INTERNATIONAL ENERGY AGENCY

Energy Policies of IEA Countries

TURKEY 2001 REVIEW

OECD

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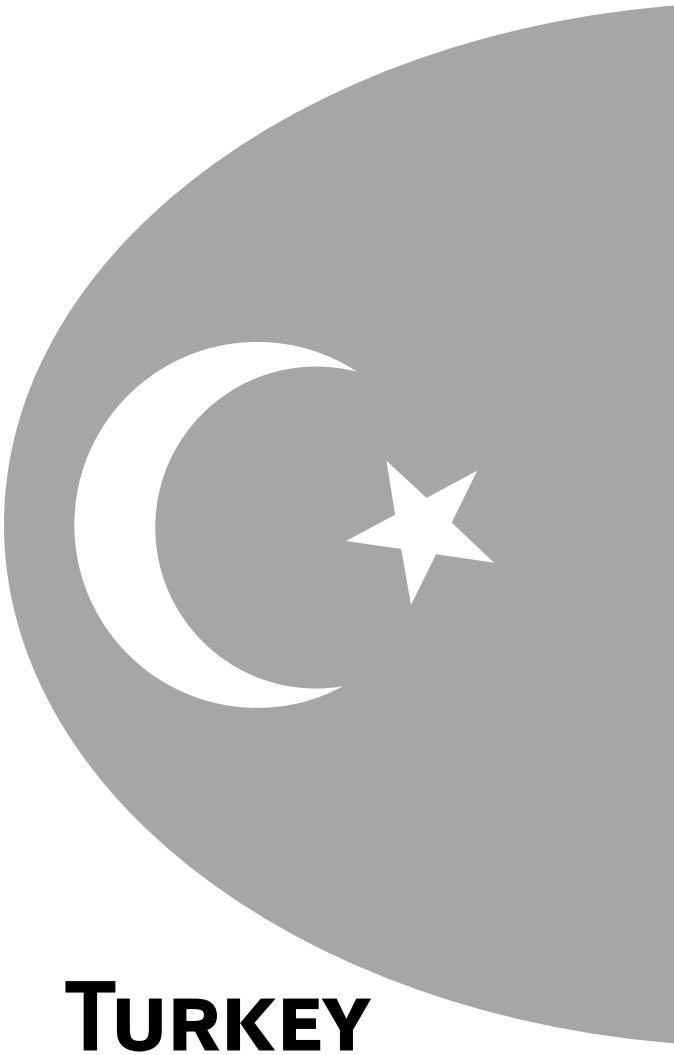

TURKEY 2001 REVIEW

INTERNATIONAL ENERGY AGENCY
9, rue de la Fédération,
75739 Paris, cedex 15, France

The International Energy Agency (IEA) is an autonomous body which was established in November 1974 within the framework of the Organisation for Economic Co-operation and Development (OECD) to implement an international energy programme.

It carries out a comprehensive programme of energy co-operation among twenty-five* of the OECD's thirty Member countries. The basic aims of the IEA are:

- To maintain and improve systems for coping with oil supply disruptions;
- To promote rational energy policies in a global context through co-operative relations with non-member countries, industry and international organisations;
- To operate a permanent information system on the international oil market;
- To improve the world's energy supply and demand structure by developing alternative energy sources and increasing the efficiency of energy use;
- To assist in the integration of environmental and energy policies.

** IEA Member countries: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States. The European Commission also takes part in the work of the IEA.*

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

Pursuant to Article 1 of the Convention signed in Paris on 14th December 1960, and which came into force on 30th September 1961, the Organisation for Economic Co-operation and Development (OECD) shall promote policies designed:

- To achieve the highest sustainable economic growth and employment and a rising standard of living in Member countries, while maintaining financial stability, and thus to contribute to the development of the world economy;
- To contribute to sound economic expansion in Member as well as non-member countries in the process of economic development; and
- To contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.

The original Member countries of the OECD are Austria, Belgium, Canada, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The following countries became Members subsequently through accession at the dates indicated hereafter: Japan (28th April 1964), Finland (28th January 1969), Australia (7th June 1971), New Zealand (29th May 1973), Mexico (18th May 1994), the Czech Republic (21st December 1995), Hungary (7th May 1996), Poland (22nd November 1996), the Republic of Korea (12th December 1996) and Slovakia (28th September 2000). The Commission of the European Communities takes part in the work of the OECD (Article 13 of the OECD Convention).

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SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

Turkey has dynamic economic development and rapid population growth. It also has macro-economic, and especially monetary, instability. The net effect of these factors is that Turkey's energy demand has grown rapidly almost every year and is expected to continue growing, but the investment necessary to cover the growing demand has not been forthcoming at the desired pace.

Several waves of liberalisation have been launched since 1983, leading to a gradual opening of the Turkish energy market and improving the situation. Turkey has made early and extensive use of financing models such as build-own-operate (BOO) and build-own-transfer (BOT). As yet, however, no decisive breakthrough has been achieved.

In the last two years, several encouraging steps have been taken towards greater liberalisation. The notion of privatisation has been introduced into the Turkish constitution for the first time. Legislation was adopted in February 2001 to allow competition in the electricity market and adapt Turkey's legislation for European Union (EU) membership. A new Gas Market Law was adopted in May 2001 for the same purposes.

Although the details of gas and power market operation are not yet clear, the IEA commends these initiatives and recommends pursuing them. The renewed macro-economic crisis of 2000/2001 should not be allowed to slow down the reform efforts. Reform will contribute to greater stability and prosperity in the long run. It will help avoid a situation in which energy supply imbalances hamper economic growth.

Meeting energy demand is of high importance in Turkey. But exploiting the country's large energy efficiency potential is also vital. Air pollution is a significant problem and, as the government's projections show, carbon emissions could rise sharply if current trends continue. The government's reference scenario projects a fourfold increase in coal use between now and 2020. Although there is reason to be sceptical about these figures, they provide graphic illustration of the environmental effects that Turkey's population growth and its anticipated leap towards full industrialisation could have if demand trends continue unbroken.

Turkey is striving to make good use of its geographic location as a transit country linking the oil- and gas-rich Caspian area to the Mediterranean and to the demand centres of the West. Several pipeline projects are under way. They could have a positive effect on the diversity and security of supply in many consuming countries. They could also help avoid further environmental strain on the maritime routes through the Bosporus. Several of these pipelines, including the Baku-Tbilisi-Ceyhan crude oil pipeline and the "Blue Stream" gas pipeline under the Black Sea, are

gradually nearing completion, but some additional attention to committing resources to these lines may be warranted.

Turkey suffered several severe earthquakes in August and November 1999, with severe damage at the Körfez (Izmit) refinery and loss of oil stocks. The IEA commends Turkey for swiftly repairing and rebuilding its oil stocks.

RECOMMENDATIONS

The government should:

Energy Market and Energy Policy

☐ Continue the process of liberalisation, restructuring and privatisation in the energy sector. Prevent any delays in the introduction of competition. Create a favourable environment for investment and ensure that the regulation of the gas and electricity markets is co-ordinated.

☐ Ensure that energy prices reflect full costs and eliminate subsidies and cross-subsidies, both direct and indirect. Take measures to increase transparency in energy regulation and in price setting.

☐ Closely monitor energy supply and demand and revise the forecasts to take account of the progress of liberalisation, energy efficiency improvements, structural changes in industry and other major factors in order to better inform all players' investment decisions.

☐ Continue and expand co-operation with neighbouring countries in all major energy policy areas.

Energy and the Environment

☐ Increase the resources for the Ministry of the Environment and strengthen collaboration with the Ministry of Health on air quality issues.

☐ Strengthen the mandate and the capability for inspection and verification of compliance of the agency or agencies responsible for the application and enforcement of air pollution legislation. Establish additional regional branches to address environmental issues in the provinces.

☐ Accelerate retrofitting of existing coal power plants with flue gas desulphurisation (FGD) and electrostatic precipitation (ESP) equipment and make efforts to increase the energy efficiency and the environmental performance of new coal plants through early adoption of advanced, clean coal technologies.

☐ Continue harmonising standards and regulations for environmental quality with those of the EU and other international bodies.

☐ To reflect its respect for the spirit of the United Nations Framework Convention on Climate Change (UNFCCC), Turkey should continue striving to limit the growth of greenhouse gas emissions, and, where possible, take additional measures. In particular, the government should develop an implementation strategy that allows it to assume a greenhouse gas emissions target no later than the second commitment period of the Kyoto Protocol.

☐ Strengthen collaboration agreements with neighbouring countries to limit energy-related pollution. In particular, seek agreements with countries bordering the Black Sea to reduce marine pollution, increase the inspection and verification of safety and environmental regulations in tankers, consider raising standards and increase resources for port authorities.

Energy Efficiency and Renewables

☐ Consider enacting appropriate energy conservation laws and establish or tighten efficiency standards for industrial boilers and electric motors. Increase the resources of energy efficiency organisations.

☐ Enhance Turkey's participation in international co-operation programmes on energy efficiency, in particular on efficiency standards and labels for household appliances and motor vehicles.

☐ Consider establishing fiscal and economic incentives for conservation measures in all sectors.

☐ Expand energy auditing programmes for industry, commercial enterprises and homes, information campaigns and training of energy managers.

☐ Promote the formation of energy service companies to invest in such opportunities.

☐ Carefully assess the potential as well as the costs of renewable sources. In particular:
- Consider steps to accelerate construction of economic hydro projects consistent with the protection of the riverine environment. Periodically re-evaluate the economic potential of hydropower.
- Evaluate the extent to which wind power resources might be economically expanded.
- Evaluate the market potential for solar-thermal heating and cooling technologies.

☐ Establish competitive bidding procedures for the selection of renewables projects that are to benefit from government support.

Coal

☐ Continue the restructuring process of the coal mining sector and the privatisation of viable mines. Consider outright privatisation of the mines that have not been transferred through the transfer of operating rights procedure.

☐ Clarify the process by which the prices for hard coal and lignite are determined. Suppress all subsidies on hard coal and eliminate residual subsidies on lignite, both explicit and implicit, as well as any purchasing requirements or preferential treatment. Social issues should be considered independently from energy prices.

☐ Promote the adoption of clean technologies for coal use in electricity generation.

Oil

☐ Pursue the strategy of more transparent, stable and efficient regulation and greater private participation in the oil sector. In particular:

- Ensure full transparency of oil product price setting, and refrain from any intervention besides the automatic pricing formula.
- Enforce the existing provisions for Third Party Access to the oil pipeline system and the gas grid.
- Complete the privatisation of the oil sector. Complete the privatisation of TUPRAS, the Turkish Petroleum Refining Company. To reduce its dominant role in the refining market, refrain from building new refineries under TUPRAS's ownership before privatisation. Ensure that the Turkish Petroleum Corporation (TPAO) can integrate vertically into the upstream and downstream market and that it can eventually be privatised.

☐ Accelerate upgrading of existing refineries to increase the production of oil products that meet international standards, including those for sulphur and lead content.

☐ Pursue the possibilities of crude oil transit through Turkey. Redirect attention to the commercial feasibility of the projects. In particular, seek to ensure further supplies for shipping. Give high priority to security of supply when establishing new pipelines.

Natural Gas

☐ Attach greater priority to the commercial and financial side of international gas supply and pipeline projects.

☐ Continue along the path of liberalisation of the natural gas market. Prevent any delays in the introduction of competition. Create a favourable market environment for investment. Take measures to ensure a smooth transition to competition.

☐ Unbundle the Turkish Pipeline Corporation (BOTAS), as foreseen. Ensure that BOTAS's transmission and marketing activities are fully separated and that its trading activities can eventually be privatised. Establish clear, transparent, non-discriminatory prices for grid services, and similar conditions for grid access.

☐ Ensure that the regulator is effective and fully independent from business interests and from government, that it has clearly defined rights and responsibilities and that it is insulated from political pressure. The regulator should be given the necessary means to carry out its tasks.

☐ Strive to make natural gas available to smaller gas consumers via extended distribution grids.

Electricity

☐ Take all necessary steps as soon as possible to implement the new competitive power market. In particular:

- Separate the Turkish Electricity Generation and Transmission Corporation (TEAS) vertically as soon as possible. Unbundle distributors' accounts for distribution and retailing, and separate the State Hydraulic Works' (DSI) accounts for hydro power activities from irrigation activities, to enhance cost transparency.
- Establish an independent regulator and independent system operators. Prevent any delays in the introduction of competition. Take measures to ensure a smooth transitional period. Separate the competitive market from the captive market during the transition period.
- Establish transmission tariffs based on a clear, transparent and non-discriminatory price formula. These tariffs must provide effective incentives for the establishment of production and transmission capacity, including interconnections, to meet future demand.
- Allow the market to determine when, where and what type of power plants are built without government interference. Base the choice of nuclear power on sound and clear economic criteria, including all related externalities. Clearly define nuclear technology choices and waste disposal options before building nuclear power plants. Increase transparency in communication with the public on these issues.
- Clarify the mechanism by which the generating assets of TEAS, and possibly DSI, will be privatised over time, and establish a clear timetable for doing so. In particular, clarify whether the assets are to be placed under private control through transfer of operating rights or through outright sale.

- Take measures to ensure that the development of the electricity sector and its transition to competition lead to improvements in security of electricity supply, productive efficiency and environmental performance of power plants.

☐ In parallel with implementation of the new Electricity act, consider expanding access to the competitive market beyond the limits currently set in the act, according to a clear timetable.

☐ Expend all possible efforts to facilitate and enhance international co-operation in the area of electricity trade and interconnection. Create a favourable market environment for investment.

Technology and R&D

☐ Strengthen R&D activities aimed towards the adaptation of new and advanced technologies to Turkey's specific needs, and concentrate efforts on a more limited number of activities, particularly in the following areas:
- Clean coal technologies.
- Flue gas desulphurisation.
- Fluidised bed combustion.
- Fossil fuel combustion efficiency.
- Wind and solar thermal.
- Energy efficiency and conservation in all sectors.

☐ Co-operate more closely with industry on R&D.

☐ Increase efforts to demonstrate and deploy new technologies that are relevant to the Turkish market.

