (including agriculture) and the residential sector accounted for 30.1% and 22.3% of demand in 2014, respectively. Demand in both sectors increased faster than the total (effectively being the main drivers of demand growth), up by 88.1% and 67.2% compared to 2004. Consequently, they have gained a larger share of total demand, up from 27.4% for commercial and 22.8% for residential. The energy sector (including coal mining, oil and gas extraction and refining) consumed 0.03% of total electricity demand; transport consumed a negligible 0.4%.

**Figure 8.4** Electricity consumption by sector, 1973-2014

\* Negligible.

\*\* Energy includes coal mining, oil and gas extraction, and refining.

\*\*\* Commercial includes commercial and public services, agriculture, fishing and forestry.

Source: IEA (2016a), *Electricity Information 2016*, [www.iea.org/statistics/](http://www.iea.org/statistics/).

## INSTITUTIONS AND REGULATORY FRAMEWORK

### 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 the **Ministry of Development (MoD)** and its **High Planning Council (YPK)** for the preparation of the national development plans, with the industry sector for demand projections, and with the **Ministry of Environment and Urbanisation (MEU)** with regard to environmental approval procedures.

Within MENR, the **General Directorate of Energy Affairs (GDEA)** is responsible for the co-ordination of electricity reforms. Its functions include the monitoring of security of electricity supply and the audit of electricity network investment.

The **Under-Secretariat of Treasury** carries out the ownership function for the state-owned energy enterprises and prepares the annual investment and financing programmes. The **Prime Minister's Privatisation Administration (PA)** had a supporting role in liberalising the Turkish electricity market, reducing the state involvement in the economy and attracting private investment.

**The Energy Market Regulatory Authority (EMRA)** is the independent regulator of the electricity market under the Electricity Market Law. EMRA is responsible for granting licences to legal entities to carry out activities in the electricity market; observing the performance of the electricity market; issuing, revising, implementing and auditing the regulations on performance standards; distribution and client services; determining and auditing the pricing principles and the lawful behaviour of market participants. EMRA regulates the network tariffs of the Electricity Transmission Company TEİAŞ and of all 21 distribution companies. A revenue cap for the income of TEİAŞ is being implemented. As regulated prices persist in Turkey, EMRA regulates the Electricity Trading and Contracting Corporation TETAŞ's tariffs for wholesale energy sales and electricity tariffs of retailers to non-eligible customers.

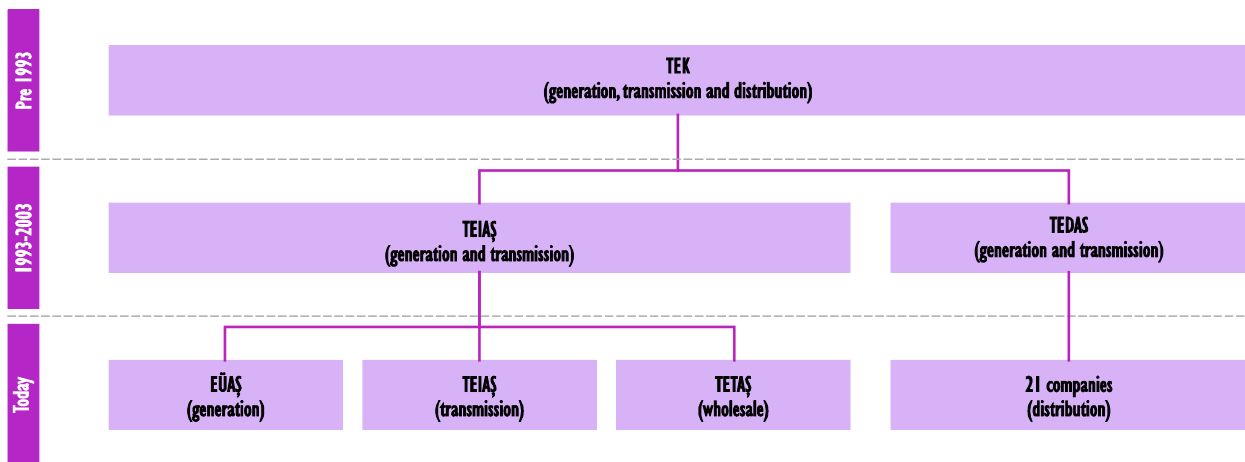


The **Competition Authority** supports the process of market opening, privatisation and liberalisation, through its decisions and opinions with regard to the authorisation of merger or acquisitions, scrutiny of market abuse, notably for the distribution privatisation tenders, and general monitoring of competition in the electricity and gas markets. It also determined the legal separation of distribution and retail activities as part of the privatisation of the distribution companies.

## INDUSTRY STRUCTURE

Today's structure of the Turkish electricity industry is the result of a long liberalisation and privatisation process, which led to the emergence of private players, next to restructured state-owned companies.

**Figure 8.5** Historical development of the electricity market structure



Source: World Bank (2015), *Turkey's Energy Transition Milestones and Challenges*, July 2015.

During the years 1980 to the 1990s, the government pursued the privatisation of power generation along four models: transfer of the operating rights (TOOR) which retained the ownership with the state; the build-own-transfer (BOT) model, where the asset was transferred to the state at the end of the contract; and the build-own-operate (BOO) contract, which was a power purchasing guarantee and full privatisation. In addition, many industry enterprises were allowed to generate their own electricity (autoproduction).

Liberalisation started with the abolishment of the monopoly of the vertically integrated Turkish Electricity Authority (TEK) in 1984 and its restructuring into the Turkish Electricity Generation and Transmission Company (TEİAŞ) and the Turkish Electricity Distribution Company (TEDAŞ) in 1993. In 2003, liberalisation continued and unbundled TEİAŞ into three separate companies: Electricity Generation Company (EÜAŞ), Turkish Electricity Transmission Corporation (TEİAŞ) and Turkish Electricity Trading and Contracting Corporation (TETAŞ) (see Figure 8.5). After failed attempts to increase the share of private companies in the electricity market, distribution holding TEDAŞ was restructured into one holding company and 20 regional subsidiaries for the implementation of distribution privatisation, in accordance with the objectives set out in the 1st Electricity Reform and Privatisation Strategy Paper of 2004.

In 2015, the structure of today's electricity market in Turkey is shown in Figure 8.6.

**Generation** activities are carried out by EÜAŞ, private generators and autoproducers. EÜAŞ owns all of the remaining state-owned assets which were not privatised, mainly large-scale hydro-reservoir power and some thermal power (lignite) plants. EÜAŞ electricity generation is sold either to state-owned TETAŞ or on the exchange or directly to regional suppliers or eligible consumers. Private producers include independent power producers (IPPs) and private companies with bilateral BOO, BOT or TOOR contracts. The autoproducers are legal entities engaged in electricity generation for their own needs. TETAŞ will be the main contractor for the nuclear power produced by the planned Akkuyu nuclear power plant (see Figure 8.7 and Box 8.1). According to the Turkish Cogeneration and Clean Energy Technologies Association, in 2013, there was 8300 MW or 14% of total installed capacity in the Turkish CHP market (TÜRKOTED, 2013).

In 2014, state-owned generation company EÜAŞ and its affiliates were responsible for 31.5% (21 880 GW) of total generation, with a portfolio of hydro and lignite power plants. IPPs operate the majority of power generation, 839 power stations, accounting for 54.9 % of total capacity. The share of private companies that hold BOT, BOO and TOOR contracts is 13.5% of total capacity (Table 8.2). The total share of private companies in the market is thus around 68%.

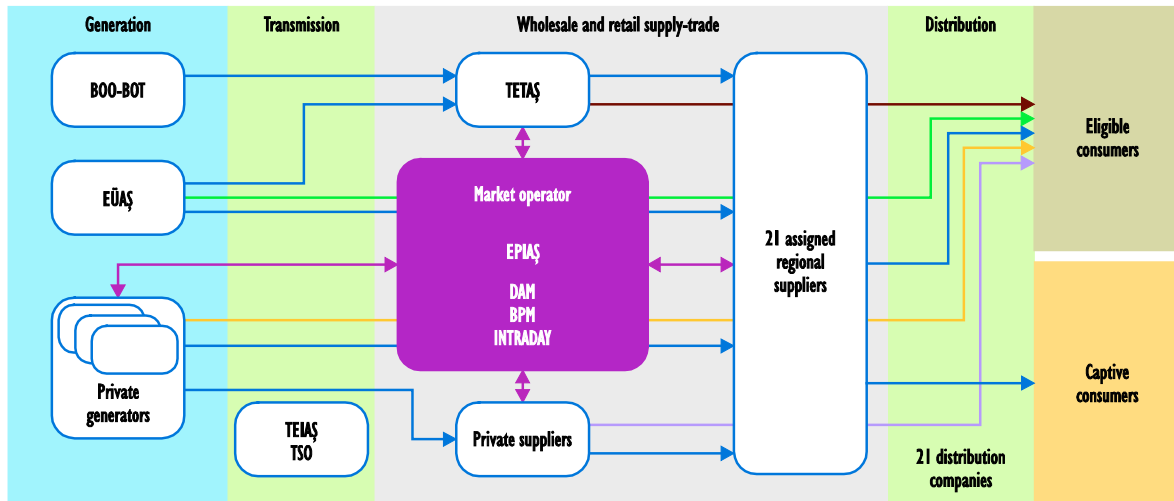
**Table 8.2** Ownership structure in generating capacity, 2014

Companies	Installed capacity, MW	Share of capacity, %	Power stations
EÜAŞ and EÜAŞ affiliates	21 879	31.5	78
TOOR	946	1.4	60
BOO	6 102	8.8	5
BOT	2 319	3.3	19
Independent power producers	38 193	54.9	839
Autoproducers	27	0.0	6
Unlicensed stations	52.8	0.1	119
<b>Total</b>	<b>69 519</b>	<b>100.0</b>	<b>1 126</b>

Source: TEİAŞ (2014), *Load Dispatching Report*.

**Transmission:** TEİAŞ is the sole transmission operator, owning and operating all transmission assets of the country, and maintaining and developing transmission facilities. TEİAŞ operated a wholesale platform, the Electricity Market Financial Settlement Centre (PMUM) until this market operation function was separated in 2013, in line with the new Electricity Market Law, and the **Energy Market Operations Company, EPIAŞ**, licensed in 2015 by EMRA.

As transmission operator, therefore, TEİAŞ only operates the balancing power market (BPM) and ancillary services, while the Istanbul Stock Exchange will operate the derivatives financial market. The independence of TEİAŞ as electricity grid operator from trading activities will be ensured once EPIAŞ has been fully established.

**Figure 8.6** Industry structure of the electricity sector, 2015

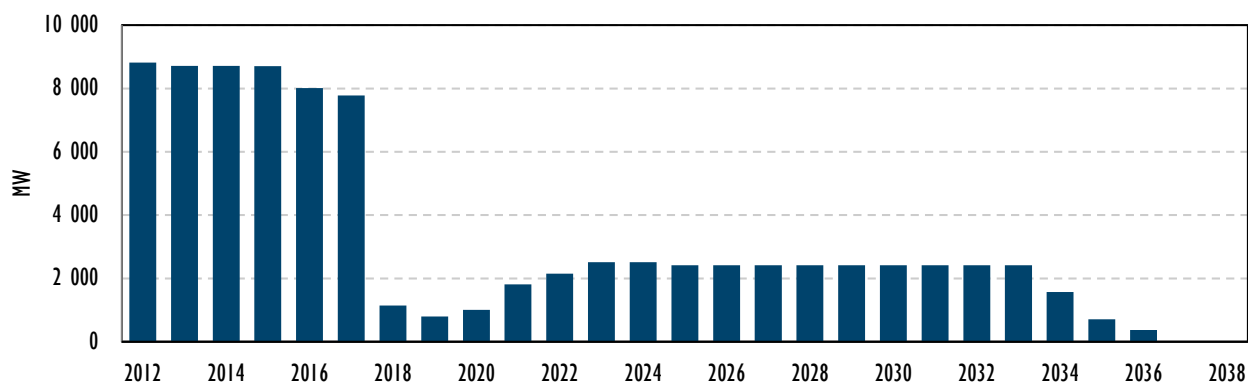
Source: Adapted from World Bank (2015), *Turkey's Energy Transition Milestones and Challenges*, July 2015.

**Wholesale trading:** A formal electricity wholesale market has been created in 2015. Since April 2015, EPIAŞ is the new operator of the wholesale market for electricity and gas, which includes the day-ahead market (DAM) and a continuous intraday market since July 2015. As other market operators in European countries, TEİAŞ holds 30% of EPIAŞ, the Istanbul Stock Exchange holds about 30%, and the remaining 40% is shared among around 100 energy market participants.

In addition to the day-ahead and intraday markets, there are a number of bilateral legacy contracts between the state and privatised companies. All of these contracts are handled by TETAŞ, the stated-owned trading company which purchases the electricity generated from EÜAŞ and other private wholesale suppliers under existing long-term take-or-pay contracts with BOO, BOT, TOOR companies at regulated prices, to fulfil state obligations after privatisation. It can be expected that once the contracts expire, TETAŞ's function would expire too. Despite the government avoiding direct equity shares in power projects (namely the Akkuyu nuclear power plant), TETAŞ however can become shareholder and maintain its position as a long-term purchaser of electricity at guaranteed prices, even after the legacy contracts expire. Box 8.1 and Figure 8.7 explain how the Akkuyu long term purchase contract may distort the wholesale market pricing, as it guarantees an out of market arrangement up to 2036.

**Distribution:** Twenty-one distribution companies with their own geographical region are all legally unbundled and privatised through TOOR contracts. The ownership of the distribution network asset remains with the state (with TEDAŞ as holding company). Distribution companies must provide non-discriminatory distribution of electricity and connection services to all system users, read their meters and prepare regional demand projections and investment plans. Distribution companies must purchase electricity from TETAŞ to compensate for loss, theft or storms in their region.

**Retail activities:** Assigned regional suppliers distribute electricity to captive consumers in their assigned region, where they are also the supplier of last resort, but also to eligible consumers countrywide.

**Figure 8.7** Forecast power production capacity under the responsibility of TETAŞ, 2012-38 (in MW)

Note: Values are indicative and may be subject to change, notably in later years because of delays or other factors. After 2020, the share of electricity production includes the production by the Akkuyu nuclear power plant.

Source: MENR data provided 2014.

### Box 8.1 Nuclear deployment in the Turkish electricity market

The total cost of the Akkuyu nuclear power plant is considered to amount to USD 20 to 25 billion and is backed by a 15-year power purchase agreement (PPA) for 70% of the electricity generated by the first two units and 30% of the last two units, at an average constant price of USD cents 12.35/kWh over the 15 years. The Intergovernmental Agreement indicates that the price can be adjusted annually to allow some flexibility for the investment payback of, but with an upper limit of US cents 15.33/kWh. The process of this adjustment is not detailed. TETAŞ will purchase the electricity under the PPA at a regulated wholesale tariff. The rest of the electricity will be sold by the Akkuyu Joint Stock Company (JSC) on the electricity market. After 15 years covered by the PPA, the totality of the electricity will be sold on the electricity market, with 20% of the Akkuyu JSC's net profit to be provided to the state budget. The Akkuyu BOO model and related PPA will have an effect on the functioning of the electricity market in Turkey, as can be understood from Figure 8.6. The decision to proceed via PPAs for the financing of the BOO model of the Akkuyu nuclear plant will prolong the period during which TETAŞ will work as intermediary between the Akkuyu JSC and the electricity market operator. It will buy on average 50% of the electricity produced by the nuclear plant during its first 15 years of operation. The wholesale tariff of TETAŞ is determined on the basis of the costs of the energy purchased, the operating costs of the organisation and its financial targets in line with the Electricity Market Law No. 6446.

## ELECTRICITY MARKET REFORMS

With the enactment of the **Electricity Market Law (EML) No. 4628 in 2001**, market liberalisation and privatisation was initiated in the sector. After the legal framework for electricity market activities and the roles and responsibilities of the market players and EMRA, its regulatory body, had been established by the EML No. 4628, a transition period followed with different attempts to privatise and liberalise. It was only during 2008-14 that reforms towards a competitive electricity market accelerated and private investment took off.

During the transition period of 2003-07, electricity demand has increased faster than investment in new generating capacity and reserve margins were down to the level of 5%

which prompted the High Planning Council to endorse the **2nd Electricity Market and Security of Supply Strategy** in 2009. Next to defining the necessary steps for privatisation and full market opening by 2015, including the phase-out of the price equalisation mechanism, the Strategy set out indicative targets for the use of indigenous energy resources in electricity generation by 2023: at least a 30% share of renewables, use of full potential of lignite and hydro, and the introduction of nuclear energy in Turkey. It also comprised a range of measures to ensure security of electricity supply, including monitoring of supply-demand balance by MENR, auctions and capacity mechanisms, and the plan to achieve the interconnection of the Turkish electricity system with the former Union of Coordination of Transmission of Electricity (UCTE), today's European Network of Transmission System Operators for Electricity (ENTSO-E).

To use its renewable potential and support the entry of renewables in electricity generation, the **Amendment Law to Utilisation of Renewable Energy Resources for the Purpose of Generating Electrical Energy No. 6094** was enacted in 2011. Feed-in tariff levels were granted for different energy sources and technologies: US cents 7.3/kWh for hydro and wind, US cents 10.5/kWh for geothermal and US cents 13.3/kWh for solar and biomass (including waste gases).

The reform of Turkey's electricity market cumulated in the **New Electricity Market Law (EML, No. 6446) of 2013** which was adopted by the Parliament on 30 March 2013. This new law assigned the rights and obligations of all participants in electricity generation, transmission, distribution, wholesale and retail sale, import, export and market operation activities. The New EML introduced the new activity of market operation (with the market operator EPIAŞ), legal unbundling of retail and distribution (the distribution company cannot own or operate generation and has to be legally unbundled from the regional supply company. It increased the maximum capacity threshold for the authorisation of renewable energy plant without licence (from 0.5 to 1 MW) to encourage distributed generation and introduced the preliminary licensing mechanism, where a generation company can receive a preliminary licence, effective for maximum 24 months, allowing it to proceed with the investment before the finalisation of the environmental and regulatory permits. New rules are introduced about the publication of available grid connection capacity more than one year in advance for solar and wind projects (which is then put forward in auctions). Transmission operator TEİAŞ informs EMRA about available capacity for the next five to ten years.

At the time of writing, MENR is preparing an update to the 2009 Electricity Market and Security of Supply Strategy Paper.

## PRIVATISATION

After unsuccessful attempts to increase the share of private investment in the power sector, the government decided to first privatise and restructure the distribution sector (TEDAŞ) and to phase out cross-subsidisation between the regions in favour of cost-recovery pricing (automatic pricing mechanism), before privatising the generation assets. A commercially viable distribution and retail sector was considered to be the prerequisite for well-functioning wholesale markets.

The privatisation of distribution companies was carried out during 2008-13 on the basis of the TOOR model, whereby TEDAŞ would maintain the network asset in state ownership but the operation would be transferred for a certain period, similar to a concession. In 2015, all distribution companies have been transferred to private parties

and are regulated by EMRA with targets for the reduction of losses and theft, and for investment. First results can be seen with improved collection rates in the privatised regions and a reduction in losses and theft, while several challenges remain. Three regions in eastern and south-eastern Turkey are unable to meet their targets. Investment needs in the distribution networks are high, including for metering and communication infrastructure, which will put pressure on tariffs. To date, distribution tariffs are regulated by EMRA, but investment in distribution is audited by MENR, which limits the regulator's independence. From the distribution sector privatisation, the Turkish government gained around USD 12.75 billion.

With regard to power generation, during 2008-12, privatisation led to an increase in the private sector's share in total installed capacity to 68% in 2014. After the privatisation process, the share of the private sector is expected to reach at least 90% of total installed capacity. In generation, the assets were privatised under the TOOR or asset sale model (e.g. hydropower plants or coal mines feeding a lignite plant).

During 2013-15, thermal power plants and coal mines were tendered. The Seyitömer, Kangal, Hamitabat, Çatalağzı, Yatağan, Yeniköy and Kemerköy thermal power plants were privatised in 2013 and 2014. In 2015, three more thermal power plants were privatised (Soma, Orhaneli, Tunçbilek, with a total installed capacity of 1 565 MW) (In total, ten thermal power plants with an installed capacity of 5 758 MW were privatised after the New EML. In 2011, 28 hydroelectric power plants (with an installed capacity of 99 693 MW) were privatised, 17 more (an installed capacity of 63 273 MW) in 2013 and five more (an installed capacity of 5 540 MW) in 2014. In total, 50 hydroelectric power plants (an installed capacity of 168 506 MW) were privatised. In 2015, no transfer agreement was signed for any hydroelectric power plant.

In total, thermal power plants and hydroelectric power plants with an installed capacity of 5 926 506 MW have been privatised. It is planned to privatise the remaining EÜAŞ generating plants with the exception of hydropower plants at cross-border rivers.

## MARKET STRUCTURE

The electricity market was opened on 3 March 2003. All large customers directly connected to the transmission system, organised industrial zones as well as consumers with consumption of more than 3.6 MWh per year (as of January 2016) are considered to be eligible customers, which means they have the right to choose their own suppliers. The eligibility limits have been reduced each year by EMRA, aiming to reach zero, with a view to increase the competitive market structure in the energy sector (see Table 8.3). In the same period, the amount of eligible electricity consumption (kWh), a theoretical market opening ratio, reached almost 86% by end of 2015 with only 1 580 533 consumers that are able to freely choose their supplier.

**Table 8.3** Market opening and eligible customers, 2009-16 (kWh)

	2002	2009	2010	2011	2012	2013	2014	2015	2016
Eligible limit value	9 000 000	480 000	100 000	30 000	25 000	5 000	4 500	4 000	3 600

Source: EMRA.

## WHOLESALE MARKET

The Turkish electricity wholesale market has been going through a major reform since the EML No. 6446 introduced the operation of an organised wholesale electricity market and the financial settlement of activities with EPIAŞ as new market operator. In addition, Turkey's joining the ENTSO-E in April 2015 was a critical milestone that will also impact the wholesale market design and its need for alignment with EU Internal Energy Market rules.

Bilateral contracts account for 75% of the market and legacy contracts between EÜAŞ, TETAŞ and suppliers still form a major portion of the bilateral contracts, which creates distortion. During the unbundling process of TEİAŞ, TETAŞ has taken over the energy purchase contracts signed by the state, in line with Framework Law No. 4628. The length of the contracts is generally 15 to 20 years.

The Turkish electricity wholesale market model is based on bilateral contracts completed by a balancing and settlement mechanism which was a combination of a day-ahead market and a real-time balancing power market. Before the creation of EPIAŞ, both of these markets were operated by the so-called PMUM, which was hosted by TEİAŞ, the transmission system operator (TSO). PMUM maintained the physical supply and demand balance, while settling the amounts payable and receivable in a combined day-ahead and balancing market. The mechanism evolved in 2009 when the balancing mechanism was moved to monthly settlement periods (in August 2009 as a first stage), and then to hourly settlement (in December 2009 as a second stage) and to a day-ahead market in 2011. The intraday market was started in July 2015.

EPIAŞ was formally established in March 2015, and took over from the PMUM day-ahead and intraday markets, together with specialised personnel. Meanwhile, a surveillance committee is being established (transparency-monitoring of market activities).

The balancing power market (BPM) is operated by TEİAŞ and its National Load Dispatch Centre. In the BPM, market participants submit capacity for both up/down regulation that can be realised within maximum 15 minutes. All up-bid prices must be greater or equal to the price of the market clearing price (MCP). All down-bid prices must be smaller or equal to the MCP. All up- and down-bids must be equal to 10 MW or more. Instructions given to the market participants are coded according to their purpose. "0" Code: the instructions given in order to balance supply and demand in real time, "1" Code: instructions for system constraints. "2" Code: for secondary reserve creation. The system marginal price is calculated for each 24 hours in real time.

When the day-ahead market is closed and instructions related to market participant bids and offers are issued by the market operator, BPM pursues the physical supply and demand equilibrium. Today, transmission operator TEİAŞ does not allow the balancing power market to generate price spikes, but sets the price on a down-ward curve at the net demand level, not the highest balancing price. Market participants have called for greater transparency and a more market-based approach for the BPM and its tariffs.

TEİAŞ also operates the ancillary services. Every generation unit of 50-MW installed capacity or above has to contribute to primary frequency control; 1% of the installed capacity is required for primary frequency control. This obligation can be fulfilled by transferring it to another market participant. Power plants of 100-MW installed capacity or above must be able to contribute to secondary control at any time; their contribution is needed according to their ancillary service agreement.

For renewable energy, there is a special regime which comes from the BPM: run-of-river type power plants, wind, solar and tidal as well as co-generation and geothermal power plants are exempted from secondary control. The secondary control reserve needs to be obtained by the system operator from the BPM. Taking into consideration the minimum cost, loading and de-loading bids of the power plants declared to the BPM are used for generating the secondary control reserve. Today, demand-side response or interruptible capacity is not available. There is a plan to hold tenders for some of the ancillary services. EMRA is to finalise the mechanism for demand-side management using an aggregator model, amid low interest by Turkish large industry to offer demand-side bids.

## RETAIL MARKET

There are 21 retailers (assigned regional suppliers), which are legally unbundled from the distribution companies since 2013, and are required to provide electricity to captive customers in their region and but they can supply other regions, too. They are also given the responsibility of last-resort supplier, newly introduced with the EML No. 6446. Thereby, assigned supply companies have the universal service obligation to supply consumers in their region if the current supplier fails to supply or goes bankrupt. Regulated prices are maintained in the segments that are not yet open to competition (non-eligible or captive consumers). The retail tariff is regulated by EMRA and is uniform across Turkey for the non-eligible consumers, mainly households. Incomplete unbundling has resulted in regional monopolies and the number of eligible consumers who have actually chosen to change their electricity supplier has been low. EMRA By-law on Electricity Market Customer Service in 2014 set out quality of supply principles and consumer switching guidance, complaints handling and consumer compensation.

## ELECTRICITY NETWORKS

### TRANSMISSION

In 2014, the transmission network spans across almost 54 000 km. Overall transmission capacity grew by 1.7% annually during 2008-12. The transmission grid is composed of a majority of high-voltage lines of 154 kilovolts and 400 kV, and a few lines of 66 kV. Since 2011, the transmission network is a state-owned monopoly under the ownership and operation of the Turkish Electricity Transmission Corporation (TEİAŞ).

