

Suat Bumin  
Energy Market Regulatory Authority of Turkey  
Ankara, Turkey

## ENERGY IN TURKEY

### **Abstract**

Because of its limited energy resources, Turkey is heavily dependent on imported oil and gas. 73 % of the world's proven oil reserves and 72 % of the world's proven gas reserves are located in the surrounding regions of Turkey: Middle East, Caspian Region and Russia. This makes Turkey a crucial bridge between energy rich regions and Europe.

There are major oil and gas pipelines going through Turkey and additional pipelines are being constructed or are being planned. There is some production of lignite which is used in power plants and industry.

Turkey's natural energy resources are quite diversified; with quite abundant coal reserves.

Energy forecasts show that primary energy demand would be 117 million TOE in 2005 and 156 million TOE in 2010.

Oil has the biggest share (39%) in total primary energy consumption, while natural gas has a share of 21% and increasing due to the recent diversification efforts of energy resources.

Turkey has about 1% of the total world hydroelectric potential and a considerable potential for electricity generation from wind.

As of early 2004, Turkey had electric power generating capacity of around 32,000 megawatts (MW), and was building 13,000 MW more.

Since adoption of Electricity Market Law in February 2001, there were significant changes towards liberalisation of power generation market and distribution in the country. Privatization of generation assets is envisaged to start in 2006.

The Electricity Market Law set the stage for new supporting laws and regulations as well as new organization of the market: the Energy Market Regulation Agency (EMRA), that oversees the power, natural gas markets, oil markets and liquefied petroleum gases market, including setting tariffs, issuing licenses, and assuring competition; the Energy Market Regulatory Board, which runs the EMRA; the Energy Market Licensing Regulation and the Electricity Market Tariffs Regulation; 4-phase approach towards electric energy

market competition that aims towards establishment of Market Financial Reconciliation Centre for balancing and settlements.

### ENERGIJA U TURSKOJ

#### **Sažetak**

Zbog svojih ograničenih izvora energije, Turska je vrlo ovisna o uvozu nafte i plina. 73 posto svjetski rezervi nafte i 72 posto svjetskih rezervi plina nalazi se u okolnim područjima Turske, što tu zemlju čini ključnim mostom između područja bogatih energijom i Europe. Kroz Tursku prolaze glavni naftovodni i plinovodni pravci, a trenutno su u izgradnji ili se planiraju i drugi plinovodni pravci. Prisutna je i proizvodnja lignita koji se koristi u proizvodnji električne energije i u industriji.

Prirodni energetske resursi Turske su raznoliki s prilično velikim zalihama ugljena.

Energetske prognoze pokazuju da će 2005. godine potrošnja primarne energije biti na razini od 117 milijuna, a 2010. godine 156 milijuna ekvivalentnih tona nafte.

U potrošnji primarne energije najveći je udio nafte od 39 posto, dok je udio prirodnog plina od 21 posto u porastu zbog nedavnih nastojanja diversifikacije izvora energije.

Turska raspolaže s oko 1 posto svjetskog hidro-potencijala te ima značajan potencijal za proizvodnju električne energije iz vjetra.

Početakom 2004. godine Turska je imala oko 32 000 MW kapaciteta za proizvodnju električne energije i još 13 000 MW u izgradnji.

Od usvajanja Zakona o tržištu električne energije, u veljači 2001. godine, dogodile su se značajne promjene prema liberalizaciji tržišta u proizvodnji i distribuciji električne energije u zemlji. Privatizacija proizvodnih kapaciteta treba početi 2006 godine.

Zakon o tržištu električne energije postavio je osnove za nove pripadajuće zakone i regulative kao i za novu organizaciju tržišta: Regulatorna agencija za tržište energije (Energy Market Regulation Agency - EMRA), koja nadgleda tržišta električne energije, prirodnog plina, nafte i ukapljenog plina, uključujući tu i utvrđivanje tarifa, izdavanje dozvola i osiguranje uvjeta konkurencije; Regulacijsko vijeće za tržište energije koje upravlja Agencijom; Propisi o izdavanju dozvola za djelovanje na energetskom tržištu; Propisi o utvrđivanju tarifa na tržištu energije; 4-fazni pristup kompetitivnom energetskom tržištu električne energije koji ima za cilj uspostavljanje Centra za tržišna financijska poravnanja, za bilanciranje i rješavanje sporova.