☐ Gradually increase the funds for research, demonstration and deployment as the economy grows.

☐ Exploit more fully the opportunities for bilateral and multilateral international co-operation.

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ORGANISATION OF THE REVIEW

An IEA review team visited Turkey in October 2000 to review the country's energy policies. This report was drafted on the basis of information received during, prior to and after the visit, including the Turkish government's official response to the IEA's 2000 policy questionnaire and the views expressed by various parties during the visit. The team greatly appreciated the openness and co-operation shown by everyone it met.

The members of the team were:

Mr Odd Sverre Haraldsen
(Team Leader)
Ministry of Petroleum and Energy
Norway

Mr Jan Hensmans
(Policy Expert)
Ministry of Economic Affairs
Belgium

Ms Zita Varga
(Policy Expert)
Ministry of Economic Affairs
Hungary

Mr Jeffrey Skeer
(Policy Expert)
Department of Energy
United States

Mr Shigetaka Seki
(IEA Secretariat)
Head, Country Studies Division
International Energy Agency

Ms Maria Rosa Virdis
(IEA Secretariat)
Energy and Environment Division
International Energy Agency

Ms Gudrun Lammers
(IEA Secretariat)
Country Studies Division
International Energy Agency

The team held discussions with the following organisations:

- Ministry of Energy and Natural Resources (MENR)
- Directorate-General for Energy Affairs (EI)
- Directorate-General of Turkish Electricity Generation and Transmission (TEAS)
- Directorate-General of Turkish Electricity Distribution (TEDAS)
- Directorate-General of State Hydraulic Works (DSI)
- Directorate-General of Petroleum Affairs (PIGM)
- Ministry of the Environment
- Ministry of Foreign Affairs
- State Planning Organisation (DPT)
- Turkish Privatisation Administration
- Turkish Scientific and Technical Research Authority (TUBITAK)
- Turkish Atomic Energy Authority
- Electric Power Resources Survey and Development Administration (EIEI)
- Turkish Coal Enterprises (TKI)
- Turkish Hard Coal Enterprises (TTK)
- Turkish Petroleum Corporation (TPAO)
- Turkish Pipeline Corporation (BOTAS)

3

ENERGY MARKET AND ENERGY POLICY

OVERVIEW

The Republic of Turkey is located between Europe and Asia, bordering the Mediterranean, Aegean and Black Seas. Its neighbours are Greece, Bulgaria, Armenia, Azerbaijan, Georgia, Iran, Iraq and Syria. With a GDP of about US$ 3,200 per capita, Turkey is an emerging economy.

Turkey is a founding Member of the IEA. The country signed an association agreement with the European Economic Community (EEC) in September 1963, the cornerstone of which was to establish a customs union with the EEC. This customs union came fully into force between Turkey and the European Union (EU) on 31 December 1995. In April 1987, Turkey presented its formal application for membership in the European Community. In December 1999,Turkey was attributed EU accession candidate status. Turkey is also a party to the Energy Charter Treaty, having ratified the treaty and deposited its instruments on 5 April 2001.

The country has about 65 million inhabitants, almost 30% of whom are under 15 years old. The population growth rate is 1.7%, the highest among IEA countries. Some 52% of the population lives in urban centres, the largest of which are Istanbul (13 million), Ankara (5 million), Izmir (3.5 million), Adana (3 million) and Bursa.

Turkey is one of the most earthquake-prone areas of the world. In August 1999, the country experienced a severe earthquake in its northern Marmara area, followed by a further shock in the Bolu area. This was the 11th major ($\geq$ 6.7 Richter scale) earthquake in Turkey since 1939. Together, the 1999 earthquakes claimed nearly 20,000 lives, injured a further 50,000 and completely destroyed about 113,000 housing units and business premises, damaging another 264,000 to varying degrees. The earthquakes occurred in Turkey's industrial heartland and therefore had a vast economic impact. The total direct cost of the damage was estimated at between $5 billion and $13 billion, not including secondary effects such as job losses by some 20-50% of the workforce in the affected regions[1].

The area's dense energy infrastructure was heavily damaged, especially oil and gas production facilities and TUPRAS's Izmit refinery. Oil and chemicals were discharged into the Marmara Sea, causing the loss of oil stocks and clean-up costs, and oil and gas distribution pipelines were damaged to some degree. Some 3,400 electricity distribution towers and some 490 km of overhead electricity lines were damaged or destroyed, and the underground cable network was extensively damaged. Although

1. *OECD Economic Surveys: Turkey*, OECD, Paris, February 2001.

Turkey lost 1% of its oil stocks, the country rebuilt its stocks to meet the IEA's International Energy Program (IEP) requirement – the equivalent of 90 days of net imports – by July 2000.

Turkey's economy offers a very contrasted picture. For more than a century, there have been attempts to industrialise and modernise the country, with varied intensity and outcomes. As a result, modern industries today coexist with pockets of subsistence farming. The major cities of western Turkey are cosmopolitan centres of industry, finance and trade, whereas the eastern part of the country is relatively underdeveloped. Over the last decades, there has been massive migration from the eastern parts of the country to the economically-advanced urban centres of western Turkey.

Between about 1930 and 1980, successive governments' economic policies focused on industrialisation through publicly-owned State Economic Enterprises (SEEs) and the replacement of foreign imports by domestic goods, resulting in a relatively closed economy, inertia in developing export industries, and persistent trade deficits. SEEs, which accounted for some 40% of total manufacturing output in 1980, were often overstaffed and inefficient. In many cases they accrued losses that were a significant drain on the government's budget. In spite of these drawbacks, industrial development was rapid.

Turkey was severely affected by the oil price increase of 1973. In the years following the first oil crisis, economic conditions deteriorated, with high unemployment, a nearly fivefold increase in the balance of payments deficit between 1973 and 1979, large external debt and annual inflation rates exceeding 100% in 1980. To redress the situation, a series of stabilisation programmes was undertaken with support from the International Monetary Fund (IMF). A decisive step was taken with the 1980 economic reform programme to open the Turkish economy to international markets. Under this programme, the government's role in the economy was reduced, subsidies and price controls were cut back, the financial sector was liberalised and foreign exchange controls were lifted, exports and foreign direct investment were encouraged, and monetary policies and exchange rates were adapted to match this strategy of opening. A privatisation programme was launched in 1985.

The reform programme was successful in restoring economic growth, fostering foreign trade and reducing external deficits to a certain degree. The share of exports in GNP rose from slightly above 4% in 1981 to almost 24% in 1997, while imports rose from about 12% to almost 30%. The economy has also undergone a significant shift away from agriculture towards the industrial and especially the services sector in the last three decades, although some 40% of the active population is still employed in agriculture.

Yet a number of factors, especially unsustainable fiscal and economic policies, resulted in persistently high inflation rates, leaving the Turkish economy vulnerable to external shocks such as the 1991 Gulf War, which isolated Turkey from some of its regional trading partners. Since 1992, average year-on-year inflation rates have

consistently been above 60%. In 1994, inflation reached 110%. It came down to 65% in 1999 after remaining above 80% in the interim years. One of the consequences was that nominal interest rates dipped below the 100% mark only during three brief episodes between 1995 and early 1999[2], reaching more than 200% in mid-1996. Real interest rates varied between –5% and 70% in the same time period, standing at about 40% at end-1999[3]. Although government debt was less than 60% of GDP and therefore of tolerable size in principle, at these interest rates the cost of debt service became very large, leading to renewed strain on public finances and renewed public sector borrowing.

Despite the high inflation, GDP grew relatively robustly at an average rate of 5% between 1983 and 1998. However, GDP growth was cyclical with bouts of vigorous growth, interrupted by sometimes severe recessions triggered by financial instability or deflationary policies. As a result, real GDP per capita grew at an average rate of 1.5% over the 1990s, below the OECD average, below Turkey's growth potential, and below the rates of some other emerging economies[4].

Throughout the last decades, successive Turkish governments have embarked upon programmes to reduce inflation and stabilise Turkey's macro-economic performance. In many cases, these programmes involved IMF support (stand-by arrangements) and contained plans to privatise SEEs, with the purpose of carrying out structural, micro-economic reform and opening the economy to the private sector, as well as raising revenue needed for fiscal rebalancing.

The last such stand-by arrangement was approved on 22 December 1999, and involves financial support from the IMF totalling 2,892 million Special Drawing Rights (SDR, about $3.8 billion) in individual tranches of SDR 221.7 million ($283 million) each. The agreement followed the severe recession Turkey went through in 1998 and 1999, which culminated in a 5% contraction of GDP in 1999.

Under this stand-by arrangement, Turkey committed itself to a large number of measures, including a host of fiscal and monetary measures, notably to bring inflation down to 25% by end-2000, to 12% by end-2001 and to 7% by end-2002, and to achieve a sustained budget surplus for the public sector of about 3.7% of GNP in 2000. To achieve this, the government set itself a target of $7.5 billion in revenues from privatisation of state-owned enterprises for 2000.

The government also committed to a range of structural reforms spanning the agricultural, banking and energy sectors, and including reform of the social security and tax systems. These reforms included in particular:

- Submission to parliament by December 2000 of a law liberalising the electricity market, and enactment of this law by end-January 2001.

2. Treasury-bill annualised nominal interest rate. See *OECD Economic Surveys: Turkey*, OECD, Paris, June 1999.
3. *Ibid.*
4. *Op. cit.* OECD, 2001.

- Amendment by January 2001 of the Law on State Economic Enterprises (Law 233) in order to allow the restructuring of the state-owned electric utility TEAS into separate generation, transmission and trading companies.

- Issuance of a decree to the same effect.

- Elimination of subsidies for energy, especially for electricity and liquefied petroleum gas (LPG).

- Launch of the privatisation (transfer of operating rights, TOOR) programme for power plants and electricity distributors. Initially, the deadline for the launch of the programme was mid-April 2001. It was then deferred to 30 June 2001 (see below).

- Establishment of a list of new power plant (build-own-transfer, BOT) projects that can benefit from treasury guarantees, provided they are in operation by 2002.

The objectives of the 1999 stabilisation programme were carried over from several earlier programmes, in particular the 1997/98 stabilisation programme[5], which had aimed at single-digit inflation by 2000 and a sustained 4% budget surplus by 1998, and had contained similar structural reforms, including accelerated privatisation compared to the earlier packages.

Among the commitments in the 1999 programme are performance criteria that must be met to trigger the payment of the individual IMF tranches. By December 2000, the second review of this programme had been completed, allowing the government to withdraw the sums related to these credit tranches, and completion of the third and fourth reviews was imminent. The reviews found that Turkey had performed satisfactorily with respect to the performance criteria. This was despite the fact that inflation in 2000 was estimated to be at least 10% higher than the target value, and that at $5.6 billion, revenue from privatisation agreements fell short of the target of $7.5 billion.

The $5.6 billion that was secured from privatisation agreements in the year 2000 alone equalled the total amount that had been collected from privatisation between 1986 and 1999. The government remained strongly committed to the programme and announced its intention to accelerate the pace of privatisation in 2001. Of the amount secured in 2000, $3.5 billion was actually collected that year, and of that amount, some $300 million was from the transfer of operating rights for power plants. Inflation had overshot the target but was lower than at any time since the mid-1980s. Renewed, relatively strong GDP growth of about 7% completed the relatively favourable result for 2000.

At that same time, a crisis erupted in the form of liquidity problems in the banking sector, presumably because of a widening current account deficit and delays in the privatisation programme. A massive outflow of foreign capital threatened to jeopardise the economic recovery and the success of the stabilisation programme. As

5. The 1997/98 stabilisation programme was not accompanied by an IMF stand-by arrangement. The last such arrangement commenced in 1994 but was suspended in 1995.

a consequence, macro-economic indicators again deteriorated very seriously, with interest rates rising to more than 2,500% in the course of December 2000[6].

In this situation, the IMF decided to provide more than $10 billion to Turkey. This amount included $2.9 billion (SDR 2,227 million) under the last allowable tranche of the stand-by agreement, and an extra $7.5 billion (SDR 5,784 million) under the Supplemental Reserve Facility, a short-term loan facility for countries in balance of payments crisis but with sound economic policies. The World Bank provided another $5 billion, of which $250 million were from its Privatisation Social Support Project (PSSP). The PSSP aims at supporting the government's privatisation programme by mitigating transitional social and economic drawbacks from privatisation. It has three sub-programmes: job loss compensation, labour redeployment and monitoring of the social and economic impact of reform.

These measures were successful in mitigating the crisis, and the fifth IMF report was concluded favourably in early February 2001. Adoption of the electricity liberalisation law, a key performance criterion, had slipped, but the government had assured the international funding organisations that this would occur in mid-February 2001. The Electricity Market Act (Law No. 4628) was adopted by the Turkish Grand National Assembly on 20 February 2001 (published 3 March 2001). The law sets 30 June 2001 as the target date for the launch of the TOOR programme for power plants. Since there were further delays, the Privatisation Administration is now devising a new programme that contains TOOR but also the option of full asset privatisation. The new Natural Gas Market Law (Law No. 4646) was enacted on 18 April 2001 (published 2 May 2001).

On 22 February 2001, the government was forced to abandon the exchange rate controls, and the Turkish lira[7] was devalued by more than 28%.

Further reform and adaptation of Turkey's economic institutions are under way. In particular, the government began taking anticorruption actions in early 2001, leading to investigations into the energy sector, especially in tendering and licensing. The government also announced a renewed reform programme in March 2001. The main focus of this programme is the banking sector.

ENERGY POLICY

Energy Policy Objectives and Institutions

The main objectives of Turkish energy policy are:

- To meet demand using domestic energy resources as the highest priority. In the medium and long term, this is to occur through a mix of public, private and foreign capital.

6. *Op. cit.* OECD, 2001.
7. On average in 2000, 100 Turkish lira (TL) = US$ 0.00016 or €0.000175.

- To develop existing sources while accelerating the penetration of new and renewable sources.

- To diversify energy sources and to avoid dependence on energy imports from a single source or country.

- To encourage private-sector investment and to accelerate capacity construction and privatisation in the power industry. Preparations are to be made for the introduction of nuclear power.