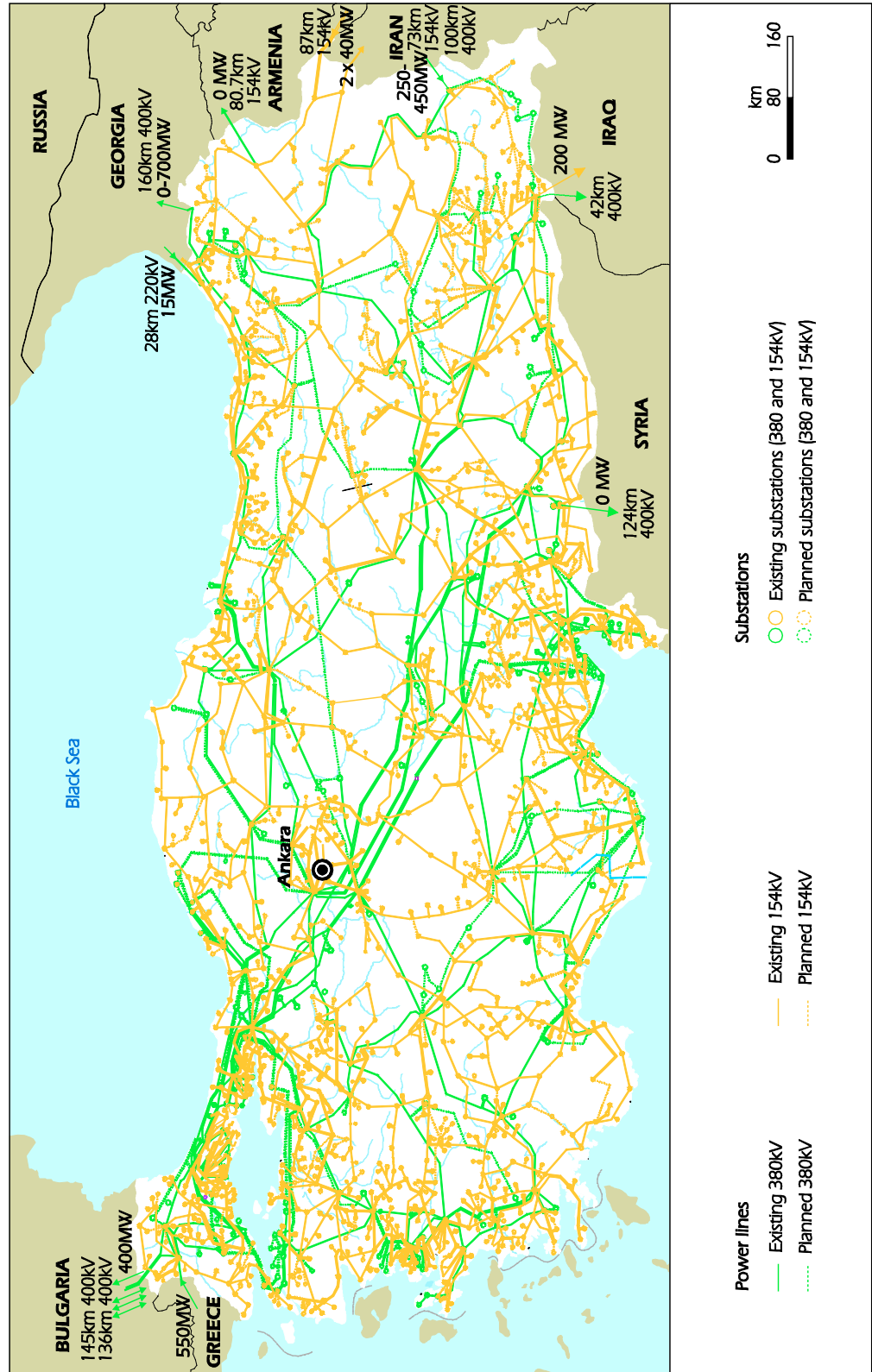
**Table 8.4** Turkey's transmission network

Base voltage level of transmission lines	Number of substations	Length of transmission lines, km
400 kV	93	17 628
220 kV	1	84.5
154 kV	575	35 919
66 kV	14	509
154 and 400 kV and underground (380+154+66 kV) cables	0	320
<b>Total</b>	<b>683</b>	<b>54 460</b>

Source: TEİAŞ (2014), *Annual Report*, 2014.

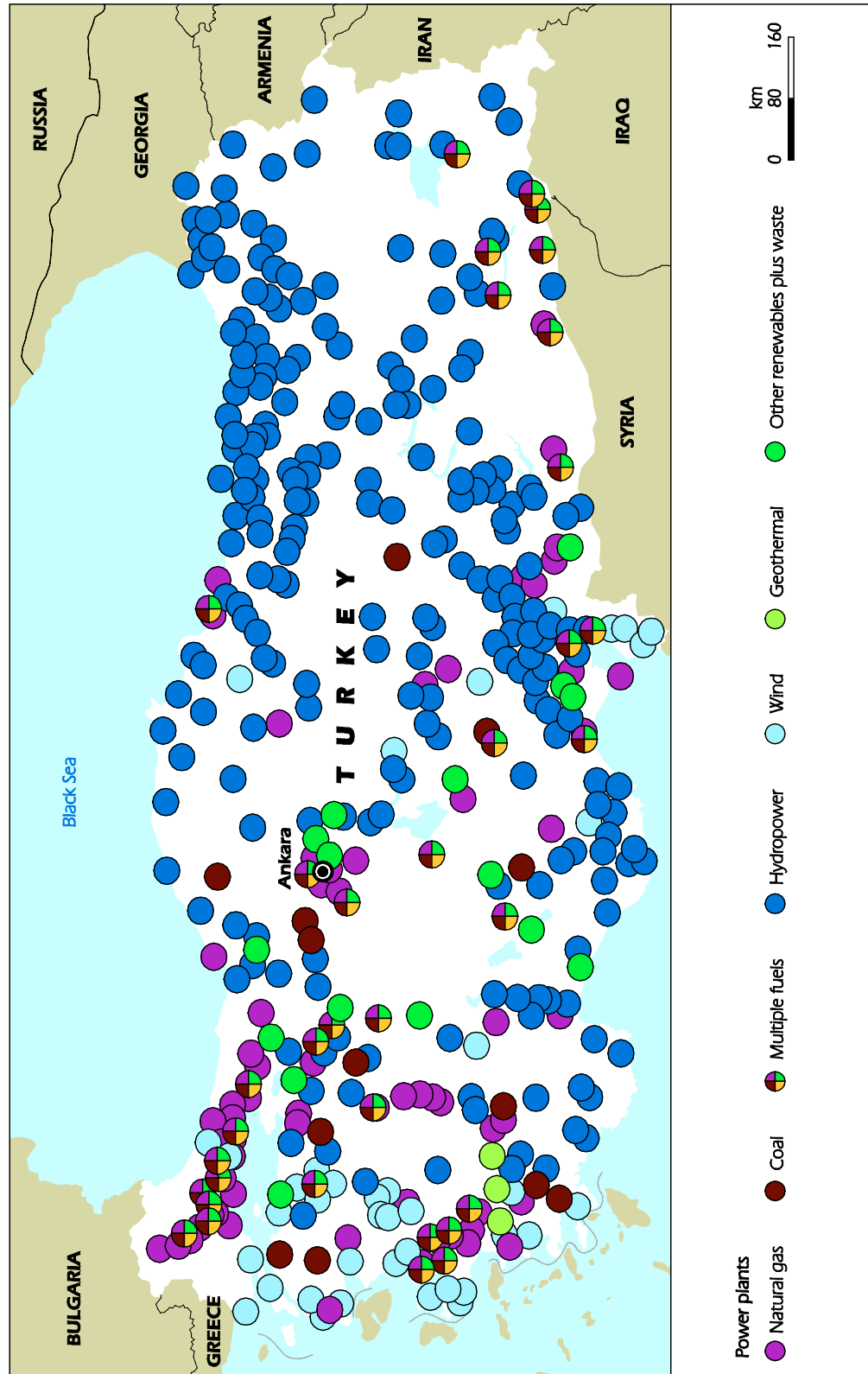


**Figure 8.8** The electricity high-voltage network of Turkey



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area.

Figure 8.9 Location of electricity generation plants in Turkey



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area.

The transmission tariff is determined by TEİAŞ and regulated by EMRA under the revenue cap method, which includes remuneration of grid investment, in line with the EML No. 6446 and the Tenth Development Plan (2014-18). The sharing of network charges is determined as 40% for generation and 60% for load. As set out in EMRA Board Decision No. 5398-1 and its annexes, transmission tariffs are based on regions and there are 14 regional tariffs for generation, 14 regional tariffs for load and a unique tariff for system operation. Import is considered as generation while export is considered as load.

## CROSS-BORDER TRANSMISSION LINES

The Turkish transmission network has cross-border lines to the electricity grids of all neighbouring countries (see Table 8.5 and Figure 8.8). However, Turkey is synchronously connected only to Greece and Bulgaria, thus to the Continental European system in the west, with the exception of a new direct current back-to-back connection to Georgia (since 2014).

Turkey operates asynchronously with all other countries: Georgia, Armenia, Nahcivan (Azerbaijan), Iran, Iraq and Syria. Standard transmission interconnections have a voltage level of 400 kV and 154 kV. There are two interconnection lines linking the Turkish system to Georgia at 220 kV in asynchronous-island mode and to Armenia, the latter, however, is not in operation. Turkey-Syria and Turkey-Iraq interconnection lines have been completed and Turkey exported electricity to Syria until October 2012 and to Iraq until June 2015 in asynchronous-island mode. Two interconnection lines already exist with Iran. One of them is the 400-kV Khoy-Başkale interconnection line which operates since the beginning of 2015. In 2015, the total interconnection capacity reached 7 GW.

In 2015, Turkey finalised its technical and administrative preparation to work with the European Network of Transmission System Operators for Electricity (ENTSO-E) and synchronised its power system with the Continental Europe power system, after four-year-long trial runs for system stability and cross-border trade. Trial parallel operation of the Turkish power system with ENTSO-E started on 18 September 2010.

During the first trial, import capacity of Turkey was limited to 400 MW while export capacity was limited to 300 MW. After improvements in the Turkish transmission system (e.g. investment into improved control systems and frequency regulation), those capacities were increased to 550 MW for import and 400 MW for export since April 2013. After the positive results of trial parallel operation, ENTSO-E took a decision in April 2014 in favour of the permanent synchronous operation of the Turkish power system with the Continental Europe system. TEİAŞ became an associate member of ENTSO-E. This marks the end of a process that had started back in 1990 with the first application of Turkey to the UCTE. Finally, a long-term agreement (LTA) was signed between TEİAŞ and ENTSO-E. In January 2016, TEİAŞ has become the first observer of the ENTSO-E since its creation in 2009. Another 100 MW increase took place after the LTA signature and necessary technical adjustment, so that import capacity reached 650 MW and export capacity 500 MW.

The parallel operation of the Turkish electricity system with ENTSO-E has resulted in a decrease of primary frequency control reserve, more stable frequency, greater harmonisation of internal grid codes in line with EU practices, and access to the EU internal energy market. The permanent synchronous connection to ENTSO-E Continental Europe promotes electricity trade. Import and export capacities can be increased even further, provided the internal power systems have no other limitations.

**Table 8.5** Interconnection capacity of the Turkish transmission system, 2015

Country	Length of transmission lines, km			Thermal capacity (MVA)
	400 kV	220 kV	154 kV	
Greece	128	-	-	1 510
Bulgaria	158 (I) 149 (II)	-	-	1 510 995
Georgia	155	28	-	287 (Hopa Batum) 1510 (Akhaltskhe-Borçka)
Armenia	-	80.7	81	574
Azerbaijan (Nahcivan)	-	-	87	2 x 132
Iran	100	-	40 73	1510 204
Iraq	42	-	-	408
Syria	124	-	-	1005
<b>Total</b>	<b>856</b>	<b>108.7</b>	<b>281</b>	<b>9 777</b>

Source: TEİAŞ/ENTSO-E (2015), *Report on Blackout in Turkey 31st March 2015*.

In the past, Turkish cross-border trade served the main purpose of balancing demand and supply with a view to compensate for insufficiencies in the hydrological conditions or the national generating capacity.

Before 2003, imports and exports were traded through intergovernmental agreements and bilateral contracts between state-owned electricity utilities.

Today, EMRA is in charge of approving supplier licences, including for import and export of electricity, subject to available capacity (TEİAŞ) and the approval of the MENR. As shown in Figure 8.3, cross-border trade has increased since ENTSO-E trial connection started in 2010. The synchronisation with the Continental European system ENTSO-E is a significant transition and driver to further approximation to the European electricity trade and market. This also facilitates trade with other neighbouring countries.

In line with ENTSO-E rules, any country operating in synchronous mode with its system can only connect to third countries by direct current connection above 110 kV.

Connecting to Continental Europe enabled Turkey to act within regional co-operation initiatives in the European internal market, the South-East European Coordinated Auction Office (SEE-CAO) and the Central-Western European Auction Office (CASC.EU), which recently created the Joint Allocation Office (JAO).

## DISTRIBUTION

Turkey's electricity distribution sector is fully liberalised after legal unbundling in 2013 and the completion of the privatisation programme of TEDAŞ and its subsidiaries since 2008.

TEDAŞ was divided into 20 regional monopoly distribution companies (see Figure 8.10), and privatised in 2011 by competitive tenders in three phases in accordance with Law No.

4046 of 1994 on privatisations. All of them are legally unbundled and privately operated. Third-party access to the distribution network without discrimination is effective under the supervision of EMRA. The owner of distribution assets is TEDAŞ but it does not operate any distribution region.

Distribution companies are responsible for their own network planning, construction and operation, with the obligation to provide electricity to captive customers in their designated regions, in addition to forecasting and submitting regional demand to TEİAŞ.

### RETAIL AND END-USER ELECTRICITY PRICES

Turkey has had the objective of moving to a fully cost-reflective tariff system, but maintains regulated end-user tariffs for non-eligible consumers (mainly households) with a uniform end-user tariff across the network and tariffs for state-owned generation/trading companies.

The pricing principles set by government policy had directed EMRA to keep electricity retail tariffs constant from 2003 through 2007. Maintaining constant retail electricity prices, amid significantly rising gas prices and generation costs, caused a severe deterioration in the financial viability of the sector. In 2008, a new cost-based energy pricing mechanism, the so-called automatic pricing mechanism, was launched.<sup>1</sup> Regulated electricity tariffs were gradually increased, as the market was opened for consumers to choose their suppliers. EMRA has applied the cost-recovery pricing mechanism in electricity since 2008 and significant price adjustments were implemented during 2008-09, bringing tariffs to cost-recovery level and allowing TETAŞ and PMUM to eliminate financial deficits by 2011.

TETAŞ wholesale tariffs are regulated, but cost-based, prepared by TETAŞ itself and submitted to EMRA, and applied to all persons and legal entities to which TETAŞ is obliged to sell electricity, and they must be set in a non-discriminatory manner. EMRA approves the tariff and assesses the average price of electricity purchases and TETAŞ's financial liabilities as a margin.

Distribution end-user tariffs (for captive consumers) are assessed and approved quarterly by EMRA. Offers may be sent back to companies to revise and provide supplementary explanation for their offers. EMRA is authorised to revise offered prices.

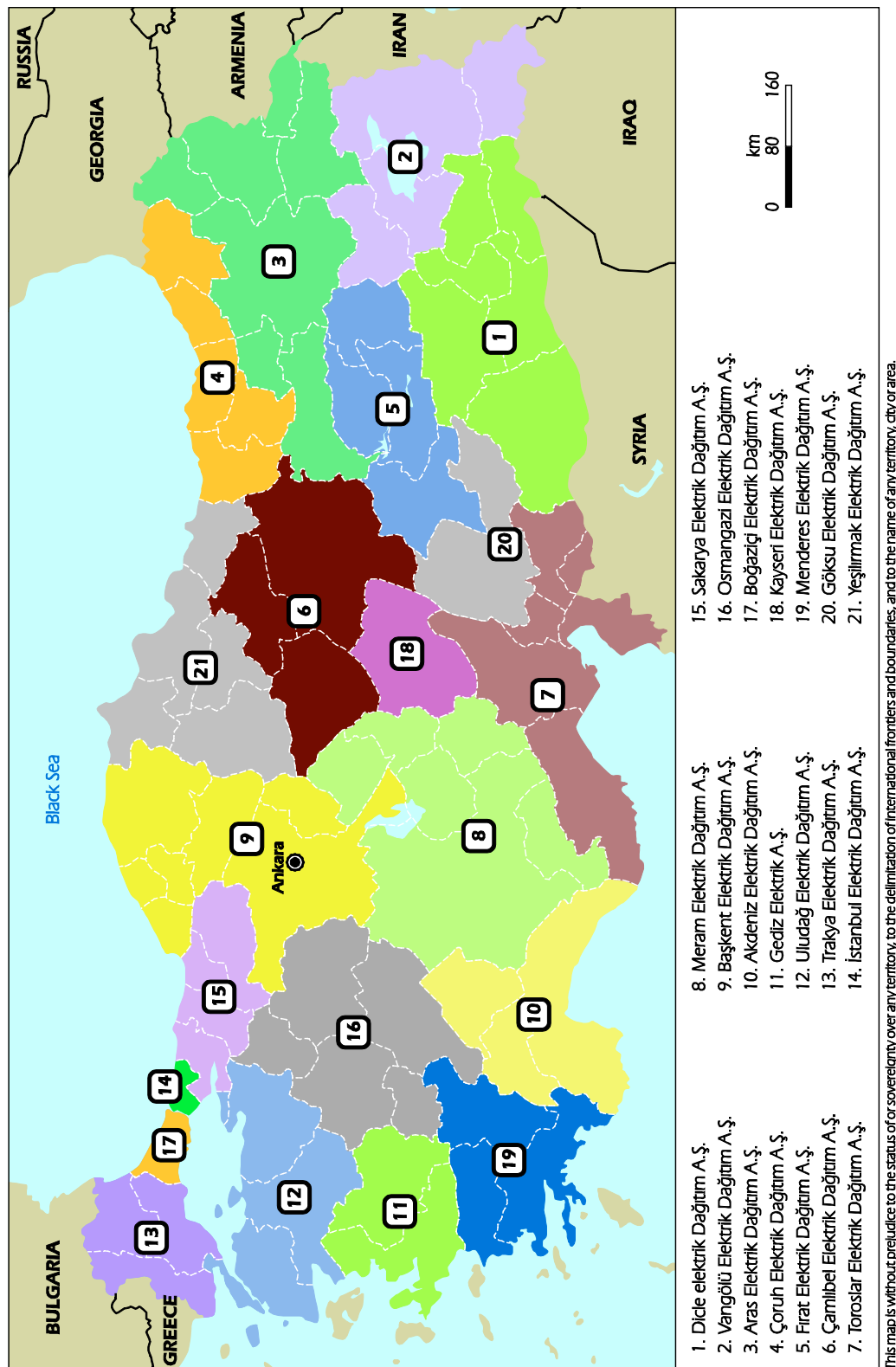
Until the end of 2015, a uniform national retail tariff was applied for all 21 retail companies, which eliminates differences between distribution regions. This price equalisation balances high- and low-cost regions between distribution companies. The uniform national retail tariff has been renewed in 2015 for another five years, even though it was supposed to be abolished several times.

At present, there is no difference between retail and last-resort tariff prices, which in practice prevents eligible consumers from switching to suppliers of other regions. The uniform tariff also undermines the possibility offered to distribution companies to compete for consumers across the country.

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1. All regulated tariffs must be cost-reflective; the price of energy (excluding regulated end-user tariffs) is to be determined by the market under competition; and if there is a need to protect some consumers, subsidies shall not be provided through tariffs, but rather through a direct subsidy mechanism.

Figure 8.10 Geographical coverage of distribution companies

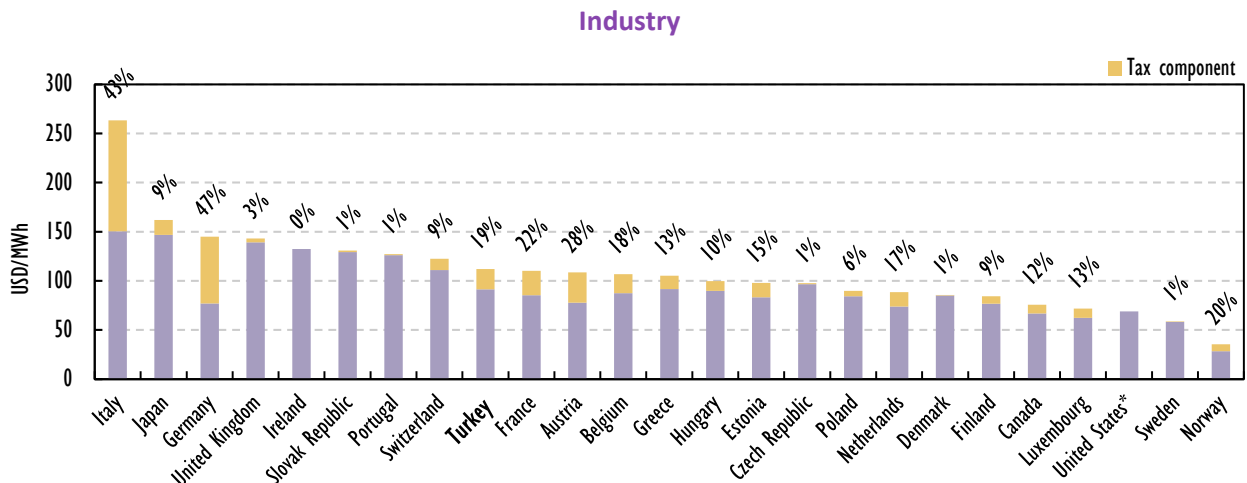


Source: Privatisation Administration.

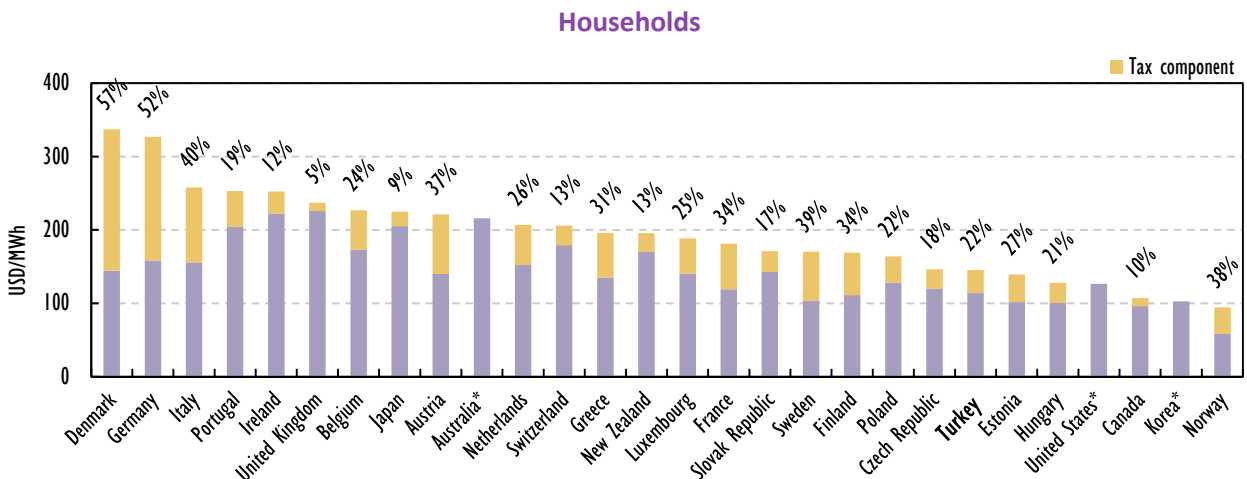
Turkey’s household prices are very low compared to neighbouring markets. Turkish household electricity prices are similar to those in Czech Republic and Estonia (Figures 8.11 and 8.12). Electricity industry prices are above the median of IEA member countries, by international comparison.

In recent years, the network component in the final electricity price has increased while supply costs have come down, notably for households which also have to face most of the taxes and levies. Since 2012, electricity prices have been on a downward trend, both for households and industry (Figure 8.13).

Figure 8.11 Electricity prices in IEA member countries, 2015



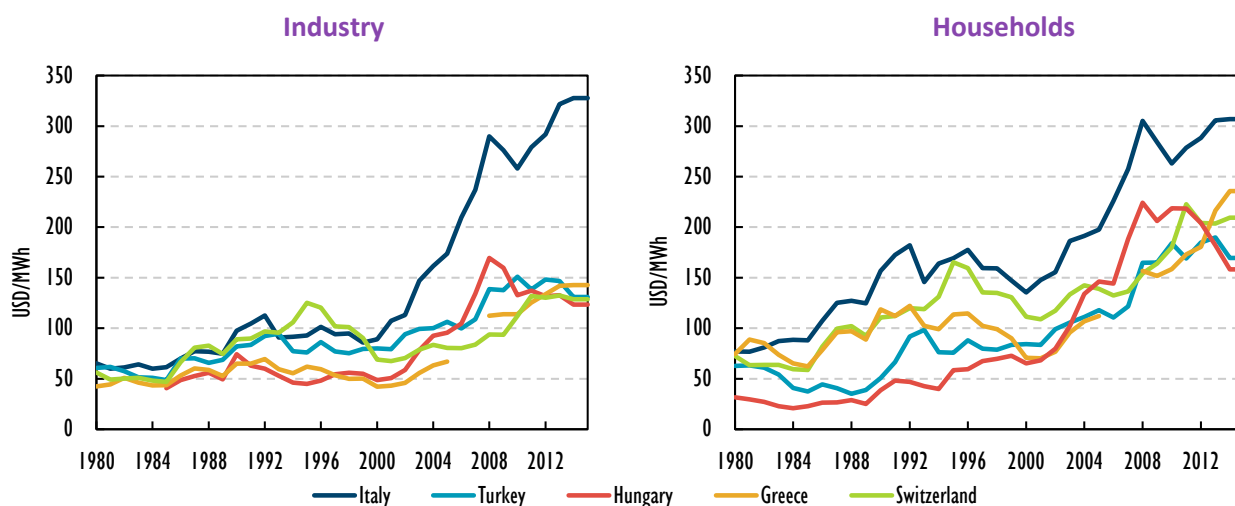
Note: Data not available for Australia, Canada, Korea and New Zealand. Data for Spain are from Eurostat and represent the Band IC (500 MWh < Consumption < 2 000 MWh) for industrial customers.



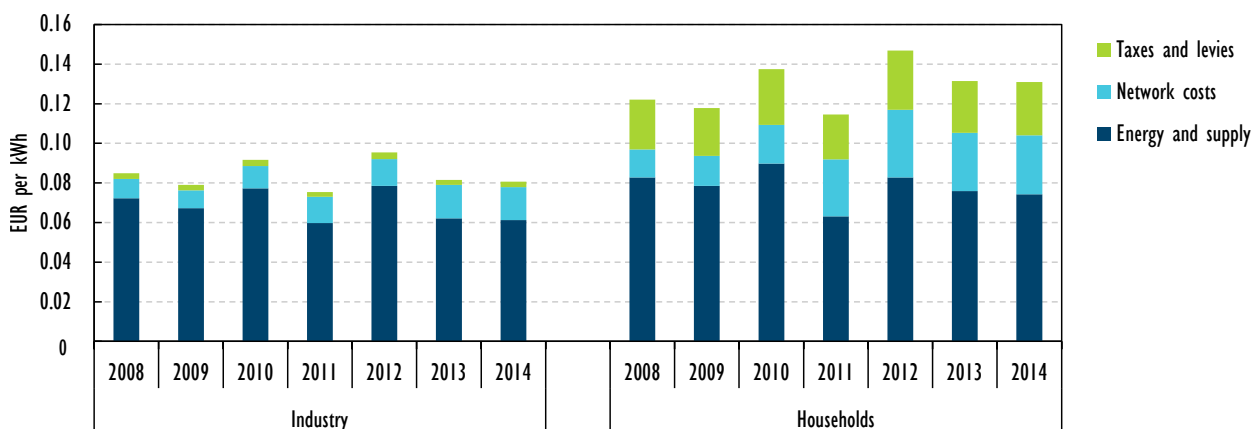
Note: Data not available for Australia and Canada. Data for Spain are from Eurostat and represent the Band DC (2 500 kWh < Consumption < 5 000 kWh) for domestic customers.