## **1. GENERAL INFORMATION OF TURKEY**

The Republic of Turkey has population of 72 million. All of Turkey's area in Asia except for about 5% in the far northwest that is separated from the rest of the country by the Dardanelles and Bosphorus straits, and the Sea of Marmara. Turkey is bordered by Bulgaria, the Black Sea, and Georgia to the north, Armenia and Iran to the east, Iraq, Syria, and the Mediterranean Sea to the south, and Greece and the Aegean Sea to the west. The capital city, Ankara, is located in the north central part of the country, Turkey's currency, New Turkish Lira, has an exchange rate of about 1.35 lira to the U.S. dollar (as of October 2005).

## **2. ENERGY OVERVIEW**

Because of its limited energy resources, Turkey is heavily dependent on imported oil and gas. There are major oil and gas pipelines going through Turkey and additional pipelines are being constructed or are being planned. There is some production of lignite which is used in power plants and industry.

### **2.1. Oil**

As much as 73 % of the world's proven oil reserves and 72 % of the world's proven gas reserves are located in the surrounding regions of Turkey: Middle East, Caspian Region and Russia. This makes Turkey a crucial bridge between energy rich regions and Europe, which spends approximately 300 billion dollars per year for the imported energy resources.

Therefore, Turkey is commonly referred to as 'The Energy Bridge between the East and the West'. While developing projects to meet its own energy demand, Turkey also wants to serve as the most feasible route on the way to the European and world markets.

Turkey's natural energy resources are quite diversified; hard coal, lignite, asphaltite, oil, natural gas, hydro, geothermal, wood, animal and plant wastes, solar and secondary energy resources such as coke and briquettes are produced and consumed. Although Turkey's oil and natural gas reserves are limited, coal reserves are quite abundant.

Energy forecasts show that primary energy demand would be 117 million TOE in 2005 and 156 million TOE in 2010. However, share of indigenous productions to meet the energy demand of Turkey are expected to be 42 % in 2005 and 38 % in 2010. Over the years, the share of indigenous production will decrease progressively and Turkey will need to import a total 96 million TOE of energy in 2010.

In Turkey, lignite has the biggest share in total primary energy production with 43 percent. The complex geology that carries high risks inhibited exploration and for this reason oil

has a share of 13 percent and natural gas has a share of 1 percent in primary energy production.

Oil has the biggest share (39%) in total primary energy consumption, while natural gas has a share of 21%. Due to the efforts in energy resources diversification, use of natural gas that has been introduced into Turkish economy recently, is rapidly growing.

Turkey has proven reserves of approximately 229 million barrels of oil, most of which are located in the Hakkari Basin in the southeast of Turkey. These fields consist of small deposits which have tended to become depleted over the years, increasing extraction costs. However, approximately 20 oil companies in Turkey have been exploring for new deposits in southern and southeastern Turkey, in the European provinces, and in the Black Sea shelf region. There are also potential offshore deposits in the Aegean Sea, but Greece has conflicting claims on this area.

The annual oil consumption of Turkey is approximately 30 million tons. While 82% of total consumption, corresponding to 24.6 million tons, is supplied from imports, only 18% is supplied from indigenous production. Major suppliers of crude oil to Turkey are Saudi Arabia, Iran, the UAE, Libya and Russia.

The 99 percent of Turkey's proven oil reserves lay under Southeast Anatolian territories. Again the major part of Turkey's proven natural gas reserves lay essentially in Thrace and in less quantity in Southeastern Anatolia.