- To improve the reliability of electricity supply through upgrades in the power transmission and distribution grid.

- To improve energy efficiency in end use and transformation, e.g. through reduction of losses in energy production, transmission and consumption.

- To protect the environment and public health.

- To make use of Turkey's geopolitical location to establish the country as a pivotal transit area for international oil and gas trade ("Eurasia energy corridor").

The following government bodies are involved in energy policy development and implementation. The Ministry of Energy and Natural Resources (MENR) is the main body for the formation and implementation of energy policy. It was established in 1963 and reports directly to the prime minister. All exploration, development, production and distribution activities for energy and natural resources are supervised and controlled by the ministry. Four main departments of the ministry carry out these activities:

- The Research, Planning and Co-ordination Board co-ordinates the activities of the dependent and related institutions, and implements the national energy policy. This board is also responsible for the preparation of long-term energy and mining plans.

- The Directorate-General of Energy Affairs is responsible for the operation of the power sector as a whole. It evaluates private-sector applications on the basis of BOT and TOOR tenders and contracts for thermal and hydroelectric BOT and TOOR plants. Energy price setting and control, environmental implications of energy use and energy conservation are also its responsibility.

- The Directorate-General of Mining Affairs enforces the Mining Law and controls exploration and production activities of private mining companies.

- The Directorate-General of Petroleum Affairs (PIGM). The main activity of this organisation is to enforce the Petroleum Law. In this function, PIGM issues licences to Turkish and foreign companies to explore, produce and refine oil. It also sets and/or controls oil and oil product prices.

The State Planing Organisation (DPT) is an advisory body to the prime minister. It assists the government in determining economic and social policy. Under the 1984 Electricity Act (Law No. 3096) it has the power to evaluate investment proposals submitted by publicly-owned companies and organisations, and to select projects that are to be included in annual investment programmes. This is done following consultation with the relevant SEEs. DPT therefore has a key role in determining which projects go ahead. The new Electricity Market Act does not require DPT approval for power plant projects.

The Electric Power Resources Survey and Development Administration (EIEI) carries out investigations and surveys to identify the energy potential of water resources. It prepares dam and hydropower plant projects. Various activities relating to energy efficiency and new and renewable energy resources are also carried out by EIEI. In particular, the National Energy Conservation Centre (NECC) within EIEI is responsible for energy efficiency.

The following state-owned companies are active in the energy market:

- Turkish Electricity Generation and Transmission Corporation (TEAS) is in charge of the planning, construction (thermal power plants only), operation and maintenance of electricity generation and transmission facilities[8].

- Turkish Electricity Distribution Corporation (TEDAS) is responsible for electricity distribution. TEDAS carries out necessary construction, operation and maintenance of distribution facilities, purchases electricity from generating utilities and sells it to retail customers.

- State Hydraulic Works (DSI) is in charge of planning, design and construction of hydro plants as well as flood protection, irrigation, water supply to big cities and land drainage.

- Turkish Coal Enterprise (TKI) is responsible for the exploration, production and marketing of domestic lignite and asphaltite.

- Turkish Hard Coal Enterprise (TTK) is responsible for the exploration, extraction and marketing of domestic hard coal.

- Turkish Petroleum Corporation (TPAO) whose main activity is exploration and production of oil and gas resources both inside and outside the country.

- Turkish Pipeline Corporation (BOTAS) is responsible for the installation of oil and gas pipelines throughout the country. It is also authorised to import natural gas, prepare plans and programmes for natural gas use in

8. TEAS was separated into three entities on 4 April 2000. See Chapter 7.

various sectors and distribute gas to certain urban areas and consumer groups.

- Turkish Petroleum Refining Company (TUPRAS) owns and operates four of the country's five refineries.

- Turkish Atomic Energy Authority (TAEK) is responsible for research and development related to nuclear energy. It is authorised to license and control establishments that use radioactive material and equipment. Site selection, construction and operation of nuclear power plants are also among its responsibilities.

Energy Taxation

Turkey's main tax on oil products is the fuel consumption tax (FCT). The FCT rates for various oil products are given in Table 1. Figures 1 and 2 show Turkey's taxation of automotive fuels compared with other countries. To alleviate the effects of oil price fluctuations and the pronounced exchange rate fluctuations of the Turkish lira against the dollar on domestic oil prices, the government linked this tax to a pre-existing mechanism, called the Fuel Price Stabilisation Fund (FPSF), as of 5 February 2000.

The FPSF was established through Decree No 98/10745 of 1 July 1998. The purpose of this fund is to stabilise domestic oil prices. The Fuel Price Stabilisation Fund is financed through a compensatory FPSF tax. The tax rate fluctuates and is inversely proportional to developments in international oil prices and the exchange rate of the Turkish lira against the dollar. The tax does not apply to fuels used in generating electricity.

Ex-refinery ceiling prices are now linked to CIF Mediterranean product prices. The ceiling price changes if the rolling seven-day average of the import price rises or falls more than 3%. When end-user oil product prices do not rise as rapidly as crude oil prices, payments are made from the FPSF to reimburse refiners' and retailers' revenue shortfalls. The fund is financed through the FPSF tax, especially during periods of low oil prices when the tax rate is high.

Through this change, oil product prices were linked to international market prices and short-term fluctuations were limited to a price band. Ex-refinery prices, distributor and retailer margins are also indexed to the U.S. dollar in order to protect refineries, distributors and retailers, as well as tax revenues, from the effects of inflation.

The purpose of this measure was to enhance price stability and predictability, as well as to eliminate the economic disadvantage of the inland refineries caused by transportation. Refineries, distributing companies and retailers are free to compete below the ceiling price. In 1999 and early 2000, the FPSF tax was applied only to diesel, and the rate was very low (about 1% of the end-user price).

The reason for this was the high volatility of crude oil prices at the time. By applying this low-rate tax, the government tried to relieve the burden on ultimate consumers.

In January 1996, Turkey signed the Customs Union Agreement with the EU. Therefore, customs duties are applied only to oil product imports from non-EU countries.

Table 1
Taxes on Oil Products, 2001

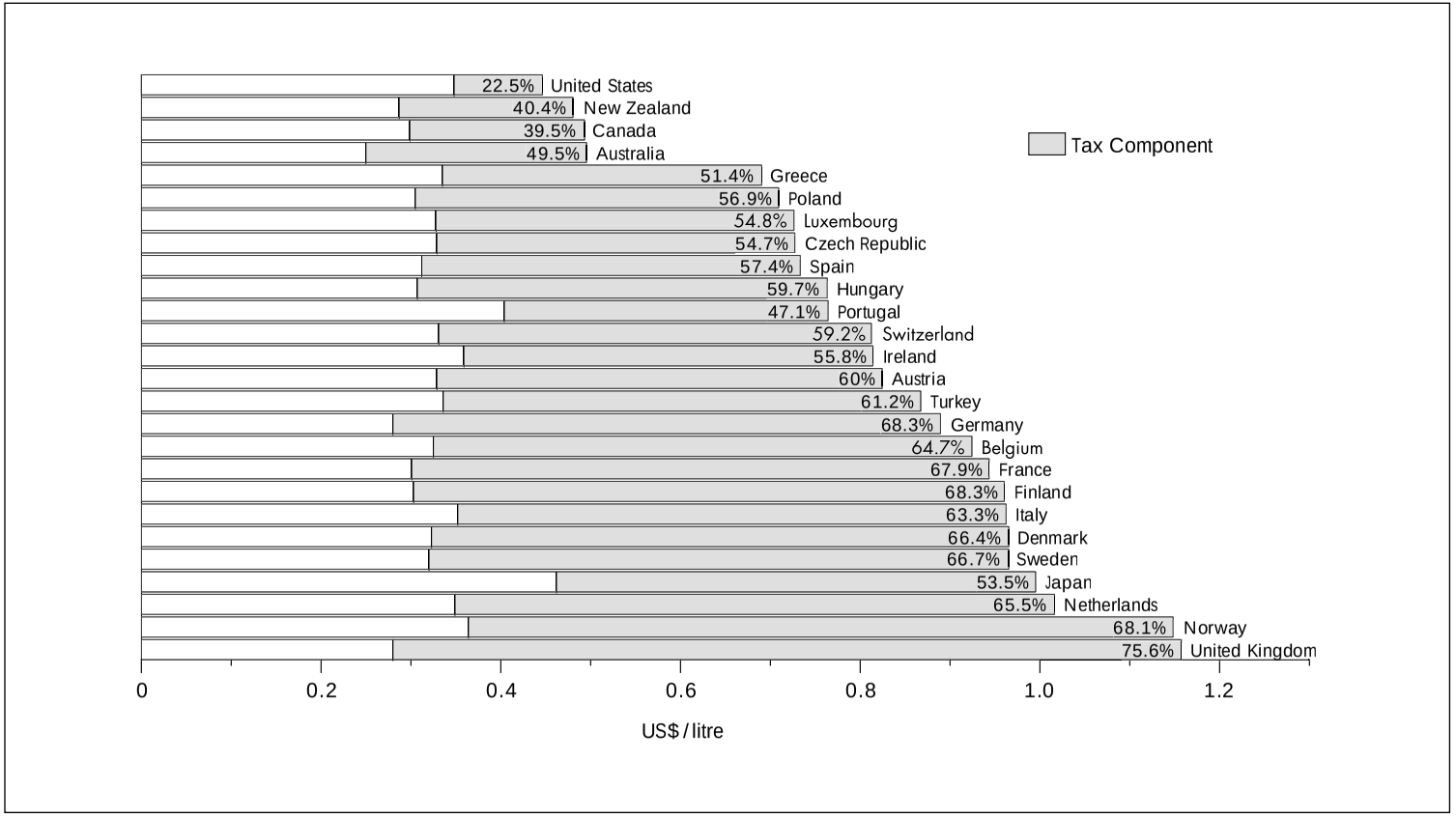
	Customs Duties %*	*FPSF TL*	*FCT TL*	*VAT %*
Premium gasoline (per litre)	4.7	5,000	431,500	18
Regular gasoline (per litre)	4.7	0	409,500	18
Unleaded gasoline (per litre)	4.7	0	424,500	18
Naphtha (fuel)	3	-	-	18
Naphtha	0	-	-	18
Kerosene (per litre)	4.7	17,750	311,500	18
Jet fuel (per litre)	4.7	0		18
Diesel oil (2% sulphur) (per litre)	3.5	0	291,200	18
Diesel oil (other) (per litre)	0	0	291,200	18
Motor diesel (per litre)	3.5	3,600	291,200	18
Heating oil (per litre)	3.5	150	113,000	18
Fuel oil 6 (industry) (per kg)	3.5	7,100	15,000	18
Fuel oil (power gen.) (per kg)	3.5	0	15,000	18
LPG (bottled), propane, butane (per kg)	0.7	40,000	185,000	18
LPG (automotive) (per kg)	0.7	40,000	185,000	40
LPG (heating) (per kg)	0.7	40,000	185,000	18
Propane (fuel) (per kg)	8	40,000	185,000	18

* There is no customs duty on imports from EU and EFTA countries, nor from Romania, Bulgaria, the Czech Republic, Lithuania, Hungary, Estonia, Israel.

Source: MENR.

Figure 1

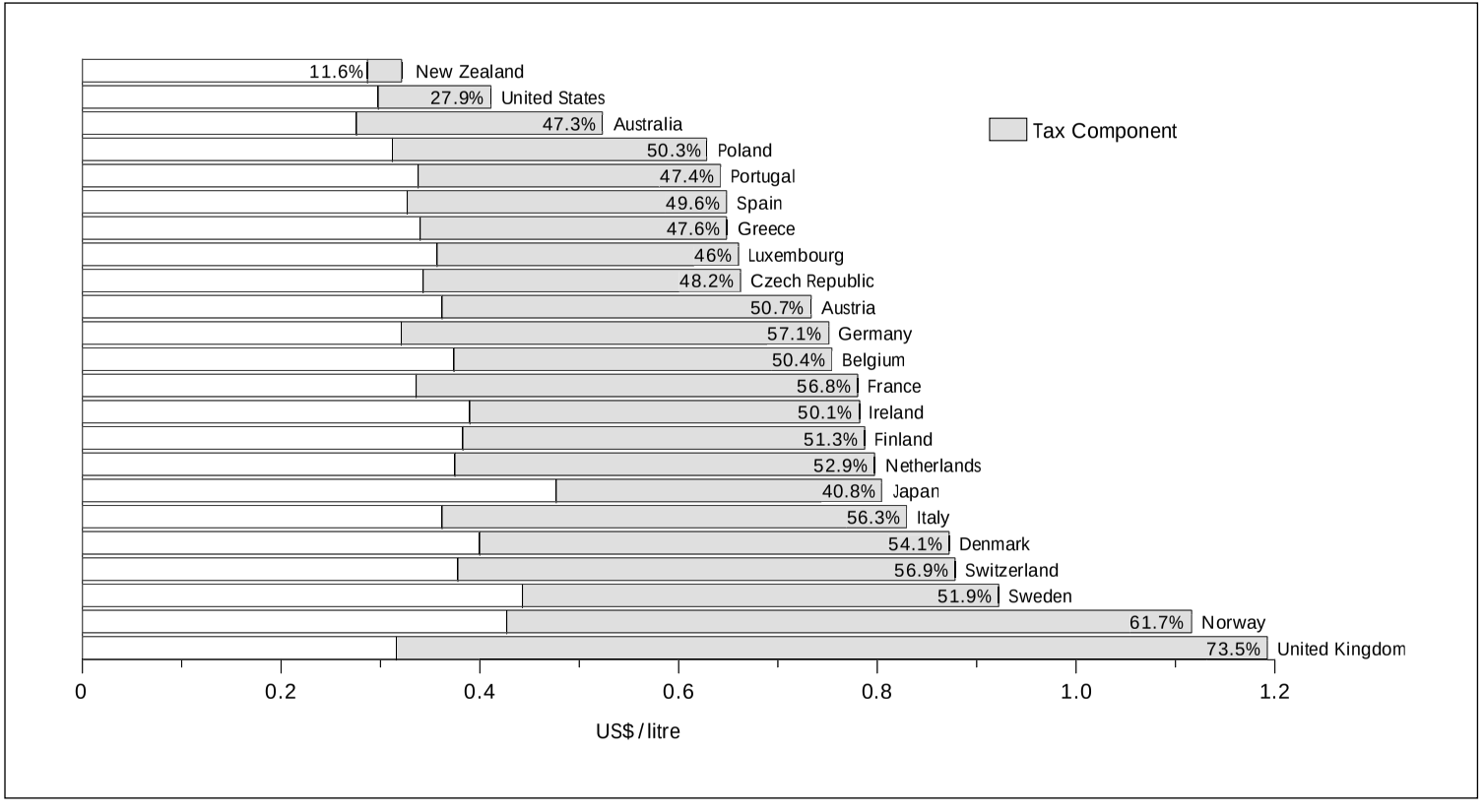
OECD Gasoline Prices and Taxes, 4th Quarter 2000



Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2000.