\* Tax information not available.

Source: IEA (2016), *Energy Prices and Taxes 2016*, Q1, [www.iea.org/statistics/](http://www.iea.org/statistics/).

**Figure 8.12** Electricity prices in Turkey and in other selected IEA member countries, 1980-2015

Note: Data on industrial prices in Hungary are not available for 1980-84 and for Greece for industrial and household prices are available for 2006-07.  
Source: IEA (2016), *Energy Prices and Taxes 2016*, Q1, [www.iea.org/statistics/](http://www.iea.org/statistics/).

**Figure 8.13** Composition of electricity prices in Turkey, industry and households, 2008-14

Sources: Eurostat (2015), *Electricity prices for domestic consumers* (biannual data from 2007 onwards) – Band DC: 2 500 kWh < consumption < 5 000 kWh (1st semester 2015); Eurostat (2015), *Electricity prices for industrial consumers* – biannual data (from 2007 onwards) – Band IC: 500 MWh < consumption < 2 000 MWh (1st semester 2015).

## SECURITY OF ELECTRICITY SUPPLY

In-depth country reviews focus on the adequacy dimension of electricity security. Adequacy in this context refers to a power system's capability to meet current and future changes in aggregate power requirements, through timely and flexible investment, operational and end-use responses on both on the generation and the network sides. In addition, the quality of electricity supply is also being considered in this context.

## ELECTRICITY SECURITY POLICIES

According to the Electricity Market Law (EML No. 6446) article 20, MENR is responsible for monitoring electricity supply security (in an annual report) and taking the necessary measures to ensure supply security.



The energy regulator EMRA monitors the electricity market developments through its annual reports.

According to EML No. 6446, every two years, MENR prepares the Electricity Demand Projection report for a period of 20 years, and transmission operator TEİAŞ presents an Electricity Generation Capacity Projection Report for five years (TEİAŞ report for 2014-2018), and a long-term development plan for electricity generation. TEİAŞ is responsible for the quality of electricity supply.

The Tenth Development Plan (2014-2018) integrates electricity supply security within the overall objectives of using all domestic and renewable energy resources to the extent possible while preparing for the introduction of nuclear power in electricity generation and increasing energy efficiency across the economy.

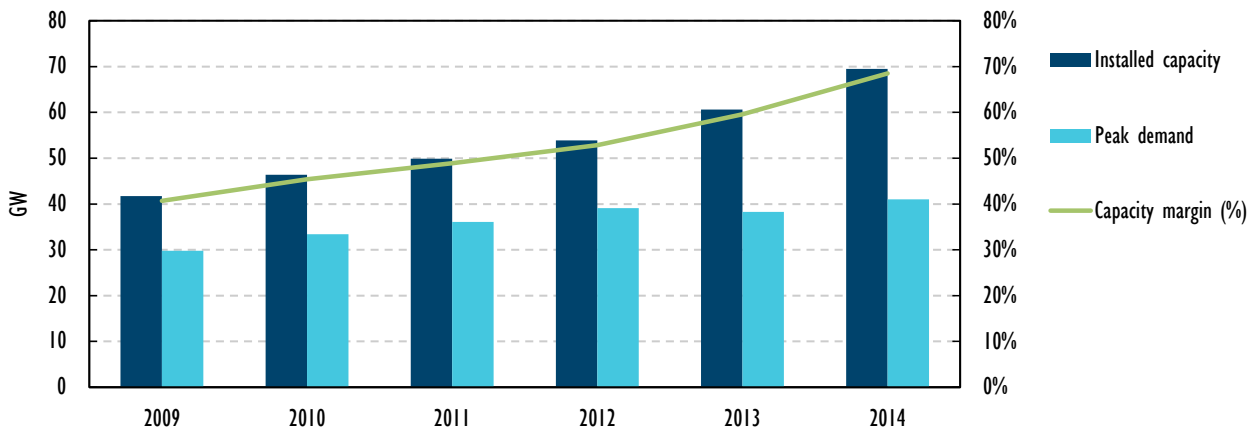
## GENERATION ADEQUACY

Following a serious shortage of capacity in 2007-08, with reserve margins reaching as low as 5%, Turkey set out measures in the 2009 Electricity Market and Security of Supply Strategy, including auctions, obligations or capacity mechanisms to procure additional capacity and safeguard security of electricity supply.

During 2008-14, investment in generation increased, and the global economic and financial crisis in 2008-09 led to the decline in energy demand, notably from electricity-intensive manufacturing industries. This made the supply/demand balance less difficult.

With peak demand reaching 41 GW and an installed capacity of 70 GW, the Turkish supply/demand capacity margin in 2014 was around 69%, marking the peak of a period of high investment and oversupply in the Turkish electricity market. This is a positive change from periods when the margins had averaged around 15% before 2008.

**Figure 8.14** Installed generating capacity and capacity margins, 2009-14

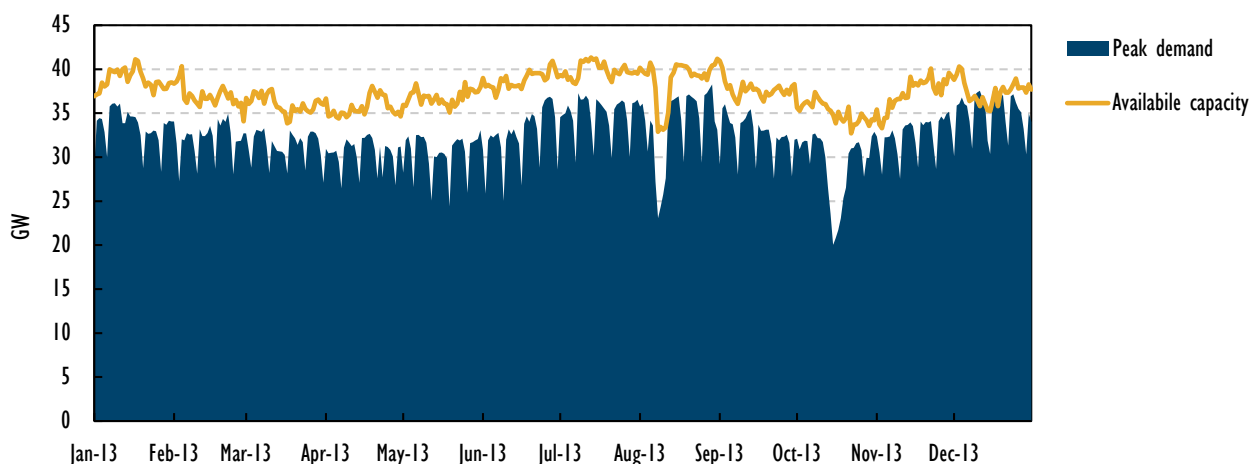


Sources: IEA (2016b) *Electricity Information 2015* and MENR (2014), *Electricity Demand Projection 2014-2035*.

In the medium term, there will be overcapacity in the Turkish market. Despite legal instruments being in place since the 2009 Strategy Paper, there seems to be no need to introduce capacity payments for generation, as the current adequacy outlook is positive with high reserve margins. However, the short-term system operation requires more attention to the management of peaks in demand and the lower availability of plants across the network.

In the past years, peak demand has grown strongly, notably in August, when high electricity demand for air conditioning coincided with droughts and low hydropower reserves. In the Turkish electricity system, the critical capacity reserve margin should be at least 35% (reliability standard), given the characteristics of lower availability of lignite plants and hydro. The hydrological conditions in the river basins change from year to year with a general trend towards drier years, leading to capacity factors between 25% and 50%. Because of age and lack of rehabilitation, capacity factors of the old lignite plants of EÜAŞ fluctuated around 40%. The actual availability can therefore be much lower than what the capacity margin suggests. For instance, in 2013, available capacity fluctuated around 35 to 42 GW, which caused constraints to system operation, notably during the winter, when actual reserve margins were down to 1% (see Figure 8.15). In addition to the low hydro basins, a number of power plants were not available because of the increasingly difficult financial position of some generators, which had led to the closure of gas-fired, power plants, in a process of market consolidation. Up to 2020, 10 GW of capacity could disappear because of the slowdown of investment and lack of foreign direct investment, and the slow creation of the wholesale electricity market.

**Figure 8.15** Availability of capacity over peak demand, 2013



Source: MENR data provided 2014.

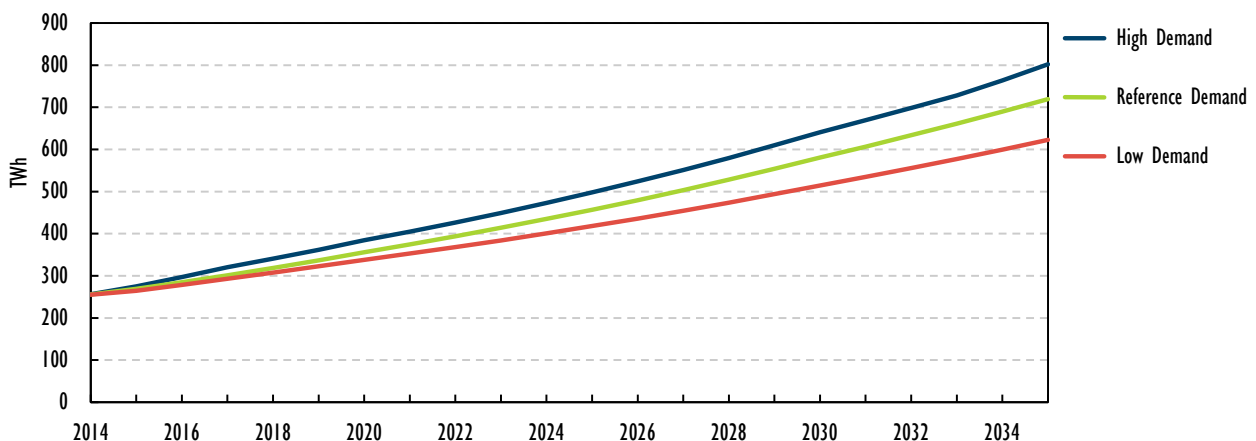
Looking at the future demand/supply adequacy of the Turkish power system, MENR expects electricity demand to increase more than threefold during the next 20 years, according to the Electricity Demand Projection 2014-2035 report. The government's reference demand scenario expects power demand growth to accelerate and to reach 581 TWh in 2030, a 127% increase over year 2014. The government's projections for demand foresee an annual increase by around 5.5% until 2023 when demand could reach 450 TWh. In 2035, total demand will reach 719 TWh (with the highest forecast at 802 TWh and the lowest at 622 TWh, as shown in Figure 8.16), mainly driven by industrialisation and urbanisation along with population growth. Electricity demand is set to increase annually by 6.7% (low-case scenario) or 7.5% (high-case scenario) until 2020, according to the government projections. However, declining trends in electricity demand since 2011 may suggest a more moderate electricity consumption growth and, in the medium term, a move towards the lower-demand scenario.

Electricity demand in 2014 reached again a historic peak. While generating capacity already increased from 45 GW (2009) to 70 GW (2014), in 2023 it would have to reach 110 GW to meet demand growth.

The government aims for a diversified electricity mix up to 2030. The 2009 Electricity Market and Security of Supply Strategy set out objectives of reaching a share of at least 30% of renewable energy in the electricity mix by 2023, exploiting all technically and economically available hydro and solar power resources, wind (20 GW), geothermal (600 MW) and indigenous coal. The share of gas in power generation should decrease to 30% by 2023 (2009 Strategy) and 38% by 2019 (MENR Strategic Plan 2015-19).

As of 2020, nuclear power should be available after the completion of the first units of the Akkuyu nuclear power plant and two additional ones, aiming to reach at least 10% of the total electricity mix by 2023, starting from zero production in 2014. According to the intergovernmental agreement (IGA) signed between the Russian Federation and Turkey in May 2010, 4 800 MW<sub>e</sub> total capacity of Akkuyu nuclear power plants' four units will be brought online during 2020-23. The IGA between Japan and Turkey in 2013 foresees the implementation of the Sinop nuclear power plant with 4 480 MW<sub>e</sub>. In 2023, Akkuyu is expected to represent 5% of the total installed capacity. In total, there will be 9.2 GW of baseload capacity from nuclear energy (from the Akkuyu and Sinop plants) and renewable energy capacities of around 17 GW added by 2023.

**Figure 8.16** Electricity demand projection, 2014-35



Source: MENR (2014), *Electricity Demand Projection 2014-2035*.

Electricity supply security cannot be taken for granted given that availability greatly differs from installed capacity and that peak demand is on the rise. The targets for the increase in power generation from baseload (nuclear and coal) and renewable energy sources could be compromised by the speed of actual progress. The outlook remains challenging if the addition of nuclear capacities does not proceed as planned and if renewable energy capacities are delayed because of slow licensing, public acceptance issues and other non-technical barriers.

Turkey's government has also planned a coal-led expansion of its power generation to support the fast growth in electricity demand, based on the existing potential of domestic lignite and hard coal. The MENR Strategic Plan 2015-19 envisages an increase of domestic coal-fired capacity to 60 TWh by 2019.

Such growth however may be compromised owing to safety concerns over mining accidents and environmental objectives, imposed by Turkey's nationally determined contribution under the COP21, which requires capping the rise in greenhouse gas emissions by 21% over the period 2021 to 2030.

Assuming a lower demand growth up to 2035 and significant uncertainties in the generation outlook, the continuous assessment of the Turkish power system is critical to security of electricity supply.

### **Box 8.2** The historic blackout of March 2015

In March 2015, Turkey experienced a ten hour-long power failure, the first in 15 years. The blackout was the result of a hydro oversupply from the east of Turkey in a situation of transmission capacity shortage. The tripping of a heavily loaded 400-kV transmission line led to the disconnection of the Turkish power system from the ENTSO-E Continental Europe grid and eventually resulted in a blackout. It was the most severe disturbance in the Turkish power system since 1999, when a large-scale earthquake caused a blackout. According to the report by TEİAŞ and ENTSO-E of September 2015 (TEİAŞ/ENTSO-E, 2015), the main causes for this blackout were as follows.

On 31 March 2015, several 400 kV lines were out of service in the critical central section of the east-to-west corridor line system (three lines due to construction works of new assets; one due to maintenance); at the same time large hydropower production volumes had to be transported over the long transmission distance (1 300 km) from the remote Coruh river hydroelectric power plants of the north-east to the major load area of Istanbul. When the transmitted power was too high for the remaining lines, and the so-called series capacitors went out of service; the east-to-west transfer at the frequency required was no longer possible. In this grid situation, with high hydroelectric generation in the east and relatively high power transmission to the west, the system was no longer compliant with the N-1 security criterion. The line with the highest load went off and created instability and consequently system separation. After the separation of the western subsystem from Continental Europe, several large thermal generators were disconnected at frequencies higher than the 47.5 Hz, outside the Turkish Grid Code rules.

Before the blackout there was no real awareness of the importance of the series capacitors for the stability of the system operation. Although the Turkish 400-kV grid is equipped with a protection system that is in line with international standards, the effect of the distance relay settings on the line that tripped first had not been correctly evaluated. A larger amount of load shedding by the under-frequency relays would have been needed to counterbalance the irregular early disconnection of generators. Regardless of the system configuration and specific load flow before the blackout, the huge imbalance of respectively 21% and 41% between load and generation in the western and eastern Turkish power subsystems, remained a difficult challenge. Current protection schemes in use in these power systems are not suitable for saving the system during such extreme imbalances.

The exceptional weakening of the east-west corridor line system, in particular in the central-northern section, and the fact that all series capacitors banks had been out of service, were not evaluated when the power (4 700 MW) had to be transmitted from east to west.

**Box 8.2** The historic blackout of March 2015 (continued)

Series capacitors can provide increased transmission capacity so that the system can handle short-term emergency loads (IEEE). TEİAŞ latest load flow and stability calculation analyses have shown that the east-to-west transmissible power with all the 400-kV lines and series capacitors banks in service is up to about 8 000 MW, in compliance with the N-1 steady state and dynamic security criteria specified by ENTSO-E for the Continental Europe system. The blackout showed the importance of reliable online automatic contingency analysis (including of series capacitors) and that off-line stability analysis in the National Control Centre (NCC) prevented the correct analysis and aggravated the situation.

Source: TEİAŞ/ENTSO-E, *Report on Blackout in Turkey 31 March 2015*, 21 September 2015.

**NETWORK ADEQUACY**

Network adequacy in Turkey is challenged by several factors. The domestic electricity transmission network has to transmit electricity between large consumption centres in the north-west (Istanbul, Ankara and Izmir) and its hydro generation facilities in the east and wind power plants in the west. The east-west transmission corridor is of crucial importance to the system operation, given the long transmission distances in Turkey and the location of its power system at the eastern end of the Continental European system, with international interconnection only on the north-west border. The transmission network has a number of internal bottlenecks and congestion around the southern Marmara Sea, north-eastern Black Sea, and Adana, owing to construction delays in the new transmission lines planned a long time ago. At the same time, the Turkish electricity system has strong interactions with the gas system. During the periods of gas supply interruptions or shortages, notably in the winter months, the power system has been under stress with peak gas demand; TEİAŞ had to introduce load shedding to disconnect gas-fired power plants. TEİAŞ has been carrying out upgrades in the transmission system (see Box 8.3) and is gradually upgrading its system operation to modern standards.

The operation and control of the Turkish electricity system is done by the National Load Dispatch Centre (NLDC) and nine regional load dispatch centres. During accession to ENTSO-E, TEİAŞ has started investing in the upgrading of its control systems and the frequency regulation. Grid integration of increasing shares of wind is a future task for TEİAŞ. The increase in distributed electricity generated from solar photovoltaic will require investment in the distribution grids and smart grid management.

Future challenges relate to the regional integration of Turkey in the European and neighbouring electricity trade. Following the successful synchronisation with the Continental European system, Turkey has to couple its day-ahead electricity market to the neighbouring region in south-east Europe, in order to fully participate in the European commercial cross-border trade through the price coupling of the regions. The market operation under EPIAŞ will need to account for cross-border trade, by applying the price coupling of the regions algorithm and moving away from the current explicit to implicit auctioning of the import and export capacity to align its capacity allocation and congestion management to EU-wide network codes and framework guidelines.

**Box 8.3** Upgrades of the transmission system by TEİAŞ

**Energy reliability of the Istanbul and Thrace regions:** To supply growing demand in Istanbul, TEİAŞ has 30 projects costing TRY 105 billion which are at 400-kV level in TEİAŞ Investment Program. Half these projects are already under construction and the other half will be tendered soon and completed in 2019-20. The most important one among 30 projects is the 400-kV Gelibolu-Sütlüce submarine power line, crossing the Dardanelles which will improve grid reliability.

**Akkuyu nuclear power plant:** To connect the 4 800 MW (4 x 1 200) Akkuyu plant by 2025 to the transmission network, TEİAŞ will have to bring online six transmission lines of 400 kV and one 400/154-kV substation. Total length of transmission lines is approximately 980 km and the total cost is TRY 300 million.

**Energy reliability of Black Sea region:** In order to provide a reliable interconnection between Turkey and Georgia, TEİAŞ performs studies and, in order to avoid transmission congestion, has 20 projects at 400 kV in the region costing TRY 600 million, 12 of which are already under construction. All 20 projects will be in service in 5 or 6 years.

**Wind energy integration in Western Anatolia:** Wind energy generation is concentrated in western Anatolia and wind power plants are in rural areas, far from the transmission network. To ensure integration of wind power plants to the network, TEİAŞ has developed 12 projects in total, costing approximately TRY 220 million.

**Energy reliability of south-eastern Turkey:** Irrigation loads in the summer cause local voltage collapses in south-eastern Turkey. TEİAŞ's investment programme includes 16 projects specific to the region costing TRY 400 million in order to solve this issue.

**Energy reliability of Çukurova region:** To secure the region's electricity supply-demand balance, TEİAŞ developed 11 projects in its investment programme. Total costs of the projects are about TRY 190 million. Eight of them are under construction.

Source: TEİAŞ, 2014.

In 2014, the new interconnection between Turkey and Georgia became operational. Turkey is a very attractive exchange for power exporters from the region.

TEİAŞ also started construction of a second power line to Iraq. Turkey sees a role for its network to support greater international grid integration in this region and a trade opportunity to connect European customers in the Mediterranean Electricity Ring (MED-RING) with suppliers from the Middle East. The facilitation of cross-border commercial energy exchanges will also foster competition in the Turkish electricity market and improve security of electricity supply in Turkey. In light of the further planned expansion of interconnection capacity to other countries, including plans to expand the interconnection to Georgia and Iran (after sanctions are lifted), internal bottlenecks in the Turkish electricity system will need to be lifted to ensure system operation.

Next to the "hardware", the software of the system is critical. As the Turkish power system becomes more and more interconnected, it will be crucial to adjust also the system operation and the safety and security of the networks over time. In particular, the upgrade of the system operation to automatic SCADA and the modernisation of the national control centre are being planned.

## Permitting and licensing of new power lines

Permitting takes about 5-7 years for new power lines and new wind power generation projects, including a two-year construction period. After the decision of constructing a new transmission line is taken, two studies are launched simultaneously by TEİAŞ. One concerns the way the project of the transmission line is designed, the specifications of the route on the map, the suitability of the area, the design of the tower, etc. The other is the commencement of the expropriation process. TEİAŞ Management Board takes a “public interest” decision for the area and this decision is confirmed by the Council of Ministers. TEİAŞ applies to the Court to evaluate the area and set compensation amounts which are appraised by the experts and paid to owner(s) of the area. Owner(s) can object to the amount and in this case the valuation process can restart. Meanwhile, an environmental impact assessment (EIA) for the transmission line project is submitted to the MEU. After MEU’s approval and public consultation in which local people are informed about the transmission project, construction of the line can start. At any point in the process, the public has the right to appeal the EIA in court. Construction of the transmission line can be fulfilled by the private sector in accordance with the Connection Agreement signed between TEİAŞ and the private sector.

The construction of a 100 km 380-kV interconnection line will serve as an example to outline the length of the process for new power lines:

- Expropriation and approval of the EIA report is approximately up to two-and-a-half years.
- Construction of the line takes approximately up to two years.
- Tender process for the determination of the company who will sign the Connection Agreement and fulfil the construction is at least four months.
- Construction of the line of about 2 years.

After the EIA procedure, the investment approval process starts. Power network investments need to be approved by MENR and involve costs being passed through to final consumers. The regulator EMRA has no full control over the investment allowed for the expansion of the electricity network, as the costs and investments are audited by the MENR. Given the uncertainty of an approval process, TEİAŞ takes a more conservative approach to network investment, notably when it comes to expanding the network to connect a new wind power generation project.

In the liberalised electricity market, independent network planning and supply/demand adequacy assessments reflect the investments needed for generation and distribution. For TEİAŞ to adequately plan the transmission network, it needs higher reassurance of the necessary public investment levels. While there is a national plan for the demand/capacity, but in the distribution regions there is no such planning. A good step forward is the mechanism of “pre-licensing” which was introduced under the new Electricity Market Law in order to accelerate regulatory approvals. The pre-licensing regime by EMRA has facilitated the fast uptake by investors; however, network investment remains the bottleneck. The procedures for environmental assessments and permits for power lines may take even longer than seven years, because many local authorities are involved and because investment in grid expansion requires approval by MENR. The government will need to support network expansion (to allow the integration of wind and solar power) and the streamlining of procedures to reduce the number of approval and permits needed from several organisations to a single point of contact.

Greater transparency and better governance, notably of the network operators in gas and electricity, and consultation of the public and industry can enhance the trust of market participants in the effectiveness of network planning and provide certainty to investors.

## QUALITY OF SUPPLY

Turkey has yet to implement the Grid Code and Service Quality Regulation. EMRA has adopted a By Law on quality of supply. There is a lack of internationally comparable data (SAIDI or SAIFI indexes) to monitor, assess and compare the quality of electricity supply.

**Table 8.6** Regulated targets for distribution losses and theft in the Turkish electricity system

Distributors	2011	2012	2013	2014	2015
AKDENİZ	8.86%	8.45%	8.05%	8.02%	8.02%
AKEDAŞ	10.03%	10.03%	10.03%	10.03%	10.03%
ARAS	22.92%	19.04%	25.70%	21.35%	17.73%
AYDEM	9.80%	9.34%	8.90%	8.49%	8.09%
AYEDAŞ	7.12%	6.79%	6.61%	6.61%	6.61%
BAŞKENT	8.46%	8.07%	7.88%	7.88%	7.88%
BOĞAZIÇI	9.12%	8.69%	10.76%	10.26%	9.78%
ÇAMLIBEL	7.72%	7.36%	7.02%	6.92%	6.92%
ÇORUH	10.90%	10.39%	10.15%	10.15%	10.15%
DİCLE	60.96%	50.63%	71.07%	59.03%	49.03%
FIRAT	12.59%	11.65%	11.11%	10.59%	10.09%
GEDİZ	8.48%	8.08%	7.70%	7.34%	7.00%
KAYSERİ	10.01%	10.01%	10.01%	10.01%	10.01%
MERAM	8.59%	8.28%	8.28%	8.28%	8.28%
OSMANGAZİ	7.21%	7.21%	7.21%	7.21%	7.21%
SEDAŞ	7.66%	7.31%	6.96%	6.64%	6.33%
TOROSLAR	9.38%	8.94%	11.80%	11.25%	10.72%
TRAKYA	7.70%	7.70%	7.70%	7.70%	7.70%
ULUDAĞ	6.96%	6.90%	6.90%	6.90%	6.90%
VANGÖLÜ	46.15%	38.33%	52.10%	43.27%	35.94%
YEŞİLIRMAK	10.35%	9.87%	9.41%	8.97%	8.78%

Transmission losses in the Turkish transmission system were around 2.3% in 2013 and have remained stable over the past five years. Distribution losses are high by international comparison, and losses differ between regions, owing to different rates of theft, losses and storms. Distribution losses have been declining since privatisation



thanks to the reduction targets set by EMRA as part of the tariff regulation of distribution companies. In three regions in south-east Anatolia, because of the war in Syria and migrant flows, losses are on the rise and limit the quality of supply.

Table 8.7 shows the outages of the transmission system. TEİAŞ keeps records of outages of overhead lines (OHLs) and calculates an outage index which is the number of outages per 100 km in 365 days:  $\text{outage index} = (100 \times N/L) \times (365/A)$ . There is no information on distribution network outages or the amount of electricity not supplied in the course of the year.