The company Turkish Petroleum Refineries (TUPRAS), which has four main refining complexes, dominates refining in Turkey: Batman in the Southeast, Aliaga near Izmir, Izmit near Istanbul and the Central Anatolian Refinery at Kirikkale near Ankara. Turkey's only private refinery is ATAS, near Mersin on the Mediterranean coast, a joint venture of British Petroleum, Shell and local Turcas Petrolculuk. The total refining capacity of these five refineries is 32 million tons/year. Recently, TUPRAS was partially privatized through IPO with 51% sold to investors for about \$ 8 billion.

The other major refinery company in Turkey is Anadolu Tasfiyehanesi AS (ATAS), which is partly owned by ExxonMobil (51%), Shell (27%), BP Amoco (17%), and the Turkish company Marmara Petrol (5%).

Main pipelines of Turkey are: Iraq - Turkey Crude Oil Pipeline with a capacity of 70.9 million tons/year, Batman-Dörtyol Pipeline with a capacity of 3.5 million tons/year and Yumurtalik - Kirikkale Pipeline with a capacity of 5 million tons/year.

The main oil company is the government-owned Turkish State Petroleum Company (TPAO), which accounts for approximately 80% of Turkey's oil production. The rest is mainly produced by Royal Dutch Shell and ExxonMobil.

As Turkey's economy has expanded in recent years, the consumption of oil has increased. This growth in consumption is expected to continue at a rate of about 2-3% per year.

Turkey expects that much of its future oil will come from countries in central Asia, such as Azerbaijan and Kazakhstan. TPAO is a partner in oil ventures in these countries.

Petrol Ofisi AS (POAS), the formerly state-owned petroleum distribution company, is now mostly privatized; 51% of POAS was sold to investors in 2000 in an IPO that raised \$1.26 billion for the Turkish government. POAS currently operates most gas stations in Turkey.

In July 2002, the Turkish government announced its intention to sell its remaining 25.8% share in POAS to Dogan Petrol Yatirimlari AS, the majority shareholder.

Total product output from Turkey's refineries and upward trend over the last decade, except in 1999 when a major earthquake severely damaged the Izmit refinery.

## **2.2. Natural Gas**

In Turkey, natural gas transmission is the responsibility of a state-owned company, BOTAS (Petroleum Pipeline Corporation). BOTAS handles oil and gas pipelines, and also has the monopoly of import, distribution, pricing, and sale of natural gas in Turkey.

Turkey's natural gas consumption is expected to grow rapidly, quadrupling within the next 20 years, with 1,400 bcf consumption projected for the year 2020. Getting this capacity by domestic production would require \$4.5 billion in foreign investment over about next 20 years.

Presently, the largest share of Turkey's imported natural gas comes from Russia, much of it via the newly-completed Blue Stream Pipeline, which provides Turkey with 14.1 trillion cubic feet (Tcf) of gas over the period of a 25-year agreement that began in 2002. However, Turkey is trying to diversify its sources, and is considering Turkmenistan, Kazakhstan, Uzbekistan, Egypt, Nigeria, Iraq, and Iran as possible sources. Under a 25-year deal signed in 1996, Turkey plans to buy 3 billion cubic meters (bcm) of natural gas per year from Iran through 2007, after which the amount will increase to 10 bcm annually. In December 2001, gas deliveries from Iran finally began, after repeated delays. Gas purchases from Iran could total \$23 billion over the arrangement period.

## **2.3. Coal**

Turkey has both hard coal and lignite deposits. The hard coal deposits are mostly located in the western part of the country, in the Zonguldak Basin, which has more than 700 million metric tons of workable reserves, about 80% of which can be coked. Lignite deposits are widespread and plentiful; reserves are estimated to more than 8 billion metric tons (7th largest in the world), most of which is economically mineable, though only about 7% has a heat content of more than 3,000 kilocalories per kilogram. About 40% of the Turkey's lignite is in the Elbistan Basin.