Figure 2

OECD Automotive Diesel Prices and Taxes, 4th Quarter 2000



Data not available for Canada, Hungary and not finalised for Turkey.
Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2000.

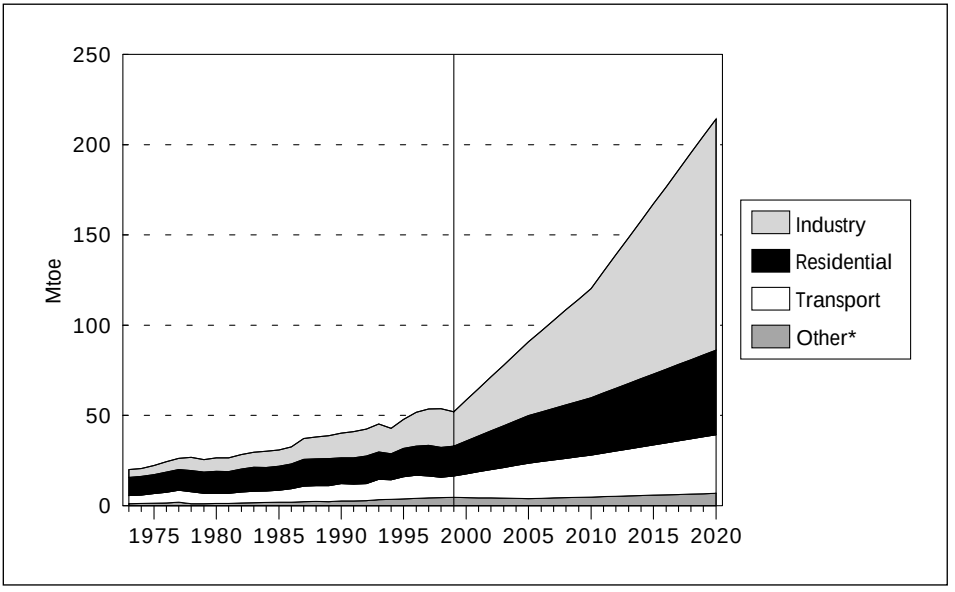
Energy Demand

With Total Primary Energy Supply (TPES) growth rates of 4% to over 5% per annum and Total Final Consumption (TFC) growth of around 4% over the last three decades, Turkey is among the fastest growing energy markets in the world, and the fastest in the IEA: in IEA Europe, annual average (TPES) demand growth was 1-1.5% in the same time period, roughly in line with IEA totals.

The government expects demand growth to accelerate in the coming two decades, with an average annual TFC growth rate of 8% between 1999 and 2005, 5.8% between 2005 and 2010, and 5.9% between 2010 and 2020. This implies a 2.7-fold increase of TFC from 57.4 Mtoe to 214.1 Mtoe.

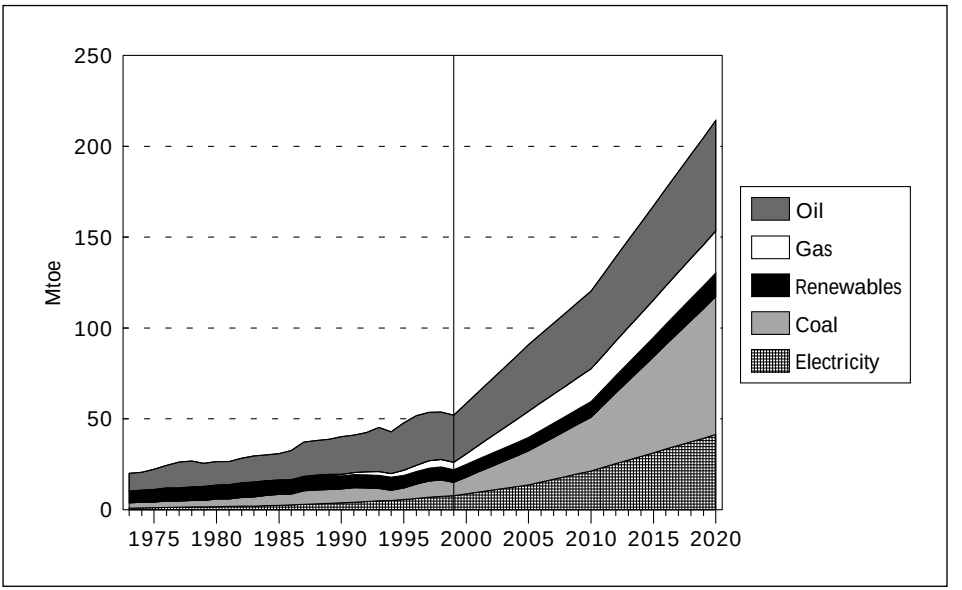
However, this demand growth occurs from a low base. Turkey's per capita TPES was 1.19 Mtoe in 1999, and is expected to grow to 3.65 in 2020. Even the 2020 figure is still significantly below the IEA's overall per capita TPES in 1973 of 4.61, let alone its current figure of 5.10 (1998). Figures 3 and 4 show past demand and future expectations by consuming sector and by source.

Figure 3
Total Final Consumption by Sector, 1973 to 2020



* includes commercial, public service and agricultural sectors.
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000, and country submission.

Figure 4
Total Final Consumption by Source, 1973 to 2020



Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000, and country submission.

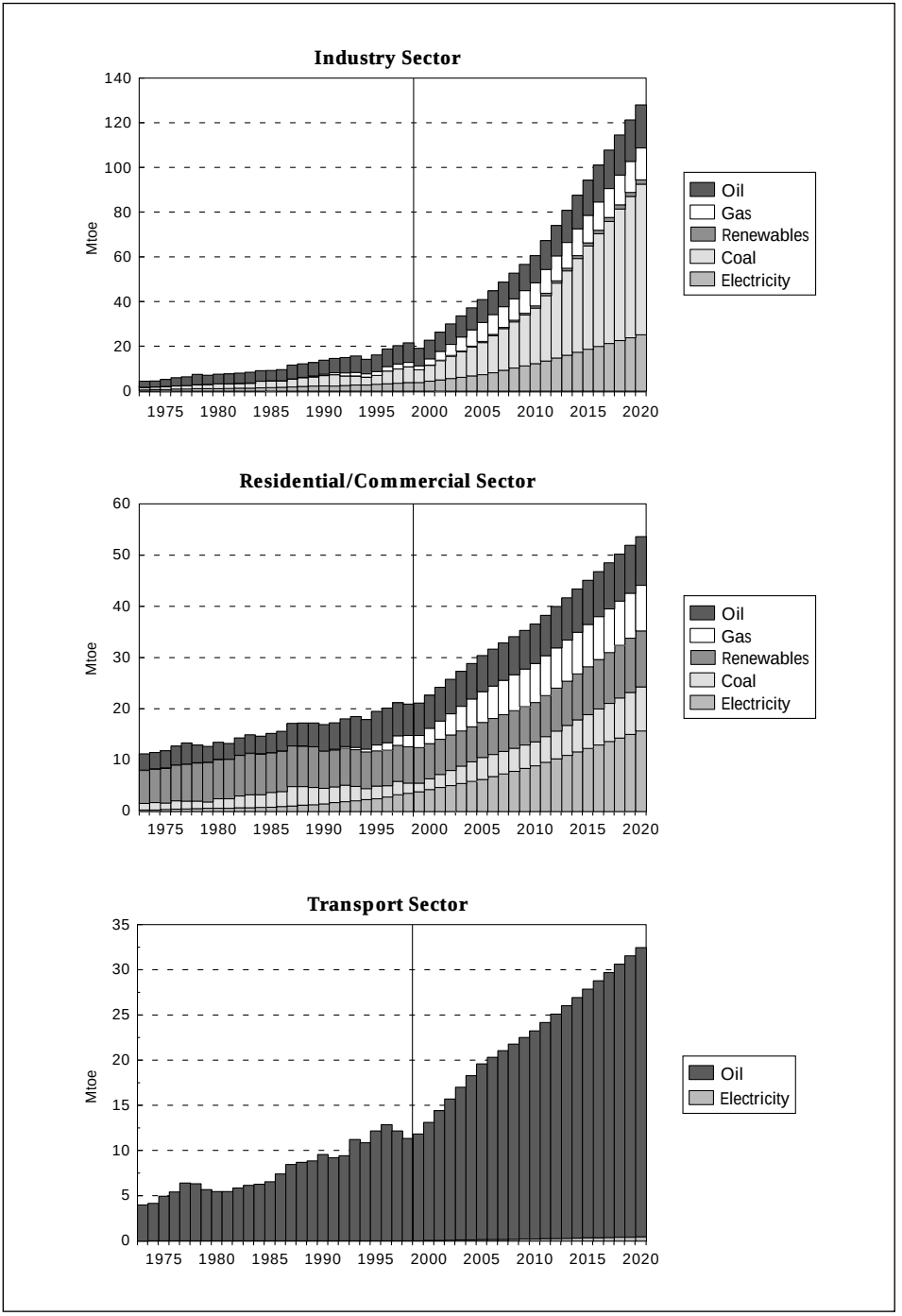
In the past, demand was distributed approximately evenly among the industrial, transport and residential sectors. With somewhat faster growth in industrial and transport demand, the industrial sector became preponderant in energy demand in the early 1990s and accounted for 40% of TFC in 1999. As can be seen from Figure 3, the government interprets this as a sign of major industrialisation over the next 20 years, causing very rapid industrial demand growth, at the end of which industry's share in TFC is expected to be 60%.

With a total of 11.37 Mtoe, transport accounted for 15.7% of TPES and 21.1% of TFC (43% of oil products consumption) in 1998. Total energy consumption of the transport sector is projected to more than double to 23.26 Mtoe by 2010 and to reach 26.7 Mtoe by 2015. In that year, its share is projected to be about 12% of TPES and 16.5% of TFC.

As can be seen in Figure 5, the government expects that industrial demand will grow primarily for coal, and, to a lesser but still significant degree, for electricity. These forecasts are derived from economic modelling carried out in the Ministry of Energy and Natural Resources, based on the MAED energy demand model. The model is based on a scenario approach, and the intermediate scenario, taken as the most probable outcome, forms the basis of the figures presented in this report. This scenario assumes unchanged government energy

Figure 5

Final Consumption by Sector and by Source, 1973 to 2020



Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000, and country submission.

policies and programmes. The Turkish government emphasises, however, that the base case presented here should be read merely as a reference scenario and not as a forecast.

The main assumptions used by the Turkish authorities for this model are the following. The Turkish population is expected to grow from 64.4 million in 1999 to 83.4 million in 2022, with annual growth rates decelerating from 1.5% to 1% towards the end of the projection period. The country's potential labour force is expected to increase slightly from 65% today to 66% in 2020. However, the model assumes that the portion of this labour force actually working will increase dramatically from about 75% today to almost 97% in 2020. This presupposes a massive decline in unemployment. Other demographic trends are assumed to follow developments of the last decades elsewhere in the OECD, e.g. declining average household size and urbanisation. The rural population is assumed to decline from 33 million in 2000 to 22 million in 2020.

GDP growth between 4.7% and 5.7% per annum is expected between 2000 and 2020. Hence, GDP in 2020 is expected to be 2.8 times its 2000 value. All sectors of the economy are expected to grow, but three sectors are expected to grow particularly strongly: the construction industry (with GDP in 2020 2.89 times its 2000 value), the services sector (3 times) and manufacturing (3.07 times).

Car ownership and distances travelled are expected to rise, as is electricity consumption per dwelling (reaching 2.56 times its 2000 value in 2020), especially for space heating, water heating, cooking and other thermal uses.

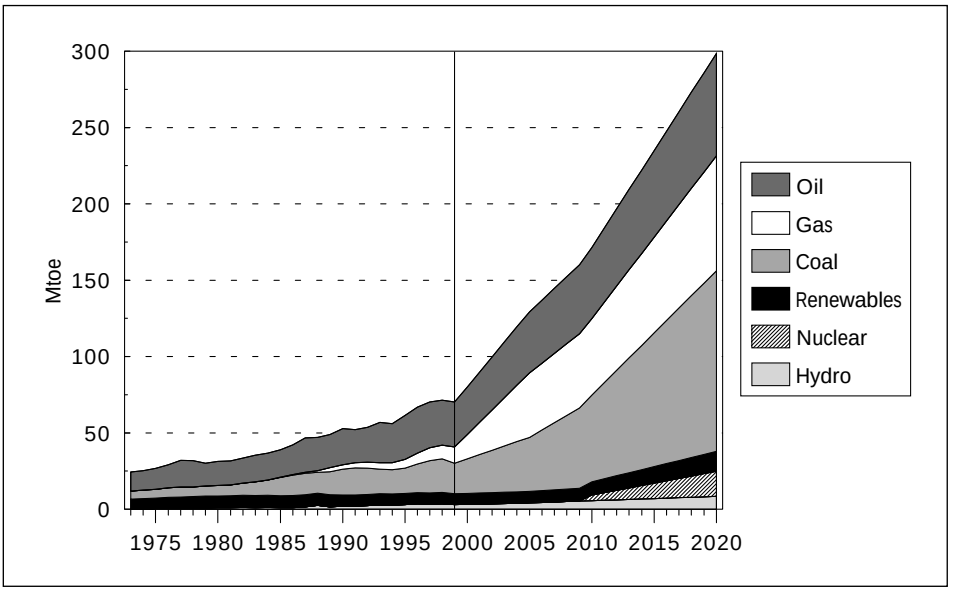
Energy Supply

Turkey has limited reserves of oil and natural gas, but proven reserves of lignite in the order of 8.4 billion tonnes. Combustible renewables, especially wood, and the country's water courses, especially the Euphrates and Tigris rivers, are other important indigenous energy resources. As can be seen in Figure 6, coal represented about 28.5% of TPES in 1999. Domestically produced coal accounted for 17% of TPES. Combustible renewables supplied 9.7%, and hydro 4.2%.