**Table 8.7** Outages of overhead transmission lines (OHLs) in 2013

	Number of outages (N)	In service duration (A)	Outage index
380 kV OHLs	1 001	346.31 (day)	5.90
154 kV OHLs	2 938	354.83 (day)	7.78

**Table 8.8** Faults in power transformers and overhead lines, 2005-14

Year	Power transformer faults		Overhead line faults (154 kV)		Overhead line faults (380 kV)	
	Long-term faults	Temporary faults	Long-term faults	Temporary faults	Long-term faults	Temporary faults
2005	15	1 072	166	2 182	11	593
2006	26	1 226	228	2 255	16	912
2007	25	1 305	200	3 019	22	1 047
2008	14	1 250	133	2 736	19	818
2009	23	1 114	183	2 745	11	1 044
2010	16	1 373	227	2 824	20	1 244
2011	15	1 242	151	2 862	37	1 540
2012	17	1 363	192	3 033	18	1 197
2013	24	1 441	177	2 761	12	989
2014*	10	1 285	156	3 214	22	1 208

\*Approximate value.

Source: TEİAŞ 2015.

## ASSESSMENT

Since the last in-depth review of 2009, Turkey has been able to set up the basis for the electricity wholesale market, following successful restructuring and privatisation of the distribution sector during 2008-13. This has attracted major private investments in power generation leading to an increase from 198.4 TWh in 2008 to 259.7 TWh in 2015, while generating capacity almost doubled in the ten-year period 2004-14.

According to its reference demand scenario, the government expects power demand growth to accelerate further to 581 TWh in 2030, a 127% increase from 2014. The government's projections foresee an annual increase in demand by around 5.5% until 2023 when demand could rise to 450 TWh. While generating capacity already increased from 45 GW in 2009 to 70 GW in 2014, it would need to reach 110 GW in 2023. Out of the total investment needs, the requirements in electricity alone are expected to be as high as USD 120 billion for the next ten years. Even if the future growth rate of power demand turns out to be lower with economic growth consolidation, substantial investment is still needed if the government aims to reach its targets.

On the generation side, the government wishes to reduce the share of natural gas in the generation portfolio to 38% (MENR Strategic Plan 2015-19), while increasing the share of renewable energy to 30% in electricity generation by 2023; and to use all the economic potential of hydro, solar, wind and geothermal until 2023. The government plans to introduce nuclear power to reach a share of at least 10% by 2023, and for domestic lignite and hard coal to be used at their full potential. Progress on the generation investment can turn out to be slower than expected, notably given delays in the permitting of new generation facilities, in particular for renewable energies, and the development of coal capacities is not in line with new greenhouse gas reduction goals of the Paris Agreement. It cannot be taken for granted that the planned investment is coming forward without further government action with regard to ensuring a stable investment environment with a new functioning wholesale market.

As electricity supply and demand are volatile, a comprehensive monitoring of security of supply and system stability (transmission constraints) based on different long-term scenarios and even beyond a ten-year perspective would be advisable. According to the Electricity Market Law of 2013, MENR is responsible for monitoring electricity security of supply and for taking the necessary measures. A yearly report to the Council of Ministers brings together MENR's demand projections, TEİAŞ's capacity projections, a long-term development plan for electricity generation by TEİAŞ and the electricity market report by EMRA.

TEİAŞ has been carrying out major upgrades in the transmission system (some projects are under construction). However, in order to avoid transmission congestion, to be prepared for the take-up of renewable energy and to make more efficient use and better management of the grid, solid network planning and investment are needed to reinforce and expand Turkey's electricity grid as well as to upgrade system operation and management, including the regional integration within the Continental Europe electricity grid of ENTSO-E. The March 2015 blackout has illustrated the crucial importance of the east-west corridor and its vulnerability to specific grid situations.

A stable investment environment in a competitive, well-functioning wholesale electricity market is critical. Progress under the Electricity Market Law of 2013 is welcome, as it requires an independent market operator for the day-ahead market and intraday markets. The Energy Markets Operating Company (EPIAŞ) was created in 2015 and separates the operation of the market from the activities of the Turkish Electricity Transmission Corporation (TEİAŞ) which focuses on balancing market and ancillary power activities, and is a shareholder in EPIAŞ. While its predecessor PMUM was a successful market platform, however, there was no intraday trading and no real deep financial market. The completion of the wholesale market with intraday and of financial markets will be a decisive phase for the Turkish power market and a fundamental driver for future investment. The wholesale electricity market EPIAŞ should increase the liquidity,

transparency and availability of financial long-term products (futures/derivatives). It is foreseen in the Electricity Market Law No. 6446 that derivative instruments regarding electricity contracts will be traded under the Istanbul Stock Exchange (Borsa İstanbul - BIST). The government should foster the creation of a fully functioning wholesale electricity market on the basis of an independent electricity TSO and the completion of EPIAŞ's operations.

Privatisation and private sector investment decreased the share of state-owned companies. Moreover, the retail market is almost fully open for industry and large consumers, and increasing market opening provides a considerable liquidity option.

With regard to power generation, the privatisation process remains incomplete; the share of the private sector in total installed capacity reached 68% in 2014. After the completion of the privatisation process, this share is expected to reach at least 90% of total installed capacity. Privatisation of all public thermal power plants and some hydropower plants is planned (8 thermal, 49 hydropower plants with a total capacity of 12 GW). The thermal power plants of Seyitömer, Kangal, Hamitabat, Yatağan, Yeniköy and Kemerköy have been privatised in 2013 and 2014. As per January 2015, the privatisation process of the Çatalağzı, Soma, Orhaneli and Tunçbilek thermal power plants is in the final stage. However, EÜAŞ (due to be privatised) and TETAŞ's role in the electricity market create strong distortion, despite the fact that mostly private companies are operating at the wholesale market (PMUM). TETAŞ is selling electricity on behalf of the state, and will retain this role in the future as per the power purchasing agreement for the Akkuyu nuclear power plant, within the scope of the remaining legacy contracts in force. The company sells nearly all of the electricity that it buys from the BOO, BOT, TOOR plants and the generation company EÜAŞ to the relevant retail arms of the distribution companies as part of these bilateral agreements. The government and EMRA should ensure that there is no distortion at EPIAŞ in the future.

Permitting takes about five to seven years for new power generation projects and related connecting transmission lines, including a two-year construction period. The land acquisition/expropriation process and approval of the environmental impact assessment report for a transmission line requires approximately up to two-and-a-half years, its construction approximately two years, followed by the tender process for the determination of the company who will sign the connection agreement and fulfil the final construction in at least 4 months. However, the capacity of the grid lags behind the investor's interest in constructing new power generation facilities, which has led to a large bottleneck, notably of renewable energy projects. Many municipal and local authorities are involved in the permitting process, as they issue construction and operation permits. There are many permits required and the government has recognised that there is considerable need for a more co-ordinated approach to energy investment. The World Bank's "Ease of Doing Business" assessment ranks the country 55th out of 189 and this indicates that Turkey has yet to ease the regulatory burden on business.

Since the last IEA in-depth review in 2009, Turkey has successfully completed the privatisation of all its 21 power distribution grids, which is a unique feature at global level and contributed to ensuring energy access to its citizen. Turkey has further opened the market by reducing the eligibility threshold. However, Turkey maintains regulated end-user tariffs (to non-eligible consumers) with a uniform rate. To ensure the harmonisation of cost differences among the distribution regions, EMRA allows cross-subsidies between distribution companies and consumer groups. The uniform national retail tariff has been renewed in 2015 for another five years, even though it was supposed to be abolished

several times. The government is therefore invited to swiftly follow this obligation and move to cost-reflective tariff system, while fully implementing quality of supply regulation and targeted social aid for vulnerable consumers.

## RECOMMENDATIONS

*The government of Turkey should:*

- *Closely monitor long-term security of supply and system stability on the basis of updated scenarios and technology pathways.*
- *Complete the privatisation of state-owned generation plants and ensure a regulatory environment and robust electricity network planning conducive to the necessary investment in new generation and grid infrastructure.*
- *Foster the full operation and transparency of the wholesale market by ensuring the full operation of the energy exchange (EPIAŞ), of the intraday and financial markets, and the harmonisation of cross-border electricity trade rules with ENTSO-E system.*
- *Streamline environmental and administrative permit procedures to support sufficient and timely investment for the benefit of energy consumers, market and system operation and security of supply.*
- *Implement fully cost-reflective tariffs and remove all remaining price regulations, including for households, while ensuring affordable and high-quality electricity supply through quality of supply regulation and targeted social aid to vulnerable customers.*

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## 9. RENEWABLE ENERGY

### Key data (2015 estimated)

**Total supply:** 15.7 Mtoe (12.1% of TPES) and 83.8 TWh (32.3% of electricity generation), IEA average: 10% of TPES and 23.5% of electricity generation

**Biofuels and waste:** 3.3 Mtoe (2.5% of TPES) and 1.5 TWh (0.6% of electricity generation)

**Hydro:** 5.8 Mtoe (4.4% of TPES) and 67 TWh (25.8% of electricity generation)

**Geothermal:** 4.8 Mtoe (3.7% of TPES) and 3.4 TWh (1.3% of electricity generation)

**Solar:** 1 Mtoe (0.7% of TPES) and 0.4 TWh (0.2% of electricity generation)

**Wind:** 1 Mtoe (0.8% of TPES) and 11.6 TWh (4.4% of electricity generation)

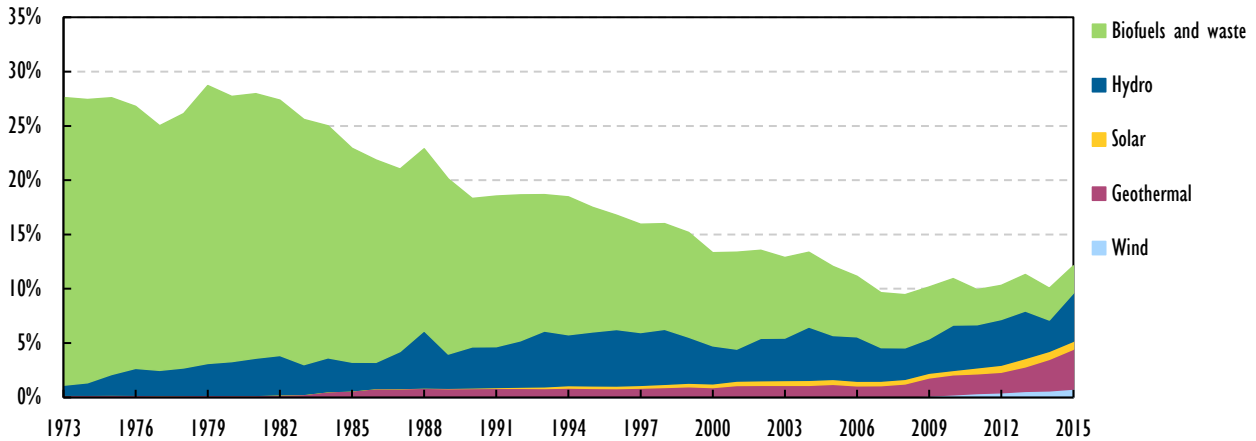
### OVERVIEW

From 2009 to 2015, Turkey saw an increase in renewable energy deployment. The share of hydro has been highly volatile year on year. Electricity demand has grown fast throughout the past decade; the Turkish power sector invested in new generation facilities, using renewable energy sources thanks to the attractive support schemes. With volatile hydropower generation, higher coal and gas use and growing electricity generation, Turkey continues to witness growing shares of renewable energy generation, with the continuous increase in total installed capacity (27.9 GW in 2014). In 2015, the share of renewable energy in total primary energy supply stood at 12.1%, and 32.3% in electricity generation. Turkey is among the International Energy Agency (IEA) member countries with good renewable electricity penetration rates. Turkey has a high potential for renewable energy resources, notably in solar, wind and geothermal. The next phase of renewable energy growth will require regulatory and administrative changes if Turkey wishes to use its full potential and accelerate the deployment in support of climate goals up to 2030.

### SUPPLY AND DEMAND

Renewable energy (RE) accounted for 15.7 million tonnes of oil-equivalent (Mtoe) or 12.1% of Turkey's total primary energy supply (TPES) in 2015. Renewables include biofuels and waste (3.3 Mtoe or 2.5% of TPES), hydropower (5.8 Mtoe or 4.4%), geothermal energy (4.8 Mtoe or 3.7%), solar (1 Mtoe or 0.7%) and wind power (1 Mtoe or 0.8%). Renewable energy as a share of TPES has decreased since 2005 and only reached back again the 2005 level in 2015, when RE represented 12.1% of total TPES. The main reason for this decline was a downward trend in the use of biofuels and waste (down by 39.3% over the same period), as well as strong growth in the use of natural gas and coal. Solar power started growing in 2011. Since 2012, wind and geothermal power increased by 97.2% and 112.7%, respectively (see Figure 9.1).

**Figure 9.1** Renewable energy as a percentage of TPES, 1973-2015

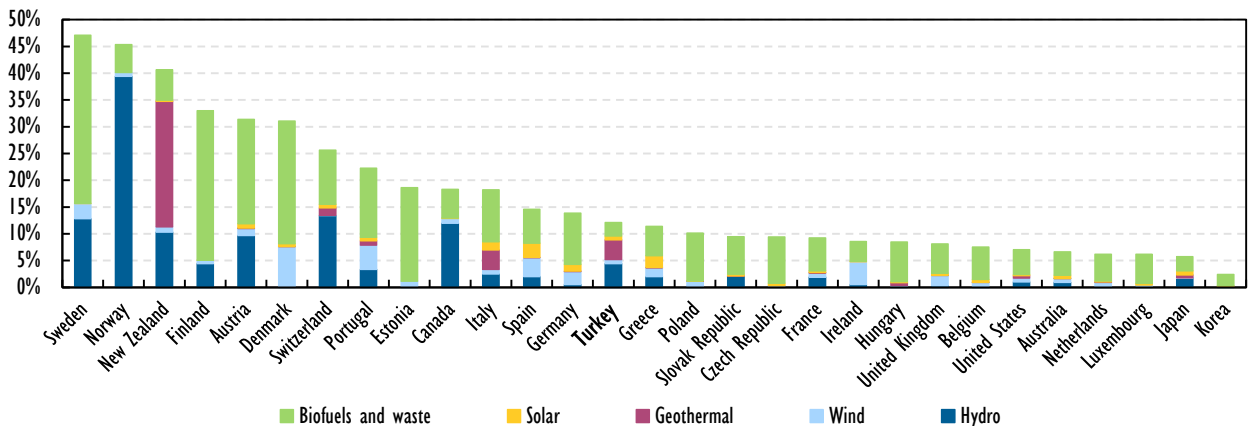


Note: Data are estimated for 2015.

Source: IEA (2016), *Energy Balances of OECD Countries 2016*, [www.iea.org/statistics/](http://www.iea.org/statistics/).

Among IEA member countries, Turkey is at the median with the fourteenth-highest share of renewables in TPES (see Figure 9.2) but has a strong position in geothermal energy, with the second-highest share in TPES, behind New Zealand and followed by Italy. By comparison, the share of solar power is seventh-highest, while hydro ranks eighth and wind seventeenth-highest.

**Figure 9.2** Renewable energy as a percentage of TPES in Turkey and in IEA member countries, 2015

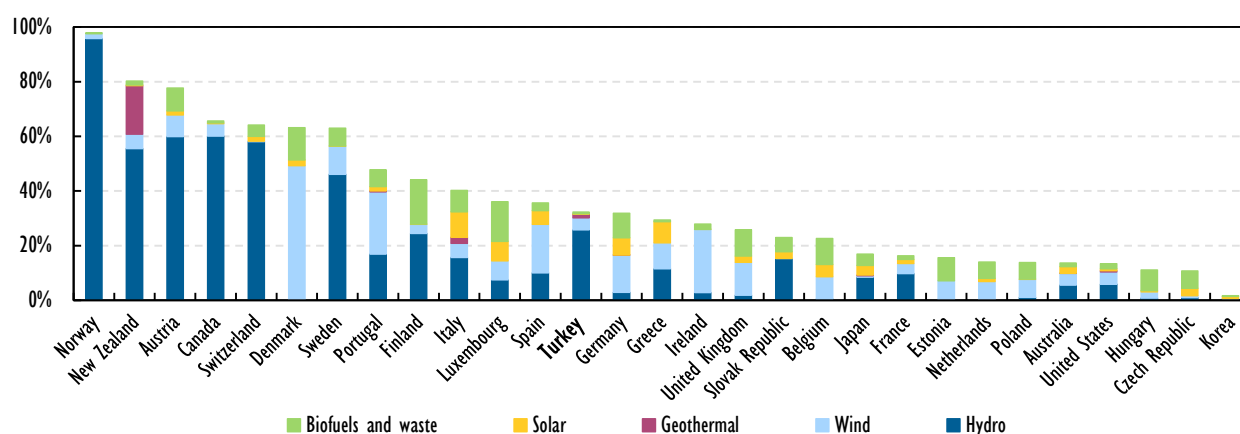


Note: Data are estimated for 2015.

Source: IEA (2016), *Energy Balances of OECD Countries 2016*, [www.iea.org/statistics/](http://www.iea.org/statistics/).

Electricity from renewable sources amounted to 83.8 terawatt-hours (TWh) in 2015, or 32.3% of total generation. Renewables in electricity generation include hydropower (66.9 TWh or 25.8% of total electricity generation), wind power (11.6 TWh or 4.4%), geothermal energy (3.4 TWh or 1.3%), biofuels and waste (1.5 TWh or 0.6%) and solar power (0.4 TWh or 0.2%). Among the IEA member countries, Turkey has the thirteenth-highest share of renewables in electricity generation (median level), with a third-highest geothermal share, the seventh-highest hydro share and fourth- and seventh-lowest share of biofuels and waste and solar (Figure 9.3). Despite its good solar potential, Turkey's total installed solar capacity is small to date, but generation is growing.

**Figure 9.3** Electricity generation from renewable sources as a percentage of all generation in Turkey and in IEA member countries, 2015



Note: Data are estimated for 2015.

Source: IEA (2016), *Energy Balances of OECD Countries 2016*, [www.iea.org/statistics/](http://www.iea.org/statistics/).

**Table 9.1** Renewable electricity generating capacity, 1990-2014 (megawatts [MW])

Technology	1990	2000	2005	2007	2008	2009	2010	2011	2012	2013	2014
Hydro	6 764	11 175	12 906	13 395	13 829	14 553	15 831	17 137	19 609	22 289	23 643
Small hydro 1 MW	0	16	15	15	16	17	17	17	18	19	19
Wind (onshore)	0	19	21	146	364	792	1 320	1 729	2 261	2 760	3 630
Geothermal	18	18	15	23	30	77	94	114	162	311	405
Biogases	0	4	9	16	33	55	71	89	132	162	204
Industrial waste	0	19	27	27	27	27	27	27	27	27	27
Solid/liquid biofuels	0	72	72	72	69	47	47	10	10	10	17
Solar PV	0	0	0	0	0	0	0	0	0	0	40
<b>Total capacity</b>	<b>6 782</b>	<b>11 307</b>	<b>13 050</b>	<b>13 679</b>	<b>14 352</b>	<b>15 551</b>	<b>17 390</b>	<b>19 106</b>	<b>22 201</b>	<b>25 559</b>	<b>27 966</b>
Solar collectors surface (1 000 m <sup>2</sup> )*	0	7 700	11 000	12 000	12 000	12 250	12 350	18 000	18 000	18 000	19 490
Capacity of solar collectors (MW <sub>th</sub> )**	0	5 390	7 700	8 400	8 400	8 575	8 645	12 600	12 600	12 600	12 600

\* Data are estimated.

\*\* Converted at 0.7 kilowatt thermal capacity per square metre (kW<sub>th</sub>/m<sup>2</sup>) of solar collector area, as estimated by the IEA Solar Heating & Cooling Programme. MW<sub>th</sub> = megawatt thermal.

Source: IEA (2015a), *Renewables Information 2015*, [www.iea.org/statistics/](http://www.iea.org/statistics/).

## INSTITUTIONS

Both the **Ministry of Energy and Natural Resources (MENR)** and the **Energy Market Regulatory Authority (EMRA)** are in charge of policies to support for renewable energy resources, besides permitting and construction authorisations required from local government entities.



MENR and its **General Directorate for Renewable Energy (GRDE)** are responsible for policies targeting renewable energy development, including the implementation of the objectives set by the government through support policies, the legal framework, and the research, development, demonstration and deployment of locally manufactured technology. GRDE is not only in charge of renewable energies, but has oversight mainly on energy efficiency policies.

The **Mineral Research and Exploration General Directorate (MTA)** is responsible for the development of geothermal energy.

The **Ministry of Environment and Urbanisation (MEU)** oversees environmental impact assessment procedures.

The system operator **Turkish Electricity Transmission Corporation (TEİAŞ)** tenders grid capacity for solar and wind energy projects and is in charge of the feed-in tariff (FIT) collection and redistribution.

EMRA is in charge of the licensing of all renewable energy facilities, except geothermal, in line with the Electricity Market Licensing Regulation. Licence application for electricity generation with EMRA can only be made on the basis of valid permits by regional government authorities.

**Regional governments** (provincial administrations, municipalities and governors) are responsible for granting construction and operating permits for solar and wind power generation facilities. They organise exploration tenders and grant exploration permits for geothermal resources. Once the exploration of geothermal resources is successful, local governments grant the operating permit.

## POLICIES AND MEASURES

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### TARGETS

Turkey has several targets for electricity generated from renewable energy sources. In the Electricity Energy Market Law (No. 6446) and the 2009 Electricity Market and Security of Supply Strategy, the government underlined the key role of renewable energy in achieving its goals of reducing import dependence, diversifying the electricity mix and meeting rising energy demand. The 2009 Strategy includes the goal of reaching 30% of renewable energy sources in electricity generation by 2023.

Renewable energy is also referred to under the measures of the Climate Change Action Plan 2011-23, the Energy Efficiency Strategy 2012-23 and the MENR Strategic Plans for the periods 2010-14 and 2015-19. Turkey's intended nationally determined contribution (INDC), adopted in September 2015 ahead of the Paris COP21 Conference, contains indicative targets of 16 GW for wind and 10 GW for solar in 2030. The wind target is below the ambitions set out in the 2009 Strategy (20 GW) and the solar target is much lower than expected solar potentials in Turkey.

In December 2014, on the basis of the results of a co-operation project between the European Bank for Reconstruction and Development (EBRD), Deloitte and MENR, the government presented the National Renewable Energy Action Plan (NREAP) for the period 2013-23 (MENR, 2014), in line with the methodology and requirements of the EU

Directive 2009/28/EC.<sup>1</sup> NREAP evaluates the renewable energy policies and the potential of Turkey and contains a number of indicative targets for the different renewable energy technologies to reach a total capacity of 61 gigawatts (GW) by 2023:<sup>2</sup>

- use all economically feasible hydropower potential for generating electricity to reach 34 GW
- increase installed power generation capacity to 20 GW of wind
- expand the use of solar power in electricity generation to utilise Turkey's potential and reach 5 GW
- use all of 1 GW of geothermal electricity potential in Turkey
- support biomass use of 1 GW
- achieve a 10% share of renewable energy use in the transport sector.

The MENR Strategic Plan 2015-19 outlines the following targets for the deployment of renewable energies in the coming five years as Table 9.2 illustrates.

**Table 9.2** Planned installed power values based on renewable energy sources (in MW)

Renewable energy source	Base year 2013	2015	2017	2019
Hydraulic	22.289	25.000	27.700	32.000
Wind	2.759	5.600	9.500	10.000
Geothermal	311	360	420	700
Solar	-	300	1.800	3.000
Biomass	<b>Base year 2013</b>		<b>2019</b>	
Share of renewable energy sources within commercial heat generation by the end of the term (%)	2		3	

Source: MENR (2014), *National Renewable Energy Action Plan (NREAP)*.

## LEGAL FRAMEWORK

In 2005, Turkey had adopted the basic legal framework for the support of renewable energy (*Law on the Utilisation of Renewable Energy in Electricity Generation No. 5346, YEKA Law*), which supported hydro, wind, solar, geothermal, biomass, biogas (including landfill gas) and wave, current and tidal energy. The Law provided for the choice between direct sales of renewable electricity into the spot market versus a general feed-in-tariff (FIT), and included supplier obligations to purchase renewable electricity, priority connection, and exemptions from licence obligations for small generators (0.5 MW), as well as reduced fees for land acquisition and project preparation.

The completion of the electricity market reforms during 2008-12 and the creation of the Turkish electricity wholesale market (PMUM) also stimulated renewable generators to

1. In line with the methodology of the EU Renewable Energy Directive, the NREAP outlines that Turkey had a 13.5% share of renewable energy in gross final consumption in 2013 and needs to reach 20.5% by 2023.

2. The Turkish government has amended these indicative targets over time with the latest intentions contained as indicative aspirations in the NREAP.

sell their electricity to the market directly, as an alternative to FITs, notably during the periods where sales margins in the spot market were much higher than FITs (until 2014).

Despite the legal framework in place since 2005, investment in renewable energy only started growing with the introduction of a technology-specific and longer-term support mechanism (YEKDEM) in 2011 by Law No. 6094 (amended in 2013 and by the new Electricity Market Law 2013) which allowed the exemption from licensing for renewable energy generation facilities with a capacity below 1 MW (un-licensed generation). The YEKDEM mechanism provides a long-term guarantee as basis for accelerated lending of Turkish and foreign banks, and international financial institutions to the renewable energy sector.

Investors in Turkey benefit from the Clean Technology Fund (CTF) loans and Global Environment Facility (GEF) grants to promote emerging renewable energy technologies and energy efficiency investments. Turkey's CTF Investment Plan blends concessional financing with the World Bank Group, EBRD lending and Turkey's own resources to promote clean energy investments. United States Trade and Development Agency (USTDA) also provides grants. As an example, the EBRD and the Clean Technology Fund are launching a programme to support Turkey's geothermal energy sector by funding exploratory drilling for resources. In 2016, the Turkish government announced it will commission 101 new hydropower plants.