The Turkish Hard Coal Institute operates five underground mines in Turkey, and is the only hard coal production entity in the country. The two most important lignite fields in Turkey -- the Afsin-Elbistan and Sivas-Kangal coal fields -- are owned by TEAS and operated by private companies under contract. Even though there is significant production of lignite and some production of hard coal in Turkey, not enough coal is mined to meet the demand. As a result, Turkey imports more than 8.5 million tons of hard coal each year, mostly from Australia, the United States, South Africa, and Russia. Coal is used mainly for electric power, steelmaking, and cement production. About 75% of the Turkey's lignite is used as a fuel source for electric power production.

### ***2.4. Hydroelectric and Other Renewable Energy***

#### **2.4.1. Hydroelectric Power**

Turkey has about 1% of the total world hydroelectric potential. There are many rivers in Turkey and five separate watersheds. The Persian Gulf watershed in eastern Turkey includes the Tigris River (known in Turkey as the Dicle River) and the Euphrates River (known in Turkey as the Fırat River), which flow southwest into Iraq and eventually merge and empty into the Bay of Basra at the northern end of the Persian Gulf. The Aras/Caspian watershed in eastern Turkey includes the Aras River, which flows eastward and whose waters eventually empty into the Caspian Sea. The Black Sea watershed covers much of the northern Turkey, and includes the Turkey's longest river, the Kizilirmak. The Mediterranean watershed covers much of southwestern Turkey, where rivers either flow south to the Mediterranean Sea or west to the Aegean Sea. The fifth watershed covers the region around the Marmara Sea, which includes several smaller rivers.

Devlet Su İşleri (DSİ), the General Directorate of State Hydraulic Works, is Turkey's state water agency, and has the responsibility for developing all of water resources in the country.

DSİ has the mission of planning, designing, constructing, and operating Turkey's dams and hydroelectric power plants, as well as domestic water and irrigation projects.

Turkey is considered to have a large amount of wind, geothermal, and solar power potential. In January 2001, Turkey announced approval for 17 wind and one geothermal BOT power plants, and in December 2004 the Parliament's Industry and Energy commission approved a draft bill encouraging renewables. Currently, wind power capacity in Turkey is around 19 MW, with units located all over the country. Potential for wind power may be as high as 120,000 MW, with particularly attractive areas for wind power located along Turkey's west coast and in southeastern Anatolia. Solar energy is mainly used for roof-top hot water. Geothermal energy potential is estimated at around 35 GW. In March 2004, the World Bank granted Turkey a \$200 million Energy Reform Loan to encourage the use of renewable energy in the country.

#### 2.4.2. Wind Energy

Turkey has a considerable potential for electricity generation from wind. A study carried out in 2002 concluded that Turkey theoretically had wind energy potential of nearly 90,000 MWe and an economical wind energy potential of about 10,000 MWe. The most promising region is in northwest Turkey, including the area around the Sea of Marmara.

Turkey is now encouraging the construction of BOT wind power plants by private power developers. The first wind power facility in Turkey, the Ares wind farm, was commissioned in November 1998, and is located near the city of Izmer in western Turkey. That facility has 12 wind turbines with total capacity of 7.2 MWe, and is owned by Gucbirliigi Holding, Inc. The Bozcaada wind farm, also near Izmer, went into operation in 2000; it has 17 turbines with total capacity of 10.2 MWe, and is owned by Demirer Holding, Inc.

Turkey has a goal of deriving 2% of its electricity from wind power. In 2000, the Government of Turkey had offered a tender for up to 390 MWe of electricity from wind power. About 25 potential sites for wind power projects had been identified.

#### 2.4.3. Geothermal Energy

Turkey has significant potential for geothermal power production, and it possesses one-eighth of the world's total geothermal potential. Much of this potential is of relatively low enthalpy that is not suitable for electricity production but is still useful for direct heating applications.