Overall, the share of Turkey's energy production in TPES was 35%, down from 64% in 1973 and 49% in 1990. Figure 7 shows energy production between 1973 and 2020. This decrease is due mainly to the increase in oil imports to almost 3.5-fold their 1973 value and 40% of TPES in 1999. Slightly less than half of oil TFC occurs in transport; there is still sizeable oil use in industry, households and power generation. Natural gas imports have also grown significantly in the last half decade, up to 15% of TPES in 1999.

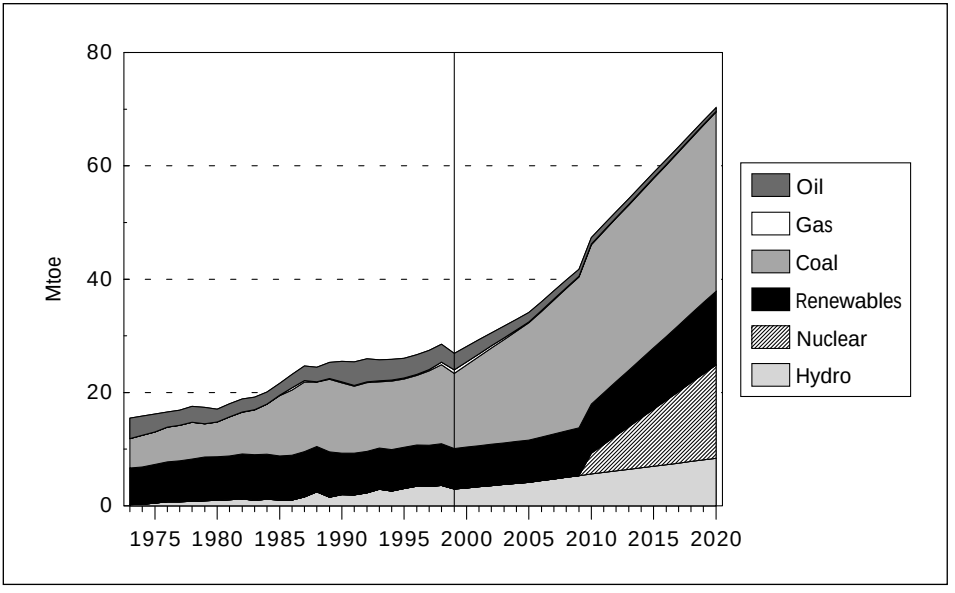
In line with the forecasts of strong energy demand growth, TPES is expected to increase to 298.45 Mtoe in 2020, 4.2 times its 1999 value of 70.33 Mtoe. The above figures demonstrate that this rise will come mainly from increased production and use of coal, increased natural gas imports, and eventually nuclear power.

Figure 6
Primary Energy Supply, 1973 to 2020



Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000, and country submission.

Figure 7
Energy Production by Source, 1973 to 2020



Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000, and country submission.

The government expects coal supply to rise from 20.1 Mtoe in 1999 to 118.4 Mtoe in 2020, more than five times current figures. It believes that domestic lignite production will almost triple and that hard coal imports will multiply by 15.

Securing the supplies thought to be necessary will require very significant investment. Tripling the power generating capacity by 2015, as considered necessary by the MENR, will require investing $3.5-5 billion per year in that time period. The construction of additional gas and oil pipelines and/or LNG terminals will require very substantial additional amounts. Among the more than one dozen oil and gas infrastructure projects currently under discussion and/or construction[9], the four most advanced together require in excess of $10 billion.

The contribution of nuclear power as of 2005 was to come from a plant to be built at Akkuyu on the southern, Mediterranean coast. The cost of this plant was estimated at between $2.5 and $4 billion. The government has made at least three attempts since the 1980s to secure construction of this plant by foreign investors under a build-own-transfer (BOT) scheme, all of which failed. Many other power plant projects have experienced a similar fate[10]. The last attempt was aborted in summer 2000, with the consequence that the 2005 start-up date for nuclear power has become unrealistic. The government now aims for 2015.

CRITIQUE

Starting from a situation with much government intervention, Turkey has made encouraging progress towards introducing competitive market forces, private and foreign investment and competition. This is clearly visible in the amendments made to the constitution introducing for the first time the notion of privatisation and facilitating foreign investment in Turkey through the possibility of international arbitration. The government should proceed on this encouraging path to improve prosperity, energy security and environmental quality in the country.

Turkey's greatest challenge in the framework of a still predominantly state-owned energy sector is to meet its fast-growing energy demand while at the same time achieving a stable budget surplus and limiting foreign debt, as required under the agreements with the IMF and the World Bank[11].

9. These are the "Blue Stream", Eastern Anatolia, Turkey-Turkmenistan and Baku-Tbilisi-Ceyhan pipelines. See Chapter 6.

11. See Chapter 7.

11. Conventional financing of major energy projects would increase the amount of foreign debt. The problem is particularly critical in the power sector. For this reason, other methods of financing energy infrastructure projects had to be found. One of them is the so-called build-own-transfer (BOT) model, under which private investors construct capacity, run it until it is depreciated, and then transfer it to government ownership. But this model has not yielded the expected capacity build-up (see Chapter 7).

Turkey's energy demand grew quickly in the past and is still growing rapidly. Therefore, the government is well advised to secure primary energy supplies and conversion capacity to enable the country to industrialise. However, there is reason to believe that the energy demand forecasts prepared by the Ministry of Energy and Natural Resources overestimate demand.

The rapid growth from a low base suggests that Turkey still has to catch up with the industrialised nations in terms of economic development and industrialisation. Economic growth was fast during periods when the economy was not throttled by deflationary policies designed to re-establish monetary and exchange rate stability. The development gap between Turkey and the industrialised nations is not yet closed and future economic growth will in all likelihood be matched by strong growth in energy demand.

But closing the gap will occur in a different economic environment from that of the past. The government is reforming the oil, gas and electricity markets. This reform is vital for Turkey to secure the necessary supplies and investment from private, and often foreign, sources. Failure to bring in this investment is bound to lead to scarcity of energy supply that will itself reduce economic growth.

The reforms will need to ensure an adequate return on investment, the abolition of below-cost energy pricing, the abandonment of unnecessary, erratic government intervention, and the phase-out of subsidies. Turkish consumers must begin to pay the full cost of their energy supplies. The following chapters, especially the Coal and Electricity chapters, suggest that the Turkish energy economy is still characterised by significant subsidies. Their abolition will have a significant effect on demand that is not reflected in the current forecasts.

If the reforms are carried out, and if massive investment in gas pipelines and power plants occurs as anticipated, there will be a massive wave of investment using new technology. Therefore, better conversion efficiencies can be expected, especially if investors in the newly competitive power market show the same preference for combined-cycle gas turbines (CCGT) as they have shown in virtually all other liberalised power markets. This tendency is not reflected in the forecasts either.

Finally, the expectation of massive use of domestic lignite and imported hard coal in industry and power generation appears exaggerated. Lignite is cheaper than natural gas as an input fuel for these industries, but gas-using equipment tends to have lower capacity cost and can be built in smaller increments. Coal also causes greater air pollution. Since Turkey intends to reduce pollution, investors will rightly fear that the construction of coal-fired power plants might entail retrofitting of costly flue gas desulphurisation (FGD), or that such equipment may be required from the outset. In both cases, the cost of coal-based generation will increase. This is likely to favour natural gas use wherever it is available, especially considering Turkey's low-quality indigenous coal.

The assumption of growing use of domestic and imported hard coal for industry is questionable. Turkish hard coal production is heavily subsidised. In light of the

need for budgetary stability, it is hard to see how more subsidies could be paid in future to finance the expected production increase. There are many understandable reasons why Turkey would prefer the use of indigenous energy: it does not strain the trade balance, it helps preserve employment and the revenue stays in the country and can contribute to capital formation. However, giving support to the use of domestic energy would be risky. Purchase requirements for lignite would scare away investors, and budgetary subsidies would once again jeopardise macro-economic stabilisation.

By introducing natural gas into the energy market in the late 1980s, the country has already improved diversification of energy supplies and energy security. To prepare for the future, the government should further promote gas and oil transit across its territory, thus increasing diversity and security of supply and gas availability in the country. On the coal side, the government should put together a realistic and socially acceptable long-term plan to reduce the domestic coal industry to economically and environmentally sustainable levels.

The government forecasts presented in this report therefore warrant the scepticism expressed by industry observers and even by the State Planning Organisation (DPT). For this reason, the DPT has disallowed government funding for energy supply projects on numerous occasions. The government would be well advised to revise its energy demand forecasts to more realistic levels.

RECOMMENDATIONS

The government should:

- ☐ Continue the process of liberalisation, restructuring and privatisation in the energy sector. Prevent any delays in the introduction of competition. Create a favourable environment for investment and ensure that the regulation of the gas and electricity market is co-ordinated.

- ☐ Ensure that energy prices reflect full costs and eliminate subsidies and cross-subsidies, both direct and indirect. Take measures to increase transparency in energy regulation and in price setting.

- ☐ Closely monitor energy supply and demand and revise the forecasts to take account of the progress of liberalisation, energy efficiency improvements, structural changes in industry and other major factors in order to better inform all players' investment decisions.

- ☐ Continue and expand co-operation with neighbouring countries in all major energy policy areas.

4

ENERGY AND THE ENVIRONMENT

CLIMATE CHANGE

Total CO_2 emissions in Turkey in 1998 amounted to 187.5 million tonnes[12] (value computed according to the reference approach), of which 47% was from coal, 42% from oil and 11% from gas. Turkey's total direct greenhouse gas emissions in 1999 amounted to 237.6 million tonnes of CO_2 equivalent, of which 89.8% was CO_2, 7.9% was methane, and 2.3% was N_2O.

Per capita CO_2 emissions were 2.9 tonnes in 1998, much less than the average of 10.9 tonnes for OECD countries. Per capita emissions have been growing steadily since 1971. The CO_2 intensity of energy (CO_2 emissions/TPES) in 1998 was 61.7 tonnes/TJ (above the OECD average of 56.3 tonnes/TJ) and has not increased much over time. Such a high carbon intensity of energy is due to the particular fuel mix of Turkish energy supply. On the other hand, the CO_2 intensity of GDP (using 1990 prices and purchasing power partities) was 0.41 tonnes/$1,000, i.e. less than the OECD average of 0.61 tonnes/$1,000 (IEA 2000)[13].

In 1998, electricity and heat production accounted for about 34% of CO_2 emissions, the other energy industries for 4.1%, manufacturing and construction for 27.4%, transport for 17.7%, residential and commercial use for 16.8% (Figure 8). Between 1990 and 1998, CO_2 emissions grew by 36% (3.9% per year). These values were lower than the OECD average rate of growth of emissions for the period 1971-1998, which was about 5.6% per year.

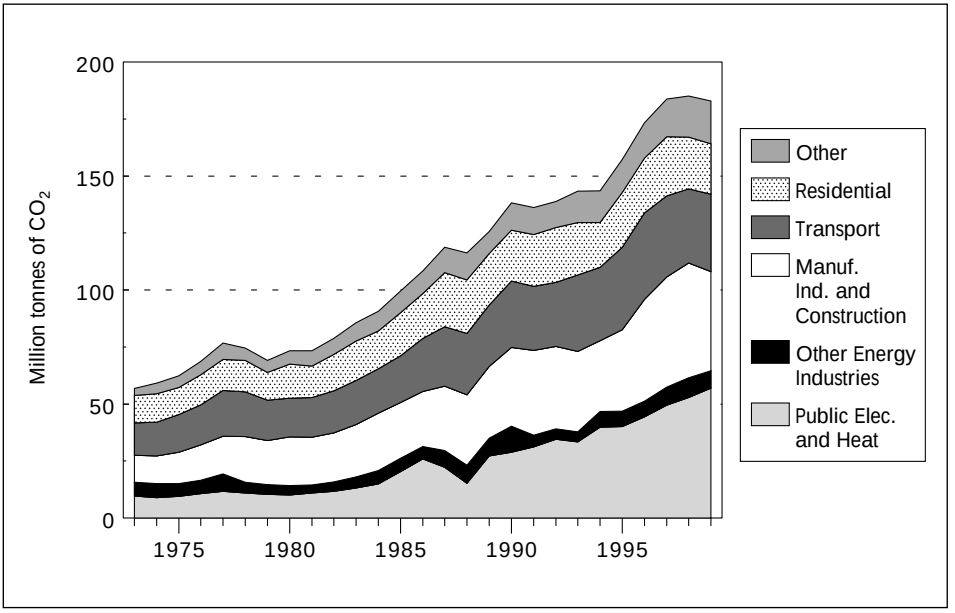
According to a study by TEAS, projected growth in CO_2 emissions (base case) would reach 440 million tonnes of CO_2 in 2012[14]. This corresponds to an average growth of 6.3% over the period 1999-2012, i.e. more than the historical rate. Such growth would closely track the increase in TPES, projected at 6.2% per year, and would be driven by energy demand in electric power generation and industrial sectors such as iron, steel and cement production. In 2012 coal use would account for about one-half of CO_2 emissions, oil for about one-third, and gas for the remainder.

12. *CO_2 Emissions from Fuel Combustion 1971-1998,* IEA/OECD, 2000.

13. *Ibid.* See also Figure 9 in Chapter 5.