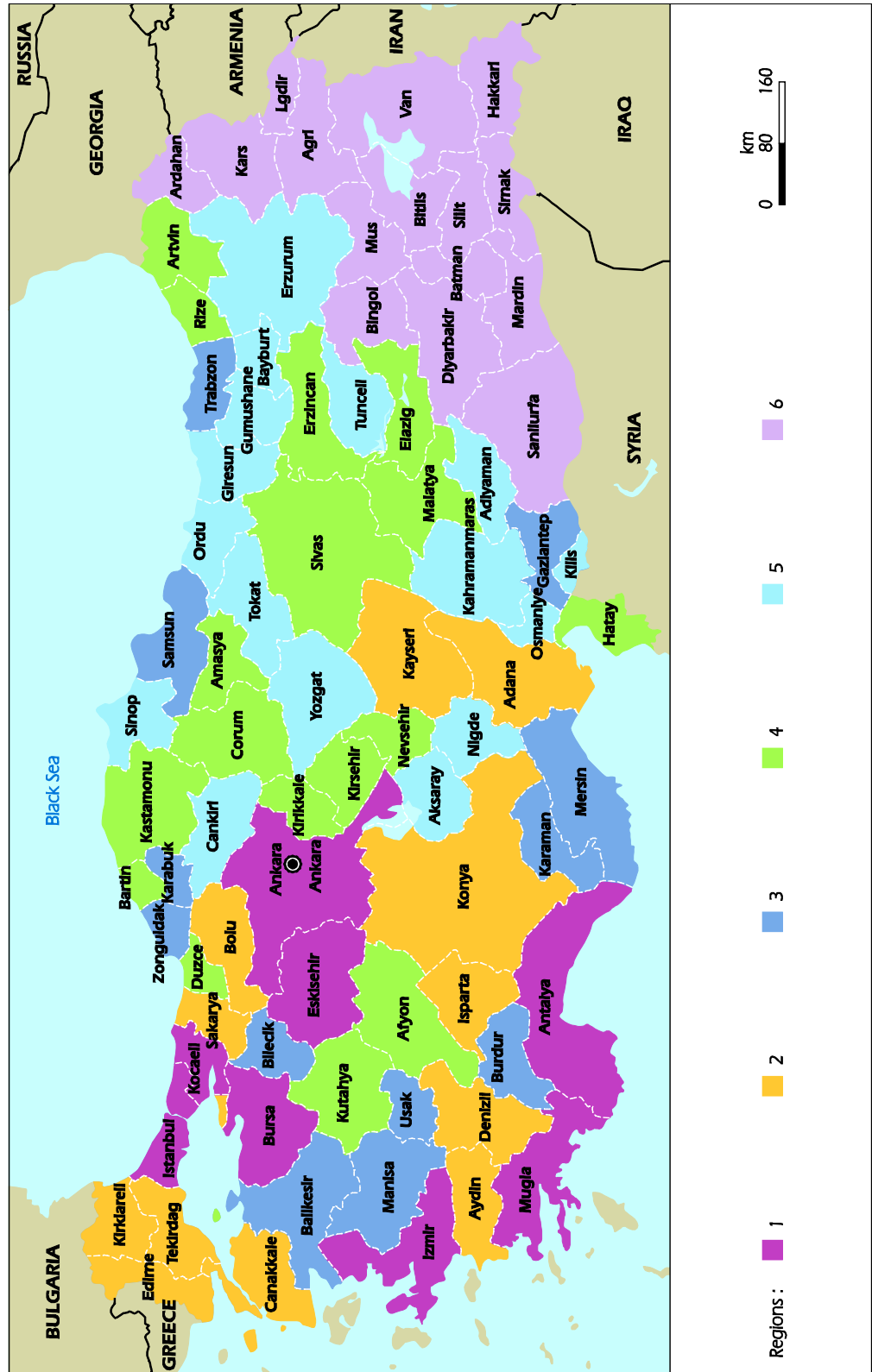
As a top-up to the FITs, on 1 January 2012, local support for domestic manufacturing and regional support were introduced under the *New Investment Incentives Programme* with four different kinds of support structures:

- *General Investment Incentive Plan* is available for all investment types which are on the programme list and have a minimum fixed investment amount. All electricity generating facilities using renewable sources are entitled to value-added tax and customs duty exemptions.
- *Regional Investment Incentive Plan* provides regional incentives with the objective to eliminate inter-regional imbalances across Turkey. Depending on their regional development, regions range from well developed (region 1) to under-developed regions (region 6). Minimum investment amounts have been determined for different kinds of investments: the minimum investment amount is TRY 1 million for Regions 1 and 2, and TRY 500 000 for regions 3, 4, 5 and 6. An additional labour cost deduction of 38% is available only for Region 6 (see Figure 9.4). Incentives are higher in least developed regions to attract investment into the region concerned.
- *Large-Scale Investment Incentive Plan* aims to improve Turkey's technological abilities and supports research and development (R&D) capacity.
- *Strategic Investment Incentive Plan* is offered for production of intermediate and final goods with high import dependence (more than 50%). Investments of TRY 50 million or above are eligible to benefit from this scheme.

These incentive plans, depending on the activities undertaken, can be applied to renewable energy facilities, R&D initiatives, development of equipment, and the manufacturing of component parts of renewable energy power plants.

The key focus of all support measures, like the targets, has been on renewable electricity rather than heat or bioenergy.

Figure 9.4 The regions under the investment incentive schemes



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area.

## ELECTRICITY

The legal framework for the promotion of renewable energy sources (RES) in Turkey was established under the 2005 *Law on the Utilisation of RES for the Purpose of Generating Electrical Energy No. 5346*, and comprehensively modified by the *Law Amending the Utilisation of RES in Electricity Generation (Law No. 6094)* in 2010, which became effective in January 2011. The 2007 *Energy Efficiency Law No 5627*, the 2007 *Geothermal Law No. 5686* and the *Electricity Market Law No. 6446* of 2013 include the legal provisions for renewable energy use for power generation. The EML No. 6446 provides for the licensing of electricity generation facilities, including renewable energy and preliminary licensing, self-consumption and grid auctions (see below). The Regulation on Electricity Market Unlicensed Electricity Generation and the Electricity Market Notification on Implementation of the Regulations relating to unlicensed generation implemented the regime for unlicensed generation and were amended in March 2016.

### Purchase obligation

Electricity retail suppliers are obliged to purchase electricity generated from renewable energy sources. They have to pay a renewable energy fee proportional to the amount of electricity that the supplier has sold to its consumers, divided by the total electric energy that all suppliers sold to all consumers in the country.

### Reduced fees for land acquisition

Law No. 6094 maintains the provision that renewable energy projects commissioned before 2020 are entitled a discount of 85% for permission, lease, easement rights and servitude right fees for the first ten years, including during the period of investment and operation (including the power lines and related connection infrastructure). This only applies to government-owned land.

### FIT scheme

Under the *Law No. 6094*, technology-specific FITs are introduced, the so-called Renewable Energy Resources Support Mechanism (YEKDEM). FITs are provided to renewable energy facilities that are commissioned before 31 December 2020 for a period of ten years with the tariff levels shown in Table 9.3 (local content support is limited to five years) and are quoted in US dollars. In 2013, the EMRA Board decided to extend to 2020 the remuneration to new facilities starting operation after 1 December 2015.

**Table 9.3** FITs for electricity produced from renewable energy sources, 2010\*

Type of electricity production facility	FITs applicable (US cents/kWh)
Hydro	7.3
Wind	7.3
Geothermal	10.5
Biomass and waste	13.3
Solar PV	13.3

\*Law on Utilisation of Renewable Energy for the Purpose of Generating Electrical Energy No 5346.

By international comparison these rates are relatively low and short-term (ten years/five years up to 2023). However, if the local content premium is added to the FIT, an additional USD 23/megawatt-hour (MWh) to USD 92/MWh could be earned per project (see Tables 9.3 and 9.4). For instance, if the facility is constructed on the basis of totally local manufactured components, then this facility receives an additional tariff that corresponds to nearly half of the FIT. This additional tariff is provided for a term of five years from the operation starting date of the production facility. This remuneration makes the onshore wind market highly competitive and attractive.

In 2015, the World Trade Organization (WTO) reviewed local content complaints against Turkey. The European Union had expressed concerns about Turkey's local content requirements in electricity generation through the WTO review procedures. It asked the Turkish government to explain how this measure would be in compliance with the WTO rules. Turkey argued that its main objective is to reduce import dependence in the energy sector; and that it does not aim to discriminate but rather to develop renewable energy without requiring investors to buy local content.

**Table 9.4** Additional FITs for local content

Part	Additional FIT (in USD cents/kWh)	Component	Ratio of domestic parts (in %)	Additional FIT for components (in USD cents/kWh)
Blades	0.8	Blade and rotor hub fittings	100	$0.8 \times 100\% = 0.8$
Generator and power electronics	1.0	Generator	55	$1.0 \times 55\% = 0.55$
		Power electronics	45	$1.0 \times 45\% = 0.45$
Turbine tower	0.6	Tower	80	$0.6 \times 80\% = 0.48$
		Tower-nacelle and tower-ground fittings	20	$0.6 \times 20\% = 0.12$
		Rotor hub	20	$1.3 \times 20\% = 0.26$
		Nacelle cabinet	5	$1.3 \times 5\% = 0.07$
		Blade-directing mechanism	10	$1.3 \times 10\% = 0.13$
Complete mechanical parts in rotor and nacelle groups	1.3	Nacelle-directing mechanism	10	$1.3 \times 10\% = 0.13$
		Rotor main shaft	10	$1.3 \times 10\% = 0.13$
		Rotor main shaft bedding	10	$1.3 \times 10\% = 0.13$
		Chassis in nacelle assembly	5	$1.3 \times 5\% = 0.07$
		Brake disks and hydraulic control systems	5	$1.3 \times 5\% = 0.07$
		Speed inverters	25	$1.3 \times 25\% = 0.33$

Source: Investment Support and Promotion Agency Turkey (2013).

Plant operators are entitled against the grid operator to the payment of a fixed FIT for all electricity fed into the grid. The costs of the FIT and the cost of the distribution grid are borne by the consumers via their electricity bills. The distribution of the FIT was organised by the transmission operator TEİAŞ and its Market Financial Reconciliation Centre until 1 July 2015. After this date, the Energy Market Operating Company (EPIAŞ), which was established in March 2015 to replace the electricity wholesale market PMUM, is conducting this process. Within the process, the total amount for each invoice period

is announced and the payment obligation rate of each supplier is determined, which is then invoiced to the supplier in question and the collections made are paid *pro rata* to the entities.

Each year in October, the investor can choose between a FIT plan and direct sales into the power wholesale market for the following year, and once it opts for the tariff, it cannot trade any more in the market during the year. According to EMRA data, in the past years, investors increasingly decided in favour of the FIT; in 2014, 38% of wind projects and 80% in 2015, 80%, had decided against the wholesale market remuneration.

Exchange rate risk is an important factor impacting the business case of renewable energy in Turkey. FITs are given in US dollars, the electricity price in Turkish liras, equipment for wind in euros and loans in Turkish liras. Amid decreasing wholesale electricity prices and higher depreciation of the Turkish lira against the dollar, a stable and longer-term financing is important for project promoters to secure their business case outlook.

The FIT varies according to the source of energy used and to whether the components of the plants are made in Turkey or not. Table 9.4 shows the additional FITs to be obtained with local content.

### **Grid integration of variable renewable energy**

The 2013 Electricity Market Law set limits for solar PV and wind power expansion, and created the framework for a gradual expansion of renewable energies, with a view to avoid cost explosion and to benefit from technology learning curves as the local manufacturing supply chain is expanding in Turkey.

Under the 2013 Electricity Market Law, MENR announces every year the maximum capacity that can be connected to the grid. Grid capacity determines the rate of renewable energies deployment. The connection of renewable energy facilities is preceded by a technical assessment of the network transmission operator TEİAŞ. Grid expansion has been slower than expected. EMRA and TEİAŞ take a conservative approach under the current regulatory model and system planning, as final investments are approved by the government, which aims to avoid cost increases in the final electricity prices.

In case of limited grid capacity, solar and wind energy compete for grid access. Under the 2013 Electricity Market Law, TEİAŞ tenders capacity to the highest bidder to obtain the connection permission, which is a prerequisite for the generation licence. Renewable energy developers agreed to pay amounts up to USD 30/MWh to 40/MWh of generated electricity in past wind power auctions. The new Electricity Market Law of 2013 changed the tendering payment mechanism to a participation fee per unit of installed megawatt capacity, instead of generation (megawatt-hour). The total participation fee shall be paid within three years to the operator TEİAŞ (instead of ten years). With a ten-year FIT remuneration period and high connection fees, the bankability of solar projects is reduced; local content will be able to attract investors, notably for projects that do not require a grid licence (under 1 MW). While the new fee payment can ensure the faster financing of the grid expansion on TEİAŞ's side, it places a higher burden on the renewable energy generator inflating the capital expenditures (CAPEX) of the project. This requires developers to take out more debt and pay more interest for the entire time of the project.

Renewable energy generators, who choose the FIT scheme participate in the Renewable Energies Support Mechanism (YEKDEM) do not have balancing responsibility. Those generators who opt to participate in the day-ahead market have balancing obligations. The rules are defined in the Balancing and Settlement Regulation, and market operations are carried out by Electricity Market Financial Settlement Centre (Piyasa Mali Uzlaştırma Merkezi, PMUM) which is replaced by a new electricity wholesale exchange EPIAŞ. The intraday market, which provides the opportunity to minimise imbalance, was introduced on 1 July 2015. Currently, curtailment of renewable energy generators is defined in the grid code for emergency purposes only. In the future, with increasing renewable energy penetration levels, the necessary curtailment methods and rules are planned to be integrated in the regulations. However, no network rules or net metering regulations are in place for distributed generation, like solar PV and others.

### Licensing regime and approval procedures

All operational licences are provided by EMRA for all electricity generation facilities. There is no legal framework in place for licensing ocean or offshore wind power and the required grid connections.

The administrative procedures for authorisation, permitting and operation are set out in the new *Electricity Market Law No. 6446* and the *Law on the Utilisation of Renewable Energy in Electricity Generation*.

There are exemptions from licence requirements (unlicensed regime) and preliminary licenses.

The *Electricity Law No. 4628* had provided for an unlicensed regime for small distributed generation facilities under 500 kW installed capacity. The Electricity Market Law No. 6446 has increased the exemptions from licence requirements for renewable energy installations with a capacity below 1 MW (unlicensed regime). A decree by the Council of Ministers can increase the threshold to 5 MW, without amending the Law. There is also no need for a generation licence if the power plant based on renewable energy is not connected to the grid; generation and consumption take place at the same measurement point. A 50% discount on the grid utilisation fee and stamp duty exemption was extended until 2023. In March 2016, the Regulations for Unlicensed Generation were amended to establish the procedures and trading principles for the surplus energy and reserves for the better integration of distributed generation into the grid and the market.

The *Electricity Law No. 6446* defines a pre-licensing step during which a generation licence is obtained during an ongoing permitting process. Experience has been mixed to date. In the first years, EMRA had issued a large amount of licences, but as the permitting and connection lines turned out to become the main barrier, the construction of facilities was delayed. The back-log was large and licence holders engaged in secondary licence trading rather than deploying renewable energy facilities, despite the fact that Law 6446 does not allow licence trading.

In March 2015, EMRA opened the pre-licence application for new wind power projects with a grid auction of 3 GW expected to be held in mid-2016. In the grid auction of May 2015 for solar capacity, bidding prices sky-rocketed to between USD 0.3 million/MW to 1.2 million/MW, illustrating the high interest of investors and the lack of grid capacity.



Several different authorities are involved in the authorisation and approval processes in licensing procedures. Permitting procedures are complex in Turkey. They evolve in three essential steps: *i)* an environmental impact assessment report from the Ministry of Environment and Urbanisation (see Chapter 8 on electricity), *ii)* cadastral records from the General Directorate of Land Registry and Cadaster, and *iii)* local authorisation for land use including spatial approval and expropriation.

With regard to land use, it is essential to obtain the permits from several organisations: the municipality where the investment will be made, the municipality of the greater region (if applicable), the Special Provincial Administration, the Ministry of Culture and Tourism, the Regional Board of Preservation of Cultural Assets, the Regional Board of Preservation of Natural Assets, and the Ministry of Environment and Urbanisation.

In addition, depending on the project, the investor has to obtain approval of other public institutions, including the General Directorate of Nature Preservation and National Parks, the State Highways Commission, the State Hydraulic Works (for hydropower investments), the Regional Board of Preservation of Cultural Assets, the provincial organisation of the Ministry of Food, Agriculture and Livestock, the Regional Directorate of Forestry, the provincial organisation of the Ministry of Environment and Urbanisation, TEİAŞ, the provincial organisation of the Ministry of Culture and Tourism, BOTAŞ (the national natural gas transmission company), the Türk Telekom, the regional electricity distribution company and the regional gas distribution company.

In the MENR Strategic Plan 2015-19, the government announces plans to streamline the licensing and permitting procedures by establishing a one-stop-shop, legislated timelines for different administrative tasks, and positive administrative silence.

### **Electricity from other renewable sources**

There is a biomass potential of 4.8 million tonnes (Mt) from forests, and over 15.3 Mt from agricultural waste. In total, the biomass potential of Turkey is 8.7 Mtoe; 49 MW was operational in 2014. Under a conservative scenario, the government aims to develop 1 000 MW of installed capacity to 2023, according to the NREAP.

MENR-GDRE estimates the economic potential of geothermal for power generation to be in the range of 600 MW, of which 94.2 was already in operation by 2014 and 127.5 MW under construction. There are 27 projects licensed of which 12 are partially or fully operational. By end of 2014, 25 out of 228 geothermal fields had a potential that is suitable for power generation.

In 2014, Turkey had no tidal wave and no offshore wind capacity deployed. Technology costs are high because of their special risk and innovation profile in the marine area, which requires a new support approach. Equally, solar power is only marginal in Turkey, despite its high solar irradiation. As technology costs have come down considerably in the past five years, the evolution of solar PV and solar thermal should be a major growth sector. The government and EMRA should adapt the support schemes to these trends.

## **HEAT**

No particular support mechanism is in place for the use of renewable energy in the heat sector. As explained earlier, Turkey uses geothermal energy in electricity generation; however, the theoretical geothermal heat potential of Turkey (31 500 MW<sub>th</sub>) remains largely undeveloped. The use of renewable energy, notably biomass

and agricultural waste for district heating and industrial processes, is another sector which has not been developed so far.

## TRANSPORT FUELS

In the transport sector, Turkey has legal obligations to blend gasoline (not diesel) with up to 3% of bioethanol. Bioethanol and biodiesel produced from domestic crops are exempted from excise duty when incorporated in gasoline or diesel fuel up to 2%.

## RENEWABLE ENERGY OUTLOOK TO 2023

In the medium-term outlook to 2023, the year marking the 100th anniversary of the Republic of Turkey and the target deadline, the government aims to have 30% of renewable energy in its electricity mix. In 2015, the share stood at 32.3%.

In 2014, the country had about 28 GW of renewable energy capacity. The IEA expects Turkey to expand its renewable energy capacity by 12 GW during the period 2014 to 2020 in the main case and by a maximum of 13.2 GW in the accelerated case (IEA, 2015b). Thereby Turkey would achieve at least 40 GW in 2020.

Assuming a lower growth in electricity demand in the coming decade, and new measures adopted by the government, Turkey can increase the share of RES. Turkey's renewable energy medium-term outlook is positive. It is the only country in OECD Europe where annual additions of renewables are stable, but growth is behind strong forecasts for many emerging economies. With that in mind, the government may want to adopt a new target for the period beyond 2023 towards 2030. This would also provide for a longer term outlook for renewable energy in Turkey, beyond the medium-term.

### Box 9.1 Medium-term forecast: Turkey's accelerated case

Much enhancement is possible in Turkey with regulatory and administrative changes. For onshore wind and solar PV, a better auction design for grid connection with floor and ceiling prices would prevent developers from overbidding. This could improve project bankability and access to lower-cost financing. The cost of financing remains high for renewables, as the majority of projects are still financed on balance sheets with uncertain revenue streams due to exchange rate risks. Financing costs could be lower with longer FIT contracts with durations of 10 to 15 years. For unlicensed projects, a more robust net metering and permitting structure would decrease regulatory risk. Should all these changes be realised, onshore wind capacity could be 0.6 GW to 1.2 GW and solar PV 1 GW higher than in the main case.

Source: IEA (2015b), *Medium-Term Renewable Energy Market Report*.

## ASSESSMENT

Turkey attributes high importance to energy generation from renewable energy sources with a view to diversify energy resources, reduce import dependence and greenhouse gas emissions and develop local manufacturing industry.

The share of renewables in TPES in 2015 was the same (12.1%) as in 2005. Over the past decade to 2014, the share of renewables in electricity production has fluctuated around

20%, with growth from 19.6% in 2009 to 28.9% in 2013, followed by a decrease to 21% in 2014, as hydropower availability has become limited, and the use of coal and natural gas increased. In 2015, the share of renewables in electricity production increased to 32.3%. Around 80% of comes from hydropower.

Turkey has set out various indicative targets but has no legally binding renewable energy target fixed in legislation. In the 2009 Electricity Market and Supply Strategy, the government stated its ambition to achieve a share of 30% renewable in electricity generation by 2023. The targets outlined in the 2009 Strategy and in the 2015 NREAP, and the targets of the INDC do not align. Apart from the INDC, Turkey does not have a long-term outlook for its renewable energy sector, which would go beyond 2023.

In 2015, Turkey already meets its 2009 target and the government could consider raising ambitions and establishing longer term targets for 2030 to promote investment into Turkey's renewable potential. The government considers that Turkey is on track to achieve its targets for solar and geothermal energy by 2023 and is currently considering more ambitious targets for the period after 2023. However, no formal announcements or legislative proposal have been made. There should be greater consistency in the setting, evaluation and commitment for the adoption of targets, and sector-specific targets for electricity, heat and transport could foster growth of renewable energy across the economy. In this regard, longer-term targets provide for the continuity of policies and support a stable investment environment. Among the main drivers for renewable energy growth in the medium term in Turkey, the IEA notes the strong need for new capacity to meet rising energy demand and the high resource potential and competitiveness. The Turkish economy is set to grow continuously in the coming decade and new capacity is needed to meet demand. The country benefits from good competitiveness of renewable energy sources.

Turkey has completed a first phase of kick-starting renewable energy development and is entering a second phase which requires adjustment of policies. Since the last IEA in-depth review, the framework for the promotion of renewable energy sources has been completed. Much in line with the IEA recommendations in the 2009 review, in 2011 Turkey amended the Law on the Utilisation of Renewable Energy Resources for the Purpose of Generating Electricity (2005) to introduce differentiated FITs for renewable energy technologies which, together with local content additions, presents an attractive guarantee for project developers and lending institutions. Turkey created a preliminary licensing procedure and increased the possibility to use licence exemptions to promote small-scale renewable energy sources (1 MW) under the new Electricity Market Law of 2013 and implementing regulations. Besides FITs, licence exemptions for new small-scale generation facilities (up to 1 MW installed capacity), lower licence fees, connection priority, purchase guarantees and assistance in project preparation and land acquisition are available. Local content support is provided in the form of add-ons to the FITs whenever locally manufactured electromechanical equipment is used in renewable energy generation facilities. This additional tariff applies for a period of five years. While Turkey does not oblige investors to purchase local content manufactured goods, these local content FIT add-ons are contested by Turkey's trade partner, the European Union within the World Trade Organization.

In Turkey, the electricity grid limitations and complex permitting procedures turned the high number of renewable energy licence applications at EMRA into a serious bottleneck, which add costs to project development. The renewable energy capacity allocation is done through auctions, given limited grid availability. At the same time,

EMRA has only limited technical capacity for the assessment of technologies and limited human resources to administer the quantity of licence applications. Increasing EMRA's resources and expertise together with the streamlined procedures of one-stop-shops can help creating faster licensing. MENR Strategic Plan 2015-19 envisages measures to address the delays by streamlining administrative procedures. Because of permitting delays and limited grid availability, Turkey created two different markets and regulatory systems for licensed and unlicensed operators, the latter becoming increasingly popular with all developers to avoid licence procedures. The increasing number of unlicensed but relatively large renewable energy resources carries power system operational and regulatory risks. The oversupply of licenses led to the secondary trading of licenses and created delays in the actual deployment of the facilities.

Every year energy generators can choose to use FIT or sell directly into the electricity wholesale market, which is internationally the best practice. However, direct marketing is becoming less attractive as wholesale electricity prices are declining in recent years. When entering the second phase of a more accelerated RES deployment, the government may wish to rethink its FIT and develop it into a longer-term premium on top of market prices. By international comparison, FIT support is rather short-term (ten-year FITs) and exposed to significant exchange rate risks, as it is quoted in US dollars.

To date, the development of renewables has mainly focused on hydro and wind, and some geothermal power. Surprisingly, solar power remains marginal, despite the favourable resource endowment. The potential of hydro and wind power is high but remains largely untapped because of technical barriers and public acceptance issues: only 40% of the hydro potential is used as local communities have raised environmental concerns against hydropower. A significant part of state-owned generation assets – 50 small-scale hydro power plants – was privatised. Studies on further privatisation of an additional 27 hydropower plants are ongoing. After the successful privatisation of small and run-of-river plants, the privatisation of the large hydro-reservoir plants has been stopped, keeping the current ownership and operation in place. The large role of these plants in the electricity market and their impact on market prices should be analysed.

Moving forward, several challenges need to be addressed: the high licence and connection fees for renewable projects, delays in grid connection and expansion, regulatory uncertainty over the regime for distributed generation and the costs blocking the expansion of notably solar power. The availability of long-term financing, including exchange rate risks are among the key challenges in the medium-term outlook.

Experience in other IEA jurisdictions points to the fact that, above a certain threshold, the integration of variable renewable generation requires more flexibility (i.e. demand response, flexible backup generation, storage) in the electricity market and system. This also requires sufficient grid expansion, both in transmission and in distribution networks. The government is already seeking to develop flexible markets and should create a regulatory framework for distributed generation and ensure that renewable energies continue to fully participate (bid for capacity) in the wholesale market, notably spot and intraday markets, where wind power can benefit from shorter gate closures. The revision of the Regulations for Unlicensed Generation in March 2016 is a positive step into this direction and welcome. The regulatory regime for distributed generation requires a comprehensive regime for net metering, capacity-based distribution pricing and the adaptation of system operation and emergency management.

The use of biomass (urban waste) for heating purposes has declined and biofuels use for transport still remains untapped. To date, Turkey does not promote co-generation or heating/cooling using renewable energy. The promotion of bioethanol is done through the blending obligation of 3% bioethanol in fuel derivatives imposed on refinery and distribution licence holders; 2% biodiesel or bioethanol produced from local resources and blended to fuel or gasoline is exempted from the special consumption tax. By international comparison, these are very low blending percentages that do not encourage the development of the industry in Turkey.

## RECOMMENDATIONS

*The government of Turkey should:*

- *Clarify subsector targets for the use of renewable energy sources in electricity, transport and heat sectors up to 2023 and 2030 in order to provide long-term visibility for investors.*
- *Remove regulatory barriers to renewables deployment so as to enable investors and other private parties to install renewable energy facilities without undue delay. Consider the establishment of “one-stop shops” for licensing and related procedures, including legislated timelines for administrative decisions, at both national and local levels.*
- *Regularly review incentive schemes in order to ensure that they are market-based, cost-effective and keep pace with technology development; adopt a technology-specific regulatory regime for distributed generation.*
- *Prepare for the take-up and distribution of larger quantities of electricity produced from renewable sources when developing and planning the electricity grid.*
- *Foster the development and support of solid and liquid biofuels.*

## References

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IEA (2015a), *Renewables Information 2015*, OECD/IEA, Paris, [www.iea.org/statistics/](http://www.iea.org/statistics/).

IEA (2015b), *Medium-Term Renewable Energy Market Report*, OECD/IEA, Paris.

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## 10. NUCLEAR ENERGY

### Key data (2015)

**Number of plants:** none in operation, two plants planned with four units each, possibly a third one later

**Planned installed capacity:** Akkuyu plant 4 800 MW<sub>e</sub> (starting in 2022); Sinop plant 4 480 MW

### OVERVIEW

Turkey has made efforts in developing nuclear energy since the 1960s. Studies to build a nuclear power plant in Turkey were started in 1965. Since 2009, decisive steps have been taken to proceed towards the construction of two nuclear power plants (NPP) on the basis of intergovernmental agreements (IGAs) concluded with the Russian Federation (hereafter “Russia”) and with Japan, for the construction of NPPs on the sites of Akkuyu and Sinop, respectively.