Turkey presently has one operating geothermal power plant, a 20 MWe facility in the Denizli-Kizildere geothermal field in the southwestern Turkey province of Denizli. The facility includes nine production wells, and also has an integrated liquid carbon dioxide (CO<sub>2</sub>) and a dry ice factory that can produce a combined total of 40,000 metric tons of the two products per year. Another 20 MWe power production unit is being planned for this facility.

There are six other geothermal fields that have been identified, all in far southwest Turkey that may be suitable for geothermal power production: the Germencik-Aydin field in Aydin Province, the Çanakkale-Tuzla field in Çanakkale Province, the Izmir-Sefirihisar field in Izmir Province, the Aydin-Salvatli field in Aydin Province, the Kutahya-Simav field in Kutahya Province, and the Dikili-Bergama field in Izmir Province.

#### 2.4.4. Electric Power

As of early 2004, Turkey had electric power generating capacity of around 32,000 megawatts (MW), and was building another 13,000 MW. With a young and growing population, low per capita electricity consumption, rapid urbanization and generally strong economic growth, Turkey has for nearly two decades been one of the fastest growing

power markets in the world. Prior to Turkey's economic difficulties in 2001, projections by Turkey's Electricity Generating and Transmission Corporation (TEAS), a public company which owns and operates 15 thermal and 30 hydroelectric plants generating 91 percent of Turkey's electricity, had indicated that rapid growth in electricity consumption would continue over the next 15 years. Now, though, power demand growth looks much weaker, with demand hit hard by Turkey's 2001 economic crisis, and with a surplus of generating capacity for the time being. Still, the government anticipates the need for significant increase in power generating capacity in the coming years, possibly 54,000 MW by 2020, requiring billions of dollars in foreign investment.

In February 2001, Turkey passed the long-anticipated Electricity Market Law, which paves the way for a free market in power generation and distribution in the country. Among other things, the legislation (which President Sezer signed into law in July 2001) calls for: 1) TEAS to be unbundled into separate generation, distribution, and trade companies; 2) trade and generation companies to be privatized, while transmission remains in the hands of state; and 3) a new regulatory board to be set up which will oversee the Turkish power market, set tariffs, issue licenses, and prevent uncompetitive practices. The new law makes uncertain the fate of dozens of BOT and TOR (transfer-of-operating-rights) power projects. In May 2002, the Energy Ministry put six power plants (Orhaneli, Hamitabat, Catalagzi, Soma A-B, and Ergil) and nine distribution grids on sale, transferring their assets to the country's privatization authority. Overall, however, progress has been slower than expected in implementing the 2001 Law. Current plans for Turkey's power distribution and generation network envisage their privatization by the end of 2006, with the country being divided into 17-20 power distribution areas.

In July 2004, the Turkish government backed off after introducing a draft bill that the World Bank, EU and others criticized for weakening the Turkey's power and gas liberalization program. The bill would have strengthened the role of the Turkish Power Trading Company (TETAS), which owns 84 percent of the sector, and possibly made it easier for the state to acquire BOT power plants.

In addition to increasing domestically generated electricity through construction of new power plants, Turkey is looking outside its borders to help meet the country's growing power demand. In December 2003, for instance, Turkey began importing 300 million kilowatthours (kwh) per year of power from Turkmenistan (via Iran), with plans to double it to 600 million kwh. Reportedly Turkey is paying 3.35 cents per kwh for the power, a lower price than it pays for power imports from Bulgaria. In April 2003, Turkey announced that it was unilaterally terminating power deliveries from Bulgaria, after declaring that Bulgaria had not met its obligations under a 1998 bilateral, 10-year energy agreement. In February 2004, Turkey again stated that it would stop purchases of power from Bulgaria, this time, reportedly, due to Bulgaria's failure to grant highway and dam contracts to Turkish contractors as provided for in a bilateral power trade agreement. Besides Bulgaria and Turkmenistan, Turkey also imports power from Russia (via Georgia) and Iran. In July 2004, Turkey and Greece agreed on a 16-mile-long power line linking the two countries, which will help to further integrate Turkey's power grid with the European network.