14. The analysis is based on a scenario approach and is therefore not a forecast. The base case assumes no change in energy policy or programmes. See Ministry of Energy and Natural Resources/Turkish Electricity Generation and Transmission Corporation: *Base Case Analysis of Energy Development and CO_2 Emissions in Turkey*, November 2000, p. 24.

Figure 8
CO_2 Emissions by Sector, 1973 to 1998



Source: *CO_2 Emissions from Fuel Combustion*, IEA/OECD Paris, 2000.

Another important greenhouse gas is methane (CH_4). According to estimates of the Turkish Ministry of the Environment, total methane emissions were about 891 thousand tonnes in 1999, of which 125 thousand tonnes were from the industrial and energy sectors and the rest mainly from enteric fermentation/animal wastes or from sanitary landfills. Methane emissions from fuel combustion remained nearly constant compared to 1990.

In 1997, emissions of nitrous oxide (N_2O) totalled 14,470 tonnes, 350 tonnes from transport and 2,790 tonnes from other energy sources; the rest was from industrial processes (nitric acid production). N_2O emissions from fuel combustion had grown little (12.5%) with respect to 1990. By 1999, total emissions stood at 17,570 tonnes. The emissions of other greenhouse gas precursors such as CO and non-methane volatile organic compounds (NMVOCs) in 1999 amounted to 4.05 million tonnes and 612 thousand tonnes respectively, a significant increase from 1990.

AIR AND WATER POLLUTION

Air Pollution

The main pollutants associated with energy use are sulphur oxides (SO_x, particularly SO_2), nitrogen oxides (NO_x) and total suspended particulates (TSP). In Turkey these emissions come mostly from the combustion of coal (especially high-sulphur

domestic lignite), oil products and fuel wood. The latter is especially responsible for indoor air pollution.

SO_2 and TSP levels have decreased in some big cities (such as Ankara, Istanbul and Bursa), thanks to fuel switching from lignite to imported coal or gas for residential uses (see Table 2). However, overall emissions have grown significantly and many millions of people, especially in smaller cities where gas distribution networks do not yet exist, remain exposed to pollutant levels that exceed World Health Organisation standards[15]. This causes health problems, including respiratory diseases, and hence increased hospitalisation costs, restricted activity days and shortened life expectation.

Table 2
Winter Season Air Pollution Trends in Turkish Cities

City	*TSP (average µg/m³)*			*SO_2 (average µg/m³)*		
	1990-91	*1998-99*	*% change*	*1990-91*	*1998-99*	*% change*
Ankara	107	62	–42	218	37	–83
Istanbul	151	68	–55	315	64	–80
Izmir	82	–	–	112	67	–40
Bursa	139	44	–68	329	81	–75
Yozgat	75	35	–53	186	181	–3
Kutaya	111	72	–35	283	277	–2
Erzurum	141	61	–57	262	149	–43
Zonguldak	130	132	+2	89	90	+1
Afyon	111	146	+24	114	149	+23
Diyarbakir	201	112	–44	285	111	–61

Source: State Institute of Statistics and Turkish Ministry of Health. Table reproduced from ESMAP: *Turkey – Energy and Environment Issues and Options Paper*, April 2000.

In 1998, Turkey emitted 1.93 million tonnes of sulphur oxides (SO_x), an amount roughly equivalent to that of 1997[16]. SO_x emissions grew about fivefold from 1982 to 1990 but since 1990 they have grown at a slower rate[17]. Per capita

15. UNDP/World Bank Energy Sector Management Assistance Programme: *Turkey – Energy and the Environment, Issues and Options Paper*, Report 229/00, April 2000.
16. *OECD Environmental Data*, Compendium 1999.
17. OECD: *Environmental Performance Review – Turkey* 1999.

emissions in 1998 were 29.8 kg, below the OECD average of 39.2 kg, but at 5.2 kg/$1,000, emissions per unit of GDP were among the highest (OECD average 2.3 kg/$1,000).

Emissions of nitrogen oxides (NO_x) totalled about 940 million tonnes and have been accelerating since the early 1990s. Per capita emissions (14.5 kg) are substantially below the OECD average (40.6 kg), but at 2.5 kg/$1,000, emissions per unit of GDP were near the OECD average (2.4 kg/$1,000).

Coal use in electric power production is a significant source of pollution (and particularly of SO_2). The industrial sector is also an important contributor. In 1998, coal and lignite accounted for about 32% of total electricity production and for 33% of final energy consumption in the industrial sector. Low-quality and high-sulphur lignite is used especially in electricity generation. In 1998 the electricity sector emitted 1.29 million tonnes of SO_2, 0.17 million tonnes of NO_x and 0.14 million tonnes of particulates.

Base case projections for electricity demand indicate an increase by a factor of two and a half by 2012, which will have to be met by 41 GW of new capacity. Of this capacity, 19% is expected to be fuelled by lignite and another 3% by imported coal for a total of 8.6 GW of new coal capacity: as current coal-fuelled capacity is about 8.36 GW, this would mean nearly tripling the present use of lignite and hard coal for electricity generation[18]. Over the same period, consumption of lignite in the industrial sector would increase by about 50% and consumption of (mostly imported) hard coal by about 160%. If the projected increases in coal use are not met with adequate investments in SO_2, NO_x and TSP abatement technologies, the resulting emissions could more than double.

Other significant sources of SO_x, NO_x and TSP are high-sulphur fuel oil use in power generation and industry, and automotive fuel use in transport. The latter in particular is bound to increase rapidly in the next 10 to 20 years. The transport sector is dominated by road transport (90-95% or more of passenger transport and 85% of freight transport). Vehicle ownership is increasing fast, although it is low compared to OECD standards (7 vehicles/100 inhabitants in 1997 against 50 vehicles/100 inhabitants for OECD)[19]. Capacity utilisation of available rail lines for passenger transport is very low for inter-city traffic and higher for suburban lines, suggesting that the construction of new mass transportation systems needs to concentrate on large metropolitan areas and take account of consumer preferences. Although the projected growth of energy demand in transport is not nearly as fast as that in the power generation and industrial sectors, the growth potential for pollutant emissions is large. Characteristically the transport sector produces emissions of lead and carbon monoxide besides the other usual pollutants.

18. Ministry of Energy and Natural Resources/Turkish Electricity Generation and Transmission Corporation: *Base Case Analysis of Energy Development and CO_2 Emissions in Turkey*, November 2000.
19. *OECD Environmental Data*, Compendium 1999.

Marine Pollution

Marine pollution from oil tanker traffic in the Black Sea and in the Marmara Sea is a serious problem for Turkey (see box). With economic growth and rising energy consumption, Turkey has been forced to import more oil and gas. Increased international demand for Caspian oil and gas has stimulated new pipeline construction, but in the short term has also dramatically increased oil tanker traffic, thus increasing the incidence of oil spills and water contamination, as well as the risk of severe accidents. As a result, the already fragile ecosystems of both the Black Sea and the Marmara Sea are now under serious pressure, and other economic activities such as fishing and tourism are also suffering severe negative impacts.

Oil Transit through the Bosporus

The Istanbul Strait, or Bosporus, is 32 km long. Istanbul, situated on both sides of the Bosporus, is a city of 13 million inhabitants. The Bosporus is the narrowest of some 30 similar straits worldwide. Bad weather conditions, strong adverse currents with variable speed and direction and numerous sharp bends make the Bosporus a dangerous waterway for tanker transportation.

Commercial shipping is regulated by the Treaty of Montreux of 1936, which guarantees free navigation in this strait. Overall, some 20,000 ships passed through the strait annually between the early 1970s and 1996. Since then, ship passage was boosted by the opening of the Main-Danube canal, and has increased 2 1/2 times to 50,000, in addition to some 700,000 vessel passages. Traffic intensity is three times higher than on the Suez Canal. Every year, 5,500 tankers carrying dangerous products such as oil, LPG and explosives, pass through the Bosporus Strait.

Since 1996, exact statistics on oil transit through the Bosporus are unavailable. In 1995, some 60-70 million tonnes of Russian oil transited this strait, down from 167 million tonnes in 1988. The US Department of Energy's Energy Information Administration estimated in 1998 that 1.7 million barrels per day passed through the Bosporus. Based on oil reserves and planned production in Russia, some 100-135 million tonnes of oil could transit in 2005. These amounts are unsustainable, as today's traffic already leads to frequent accidents. The government believes that any additional oil transit will bring a very high risk of accidents and endanger the population and the sea.

Following a major accident in 1994, Turkey tightened the safety rules for ships passing through the straits of Istanbul and Canakkale. Among other things, the current rules restrict the right of passage for tankers to daytime, require 24 hours advance notice, stipulate mandatory pilotage, and reserve the right for Turkey to close the waterways to other traffic when large vessels are passing or during hazardous weather conditions. A modern vessel-tracking system is about to be installed.

A Convention for the Protection of the Black Sea was signed in 1992 with Georgia, Romania, Russia, Bulgaria and Ukraine and came into force in 1994. After a serious accident in 1994, Turkey passed a regulation that requires ships carrying hazardous material to report to the Ministry of the Environment. But Turkey has not stringently enforced this law. A recent regulation enables State Port Authorities to inspect ships and tankers for safety and environmental protection measures, but this work requires increasing manpower and resources. Turkey has backed international efforts to increase pipeline transport of oil and gas from Central Asia. However, recent agreements to ship more oil through Russian Black Sea ports indicate that a large number of tankers will continue to pass through the straits for some time.

RESPONSE POLICIES

Climate Change Mitigation

Turkey has not signed the UN Framework Convention on Climate Change (UNFCCC). Although Turkey was a Member of the OECD in 1992 when the UNFCCC was adopted (and as such was included among the countries of the Convention's Annexes I and II), it is still not fully industrialised.

There are understandable reasons for this position: with respect to a variety of indicators, Turkey falls below OECD norms. For example, its GDP as well as its per capita CO_2 emissions are lower than the OEDC average – and more in line with many of the advanced non-OECD countries. Concerned about the potential economic implications of compliance, Turkey has therefore not signed the UNFCCC, nor has it made commitments under the Convention's Kyoto Protocol. To date, the government has argued that the country does not have the financial or technological capability of Annex I and Annex II countries and therefore cannot meet the emissions reduction commitments; it has also claimed that it does not have the capacity to provide financial and technical assistance to non-Annex I developing countries. For these reasons Turkey has sought to have the Convention amended to remove Turkey from both Annexes I and II of the UNFCCC.

Turkey has, however, supported the Convention's overall objective to stabilise greenhouse gas concentrations in the atmosphere. Turkey supports the principle of "common but differentiated responsibilities" in which commitments to reduce emissions are commensurate with each country's development levels. As a show of goodwill and to prove the progress in reducing greenhouse gas emissions since 1990, at the fourth Conference of Parties to the Climate Convention (COP IV) in November 1998 Turkey submitted a National Report on Climate Change, prepared jointly by the Ministry of the Environment, the Ministry of Energy and Natural Resources, the State Planning Organisation and the State Institute of Statistics. Given Turkey's observer status under the UNFCCC, this was not a requirement, but was considered a valuable exercise for further policy analysis.

Although Turkey has agreed in principle that it will attempt to limit emissions, it has so far not developed a mandatory greenhouse gas abatement strategy. For this reason, there are no specific greenhouse policies, such as carbon taxation, or emissions trading schemes. Nevertheless, Turkey is striving to increase energy efficiency and the use of renewables, with obvious greenhouse benefits. These policies are described in Chapter 5.

Air Pollution Abatement

Ambient air quality standards for four pollutants in Turkey were established in 1986 (Table 3). They are less stringent than the standards recommended by the World Health Organisation. The lack of regular monitoring of pollutants is a serious problem in Turkey: only SO_2 and particulate matter (PM) levels are regularly measured in major cities, while measurement of NO_2 and Ozone (O_3) levels began only recently in a few selected cities.

Table 3
Turkish and WHO Air Quality Standards
(µg/m³)

	Turkish Standards		*WHO Standards*	
	LTS	STS[a]	LTS	STS
SO_2	150	400	50	125
NO_2	100	300	–	150
PM_{10} (<10µ)	150	300	50	120
O_3 (in ppb)	110	–	100-200	–

µg/m³: micrograms per cubic meter
LTS: long-term standards (maximum annual average)
STS: short-term standards (maximum daily average)
PM: particulate matter
ppb: parts per billion
–: not applicable
[a] Turkey's ambient air quality standard for SO_2 on an hourly basis is 900 µg/m³

Source: State Institute of Statistics and Turkish Ministry of Health. Table reproduced from ESMAP: *Turkey – Energy and Environment Issues and Options Paper*, April 2000.

For coal-fired power plants, the SO_2 emissions standard specified by the Air Quality Control Regulations is 1,000 mg/Nm³ for plants with a capacity of 300 MW or more, but emissions from large thermal plants routinely exceed those limits. For Total Suspended Particulate (TSP) matter, the regulations limit emissions to 250 mg/Nm³ for retrofitted thermal plants commissioned before 1986 and 150 mg/Nm³ for

thermal plants commissioned after the regulations were issued. Furthermore, all new lignite-fired power plants are required to have flue gas desulphurisation (FGD) and electrostatic precipitators (ESPs) for SO_x and TSP while this must be retrofitted in older plants. So far, only two of the existing plants (Cayirhan and Orhaneli) have been retrofitted with FGD: work is under way at four more sites and planned at the remaining ones. All new plants already use ESP, but the efficiency of ESP devices in some of the older plants is significantly below world standards[20]. According to government plans, the retrofitting and standards implementation programme at lignite-fired power plants should allow a 23% decrease in their SO_2 emissions in 2010 with respect to 1998 amounts and a much more dramatic decrease in emissions produced per kWh. NO_x and particulate emissions, however, would still increase by 150% and 28%, respectively.

The Air Quality Control Regulations set penalties for non-compliance with air quality standards for power plants and give local Public Health Boards (under the Ministry of Health) the responsibility to monitor air quality in their areas and to take measures when emissions exceed limits. Under this law, the Ministry of Health has the authority to enforce compliance through a series of measures including warnings to polluters, fines and, in the most serious cases, suspending operation of non-compliant entities.