At the Akkuyu site (four VVER-1 200 megawatts electrical [MW<sub>e</sub>] units) preparations are most advanced and will meet plans to have the units online by 2023; construction should commence in 2017. The project is relying on a build-own-operate (BOO) model. Feasibility studies are ongoing at Mitsubishi Heavy Industries and Itochu for the construction of the Sinop NPP (4 480 MW<sub>e</sub> with four generation-III pressurised water reactors [PWR] of type Atmea I).

Going forward, the government will need to adopt the required legal framework and measures to ensure the full ownership of the nuclear technologies which will be used in the country, even more so as the technologies are from diverse origins. This includes the task of ensuring a competent regulatory oversight by an independent regulatory body, which will be established by separating the regulatory responsibilities of the Turkish Atomic Energy Authority (TAEK). Specific arrangements have to be put in place, early enough into the process, for the long-term management of the spent fuel and waste associated with the operation of the plants and their decommissioning.

Engaging in nuclear programmes means a commitment for decades, from the decision to build to the final disposal of radioactive waste. It is therefore important to start considering the involvement of civil society from the start.

### HISTORY OF NUCLEAR ENERGY POLICY

Between 1967 and 1970, a feasibility study was undertaken by a foreign consulting company for the construction of an NPP of 300 to 400 megawatts (MW). This plant would have been in operation in 1977. However, the project could not come to fruition because of problems related to site selection, among others.

In 1973, the Turkish Electricity Authority (TEK) decided to build an 80-MW<sub>e</sub> prototype plant. However, in 1974, the project was cancelled because it could have delayed the construction of a plant with greater capacity. Instead of a prototype plant, TEK decided to build a 600 MW<sub>e</sub> NPP in southern Turkey. Site selection studies were made in 1974 and 1975, and the Gulnar-Akkuyu location was found suitable for the construction of the first NPP. In 1976, the Atomic Energy Commission granted a licence for the Akkuyu site. In 1977, a bid was prepared, and the companies ASEA-ATOM and STAL-LAVAL were awarded the contract as the best bidders. Contract negotiations continued until 1980. However, in September 1980, following the Swedish government's decision to withdraw a loan guarantee, the project was cancelled.

A third attempt was made in 1980. Three companies were awarded the contract to build four NPPs: one CANDU unit by Atomic Energy of Canada Ltd. (AECL), one PWR unit by KWU in Akkuyu, and two boiling water reactor (BWR) units by GE in Sinop. Because of Turkey's request to apply the build-operate-transfer (BOT) model, KWU resigned from the bid. Although Canadian AECL accepted the BOT model, it insisted upon a governmental guarantee for the BOT credit. The Turkish government refused to give such a guarantee, and consequently the project was cancelled.

In 1993, the Supreme Council for Science and Technology identified nuclear electricity generation as the third-highest priority for the country. In view of this decision, the Turkish Electricity Generation and Transmission Company (TEİAŞ) included an NPP in its 1993 investment programme. In 1995, TEİAŞ selected Korean KAERI as the consultant for the preparation of the bid specifications. The bidding process started in 1996. Three consortiums (AECL, NPI and Westinghouse) offered proposals in 1997. In July 2000, after a series of delays, the government decided to postpone the project.

### LEGAL RULES FOR NUCLEAR POWER DEVELOPMENT

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The Turkish Atomic Energy Authority Law No. 2690 was adopted in 1982. In 2007, the Law on Construction and Operation of Nuclear Power Plants and Energy Sale (No. 5710) was ratified and entered into force on 21 November 2007.

In 2008, the Regulation Regarding the Principles, Procedures and Incentives for the Contracts and the Contest for the Implementation of Law No. 5710 was published in the *Official Gazette* on 19 March 2008. The Regulation sets out the procedures and principles regarding the construction and operation of NPPs for electricity production, and regulates the energy sales.

The Law and Regulation aimed at facilitating the investment and operation by the private sector, supported by power purchase agreements (PPAs). The Law allows the state to take part in nuclear power projects by means of public-private partnerships. The Turkish Atomic Energy Authority (TAEK) issued a set of criteria that establish general principles that should be met by investors.

### THE AKKUYU PROJECT

A tender for construction and operation of NPPs and energy sale was held on 24 September 2008 by the Turkish Electricity Trading and Contracting Company (TETAŞ), for the construction of four units at the Akkuyu site. Neither the government, nor a Turkish state-owned entity would be directly involved in the financing, ownership or

operation of the plant. Only one consortium bid for the competition. After evaluation of the technical documents provided by the consortium, TAEK announced, on 19 December 2008, that the future NPP met TAEK's criteria. The last envelope given by the consortium on 24 September 2008, and containing the energy sale unit price, was opened by TETAŞ on 19 January 2009. After assessment, the competition was closed by TETAŞ on 20 November 2009. However, the tender was annulled following the decision of the State Council (the Turkish Supreme Administrative Court) to suspend some articles of the relevant laws and regulations.

Direct government-to-government discussions were engaged on Akkuyu as part of wider energy co-operation which resulted in the signature of the "Agreement between the Governments of the Republic of Turkey and of the Russian Federation for Cooperation on the Establishment and Operation of a Nuclear Power Plant at Akkuyu in the Republic of Turkey" on 12 May 2010. The IGA was ratified by both Parliaments in the same year, providing the legal framework for the realisation of the project.

The Akkuyu NPP project will be the first project to be built under a BOO model. The plant will be owned and operated by the Akkuyu NPP's Joint Stock Company (JSC) which was established in December 2013 under Turkish law. The JSC will also be the investor. Rosatom, Russia's state-owned nuclear organisation, via some of its affiliates, is holding the shares of the JSC and finances the project, but up to 49% may be sold to other investors at a later stage. This BOO model is a full-service model under which Rosatom will provide engineering, filing of the permits, construction, supply of equipment, commissioning, training, operation, maintenance, waste management and decommissioning services for the NPP. Fuel services are also part of the deal. The Turkish side allocates the site, facilitates licences and permits and provides the grid connection, and guarantees the purchase of electricity as per the PPA.

The Akkuyu NPP will have a total installed capacity of 4.8 GW<sub>e</sub> comprised of four VVER1200 units (AES 2006 design with a reference plant under construction in Russia in Novovoronez). It is a GEN-III design with passive and active safety systems fulfilling advanced safety requirements. The first unit is planned to come online in 2020 and the last one in 2023. Seven years were foreseen between the finalisation of all approvals and permitting and the first plant operation; however, this timeline could be delayed. The environmental impact assessment (EIA) was approved in December 2014 by the Turkish Ministry of Environment and Urbanisation. The official ceremony to launch the site preparation activities took place in April 2015. The Akkuyu Power Consortium (APC) plans to submit the construction licence application in June 2016 and to start construction in mid-2017. Operation of the first unit is anticipated in 2022.

## THE SINOP PROJECT

State-owned EÜAŞ has been recognised the Turkish Atomic Energy Authority (TAEK) as the owner of the second NPP project in Sinop and launched the process of site licensing. Turkey is planning the construction of a second nuclear power plant at the Sinop site. After negotiations with the government of Japan, an IGA was signed between Turkey and Japan on 3 May 2013 on the "Cooperation for the Development of Nuclear Power Plants and the Nuclear Power Industry in the Republic of Turkey". According to this IGA, the share of the government of Turkey will be up to 49% in the Sinop Project Company, with EÜAŞ being the Turkish shareholder, together with a consortium consisting of Mitsubishi, Itochu, and GDF Suez (now called Engie). Negotiations of implementing



agreements are ongoing, and the IGA and HGA (host government agreement) was ratified by the Turkish Parliament in April 2015. In the case of Sinop, the public-private-partnership model will be applied.

The Sinop project would consist of four ATMEA-1 model nuclear reactors, each with 1 120 MW<sub>e</sub> installed capacity. The estimated total cost of the project is USD 22 billion. According to the IGA, TETAŞ would buy 100% of the generated electricity for a period of 20 years. The operation of unit 1 could be expected for 2023.

### THE THIRD NPP PROJECT

EÜAŞ has been tasked by the government to start initial site selection for a third NPP project. EÜAŞ signed a memorandum of understanding with Westinghouse Electric Company and the People's Republic of China's State Nuclear Power Technology (SNPTC) in November 2014 on Co-operation for the Development of a Nuclear Power Plant Project and the Nuclear Power Industry in the Republic of Turkey. On behalf of the delivery team of Westinghouse and SNPTC, a development report for the project was provided in June 2015. The review and assessment of the report is in progress.

### LEGAL FRAMEWORK AND INSTITUTIONAL OVERSIGHT

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The 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 construction of the Akkuyu NPP as well as for the other projects, the IGAs, once ratified by Parliament, constitute the legal basis for the given project. PPAs fix the conditions (prices, fraction of electricity concerned, duration). For the Akkuyu NPP, the roles and responsibilities of the different parties are clarified in the IGA, for example in case of construction delays due to issuing permits (responsibility on the Turkish side) or supplying equipment (responsibility of the Russian supplier).

When it comes to nuclear energy, specific legal and regulatory frameworks are needed for nuclear safety and security aspects. The Turkish Atomic Energy Authority Law No. 2690 dates back to 1982. A new draft law is being finalised, which will be comprehensive and cover the full set of issues:

- principles of nuclear safety
- independence of the Safety Authority (see next section)
- responsibilities for authorisations and licensing
- detailed enforcement rules
- radioactive waste management policy and authority
- decommissioning and radioactive waste management fund.

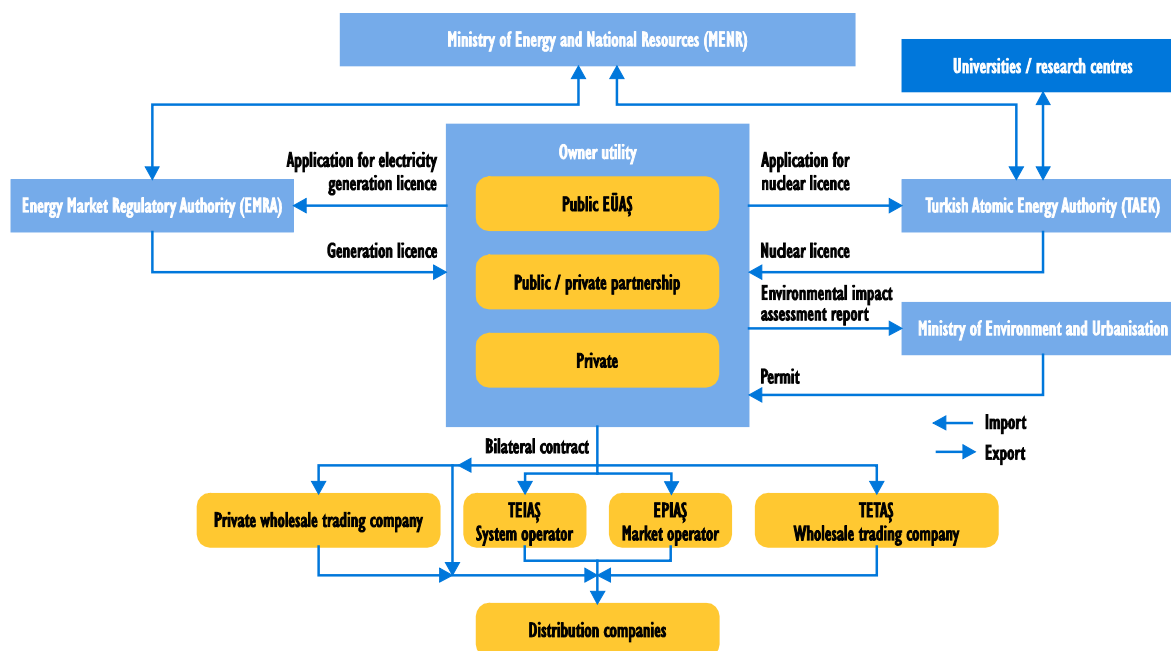
This draft Nuclear Law should be finalised, presented to Parliament and entered into force as soon as possible, as concrete steps for the start of the construction of nuclear plants are going ahead.

A specific issue is related to the handling of third-party liability. The IGA between Turkey and Russia indicates that the third-party liability for nuclear damage will be regulated in

compliance with the International Instruments to which Turkey adheres and the Turkish national laws and regulations. Turkey is a Contracting Party of the 1960 Paris Convention. It also signed and ratified the Amending Protocols of 1964 and 1982. The Amending Protocol of 2004 was signed and ratification is awaited for which a separate draft Law on Third Party Liability has been prepared. The responsibility of insuring the risks for the operation period of the project is with the project company (owner of the plant, Akkuyu JSC in this case). The details have not been specified in the IGA and need to be negotiated.

Turkey is party of a full range of International Instruments related to nuclear safety and security. It is active in the International Atomic Energy Agency (IAEA) and Organisation for Economic Co-operation and Development (OECD)'s 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 exists also with regulatory bodies of a number of countries. The different stakeholders involved in a nuclear project, as well as the institutional set-up and lines of responsibilities, are represented in Figure 10.1.

**Figure 10.1** Nuclear energy institutional landscape in Turkey

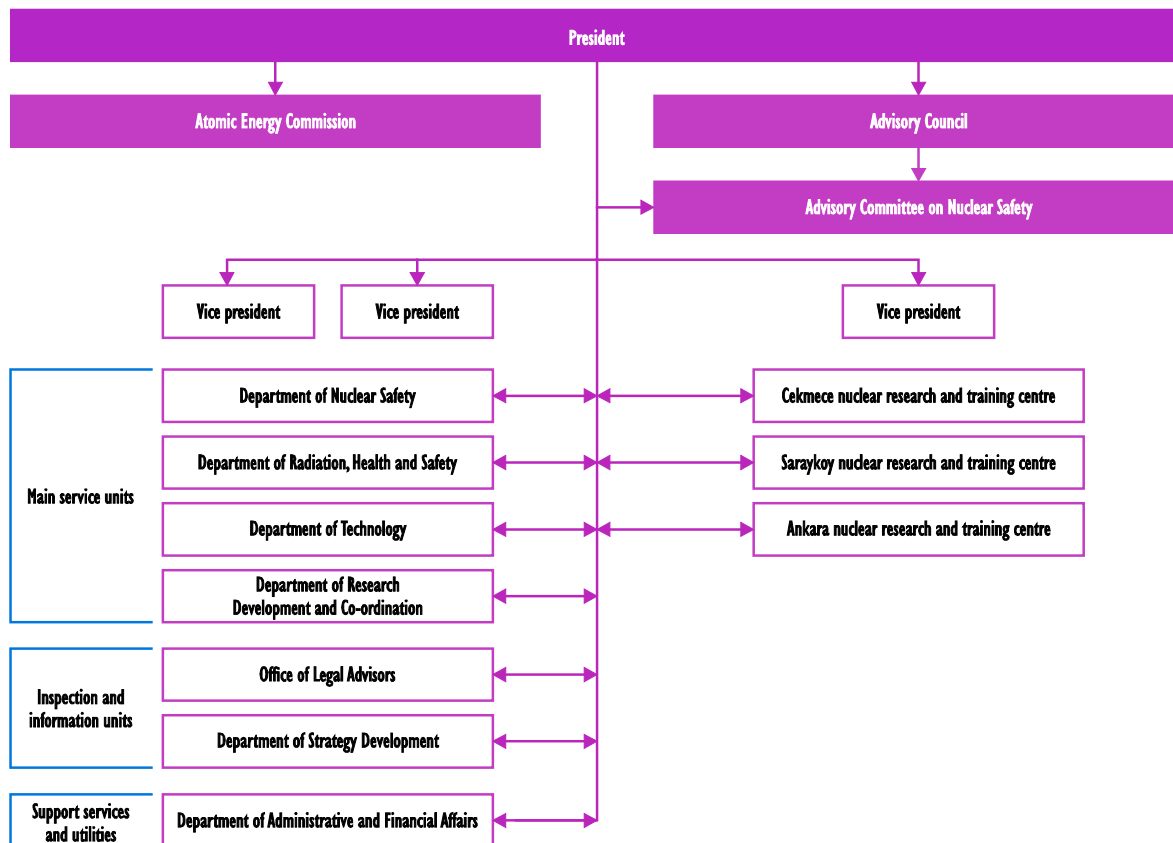


## NUCLEAR SAFETY

Historically, the function of the safety authority (nuclear regulatory body) in Turkey has been performed by the Turkish Atomic Energy Authority (TAEK). It was established in 1956 as the Atomic Energy Commission and was restructured in 1982. It still mixes regulatory functions (in particular as the nuclear regulatory body) with promotional activities such as technology, research and development. (Two research reactors were operated by TAEK; one is decommissioned and the other is undergoing refurbishment for seismic upgrade).

The draft nuclear law under preparation foresees the full separation and independence of the nuclear regulatory body function from the other duties and activities of TAEK. It will be important to ensure that, beyond the changes in structure, the means and resources of the safety authority will be commensurate with the new tasks associated with regulatory oversight and licensing of the construction and operation of nuclear power plants in Turkey.

**Figure 10.2** Structure of TAEK (since 1982)

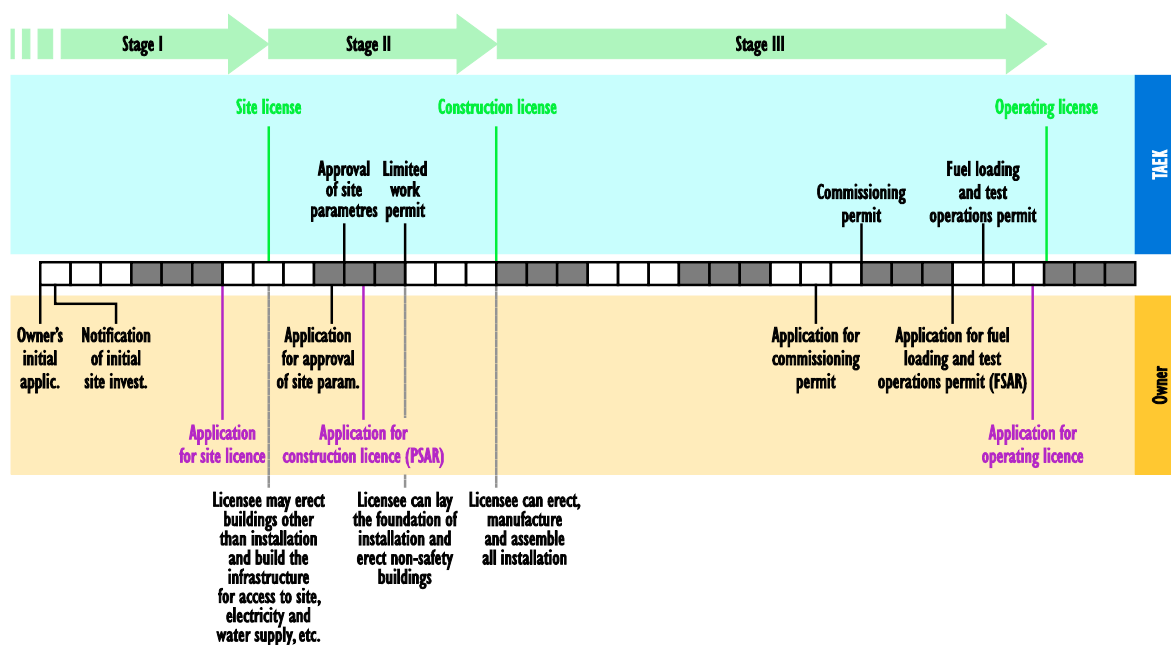


The ongoing licensing process of Akkuyu NPP is illustrated in Figure 10.3 and Box 10.1, showing the duties on the side of the plant owner, Akkuyu JSC, and the Safety Authority, currently within TAEK. Licensing is based on a set of applicable regulations, guides, codes and standards. Documents are prepared by the owner according to TAEK's requirements, but they mostly reflect the rules, codes and standards of the country of origin and the reference plant. The workload involved to become familiar with these rules, codes and standards and to give the approvals and licences in time for the planned construction schedule will drastically increase in the coming months. This represents a particular challenge, as the future licensing processes for the other two planned NPP projects will be totally different as they will need to be tailored to the country of origin and the owner and investor.

In case of different origins of the nuclear plants to be built in Turkey, the requirements for licensing and safety oversight are going to be more demanding. In 2015, the Nuclear Safety Department of TAEK had 76 staff to cover the full range of nuclear safety, security

and safeguards duties. Additional 20 to 40 people are expected to be recruited for the Akkuyu NPP licensing process, and 40 to 60 more depending on the developments for the Sinop NPP. While setting up an independent safety authority, existing competences of TAEK, for example its promotional activities, will need to be reorganised. This could be done under the umbrella of MENR, and become the seed for the development of a strong local competence pool of nuclear technology research and engineering. If appropriately separated from promotional activities, the creation of a Turkish Nuclear Safety Organisation (TNSO) can provide technical support to the Safety Authority.

**Figure 10.3** Licensing stages for NPPs in Turkey



**Box 10.1** Timelines for the construction and commissioning of the Akkuyu NPP

05/2010	Signature of the IGA
2010	Ratification by Parliaments
12/2010	Establishment of the Akkuyu JSC (owner and investor)
2011	Application for the environmental impact assessment and electricity generation licence
12/2014	Final decision on the environmental impact assessment by MEU
05/2016	Application for the construction licence
2015	Final decision on the electricity generation licence and signature of power purchase agreement
12/2017	Approval of the construction licence
2020-23	Start operation of units 1 to 4

## RADIOACTIVE WASTE MANAGEMENT AND DISPOSAL

Under Law No. 5710, the owner of the NPP shall be responsible for fuel supply, decommissioning and dismantling of the power plant at the end of its operational life.

Law No. 5710 gives responsibility to MENR and the Under-Secretariat of Treasury to establish a National Radioactive Waste Fund and a Decommissioning Fund in order to cover the costs related to the siting of the interim storage or final disposal area under the scope of waste management; construction, licensing, operation and decommissioning of storage facility; transport and processing of spent fuel or high-level radioactive waste to be stored in an interim storage area or to be disposed of in a final disposal area; conduct of research and development activities to provide management of radioactive wastes and the costs arising from dismantling the NPP. Procedures and principles regarding the establishment, financing and management of such funds shall be prepared by MENR and the Under-Secretariat of Treasury. The owner of the NPP shall be liable to pay USD cents 0.15/kWh into each of these funds.

The provisions of the Paris Convention on Third-Party Liability in the Field of Nuclear Energy dated 29 July 1960 and its amendments and other national and international regulations are applicable to Turkey.

## ASSESSMENT

Since the last IEA in-depth review in 2009, successful steps have been taken to proceed towards the construction of the first two nuclear plants in the country, fostered by the strong political support and direct involvement of the government. The roadmap for nuclear energy deployment is to have at least 10% of the electricity generation from nuclear in 2023 (or 5 GW of nuclear installed capacity at the Akkuyu site), the date of the centenary of the Republic of Turkey. Turkey is also planning the construction of a second nuclear power plant at the Sinop site. Turkey is expected to have at least 10 GW<sub>e</sub> installed nuclear capacity in the next 10-15 years.

After earlier failed attempts to organise bidding processes, Turkey found advantages in conducting direct negotiations with an Intergovernmental Agreement and using a BOO model for the Akkuyu NPP, both to initiate the project without having to go through a bidding process and to secure financing.

While the country is progressing towards the liberalisation of its electricity sector, specific *ad hoc* mechanisms are being used to foster “private” investment for the construction of capital-intensive, modern (Generation III) nuclear plants. The financing models proposed for the two most advanced nuclear projects (Akkuyu and Sinop), while at different stages of maturity, rely both on a PPA, adapted to the needs of Turkey and the respective investor(s)/supplier. The government of Turkey is keen to avoid taking major financial risks in the projects. According to publicly available information, the main financial risks associated with the Akkuyu project lies on the shoulders of the Akkuyu Joint Stock Company, and therefore indirectly for the present time with Russia. Some financial risks are shared by TETAŞ as purchaser, at a non-escalated price fixed at 50% of electricity produced during 15 years (see Chapter 8 on electricity), and by the Turkish government when it comes to deadlines in supplying the site and support services, including permits and authorisations, and related safety issues.

To date, the Department of Nuclear Safety (DNS) of Turkish Atomic Energy Authority (TAEK) has around 80 staff members. There is a plan to increase the staff by 20-40 people for the licensing of Akkuyu and 40-60 additional staff for Sinop licensing. DNS has been actively cooperating with IAEA and vendor country regulatory organizations in order to support its capacity building activities. Although, DNS has experience with regulating research reactors, it relies on the support from IAEA (peer reviews) and contracts with competent foreign Technical Safety Organisations (TSOs) in the field of regulating nuclear power plants.

The INIR (Integrated Nuclear Infrastructure Review) mission of the IAEA in 2013 recommended establishing a regulatory body without promotional responsibilities and independent from entities having responsibilities or interests that could unduly influence its decision making. TAEK needs to be separated from its promotional R&D functions. A draft law on nuclear energy is being prepared. It includes an effectively independent regulatory body; a clear delineation of responsibilities; and adequate provisions on licensing, inspection and enforcement, nuclear safety, emergency preparedness and response, transport of radioactive material, management of radioactive waste and spent fuel, decommissioning, nuclear security, civil liability for nuclear damage, safeguards and import/export controls.

The draft law on nuclear energy will set the policy for (long-term) radioactive waste management in Turkey and for the establishment and operation of the funds for nuclear decommissioning and waste management. This will include the establishment of a Radioactive Waste Management Authority or adoption of the radioactive waste management responsibility by TAEK after the separation of the nuclear regulatory authority function for all types and levels of radioactive waste (low-, intermediate- and high-level wastes). Turkey should complete the work to define a national policy and strategy for the front and back-end of the nuclear fuel cycle, including clarification of the long-term technical responsibility for the management and disposal of spent fuel or high-level waste.

The independent nuclear regulatory body will have to review, assess and license two plants of different models and from different suppliers. Site-specific licences will have to be issued at different stages of the projects. This will require highly competent and trained staff, in sufficient numbers, considering provisions in the IGAs mentioned above through which the government took the responsibility to “facilitate” the licensing and authorisation process. Besides the independent nuclear regulatory body, the Ministry of Environment and Urbanisation (MEU), as responsible authority for co-ordination of the EIA, is also involved in all nuclear-related decisions having an impact on the environment (from site selection and permitting, waste management, planning emergency situations, and others). MEU will need to secure the appropriate oversight.

For the Akkuyu NPP, 207 Turkish students are being sent to Russia for nuclear engineering education, given in the Russian language. In total, 600 Turkish students are supposed to be working in the operation staff of the Akkuyu plants. Beyond the “education” stage, specific training applied to the technologies of the individual plants will also be necessary. This can best be organised in close co-operation with the supplier/(foreign) operator of the plants. A plant-specific simulator should ideally be built on the sites of the plants to train operators and the nuclear regulatory body. More broadly and with a longer-term perspective, a fully-fledged competent nuclear industry base needs to be established in Turkey. The Nuclear Energy Project Implementation Department (NEPID) within MENR should have the responsibility of setting up the

adequate framework for this to happen. This should allow the possible longer-term transfer of responsibilities for the operation of the nuclear plants to Turkish personnel (ensuring also that all related technical documentation is translated to Turkish language). It would also be useful, within this framework, to create a Turkish “nuclear architect engineer” entity (enterprise) able to be the competent Turkish interface for the suppliers of nuclear technologies. In addition, this could help local servicing enterprises to find their niche on the Turkish (and wider) nuclear market.