Turkey has significant hydroelectric power resources (more than 104 total plants, installed capacity over 10.2 GW), and is developing a great deal more, especially as part of the \$32 billion Southeast Anatolia -- GAP -- hydropower and irrigation project. When completed, GAP, which is considered as one of the most ambitious water development projects ever, will include 21 dams, 19 hydro plants (with around 7.5 GW of power generating capacity), and a network of tunnels and irrigation canals. Major Turkish hydro dams as part of the GAP include: Ataturk (2,400 MW capacity); Karakaya (1,800 MW); Ilisu (1,200 MW; the largest hydro project on the Tigris River, but highly controversial due to environmental concerns); Cizre (240 MW); Silvan/Kayser (240 MW); Hakkari (208 MW); Alpaslan II (200 MW); Batman (198 MW); Konaktepe (180 MW); and Karkamis (180 MW).

Privatization of generation assets is envisaged to start in 2006. The goal entails a further market-opening plan as follows: current market opening of 29% (eligible customers being those consuming more than 7.7 GWh per annum) will gradually be increased until the end of 2011 and with a view to reach 100%. Regarding harmonisation of legislation, steps have focused on further improvement of implementing legislation of the Electricity Market Law, including licencing and tariffs regulations. The problem of unpaid bills, losses in distribution decreased to an 18.6% level of the electricity generated in 2004 and the target for 2005 is to reduce the loss to around 17.5%.

#### 2.4.5. Nuclear Energy

In July 2000, Turkey canceled its plans for building a 1,400 MWe nuclear power plant at Akkuyu Bay on its Mediterranean coast north of Cyprus. Prior to the cancellation, three international consortia were bidding for the \$2.5 billion contract. The cancellation was directly caused by Turkey's economic situation and the Turkish Treasury Department's refusal to grant a sovereign guarantee for the project. However, there had been much opposition to the project for a variety of reasons, including a significant seismic risk in the area where the power plant was to be sited.

#### 2.4.6. Energy Policy and Regulation

In August 1999, the Turkish Parliament passed constitutional amendments by large majorities, which will significantly improve trade and investment.

Eventually, all the units except transport would be privatized. The plan is to sell off 10% of the BOTAS market share each year, leaving only 20% at the end.

Turkey's Electricity Market Law went into effect in March 2001. This law sets up a path toward a free market in power generation and distribution. Under the law, the state-owned Turkish Electricity Generation and Transmission Corporation (TEAS) was split into separate state-owned companies for electricity generation (TEUAS), electricity transmission (TEIAS), electricity distribution (TEDAS), and electricity trade (TETAS). Eventual privatization of the generation and trade companies is expected, but transmission

of electricity will continue to be run by the state. The new law also set the stage for a new organization, the Energy Market Regulation Agency (EMRA), that oversees the power, natural gas markets, oil markets and liquified petroleum gases market, including setting tariffs, issuing licenses, and assuring competition.

The Energy Market Regulatory Board, which runs the EMRA, was commissioned on November 19, 2001. In May 2002, the EMRA issued drafts of the Energy Market Licensing Regulation and the Electricity Market Tariffs Regulation, and these regulations went into effect in August 2002. EMRA has announced a 4-stage approach to a competitive electricity market. The first stage grants licenses to firms in the electricity, natural gas markets, oil markets and liquified petroleum gases markets, while the second stage, which is expected to start March 3, 2003, will give large industrial users the right to choose their electricity provider. The third stage will start to set up the Market Financial Reconciliation Center for balancing and settlements and the fourth stage will make this Center fully operational.

Turkey expects a very large growth in energy demand as its economy expands, especially for electricity and natural gas, and has adopted a policy of encouraging foreign investment in power plants and natural gas pipelines to meet the anticipated demand. During the second half of the 1990s, Turkey implemented new methods for energy project financing and ownership. Three models were offered: "Build-Operate-Transfer" (BOT), "Build-Own-Operate" (BOO), and "Transfer of Operating Rights" (TOR).

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