The Ministry of the Environment, established in 1991, also has responsibilities in pollution prevention and control through its 34 local branches, but is insufficiently equipped and staffed to carry out monitoring and enforcement. The main responsibility of the ministry is co-ordinating environmental issues and activities at the national and international level, drafting laws, rules and regulations, and conducting training. In fact, responsibility for energy and environment issues is shared among different ministries and public bodies, including the Ministry of Energy and Natural Resources and the Ministry of Forestry.

The industrial sector is responsible for significant air pollutant emissions. Besides hard coal and lignite, which are heavily used in the iron and steel industry and in the cement industry, the manufacturing sector uses heavy fuel oil. The marketed product, No. 6 HFO, has a sulphur content of 3.5% (with a maximum allowable content of 4%), and while it is used legally in industrial areas, it is often sold illegally for heating in residential areas (where 1.5% sulphur fuel oil should be used[21]). Although forbidden for household use, high-sulphur coal is still used by poorer households, because of insufficient enforcement of this ban.

Nearly half of the vehicles in Turkey use diesel fuel. Standards for maximum sulphur content in diesel oil are being tightened from the current 0.7% (mass on mass) to a planned level of 0.2% m/m in 2005, in line with current EU regulations. The EU specifies that a maximum of 0.05% sulphur content should be achieved by

20. ESMAP: *Turkey – Energy and Environment Issues and Options Paper*, April 2000.

21. OECD: *Environmental Performance Review – Turkey*, 1999.

2005, but Turkey will not be able to produce diesel oil meeting these specifications before 2007. Turkey will be subject to further stringent standards under EU legislation in connection with its candidacy to join the EU.

A significant obstacle is the insufficient production capacity for low-sulphur fuels in Turkish refineries, which is leading to an increase in imports of high-quality automotive fuels. Construction of three new desulphurisation units is planned in three major refineries owned by TUPRAS. There have been delays, but TUPRAS expects the units to be in operation in 2004, and thus to be able to meet the EU standard for 2005.

Leaded gasoline (with a lead content of 0.84 g/litre and a sulphur content of 0.15% for premium RON 95 leaded gasoline) has not yet been phased out and represents about 80% of gasoline sales in Turkey. Lead emissions from transport fuels are therefore very high. In order to discourage leaded gasoline use, higher excise taxes are charged (since 1998 the excise tax has been 282% of the pre-tax price for leaded and 272% for unleaded gasoline). In 2000, the tax advantage for unleaded gasoline was not sufficient to cover the higher production (or import) costs and the price incentive disappeared[22]. The shift to unleaded gasoline, which according to government plans should be completed by 2005, also requires the upgrading of existing refineries and the construction of hydro cracking and isomerisation units. Whether this will be done on time to meet the stated objectives is uncertain.

To decrease urban air pollution, over 80% of commercial taxis in Turkey have converted to LPG fuel. Because of lower taxation, the end-user price of LPG is about 60% lower than the price of gasoline. This results in a rapid payback of the cost of vehicle conversion. About 150 buses in Ankara and Istanbul have been converted to natural gas. However, much larger investment needs to be made in mass transport systems, especially in big cities, to improve urban transport and to reduce urban air pollution. At present, a subway system exists only in Ankara. It was opened in 1996 and is being expanded. In Istanbul and Izmir systems are still under construction and in two more cities (Bursa and Adana) they are at the planning stage[23].

Policies concerning emissions regulations for the transport sector and their implementation are the responsibility of the Ministry of Transport. In 1993 an agreement was reached between the Ministry of the Environment and the automobile manufacturers concerning environmental performance standards in new cars. Under the agreement all imported and locally-produced new automobiles are to be equipped with catalytic converters, starting in 2000. Currently, all new cars produced in Turkey are equipped with catalytic converters and Euro/93 standards are in place. However, only an estimated 30% of the existing car stock is equipped with catalytic converters.

22. IEA: *Energy Prices and Taxes - 3rd quarter 2000*, Paris 2001.
23. OECD: *Environmental Performance Review – Turkey*. 1999.

Climate Change

The Turkish government declared its willingness to comply with the general provisions of the UNFCCC (e.g. to inventory emissions, to develop programmes to mitigate climate change, and co-operate in technology development and diffusion), although it continues to argue it should be exempted from specific obligations of Annex I Parties. With respect to adopting specific mitigation targets under either the Convention or the Kyoto Protocol, Turkey has a wide range of alternatives:

- Ask to be removed from the Annexes and even choose to stay entirely out of the international climate change legal framework. This reflects Turkey's current legal position although it has participated as an observer to the UNFCCC negotiating process.

- Sign on to the UNFCCC as an Annex I country but not to the Kyoto Protocol. It is unclear how this would change Turkey's current situation: the FCCC target, which is non-binding, required returning to 1990 emissions levels by the year 2000, and there is no specific obligation post-2000. Very few countries have met this target.

- Sign on to the UNFCCC as an Annex I country and become a party to the Kyoto Protocol. This would bring the benefit of participation in the flexibility mechanisms (emissions trading, joint implementation), but would require setting (and having international agreement on) a target level for emissions reductions.

- Negotiate becoming a party to the UNFCCC as a non-Annex I country, but take on a "voluntary commitment", either in the form of reducing absolute emissions or in terms of lowering the carbon intensity of its economy (on a PPP basis). The latter solution would give more room for limiting greenhouse gas emissions without slowing economic growth.

The CO_2 intensity of energy in Turkey is higher than the OECD average and the CO_2 intensity of GDP is fairly high. Although it is lower than the OECD average in PPP, some room exists for improvements both in the energy efficiency of the economy and in CO_2 intensity. Therefore, either of the last two options outlined above could be viable, and environmentally beneficial.

As the climate debate remains a high-profile international issue – and is likely to emerge as a key question for Turkey with respect to its future entry into the European Union – the government will need to consider the implications of these options as it develops a domestic energy policy.

In the interim, a wide variety of greenhouse gas emissions reduction policies and measures is available: energy efficiency and conservation measures, increasing the shares of new and renewable energy sources in the energy supply base, switching from high- to low-carbon fuels (e.g. from coal to gas), adoption of emissions

reduction systems, limiting the use of energy and preventing losses from energy distribution systems.

A suitable combination of many of the above measures could no doubt be identified. However, the precise measures and timing of a commitment to reduce greenhouse gas emissions (at least with respect to the base line) within the UNFCCC framework should be defined on the basis of in-depth studies of different policy and technology scenarios for Turkey. Energy demand forecasts should be examined more carefully, especially in view of the likely impacts of the privatisation programme in the energy sector and of industrial restructuring in manufacturing on energy prices and on overall energy demand. Environmental impacts and economic costs associated with each scenario should be identified and trade-offs assessed.

Air and Water Pollution

While much progress has been made towards limiting some of the most obvious cases of local air pollution (especially in big cities), much remains to be done in various areas and sectors of the energy system. In the electric power sector, if the policy to continue and increase use of local lignite is confirmed, upgrading of existing plants with FGD and ESP equipment needs to be made an absolute priority. As noted earlier, to date only two out of 15-16 coal-fired power plants are equipped with FGD devices, and four more are in the process of being retrofitted.

Furthermore, new plants using cleaner coal and more efficient technologies such as circulating (CFBC) or pressurised fluidised bed combustion (PFBC) or integrated gasification combined cycled gas turbines (IGCC) could be built, which would greatly reduce the amount of fuel required, and therefore carbon emissions per kWh. The planned increase in use of natural gas for electricity generation would also work in that direction. The liberalisation of the gas and electricity markets is likely to favour the use of gas in power generation, where it is available.

Existing standards and regulations on air quality and polluting emissions are not sufficiently enforced and there is room for tightening the standards themselves. The responsibility for enforcement should be clearly defined within the government and the agency in charge of enforcement should receive sufficient resources. This may require an increase in staffing levels as well as financial resources. If the Ministry of the Environment or a subordinate body remains the main enforcement agency, it should be allowed to operate according to its mandate. A clearer separation of roles, functions and responsibilities *vis-à-vis* the Ministry of Health and the Ministry of Transport is called for. As policies concerning emissions from the transport sector are the responsibility of the Ministry of Transport, the Ministry of the Environment does not currently have authority for monitoring pollution from transport or for enforcing regulations.

In the heat market, existing emission standards and boiler specifications must be enforced. Given the existing air pollution problems and the gap that still exists

between Turkish and EU legislation, further limitations on the use of lignite and high-sulphur oil for heating should be put in place in cities beyond a certain size, and, where possible, natural gas distribution networks should be built or extended. These measures would help reduce urban pollution, especially if applied in parallel with a growth of mass transport systems (buses, trams, metro). Notably, the connection of Ankara to the natural gas network in 1988 led to a very significant decline in local air pollution in Turkey's capital. The problem of upgrading refinery processing capacity for low-sulphur and unleaded fuels for both heating and transport also needs to be addressed as early as possible.

The Turkish government has rightly assessed the situation of tanker traffic in the Bosporus Strait as unsustainable and is making efforts to reduce its environmental hazards, both by suggesting alternative transportation routes for oil and by negotiating in international forums. These efforts are laudable and should be continued.

RECOMMENDATIONS

The government should:

- ☐ Increase the resources for the Ministry of the Environment and strengthen collaboration with the Ministry of Health on air quality issues.
- ☐ Strengthen the mandate and the capability for inspection and verification of compliance of the agency or agencies responsible for the application and enforcement of air pollution legislation. Establish additional regional branches to address environmental issues in the provinces.
- ☐ Accelerate retrofitting of existing coal power plants with FGD and ESP equipment and make efforts to increase the energy efficiency and the environmental performance of new coal plants through early adoption of advanced, clean coal technologies.
- ☐ Continue harmonising standards and regulations for environmental quality with the EU and other international bodies.
- ☐ To reflect its respect for the spirit of the UNFCCC, Turkey should continue striving to limit the growth of greenhouse gas emissions, and, where possible, take additional measures. In particular, the government should develop an implementation strategy that allows it to assume a greenhouse gas emissions target no later than the second commitment period of the Kyoto Protocol.
- ☐ Strengthen collaboration agreements with neighbouring countries to limit energy-related pollution. In particular, seek agreements with countries bordering the Black Sea to reduce marine pollution, increase the inspection and verification of safety and environmental regulations in tankers, consider raising standards and increase resources for port authorities.

5

ENERGY EFFICIENCY AND RENEWABLES

ENERGY EFFICIENCY

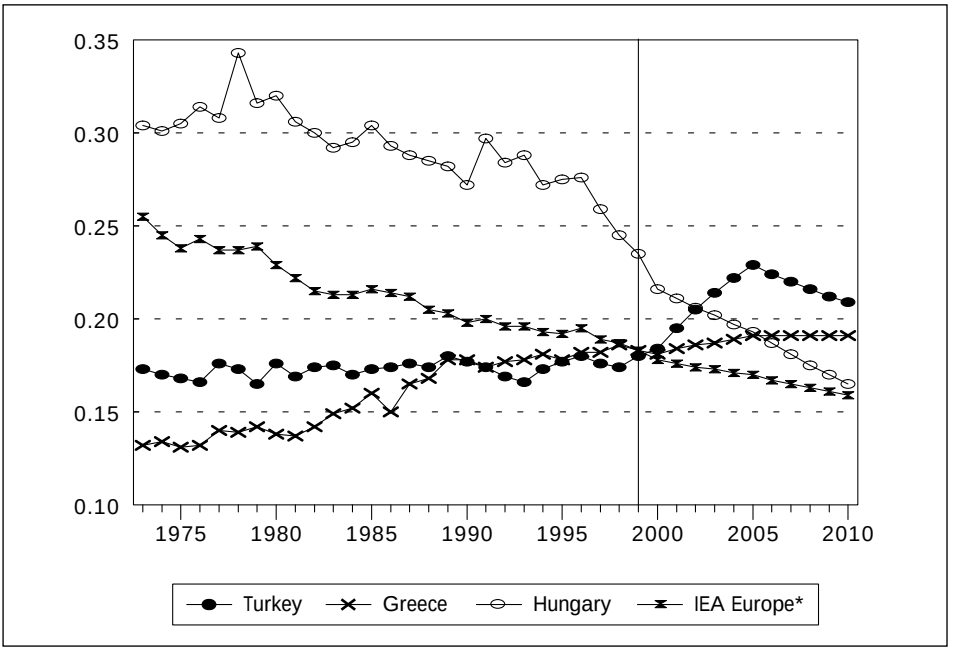
Energy Efficiency Potential

In Turkey, per capita energy consumption (measured as TPES/population) in 1998 was equal to 1.11 toe, much less than the average of 5.10 toe for all IEA countries. But its growth is much faster than the IEA average and is projected to remain fast in the coming two decades as the economy develops. Energy intensity (measured as toe/$1,000 GDP at 1990 prices and exchange rates) in 1998 was 0.35 toe, compared with an IEA average of 0.24 toe, and has increased slowly in recent years. If purchasing power parities are used,Turkey's energy intensity fell well below the IEA average (see Figure 9).

Figure 9

Energy Intensity in Turkey and in Other Selected IEA Countries, 1973 to 2010

(toe per thousand U$ at 1990 prices and purchasing power parities)



* excluding Norway from 2000 onwards.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000; *National Accounts of OECD Countries*, OECD Paris, 2000, and country submissions.

The Turkish government acknowledges the need to reduce the energy intensity of GDP and to improve the energy efficiency of the economy. According to estimates of the National Energy Conservation Centre (NECC, established in 1992 as part of EIEI within the Ministry of Energy and Natural Resources), Turkey has an energy conservation potential equal to 14 Mtoe/year, or nearly 20% of total consumption in 1998. The centre estimates that an amount corresponding to $3 billion could be saved through conservation measures in three main end-use sectors.

The industrial sector accounted for 39.9% of total final energy consumption and for 51.5% of electricity consumption in 1998, while the agriculture, household and services sectors together accounted for 38.9% of final energy consumption and 48.1% of electricity consumption. Although all four sectors have important potential for energy conservation, industry has been targeted as a priority area for energy conservation programmes owing to the projected rapid expansion of industrial energy demand.