TAEK has become the centre for nuclear education/training and nuclear R&D in Turkey, since the separation of its functions as nuclear regulatory authority. This function could be used as starting point for the creation of a nuclear education/training/research platform in Turkey, in co-operation with universities and MENR. It could also serve, if internal independence is organised, as the Turkish Technical Support Organisation, supporting the nuclear regulatory body (using the Finnish model where VTT is the national research centre, but an “independent” part serves also as the technical safety organisation within the nuclear regulatory body, allowing the shared use and management of laboratories and facilities).

As Turkey is launching an extensive nuclear programme, which will be in operation over a long period of time, it is critical to organise public information and participation programmes. Experience in other countries has shown the major impact this may have on the long-term viability of nuclear programmes and their assets. Sixty years of expected operation of nuclear plants is a very long time when it comes to the evolution of society. The Nuclear Regulatory Body, TAEK and MEU should be fully involved in this process.

## RECOMMENDATIONS

*The government of Turkey should:*

- *Proceed urgently towards the adoption of the draft Nuclear Law, leading to the full administrative independence of the nuclear regulatory authority (outside TAEK).*
- *Ensure that the nuclear regulatory body has the highest level of competence and the necessary resources. Consider wide support from outside competent organisations, including peer regulatory bodies and/or technical safety organisations with adequate experience, from the country of origin of the supplier and elsewhere.*
- *Strengthen the Ministry’s Nuclear Energy Project Implementation Department to become the driving force for building the Turkish nuclear industrial base, using TAEK as scientific base. Ensure an education/training/R&D programme for Turkish specialists, as a complement to suppliers training.*
- *Ensure from the early stages that information and public participation are included in all the necessary steps of development of the nuclear programme.*

## References

- WNA (World Nuclear Association), (2014), *Nuclear Power in Turkey*, WNA, London.
- EDAM (2011), *The Turkish Model for Transition to Nuclear Power*, Istanbul.

**PART III**  
**ENERGY TECHNOLOGY**





## 11. ENERGY TECHNOLOGY RESEARCH, DEVELOPMENT AND DEMONSTRATION

### Key data (2015 estimated)

**Government energy RD&D spending:** TRY 139 million or EUR 46.2 million

**Share of GDP:** 0.08%

**R&D per capita:** TRY 1.8 or EUR 0.6

### OVERVIEW

The Turkish government focuses on energy technology research and development (R&D) and innovation with a view to develop its manufacturing industry towards a high value-added and internationally competitive and energy-efficient production. The country has a solid foundation for energy engineering and research and a well-educated workforce at technical universities and institutions, notably at the Scientific and Technological Research Council of Turkey (TÜBİTAK), the country's leading R&D institution.

Energy has been prioritised for R&D and innovation by the Supreme Council for Science and Technology (SCST) and, in 2011, the National Energy R&D and Innovation Strategy was presented. For the implementation of the Strategy under the co-ordination of TÜBİTAK, the High-Level Prioritisation Group for Energy was set up and the Energy Efficiency Technology Roadmap prepared followed by the prioritised calls for R&D and innovation by TÜBİTAK. Following the 26th meeting of the SCST on energy, a number of national initiatives in energy R&D and innovation were launched.

### INSTITUTIONAL FRAMEWORK

Under the prime minister, several ministries and related institutions carry out activities in the area of R&D in energy technologies. The highest decision-making body for R&D and innovation policy is the **SCST**, which has initiated and is monitoring developments on national energy landmark projects as well as action items under the National Energy R&D and Innovation Strategy.

The **Ministry of Development (MoD)** is in charge of planning public investment related to basic R&D activities in universities and public institutions across all sectors. In addition to the preparation of the Technological Research Sector Investment Budget, MoD presents National Development Plans. The 10<sup>th</sup> National Development Plan for the years 2014-18 includes two transformation programmes on energy. The **Ministry of Economy (MoE)** provides Investment Incentive Certificates for the agriculture, mining, manufacturing, services and energy sectors.

The **Ministry of Science, Industry and Technology (MoSIT)** and affiliated **Scientific and Technological Research Council of Turkey (TÜBİTAK)** are the main R&D funding and

performing institutions. In the energy sector, the TÜBİTAK Marmara Research Centre (TÜBİTAK-MAM) and related Energy Institute conduct research activities through project funding and technical support from the Technological Research Sector Investment Budget. TÜBİTAK-MAM engages different governmental institutions (including those under the MENR) for different energy-related projects and programmes. TÜBİTAK is an autonomous institution and is governed by a scientific board whose members include scholars from universities and representatives from industry and other research institutions. TÜBİTAK is responsible for promoting, developing, organising, conducting and co-ordinating R&D in line with national targets and priorities. TÜBİTAK acts as an advisory agency to the Turkish government on science and research issues, and is the secretariat of the SCST. The meetings of the SCST, which are chaired by the prime minister, are attended by close to 20 ministers and deputy prime ministers and by over 100 senior officials. The SCST has convened periodically since 2004 on the basis of two meetings per year.

The **Ministry of Energy and Natural Resources (MENR)** and its General Directorate of Energy Affairs (GEDA) is tasked to monitor, evaluate, and co-ordinate technology RD&D activities in the field of energy. Its **General Directorate for Renewable Energy (GDRE)** is tasked with the evaluation of hydropower, wind, geothermal, solar, bioenergy and other renewable energy resources and analyses for the effective and efficient use of energy resources. It should also be noted that GDRE has undertaken key R&D projects in collaboration with TÜBİTAK-MAM Energy Institute, an example of which is the Monitoring and Forecasting System Development for Wind Generated Electrical Power in Turkey Project (RITM). In addition, GDRE is the secretariat of the Energy Efficiency Coordination Board. MENR's **Nuclear Energy Project Implementation Department (NEPID)** is responsible for the co-ordination, commissioning and preparation of technology infrastructure, undertaking or necessary studies. The **Turkish Atomic Energy Authority (TAEK)** carries out activities to direct the national industry towards nuclear energy technology. The **General Directorate of Mineral Research and Exploration (MTA)** conducts and participates in mining, exploration and geological research projects. MTA provides services of exploration, research, analysis, infrastructure and databases.

Lignite producer **General Directorate of Turkish Coal Enterprises (TKİ)** conducts and participates in national and international projects on the clean coal technologies, particularly coal preparation and enrichment, coal gasification, production of alternative products from coal (humic and fulvic acid, organomineral fertiliser and others).

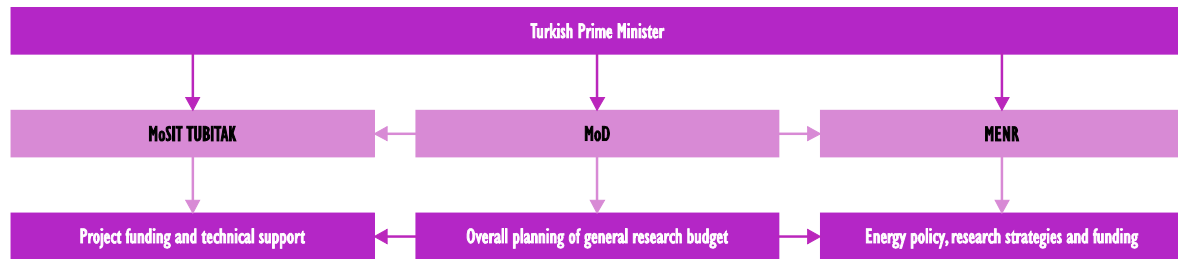
**Electricity system operator TEİAŞ** carries out several projects in the field of electricity transmission R&D in collaboration with other institutions.

**The National Boron Research Institute (BOREN)** provides insight into innovative initiatives in the research, development and commercialisation of boron products and technologies.

The **Technology Development Foundation of Turkey (TTGV)** is a non-profit foundation which brings together 24 private-sector organisations, five public institutions, 11 umbrella organisations and 15 individuals. TTGV is the first and only public-private partnership to support R&D and innovation in Turkey. It was established through the signing of an international loan agreement by the Republic of Turkey and the World Bank. TTGV set up the Green Energy Accelerator Fund with USD 10 million to promote the commercialisation of energy R&D results.

The 26 **regional development agencies** provide technical support for studies by local authorities; improve co-operation between the public and private sectors and non-governmental organisations (NGOs); and ensure effective use of resources and R&D strategies. Development agencies provide funding for R&D in energy efficiency, clean production and renewable energy. Industry, universities and NGOs all benefit from their funds.

**Figure 11.1** The main institutional framework of energy R&D in Turkey



## POLICIES, PRIORITIES AND EVALUATION

The new framework for energy R&D policy was set in 2010. Energy was designated a priority area for R&D and innovation by the prime minister. Energy is a focus sector of Turkey's National Science, Technology and Innovation Strategy (2011–16). On the basis of the strategy, TÜBİTAK developed subsector R&D strategies and in 2011 the National Energy R&D and Innovation Strategy of Turkey was presented. It prioritises R&D and innovation in the areas of energy efficiency, electricity production from renewable energy sources, clean coal technologies, and clean energy production and consumption. The National Energy R&D and Innovation Strategy was co-ordinated by TÜBİTAK with stakeholders from public and private sectors and was adopted at the 23rd meeting of SCST in 2011. The vision of the Strategy is to “*utilise energy resources effectively and efficiently without compromising environmental quality and welfare based on the knowledge and innovative products that are produced in the field of energy technologies,*” under the 21 action items and following objectives:

- provision of support to energy R&D and innovation projects in line with national needs
- advancement of the R&D and innovation capacity in the field of energy
- diffusion and effective utilisation of the results of energy R&D projects
- mobilisation of governance mechanisms for energy R&D and innovation.

The High-level Prioritisation Group in Energy was formed to identify technology sub-fields in the energy sector. The Group involved stakeholders from academia with leading expertise in energy, business leaders of the energy sector, governmental representatives, and non-governmental organisations for energy efficiency. Energy efficiency in buildings and industry are among the top priorities.

An Energy Efficiency Technology Roadmap was co-ordinated by TÜBİTAK on the basis of the multiple stages of Delphi statement collection, expert meeting, Delphi survey, data analysis, and focal group meeting. In total, 230 different contributions were received

during the various stages of the co-ordination process. The Roadmap was finalised by adopting the milestones directed to seven targets.

Since 2012, TÜBİTAK has been opening calls in the priorities of the energy sector in three different research and technology development programmes, which are coded as the TÜBİTAK Programmes 1003, 1511 and 1007, the target audiences of which are the academia, private sector, and consortiums to address public needs (see below section on programmes and funding).

At the 26th meeting of the Supreme Council (SCST) in 2013 dedicated to energy national R&D and innovation, several new initiatives and landmark projects for the energy sector were launched. These projects are under the joint responsibility of MENR and TÜBİTAK, in association with the Ministry of Development, the Ministry of Economy, and the Ministry of Food, Agriculture and Livestock. The national energy landmark projects are as follows:

- development of National Design and Manufacturing Capability for Thermal Power Plants (MILTES)
- development of Hydroelectric Energy Technologies (MILHES)
- development of Wind Energy Power Plant Technologies (MILRES)
- development of Solar Energy Technologies (MILGES)
- development of National Design and Manufacturing Capability for Thermal Power Plant Flue Gas Treatment Technologies (MILKAS)
- development of Coal Gasification and Liquid Fuel Production Technologies.

At the 26th meeting of the SCST, a Decree on Increasing Energy Efficiency was adopted which focuses on the development of support mechanisms and a regulatory framework for the diffusion of energy-efficient technologies. Under the decree, the Energy Efficiency Programme (VAP) has been initiated. At the 29th meeting of the SCST in 2016, the previous Decree on the National Nuclear Technology Development Programme was completed and a new Decree for the period 2016 to 2023 was adopted.

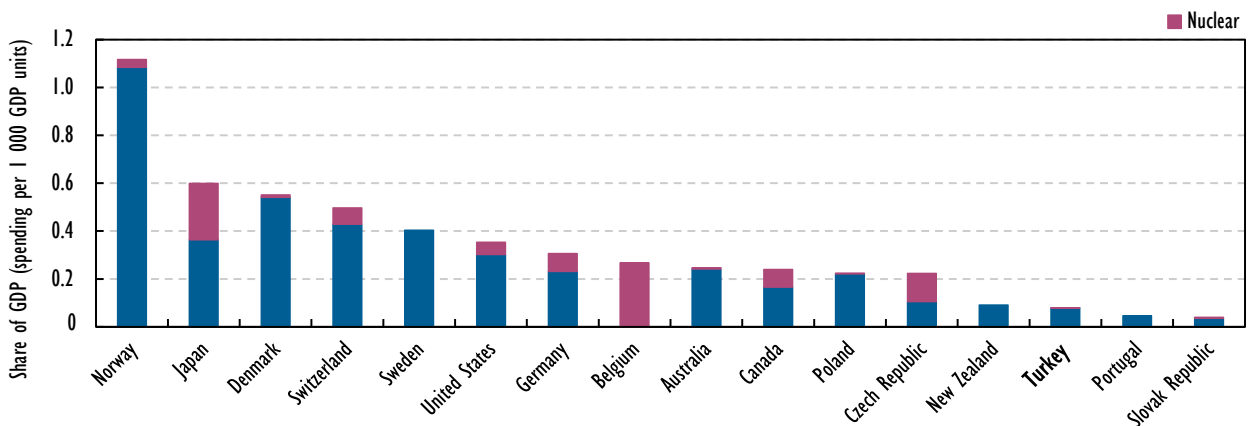
The 10th National Development Plan 2014–18 contains national R&D targets with a view to foster the structural transformation of the Turkish manufacturing sector and to establish high value-added and technology-intensive production and diversified export structure for its products, technologies and services. Two of the transformation programmes under the Plan are the Energy Production Based on Local Resources Programme and the Energy Efficiency Development Programme, both prepared in collaboration with the Energy Security and Efficiency Expert Commission. The Mid-term Programme of the Plan further emphasises the importance of security of energy supply, local production of renewable energy technologies, and other targets. Annual programmes are adopted for the development of energy infrastructure.

The MENR Strategic Plan 2015-19 contains a priority on energy technology R&D. Building on a Strength Weaknesses Opportunities and Threats (SWOT) analysis, MENR announces a new energy R&D strategy and objectives to move from academic results to commercialisation, to improve control and monitoring of projects and better co-operation of government, universities and industry through the following actions:

- prepare MENR R&D Strategy and Critical Technology Plan to guide R&D projects in co-operation with universities, research institutions and the industry sector
- create a roadmap and an inventory for domestic equipment development in energy and natural resources sectors
- increase the rate of domestic technological contribution in manufacturing by 2019 to 30%, and by 45% in renewable power plants
- establish an Energy and Natural Resources Institute with its own R&D co-ordination department.

## R&D PROGRAMMES AND FUNDING

**Figure 11.2** Government energy R&D spending as a ratio of GDP in IEA member countries, 2015



Note: Data are estimated for 2015.

## DIRECT FUNDING

In 2015, the total budget for public energy R&D amounted to TRY 139 million or EUR 46.2 million, an increase from TRY 129.7 million in 2014. The share of government energy RD&D spending in GDP was 0.008%. In 2014, energy R&D spending as a share of total R&D spending (TRY 1 717.8 million) was 7.55%. For 2016, it is projected that the energy R&D spending will reach TRY 208.3 million or EUR 65 million.

In total, over 60 support programmes for R&D and innovation in Turkey, excluding scholarships, cover a wide spectrum ranging from basic and applied research to commercialisation, intellectual property rights, and investment.

TÜBİTAK supports a large number of programmes, including those for the preparation of university R&D strategies with specialisation in the areas of competences, technology development, entrepreneurship, and seed capital. Dedicated energy funding is given through call-based programmes of TÜBİTAK (namely, 1003, 1511 and 1007) with a total budget of TRY 109 million. This includes the funding programmes of the Academic R&D Funding Directorate (ARDEB), Technology and Innovation Grant Programmes Directorate (TEYDEB), and Public Research Grant Committee (KAMAG), which are provided to academic and private-sector researchers, entrepreneurs, and/or research consortiums, including public research institutes. The budget excludes the research activities of the TUBITAK-MAM Energy Institute that are funded from other public sources.

MENR's Energy Sector Research and Development Projects Support Programme (ENAR) had a budget of EUR 21 million up during 2011-14. The MENR aims to spend EUR 106 million by 2015, a significant increase in annual spending.

**Table 11.1** The main energy research programmes in Turkey

Programme	Funding organisation	Budget (in euros)	Time period
Research and Development Projects Support Programme	MENR	21 million	2010-14
TTGV R&D Projects Support Programme – Technology Development Project Support	MEN	Up to 771 000	Ongoing
TTGV Environmental Projects Support Programme – Environmental Technologies Support	TTGV	Up to 771 000	Ongoing
TTGV Environmental Projects Support Programme – Energy Efficiency Support	TTGV	77 000 to 771 000	Ongoing
TTGV R&D Projects Support Programme – Advanced Technology Projects	TTGV	771 000 to 2.31 million	2010 onwards
Industrial Thesis Support Programme (SAN-TEZ)	MoSIT	N/A	2007 onwards
TÜBİTAK R&D Support Programmes	TÜBİTAK	34 million	Ongoing

Sources: TTGV, TÜBİTAK (2011), *Ulusal Enerji Ar-Ge ve Yenilik Stratejisi*, TÜBİTAK (2010), *National Science, Technology and Innovation Strategy (2011–2016)*, and SETIS (2016), *Energy Research Knowledge Centre, Turkey*, MENR data provided 2015.

## INDIRECT FUNDING

The Ministry of Industry and Trade, through its bounded institution KOSGEB, provides funds for small and medium-sized enterprises (SMEs).

The Technology Development Foundation of Turkey (TTGV) provides loan funds and financing for start-ups. International and public funding is allocated through TTGV and its two environmental programmes, *i)* Environmental Technologies Support and *ii)* Energy Efficiency Support; and through its three R&D project support programmes: *i)* R&D Project Supports Technology Development Project Support; *ii)* Commercialisation Project Support; and *iii)* Advanced Technology Projects Support Programme (ITEP). A Credit Guarantee Fund provides guarantees on SME loans for facilitating risk-sharing and lending among Turkish banks.

The Ministry of Finance provides tax reductions for the R&D expenditures of private firms.

The government promotes investment through a large range of special tax incentives at R&D centres with a minimum of 30 full-time-equivalent R&D personnel, and at Design Centres with a minimum of 10 employees (Law of R&D Activities Support No. 5746). The government also provides tax incentives to companies operating in Technology Development Zones, which are designed to attract investments in high-tech fields and to support R&D activities under the Law on Technology Development Zones (TDZ) No. 4691 up to the end of 2023.

## TÜBİTAK

TÜBİTAK and its directorates – Academic R&D Funding Directorate (ARDEB) and Technology and Innovation Grant Programmes Directorate (TEYDEB) – manage R&D project funding through three main call-based programmes: *i)* Support Programme for Research, Technological Development and Innovation Projects in Priority Areas (TÜBİTAK 1003), *ii)* Public Institutions Research and Development Projects Support Programme (TÜBİTAK 1007) and *iii)* Support Programme for Research, Technological Development and Innovation Projects in Priority Areas (TÜBİTAK 1511)

TÜBİTAK's Funding Directorate ARDEB provides R&D funding to researchers from universities and implements the programmes TÜBİTAK 1003 and TÜBİTAK 1007. TEYDEB Directorate provides R&D funding to private-sector firms and entrepreneurs and implements TÜBİTAK 1511 programme. In terms of technology focus, TÜBİTAK calls have been opened for renewable energies (solar, wind, bioenergy), clean coal technologies, energy efficiency in buildings and industry, hydrogen and fuel cells, energy storage, electrical power conversion, transmission and distribution, and electric vehicles.

The TÜBİTAK-MAM Energy Institute and its three units (Advanced Energy Technologies, Power Electronics and Control Technologies, and Electrical Power Technologies) carry out research in technologies such as gas, thermal plants, fuel cells, fuels, combustion and gasification, vehicles, batteries, conversion technologies, power systems analysis, planning and information systems, and automation.

Large firms can apply for grants from TÜBİTAK to finance up to 60% of the project's total expenses. SMEs can receive higher support rates. The grants can cover personnel costs, materials to be used, outsource consultancy, travel and general expenses. Projects that involve collaboration are eligible for higher budgets.

## MENR-GDRE

MENR-GDRE has two energy R&D programmes: MILRES (the National Wind Energy Systems Development and Prototype Turbine Production Project) and the National Boiler Project, which develops highly efficient boiler designs (such as fluidized bed, gasification, etc.) for better utilisation of indigenous low-quality lignite resources. Both programmes are based on the collaboration of TÜBİTAK, universities, research centres and industry, and aim to commercialise Turkish academic R&D into domestic technologies supported by local content requirements and renewable support schemes.

The Middle East Technical University has research and development centres for both wind and solar power technologies. Istanbul Technical University's Institute of Energy conducts research on all lines of renewable energy technology. Ege University's Solar Energy Institute focuses on wind, solar and other renewable hybrid electricity systems. The Ege University Institute has manufactured solar photovoltaic cells and wind power turbines. Although the university uses locally manufactured equipment to meet part of its own energy needs, there seems to be a long way to go before commercialisation. The Ostim Renewable Energy and Environment Technologies Group works in collaboration with university institutes in order to promote Ostim Industrial District companies.

MENR-GDRE implements the Energy Efficiency Programme (VAP) under the Decree on Increasing Energy Efficiency which was adopted at the 26th meeting of the SCST as well as the Energy Efficiency Law of Turkey. Under VAP, firms that have an energy



consumption of at least 1 000 toe may be funded for energy efficiency projects that have a payback period of maximum five years. The VAP programme supports deployment.

MENR funds basic and applied RD&D and technology transfer projects through the Energy Sector Research-Development Projects Support Programme (ENAR) in the area of clean energy technologies, electromechanical equipment manufacturing technologies for energy, energy-efficient technologies, emission mitigation technologies, conversion technologies, energy transmission and distribution technologies.

## MoSIT

The Ministry of Science, Industry and Technology (MoSIT) supports public-university-industry co-operation through the Industrial Thesis Support Programme. It also supports firms in experimental development projects with their university partners. Depending on their size, companies can receive support of 65% to 85% of the total project budget. Support for energy-related R&D projects focuses on energy efficiency in industry and renewable energy (mainly solar).

## INTERNATIONAL CO-OPERATION

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In the framework of the IEA Technology Collaboration Programmes (TCPs), Turkey participates as a Contracting Party in four TCPs related to energy efficiency or renewables (Energy Storage, Hybrid and Electric Vehicles, Photovoltaic Power Systems and Solar Heating and Cooling). In addition, the Greater City Municipality of Ankara participates as a sponsor in the TCP on Energy in Buildings and Communities. TÜBİTAK and MENR participate to the IEA Committee on Energy Research and Technology (CERT).

Turkey also participates in the International Partnership on Energy Efficiency (IPEEC), the Asia-Pacific Economic Cooperation's Energy Working Group (APEC-EWG), the G20 Energy Sustainability Working Group which it co-chaired in 2016 under the People's Republic of China's G20 Presidency.

On 12 May 2014, the Agreement concerning granting the status of Associate Member of the European Organisation for Nuclear Research (CERN) has been signed between Turkey and CERN, after having had the status of observer at CERN since 1961. A co-operation agreement between TAEK and CERN had already been signed regarding the development of scientific and technical co-operation in high-energy physics in 2008. Associate membership will provide important opportunities for Turkish scientists and Turkish industry regarding training, career development and industrial collaboration.

During 2007-14, Turkey has been able to access EU energy RD&D funding, under the EU Seventh Framework Programme and the instruments for Pre-Accession. For 2014-20, Turkey is associated to the EU Horizon 2020 programme. TÜBİTAK is engaged in the Solar ERA-Net and the Geothermal ERA-Net programmes with joint programming.

## ASSESSMENT

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The government of Turkey considers energy technology development as critical to economic growth, competitiveness and domestic business development. Commercialisation and technology transfer have become priority objectives.

The government's long-term R&D policy is guided by the National Science, Technology and Innovation Strategy for the period 2011-16, prepared by the Scientific and Technological Research Council of Turkey (TÜBİTAK). The strategy makes the energy sector one of the key sectoral priorities. The effectiveness of R&D funding and the monitoring of the programmes are key areas of attention. The plan to revise the energy R&D strategy in the coming years provides an opportunity for the government to monitor, evaluate and align its energy RD&D policy and funding with the new energy technology objectives of the MENR Strategic Plan 2015-19.

The highest decision-making body for R&D and innovation policy is the SCST, which is under the authority of the prime minister. TÜBİTAK is the main player in the R&D space, as an institution of the Ministry of Science, Industry and Technology and, through its Marmara Research Centre (TÜBİTAK-MAM) and Energy Institute, it is involved in the policy setting, funding and direct engagement with governmental institutions for different energy-related projects and programmes. MENR-GDRE has two energy R&D funding programmes focused on renewable energies and clean coal technologies. Despite being tasked to co-ordinate and supervise some energy technology RD&D projects and programmes, MENR has not carried out any evaluation or monitoring after 2010. In the area of nuclear energy R&D, the Nuclear Energy Project Implementation Department under MENR and the Turkish Atomic Energy Authority (TAEK) are involved in the preparation of the technological infrastructure.

In light of the institutional set-up, the co-ordination of the innovation and energy RD&D policies is a crucial success factor to strengthen the energy RD&D results. In this context, the 2012 collaboration protocol signed by MENR, MOSIT, and TÜBİTAK is welcome and co-operation on funding and priority setting should be actively fostered.

Energy R&D funding priorities are set by the Supreme Council and implemented through technology roadmap studies and funding calls by TÜBİTAK. Its funding priorities are aligned with the energy strategy priorities and focus on fossil fuels (gas, coal and biomass combustion and gasification, thermal plant technologies), fuel cells, battery and energy storage, power electronics and control technologies such as vehicles, batteries and power systems analysis and planning technologies) and renewable energy. Funding also focuses on energy efficiency projects (for priorities identified in its Energy Efficiency Technology Roadmap), in line with the Energy Efficiency Law and the Energy Efficiency Strategy.

Next to TÜBİTAK funding through three main calls for proposed programmes, a large range of investment incentives in the form of tax breaks, is given to projects using local content, and for technology development zones and R&D technology centres. In comparison to other member countries, the OECD rates Turkey's overall RD&D and innovation performance as below average (OECD, 2012). The number of patents remains low and RD&D spending focuses on non-resource-based industries. Energy R&D is developed in the universities and has yet to bridge the gap to commercialisation. Commendably, TÜBİTAK has recently established a Technology Transfer Office Support Programme. The government should further leverage the private business participation in commercialisation through innovation incubators, seed and venture funds for energy technology.

Of particular note since the last in-depth review is the forthcoming change in the organisation of nuclear research in Turkey. The restructuring of the nuclear authority will result in TAEK focusing on nuclear RD&D in the future. The country's nuclear strategy

implies significant technical capabilities and skills, in particular in the areas of licensing, safety and waste management, and international technology co-operation. Public energy RD&D priorities and funding should be well aligned to those new needs. Turkey is advised to step up its engagement in international collaboration – through its work with the International Atomic Energy Agency (IAEA) and new opportunities with the Nuclear Energy Agency (NEA) of the OECD, and bilateral industry co-operation.

For decades TAEK has been the centre for nuclear education/training, as well as for nuclear R&D in Turkey. This function, after the separation of the nuclear regulatory authority function, could be used as a starting point for the creation of a nuclear education/training/research platform in Turkey, in co-operation with universities and MENR. It could also serve, if internal independence is organised, as the Turkish technical support organisation, supporting the Nuclear Regulatory Body (using the Finnish Model where VTT is the national research centre, but an “independent” part serves also as the technical support of the Nuclear Regulatory Body, allowing the shared use and management of laboratories and facilities). MENR-NEPID could become the driving force for building the Turkish nuclear industrial base, using TAEK as scientific base. The government should ensure a fully-fledged education/training/R&D programme for Turkish specialists, as a complement to plant-specific suppliers training.

Turkey has been active in the IEA TCPs, notably in energy improvements in buildings (Buildings and Communities, Energy Storage), transport (Hybrid and Electric Vehicles), and renewables (Hydrogen, Photovoltaics). For 2014-20, Turkey is associated to the new EU Horizon 2020 programme and has an opportunity to increase its collaboration, provided eligible projects can be identified.

## RECOMMENDATIONS

*The government of Turkey should:*

- *Ensure strong co-ordination of energy research policies and funding among the ministries by encouraging the creation of research networks and memoranda of understanding among R&D bodies.*
- *Ensure an appropriate level of public funding of Turkey’s core energy research programme in line with Turkey’s ambitions under the 2023 Vision. Regularly monitor, assess the level of public and private funding and outcomes of energy RD&D programmes, and provide data to the IEA data centre.*
- *Leverage business participation in the priority setting, co-funding and evaluation of energy R&D and commercialisation results, by encouraging dedicated technology platforms for the collaboration of industry, academia and the government. Bridge the gap to commercialisation through innovation incubators, seed and venture funds for energy technology, and private SME start-up facilities.*
- *Align energy R&D capabilities with the nuclear energy programme by capacity building of skilled personal for nuclear safety, waste management and developing a dedicated nuclear energy RD&D programme.*
- *Maintain and expand the engagement in international energy technology co-operation, such as the IEA Technology Collaboration Programmes, the International Atomic Energy Agency and OECD’s Nuclear Energy Agency and other programmes of key interest to Turkey.*

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**PART IV**  
**ANNEXES**



## ANNEX A: ORGANISATION OF THE REVIEW

### REVIEW CRITERIA

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The main objective of the review is to provide the Ministry of Energy and Natural Resources (MENR) with an assessment of the country's energy policy and to set out recommendations for developing energy policies that can contribute to sustainable economic development, based on the IEA Shared Goals.

The Shared Goals are of particular relevance for the conduct of the country reviews, as they provide a common yardstick for assessing member-country energy policy achievements. 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 conducted by the IEA. The Shared Goals are presented in Annex C.

### REVIEW TEAM

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The IEA in-depth review team visited Ankara from 8 to 12 December 2014. Over the course of the week, the team met with government officials, regulators, stakeholders in the public and private sectors as well as other organisations and interest groups, each of whom helped the team identify the challenges facing energy policy makers in Turkey.

The members of the team were:

*IEA member countries*

Ms. Florence Tordjman, France (team leader)

Mr. Michael Schultz, Germany

Mr. James Rose, United Kingdom

Ms. Isabel Soares, Portugal

*European Commission*

Mr. Roderic van Voorst, DG Energy

*OECD Nuclear Energy Agency*

Mr. Marc Deffrennes

*International Energy Agency*

Mr. Kijune Kim

Mr. Carlos Fernandez Alvarez

Ms. Sylvia Beyer



The review has benefited from the co-operation, assistance and information provided by the many experts involved in the review process. The IEA secretariat and the review team wishes to express its gratitude to the Ministry of Energy and Natural Resources (MENR), Mr. Sefa Sadık Aytekin, Deputy Under-Secretary and his staff, notably Mr. Öztürk Selvitop, Ms. Halime Semerci and to the team at the General Directorate for Energy Affairs and other general directorates of MENR for their input and support throughout the review process. The team is thankful to Ms. Semerci for co-ordinating the review and for the support by her colleagues, Ms. Sevgi Gülay Taşdelen, Mr. Kutlu Pekel, Mr. Fırat Çağlar Köylü, and Mr. Cem Doğan throughout the review visit in Ankara in December 2014. The team also wishes to thank the OECD Permanent Representation of the Republic of Turkey in Paris, notably Ms. Elif Atalay and Mr. Ismail Aydil as well as Mr. Hasan Özkoc, Senior Energy Expert at the EU Delegation in Ankara for their support. Special thanks to the Energy Market Regulatory Authority (EMRA) and the transmission system operator TEİAŞ's dispatch and control centre for inviting the team to their headquarters and to the 6th World Forum on Energy Regulation in 2015. The IEA Secretariat thanks the many other organisations involved in the review week and for their close co-operation during the entire review and the many colleagues at the regulator EMRA and TÜSIAD offices.

Ms. Sylvia Beyer (IEA) managed the review and drafted all chapters with the exception of coal and nuclear energy. Mr. Marc Defrennes (OECD/NEA) completed Chapter 10 on nuclear energy and Mr. Carlos Fernandez (IEA) Chapter 6 on coal.

The report would not have been concluded without the fruitful discussions, comments and input provided by the review team members cited above and many IEA colleagues. The report has benefited from the valuable comments from Mr. Aad van Bohemen, Ms. Carry Pottinger, Mr. Simone Landolina, Mr. Kijune Kim, Mr. Samuel Thomas, Mr. Bryant Tyler, Ms. Toril Bosoni, Mr. Markus Klingbeil, Mr. Paolo Frankl, Mrs. Maki Yamaguchi, Mr. Marc-Antoine Eyl-Mazzega, Mr. Rodrigo Pinto Scholtbach, Mrs. Kate Dourian, Mrs. Peg Mackey, Ms. Costanza Jacazio and Mr. Heymi Bahar, as well as former IEA experts and staff members, Mr. Suleyman Bulut and Mr. Rod Jansen.

Special thanks go to the IEA Secretariat with regard to the data, publication and editing. Importantly, the report has received valuable support with timely and comprehensive data from Ms. Roberta Quadrelli, Mr. Remi Gigoux, Ms. Soyeon Park, Ms. Yun Ji Suh on the IEA energy statistics and energy balances, including the RD&D and the Energy Efficiency Indicators Databases.

Mr. Oskar Kvarnström and Mr. Bertrand Sadin ensured the preparation of the design of the report with figures, maps and tables. The IEA Communication and Information Office (CIO), in particular, Ms. Rebecca Gaghen, Ms. Astrid Dumond, Mr. Sadin and Ms. Madgalena Sanocka provided essential support towards the report's production and launch. The author thanks in particular for the time and dedication of Ms. Viviane Consoli, Ms. Therese Walsh and Ms. Rebecca Gaghen who ensured the editorial finalisation of the report.

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## ORGANISATIONS VISITED

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Prime Ministry Privatisation Administration (PA)  
Under-Secretariat of Treasury (TT)  
Ministry of Energy and Natural Resources (MENR)  
Ministry of Environment and Urbanisation (MEU)  
Ministry of Foreign Affairs (MFA)  
Ministry of Science, Industry and Technology (MSIT)  
Ministry of Transport, Maritime Affairs and Communication  
Turkish Competition Authority (TCA)  
Energy Markets Regulatory Authority (EMRA)  
Turkish Atomic Energy Authority (TAEK)  
Turkish Petroleum Corporation (TPAO)  
Mineral Research & Exploration General Directorate (MTA)  
Turkish Coal Enterprises (TKI)  
Petroleum Pipeline Corporation (BOTAS)  
Electricity Generation Company (EÜAŞ)  
Turkish Electricity Transmission Corporation (TEİAŞ)  
Turkish Electricity Trading and Contracting Corporation (TETAŞ)  
United Nations Development Program (UNDP)  
World Bank (WB)  
European Investment Bank (EIB)  
European Bank for Reconstruction and Development (EBRD)  
Delegation of the European Union to Ankara  
International Finance Corporation (IFC)  
Kreditanstalt für Wiederaufbau (KfW)  
Turkish Industry and Business Association (TÜSIAD)  
Turkish Privatisation Administration (TPA)  
Turcas Enerji Holding (TURCAS)  
Turkish Scientific and Technical Research Council (TÜBİTAK)  
Energy Traders Association (ETD)  
Shell Upstream Turkey  
SOLER  
Association of Electricity Producers (EÜD)



**ANNEX B:**  
**ENERGY BALANCES**  
**AND KEY STATISTICAL DATA**



		Unit: Mtoe						
SUPPLY		1973	1990	2000	2010	2013	2014	2015E
<b>TOTAL PRODUCTION</b>		<b>15.53</b>	<b>25.82</b>	<b>25.86</b>	<b>32.40</b>	<b>31.50</b>	<b>31.35</b>	<b>32.15</b>
Coal		5.21	12.37	12.49	17.52	15.64	16.20	13.45
Peat		-	-	-	-	-	-	-
Oil		3.59	3.61	2.73	2.65	2.54	2.61	2.66
Natural gas		-	0.18	0.53	0.56	0.44	0.40	0.32
Biofuels and waste <sup>1</sup>		6.45	7.21	6.51	4.56	3.57	3.49	3.25
Nuclear		-	-	-	-	-	-	-
Hydro		0.22	1.99	2.66	4.46	5.11	3.50	5.75
Wind		-	-	0.00	0.25	0.65	0.73	0.99
Geothermal		0.05	0.43	0.68	1.97	2.64	3.52	4.76
Solar/other <sup>2</sup>		-	0.03	0.26	0.43	0.91	0.90	0.95
<b>TOTAL NET IMPORTS<sup>3</sup></b>		<b>8.72</b>	<b>27.77</b>	<b>49.98</b>	<b>73.53</b>	<b>86.03</b>	<b>90.12</b>	<b>99.50</b>
Coal Exports		-	-	-	-	0.01	0.09	0.17
Coal Imports		0.01	4.21	9.31	13.85	17.50	19.39	22.12
Coal Net imports		0.01	4.21	9.31	13.85	17.49	19.30	21.95
Oil Exports		0.84	1.88	1.29	6.41	7.48	7.00	7.81
Oil Imports		9.68	23.13	30.54	36.96	40.67	40.87	49.89
Oil Int'l marine and aviation bunkers		-0.13	-0.30	-0.92	-1.59	-2.23	-3.60	-4.10
Oil Net imports		8.71	20.94	28.33	28.97	30.95	30.27	37.98
Natural Gas Exports		-	-	-	0.53	0.56	0.52	0.51
Natural Gas Imports		-	2.68	12.05	31.31	37.26	40.55	39.70
Natural Gas Net imports		-	2.68	12.05	30.78	36.70	40.03	39.19
Electricity Exports		-	0.08	0.04	0.17	0.11	0.23	0.26
Electricity Imports		-	0.02	0.33	0.10	0.64	0.68	0.64
Electricity Net imports		-	-0.06	0.29	-0.07	0.53	0.45	0.38
<b>TOTAL STOCK CHANGES</b>		<b>0.11</b>	<b>-0.87</b>	<b>0.12</b>	<b>0.74</b>	<b>-0.59</b>	<b>0.07</b>	<b>-1.97</b>
<b>TOTAL SUPPLY (TPES)<sup>4</sup></b>		<b>24.36</b>	<b>52.72</b>	<b>75.96</b>	<b>106.66</b>	<b>116.94</b>	<b>121.54</b>	<b>129.68</b>
Coal		5.15	16.87	22.51	32.17	32.17	35.88	35.34
Peat		-	-	-	-	-	-	-
Oil		12.48	23.40	30.40	31.51	33.46	32.80	39.03
Natural gas		-	2.86	12.63	31.39	37.55	40.19	39.22
Biofuels and waste <sup>1</sup>		6.45	7.21	6.51	4.56	3.93	3.56	3.25
Nuclear		-	-	-	-	-	-	-
Hydro		0.22	1.99	2.66	4.46	5.11	3.50	5.75
Wind		-	-	0.00	0.25	0.65	0.73	0.99
Geothermal		0.05	0.43	0.68	1.97	2.64	3.52	4.76
Solar/other <sup>2</sup>		-	0.03	0.26	0.43	0.91	0.90	0.95
Electricity trade <sup>5</sup>		-	-0.06	0.29	-0.07	0.53	0.45	0.38
<b>Shares in TPES (%)</b>								
Coal		21.1	32.0	29.6	30.2	27.5	29.5	27.3
Peat		-	-	-	-	-	-	-
Oil		51.3	44.4	40.0	29.5	28.6	27.0	30.1
Natural gas		-	5.4	16.6	29.4	32.1	33.1	30.2
Biofuels and waste <sup>1</sup>		26.5	13.7	8.6	4.3	3.4	2.9	2.5
Nuclear		-	-	-	-	-	-	-
Hydro		0.9	3.8	3.5	4.2	4.4	2.9	4.4
Wind		-	-	-	0.2	0.6	0.6	0.8
Geothermal		0.2	0.8	0.9	1.8	2.3	2.9	3.7
Solar/other <sup>2</sup>		-	0.1	0.3	0.4	0.8	0.7	0.7
Electricity trade <sup>5</sup>		-	-0.1	0.4	-0.1	0.5	0.4	0.3

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.

2015 estimated data are only available for energy supply and economic indicators.

Unit: Mtoe

DEMAND	Unit: Mtoe						
FINAL CONSUMPTION	1973	1990	2000	2010	2013	2014	2015E
<b>TFC</b>	<b>19.86</b>	<b>40.07</b>	<b>57.85</b>	<b>77.75</b>	<b>85.22</b>	<b>85.75</b>	..
Coal	2.97	7.53	10.85	14.12	11.11	10.57	..
Peat	-	-	-	-	-	-	..
Oil	9.54	20.37	26.13	28.39	31.09	30.54	..
Natural gas	-	0.71	4.91	13.13	18.98	19.40	..
Biofuels and waste <sup>1</sup>	6.45	7.21	6.46	4.44	3.68	3.26	..
Geothermal	0.05	0.36	0.62	1.39	1.46	1.49	..
Solar/other <sup>2</sup>	-	0.03	0.26	0.43	0.80	0.80	..
Electricity	0.85	3.87	8.25	14.62	16.87	17.67	..
Heat	-	-	0.39	1.23	1.23	2.03	..
<b>Shares in TFC (%)</b>							
Coal	14.9	18.8	18.7	18.2	13.0	12.3	..
Peat	-	-	-	-	-	-	..
Oil	48.0	50.8	45.2	36.5	36.5	35.6	..
Natural gas	-	1.8	8.5	16.9	22.3	22.6	..
Biofuels and waste <sup>1</sup>	32.5	18.0	11.2	5.7	4.3	3.8	..
Geothermal	0.2	0.9	1.1	0.0	0.0	0.0	..
Solar/other <sup>2</sup>	-	0.0	0.0	0.0	0.0	0.0	..
Electricity	4.3	9.6	14.3	18.8	19.8	20.6	..
Heat	-	-	0.7	1.6	1.4	2.4	..
<b>TOTAL INDUSTRY<sup>6</sup></b>	<b>4.28</b>	<b>13.71</b>	<b>23.26</b>	<b>29.92</b>	<b>31.29</b>	<b>30.94</b>	..
Coal	1.14	4.50	8.83	7.29	5.78	5.54	..
Peat	-	-	-	-	-	-	..
Oil	2.59	6.18	8.23	8.13	7.88	6.02	..
Natural gas	-	0.67	1.76	6.51	8.26	8.83	..
Biofuels and waste <sup>1</sup>	-	-	-	-	-	-	..
Geothermal	-	-	-	-	-	-	..
Solar/other <sup>2</sup>	-	0.01	0.10	0.13	0.28	0.28	..
Electricity	0.55	2.35	3.96	6.65	7.86	8.24	..
Heat	-	-	0.39	1.23	1.23	2.03	..
<b>Shares in total industry (%)</b>							
Coal	26.7	32.8	38.0	24.4	18.5	17.9	..
Peat	-	-	-	-	-	-	..
Oil	60.4	45.1	35.4	27.2	25.2	19.4	..
Natural gas	-	4.9	7.6	21.7	26.4	28.6	..
Biofuels and waste <sup>1</sup>	-	-	-	-	-	-	..
Geothermal	-	-	-	-	-	-	..
Solar/other <sup>2</sup>	-	0.1	0.4	0.4	0.9	0.9	..
Electricity	12.9	17.2	17.0	22.2	25.1	26.6	..
Heat	-	-	1.7	4.1	3.9	6.5	..
<b>TRANSPORT<sup>4</sup></b>	<b>4.38</b>	<b>9.22</b>	<b>11.76</b>	<b>14.63</b>	<b>19.56</b>	<b>20.57</b>	..
<b>OTHER<sup>7</sup></b>	<b>11.20</b>	<b>17.14</b>	<b>22.83</b>	<b>33.20</b>	<b>34.37</b>	<b>34.24</b>	..
Coal	1.30	3.01	2.02	6.83	5.34	5.03	..
Peat	-	-	-	-	-	-	..
Oil	3.11	5.02	6.25	5.91	4.42	4.55	..
Natural gas	-	0.04	3.11	6.41	10.41	10.19	..
Biofuels and waste <sup>1</sup>	6.45	7.21	6.46	4.43	3.28	3.11	..
Geothermal	0.05	0.36	0.62	1.39	1.46	1.49	..
Solar/other <sup>2</sup>	-	0.02	0.17	0.30	0.52	0.52	..
Electricity	0.29	1.49	4.22	7.92	8.94	9.35	..
Heat	-	-	-	-	-	-	..
<b>Shares in other (%)</b>							
Coal	11.6	17.6	8.8	20.6	15.5	14.7	..
Peat	-	-	-	-	-	-	..
Oil	27.7	29.3	27.4	17.8	12.9	13.3	..
Natural gas	-	0.2	13.6	19.3	30.3	29.8	..
Biofuels and waste <sup>1</sup>	57.6	42.0	28.3	13.4	9.5	9.1	..
Geothermal	0.4	2.1	2.7	0.0	0.0	0.0	..
Solar/other <sup>2</sup>	-	0.1	0.7	0.9	1.5	1.5	..
Electricity	2.6	8.7	18.5	23.9	26.0	27.3	..
Heat	-	-	-	-	-	-	..

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.

2015 estimated data are only available for energy supply and economic indicators.

Unit: Mtoe

DEMAND							
ENERGY TRANSFORMATION AND LOSSES	1973	1990	2000	2010	2013	2014	2015E
<b>ELECTRICITY GENERATION<sup>8</sup></b>							
Input (Mtoe)	2.77	10.78	22.66	36.85	40.61	45.89	..
Output (Mtoe)	1.07	4.95	10.74	18.16	20.65	21.67	22.33
Output (TWh)	12.43	57.54	124.92	211.21	240.15	251.96	259.69
<b>Output Shares (%)</b>							
Coal	26.1	35.1	30.6	26.1	26.6	30.3	28.3
Peat	-	-	-	-	-	-	-
Oil	51.4	6.9	7.5	1.0	0.7	0.9	0.8
Natural gas	-	17.7	37.0	46.5	43.8	47.9	38.6
Biofuels and waste <sup>1</sup>	1.6	-	0.2	0.2	0.4	0.5	0.6
Nuclear	-	-	-	-	-	-	-
Hydro	20.9	40.2	24.7	24.5	24.7	16.1	25.8
Wind	-	-	-	1.4	3.1	3.4	4.4
Geothermal	-	0.1	0.1	0.3	0.6	0.9	1.3
Solar/other <sup>2</sup>	-	-	-	-	0.1	0.1	0.2
<b>TOTAL LOSSES</b>	<b>4.19</b>	<b>11.57</b>	<b>18.05</b>	<b>26.89</b>	<b>29.80</b>	<b>33.14</b>	<b>-0.04</b>
of which:							
Electricity and heat generation <sup>9</sup>	1.70	5.83	11.53	17.46	18.63	22.12	..
Other transformation	1.50	3.17	1.78	2.87	3.66	3.25	..
Own use and transmission/distribution losses <sup>10</sup>	1.00	2.57	4.74	6.56	7.52	7.77	..
<b>Statistical Differences</b>	<b>0.30</b>	<b>1.07</b>	<b>0.06</b>	<b>2.02</b>	<b>1.91</b>	<b>2.65</b>	<b>..</b>
<b>INDICATORS</b>	<b>1973</b>	<b>1990</b>	<b>2000</b>	<b>2010</b>	<b>2013</b>	<b>2014</b>	<b>2015E</b>
GDP (billion 2010 USD)	165.08	348.93	500.18	731.14	846.26	870.92	905.62
Population (millions)	38.07	55.12	64.25	73.00	75.77	76.62	77.48
TPES/GDP (toe/1000 USD) <sup>11</sup>	0.15	0.15	0.15	0.15	0.14	0.14	0.14
Energy production/TPES	0.64	0.49	0.34	0.30	0.27	0.26	0.25
Per capita TPES (toe/capita)	0.64	0.96	1.18	1.46	1.54	1.59	1.67
Oil supply/GDP (toe/1000 USD) <sup>11</sup>	0.08	0.07	0.06	0.04	0.04	0.04	0.04
TFC/GDP (toe/1000 USD) <sup>11</sup>	0.12	0.11	0.12	0.11	0.10	0.10	..
Per capita TFC (toe/capita)	0.52	0.73	0.90	1.07	1.12	1.12	..
CO <sub>2</sub> emissions from fuel combustion (MtCO <sub>2</sub> ) <sup>12</sup>	52.8	127.1	201.2	265.4	284.0	307.1	..
CO <sub>2</sub> emissions from bunkers (MtCO <sub>2</sub> ) <sup>12</sup>	0.4	0.9	2.8	4.8	6.9	11.0	..
<b>GROWTH RATES (% per year)</b>	<b>73-90</b>	<b>90-00</b>	<b>00-10</b>	<b>10-12</b>	<b>12-13</b>	<b>13-14</b>	<b>14-15</b>
TPES	4.6	3.7	3.5	5.3	-1.1	3.9	6.7
Coal	7.2	2.9	3.6	4.3	-8.2	11.5	-1.5
Peat	-	-	-	-	-	-	-
Oil	3.8	2.7	0.4	3.1	-0.1	-2.0	19.0
Natural gas	-	16.0	9.5	8.9	0.8	7.1	-2.4
Biofuels and waste <sup>1</sup>	0.7	-1.0	-3.5	-9.8	5.9	-9.2	-8.7
Nuclear	-	-	-	-	-	-	-
Hydro	13.7	2.9	5.3	5.7	2.7	-31.6	64.6
Wind	-	-	55.7	41.7	29.0	12.8	35.6
Geothermal	13.7	4.7	11.1	6.6	17.9	33.6	35.0
Solar/other <sup>2</sup>	-	25.1	5.1	33.3	18.1	-0.4	5.5
TFC	4.2	3.7	3.0	6.0	-2.4	0.6	..
Electricity consumption	9.3	7.9	5.9	6.5	1.7	4.7	..
Energy production	3.0	0.0	2.3	-2.6	2.5	-0.5	2.6
Net oil imports	5.3	3.1	0.2	4.9	-2.9	-2.2	25.5
GDP	4.5	3.7	3.9	5.4	4.2	2.9	4.0
TPES/GDP	0.1	0.1	-0.4	-0.1	-5.1	1.0	2.6
TFC/GDP	-0.3	0.1	-0.8	0.6	-6.3	-2.2	..

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.

2015 estimated data are only available for energy supply and economic indicators.



## Footnotes to energy balances and key statistical data

1. Biofuels and waste comprises 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. Other includes tide, wave and ambient heat used in heat pumps.
3. In addition to coal, oil, natural gas and electricity, total net imports also include peat, biofuels and waste and trade of heat.
4. Excludes international marine bunkers and international aviation bunkers.
5. Total supply of electricity represents net trade. A negative number in the share of TPES indicates that exports are greater than imports.
6. Industry includes non-energy use.
7. Other includes residential, commercial and public services, agriculture/forestry, fishing and other non-specified.
8. Inputs to electricity generation include inputs to electricity, CHP and heat plants. Output refers only to electricity generation.
9. 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 33% for nuclear and solar thermal, 10% for geothermal and 100% for hydro, wind and solar photovoltaic.
10. Data on “losses” for forecast years often include large statistical differences covering differences between expected supply and demand and mostly do not reflect real expectations on transformation gains and losses.
11. Toe per thousand US dollars at 2010 prices and exchange rates.
12. “CO<sub>2</sub> emissions from fuel combustion” have been estimated using the IPCC Tier I Sectoral Approach from the 2006 IPCC Guidelines. In accordance with the IPCC methodology, emissions from international marine and aviation bunkers are not included in national totals. Projected emissions for oil and gas are derived by calculating the ratio of emissions to energy use for 2013 and applying this factor to forecast energy supply. Projected emissions for coal are based on product-specific supply projections and are calculated using the IPCC/OECD emission factors and methodology.

## 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 hydro power, 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, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States.

**ANNEX D: GLOSSARY AND ABBREVIATIONS**

b/d	barrels per day
bcm	billion cubic metres
CCGT	combined-cycle gas turbine
CCCB	Climate Change Coordination Committee
CCS	carbon capture and storage
CHP	combined production of heat and power
EEA	European Economic Area
EIA	environmental impact assessment
EECB	Energy Efficiency Coordination Board
EU	European Union
GDEA	General Directorate of Energy Affairs
GDRE	General Directorate of Renewable Energy
GDP	gross domestic product
KOSGEB	Small and Medium Enterprises Development Organization
OECD	Organisation for Economic Co-operation and Development
TWGMA	Turkish White Good Manufacturer Association
TSE	Turkish Standard Institute
TTGV	Technology Development Foundation of Turkey
YEKDEM	Feed-in-Tariff

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## Energy Policies of IEA Countries

# Turkey

Since the last International Energy Agency (IEA) review of Turkey's energy policies, the country's reliance on natural gas use has grown along with rising oil and gas imports, leaving the Turkish economy increasingly exposed to the volatility in oil and gas prices. Turkey aims to promote sustainable economic growth - the IEA urges the government to set a longer term energy policy agenda for 2030. However, owing to declining global liquefied natural gas prices, Turkey now has an opportunity to reduce its single supplier dependence, build a competitive gas market, and move ahead with its plans to create a regional gas hub.

Turkey's power sector reforms have attracted private investment and fostered economic growth and energy access. Integration into a regional gas and electricity trade framework is moving along as a result of the first interconnection of Turkey with the European electricity grid and the construction of the Trans-Anatolian Natural Gas Pipeline that will deliver gas from the Caspian to Turkey and the European Union.

In that context, the IEA urges Turkey to complete the liberalisation of its electricity and gas markets in order to attract critically needed investment. The review also notes that Turkey should set up independent transmission system operators, competitive wholesale markets, and foster resilient and modern gas and electricity infrastructure.

This review analyses the energy policy challenges facing Turkey and provides recommendations for further policy improvements. It is intended to help guide the country towards a more secure, sustainable and affordable energy future.