The structure of industry in Turkey is energy-intensive. Within the industrial sector, iron and steel manufacturing (about 35% of industrial energy use) and cement production (19%) are by far the largest energy users. However, the petrochemical industry, the fertiliser industry, the textile industry, ceramic products and paper manufacturing as well as sugar production are also major users. According to the NECC, the potential for conservation in these sectors ranges from 20% to 35%.

A considerable share of the energy-intensive industries, and some of the most energy-inefficient ones, remain under government control. Industry privatisation, if pursued according to plan, is likely to result in closure of the oldest and most inefficient operations and in modernisation for the surviving ones. The progressive elimination of energy price subsidies will also stimulate energy conservation. This process may well boost the overall energy efficiency of Turkish industry, and government projections of industrial energy demand may prove to have been significantly overestimated. Nonetheless, government engagement in energy efficiency programmes for industry is needed and could have major benefits.

In a 1996 study, the EIEI/NECC assessed the potential for energy conservation in industry at 4.2 million toe (nearly 24% of industrial energy use for that year) and an approximate cash value of $1 billion/year. The total investment required to achieve this conservation potential would be close to $2.3 billion. The payback period for these investments would range from a minimum of one year to a maximum of three years. The measures required to bring these savings about would include the adoption of various forms of waste heat recovery, increased use of co-generation of electricity and heat/steam, and the use of more efficient boilers.

In the residential/commercial sector, more than 80% of the energy consumed is used for heating. Energy use per unit of building area could be reduced by nearly half – according to an EIEI study carried out based on questionnaires in 1997 – through the application to all buildings of the new Heat Insulation Standards on building envelopes, issued in 1999 (effective in June 2000). While existing

buildings require 200-250 kWh/m^2, the new standards could bring requirements down to 100-150 kWh/m^2. At current rates of building stock turnover, the estimated energy efficiency gains could take several decades to materialise.

According to a study carried out in the framework of the World Bank's ESMAP programme[24], major efficiency improvements are also possible in power generation by increasing power plant size from the existing average of 150-340 MW (coal-fired units); by requiring higher efficiency specifications for new plants (for example, large supercritical power plants have net efficiencies of 39-41% instead of the 35-37% of the existing small units); and by increasing the use of co-generation, especially in industry.

According to ESMAP's estimates, the higher investment costs would be more than offset by lower fuel costs and by a significant reduction in pollutant emissions. Furthermore, transmission and distribution losses (together currently close to 18-20% of gross power generation) could be reduced. The greatest potential for reduction is in distribution losses (> 70% of total losses); IEA energy balances show that distribution losses could be halved. In particular, non-technical distribution losses, caused mostly by poor management systems (customer, meter and billing management), could be significantly reduced with relatively small physical investment.

As living standards rise, use of electrical appliances is increasing fast and boosting electricity demand. Increasing use of air-conditioning, especially in the Mediterranean region, has shifted the peak hours of electricity demand to noon in the summer. As efficiency labelling for air-conditioners (as well as for many other appliances) is non-existent or is only now under preparation, there is room for significant improvement. Because electricity consumption for lighting accounts for 30-40% of power consumption in the residential sector, significant energy conservation potential (up to 80%) exists also in this area, through the use of compact fluorescent light bulbs.

In the transport sector, plans exist to extend the network of urban mass transport systems (buses, above-ground and underground metro lines and suburban rail) especially in larger cities, for the purpose of easing local air pollution problems and traffic congestion.

Energy Efficiency Institutions and Legislation

Several government entities are directly or indirectly involved in energy conservation issues and activities. Besides the EIEI/NECC, these include the State Planning Organisation, the Ministry of Industry and Commerce, the Ministry of

24. UNDP/World Bank Energy Sector Management Assistance Programme: *Turkey – Energy and the Environment, Issues and Options Paper*, Report 229/00, April 2000.

Reconstruction and Resettlements, the Ministry of Transportation, the Scientific and Technical Research Council, the Ministry of Public Education and the Turkish Standards Institute.

The EIEI/NECC's energy conservation activities concentrate mostly on the industrial sector and consist of energy audit programmes in various industrial plants, using three buses equipped with standard measurement equipment; energy conservation training programmes for technical personnel at industrial plants (using buses equipped with audiovisuals and information materials) and energy manager courses. The Energy Manager programme is to receive support from the Japan International Co-operation Agency, in the form of equipment donations and technology and information transfer.

A regulation issued in 1995 by the MENR and NECC requires industrial establishments with annual consumption above 2000 toe to set up an internal energy management system, conduct energy audits and monitor energy consumption. About 600 plants are covered by this regulation.

In the residential sector, a series of studies on energy efficiency regulation and labelling of household appliances (refrigerators and washing machines), air-conditioners and lighting devices has been initiated with the collaboration of the Turkish Standards Institute, the Ministry of Industry and Trade and the manufacturers. As mentioned above, new building insulation standards introduced in June 2000 should lower heating energy requirements by 100-150 kWh/m^2, depending on the region.

Furthermore, new legislation is being prepared with the aim of requiring appropriate energy management systems – and energy managers – for large commercial buildings (business centres, hotels, hospitals, housing estates and shopping centres) that consume energy over a certain threshold. Energy conservation awareness campaigns have also been promoted jointly by the NECC and the Energy Conservation Co-ordination Board of the MENR.

RENEWABLE ENERGY SOURCES

Turkey has substantial reserves of renewable energy sources. Renewable energy production represented about 14.4% of TPES, i.e. 10.10 Mtoe in 1999, and renewables are the second-largest domestic energy source after coal. Slightly less than two-thirds of this production is supplied by biomass and animal waste; another third is supplied by hydro power and about 0.5% of the total is produced from geothermal, wind and solar sources.

Government projections for the near future indicate a progressive decrease in use of wood, animal wastes and other combustible and renewable energy sources. The reasons for this are the expected rise in living standards as well as limits on deforestation. The use of hydropower on the other hand is projected

to increase as the economic potential of this resource, estimated at about 124 TWh, is progressively exploited. At present 30% of the potential is used. The government expects that in 2020 hydroelectric generation will reach 97.5 TWh (or 8.4 Mtoe).

The geothermal energy potential in Turkey is estimated at 35 GW, but only a small part is being utilised[25]. Its use is expected to increase to 6.3 Mtoe by 2020, especially for direct heating. The proposed Geothermal Law, currently being drafted by the MENR, should provide the necessary regulatory framework for this purpose.

Solar energy has interesting potential in Turkey. An estimated 3.5 million m^2 of flat plate collectors for solar heating are already installed in Turkey, especially in the southern and western regions and in the residential and commercial sectors. Preliminary studies indicate that the country has an average 2,640 sunshine hours annually, with an average solar intensity of 3.6 kWh/m^2 per day, with higher peaks at some locations. A more in-depth evaluation of the solar radiation potential has been initiated in co-operation with the State Meteorological Organisation. Solar energy use is expected to increase about sevenfold from its 1999 value of 0.11 Mtoe.

The western coast and south-eastern Anatolia have been identified as very favourable locations for wind power generation, with annual average wind speeds around 2.5 m/s and annual wind power densities of 2.4 W/m^2. Progress in wind energy technology in recent years has drawn private-sector attention to this energy resource. As a consequence, numerous companies have submitted their applications to the MENR for the construction of new wind power plants and three plants have been commissioned.

One of them is an autoproducer plant and the other two were built on the build-own-transfer (BOT) model (for the progress of BOT wind power projects, see also Chapter 7). Wind power production is not very large, but total installed capacity has reached 18.9 MW and 72 new projects totalling about 2,000 MW are under evaluation by the MENR. The goal is for wind power to represent about 2% of installed electric power capacity in 2005.

Biogas production potential has been estimated at 1.5-2 Mtoe but neither the government nor the private sector has yet expressed any interest in using this resource. There are two BOT power plant projects using biogas (Ankara and Adana waste-to-power plants), but not much progress has been made and the government fears the projects will lapse. However, the new Electricity Market Law provides better opportunities for such plants in future. There is one autoproducer waste-to-energy power plant in operation in Izmit. This plant was commissioned in 1998 and has an installed capacity of 5.4 MW. A contract has been signed for another autoproducer plant of 5.4 MW in Istanbul, to be constructed by the municipality of Istanbul.

25. UNDP/World Bank Energy Sector Management Assistance Programme: *Turkey – Energy and the Environment, Issues and Options Paper*, Report 229/00, April 2000.

Energy Efficiency

Turkey has major potential for energy efficiency improvements. Exploitation of this potential could reduce environmental emissions and improve security of supply. The potential for renewables is also significant. In recent years, progress has been made in both fields. New energy efficiency legislation and regulations are under preparation that will go some way towards using this potential. Turkey now has a clear target for wind generation, and numerous wind projects were submitted under the BOT programme in recent years.

However, much remains to be done. The single most important policy imperative is to establish cost-covering prices for all energy products and services. This is necessary for reasons of economic efficiency alone, but is equally necessary in order to bring about appropriate investment in energy-efficient and renewable technologies. Cost-covering energy prices make an essential contribution to the economic development of the country and ensure that the corresponding energy demand can be supplied. They also go some way towards limiting the environmental strain. Setting energy prices at levels below costs encourages the inefficient use of energy and makes investment in energy efficiency and renewables less profitable. Although progress has been made in this respect, there is still significant below-cost pricing, especially in the electricity supply industry. Once cost-covering prices are achieved, the government should consider the possibility of internalising externalities into energy prices through fiscal and economic incentives in all sectors.

More efficient energy pricing should be complemented by a balanced mix of other measures: mandatory energy efficiency standards for appliances, motors and buildings; voluntary agreements; energy labelling; information and training campaigns. Here also, progress has been made. Within the limits of its resources and legal and administrative mandate, NECC has applied energy efficiency policy effectively. NECC stresses in particular public information and professional training, both of which are needed in Turkey.

But given the large anticipated growth in energy demand, all areas of energy efficiency policy should be strengthened. First, the legal and resource base should be strengthened through the enactment of appropriate energy conservation laws that combine and build on existing legislation, while increasing funding and staffing levels of NECC and other energy efficiency agencies. Strengthening of energy efficiency legislation will in any case be necessary for harmonisation with European Union legislation. Next, efficiency standards and labels should be tightened or established where non-existent. There should be standards and labels for all types of energy-using equipment, including household appliances, vehicles, industrial boilers and electric motors.

Co-operation with industry on energy efficiency should also be reinforced. Energy auditing programmes can demonstrate to managers where cost-effective energy efficiency opportunities exist. There is also scope for greater use of auditing in

Turkey. Information campaigns and training of energy managers should accompany these efforts. In the transport sector, investment in urban public transport should be increased, as growing urbanisation leads to increased urban pollution and traffic problems.

Renewables

Turkey's main renewable energy sources are fuel wood and hydro power. The use of fuel wood and animal wastes will decline in share and absolute terms as Turkey becomes more prosperous, as has happened in all other IEA countries, because of the convenience of using oil, gas or even electrical heating and cooking where these options are available. If the use of biomass is to be sustained in future, measures will at some stage have to be phased in to support it. In this respect, Turkey could benefit from other countries' experiences.

Several issues must be considered in this context. First, fuel wood must be used in a sustainable manner. Turkey carries out afforestation programmes in deforested, arid areas for environmental reasons; these must not be jeopardised, and forest exploitation and wood harvesting must occur in a controlled manner. Second, waste incineration for electricity generation should be considered as a renewable option in the future, but this should be done using appropriate technology to ensure high health and environmental standards, in particular with respect to air emissions.

In Turkey's situation, where government expenditure has to be tightly controlled, it is of great importance that the most cost-effective resources be developed. Therefore, the government should attempt to develop competitive renewables first, and base support for renewables, if necessary, on cost-effectiveness. The government should investigate which options are viable without financial support. This may be the case for certain hydro projects and for solar thermal applications. The potential of these and other renewable energy sources should be evaluated regularly. For those renewables that need support, bidding procedures should be implemented to ensure that the most cost-effective renewables are supported.

RECOMMENDATIONS

The government should:

- ☐ Consider enacting appropriate energy conservation laws and establish or tighten efficiency standards for industrial boilers and electric motors. Increase the resources of energy efficiency organisations.

☐ Enhance Turkey's participation in international co-operation programmes on energy efficiency, in particular on efficiency standards and labels for household appliances and motor vehicles.

☐ Consider establishing fiscal and economic incentives for conservation measures in all sectors.

☐ Expand energy auditing programmes for industry, commercial enterprises and homes, information campaigns and training of energy managers.

☐ Promote the formation of energy service companies to invest in such opportunities.

☐ Carefully assess the potential as well as the costs of renewable sources. In particular:

- Consider steps to accelerate construction of economic hydro projects consistent with the protection of the riverine environment. Periodically re-evaluate the economic potential of hydropower.
- Evaluate the extent to which wind power resources might be economically expanded.
- Evaluate the market potential for solar-thermal heating and cooling technologies.

☐ Establish competitive bidding procedures for the selection of renewables projects that are to benefit from government support.

6

FOSSIL FUELS

COAL

Industry Overview

Turkey has significant coal reserves, especially lignite, but also some hard coal. At end-1999, hard coal reserves were estimated at about 1.12 billion tonnes[26], 428 million tonnes (38%) of which were proven reserves. Total proven lignite reserves were estimated at about 8.4 billion tonnes. Turkish lignite has low calorific value and high sulphur, dust and ash content. Turkish hard coal is of low grade but of cokeable or semi-cokeable quality. About 75% of the reserves contain coal with calorific values below 2,500 kcal/kg, and less than 10% have a quality over 3,000 kcal/kg.

Hard coal is found and mined in only one location, the Zonguldak basin near the north-western Black Sea coast (see Figure 10). This mine is operated by the fully state-owned Turkish Hard Coal Enterprise (TTK). TTK has a *de facto* monopoly in hard coal production, processing and distribution. There are no legal restrictions on operations by the private sector, but the operating conditions are too unattractive for private capital. The Zonguldak basin has a complex geological structure that renders mechanised production impracticable.

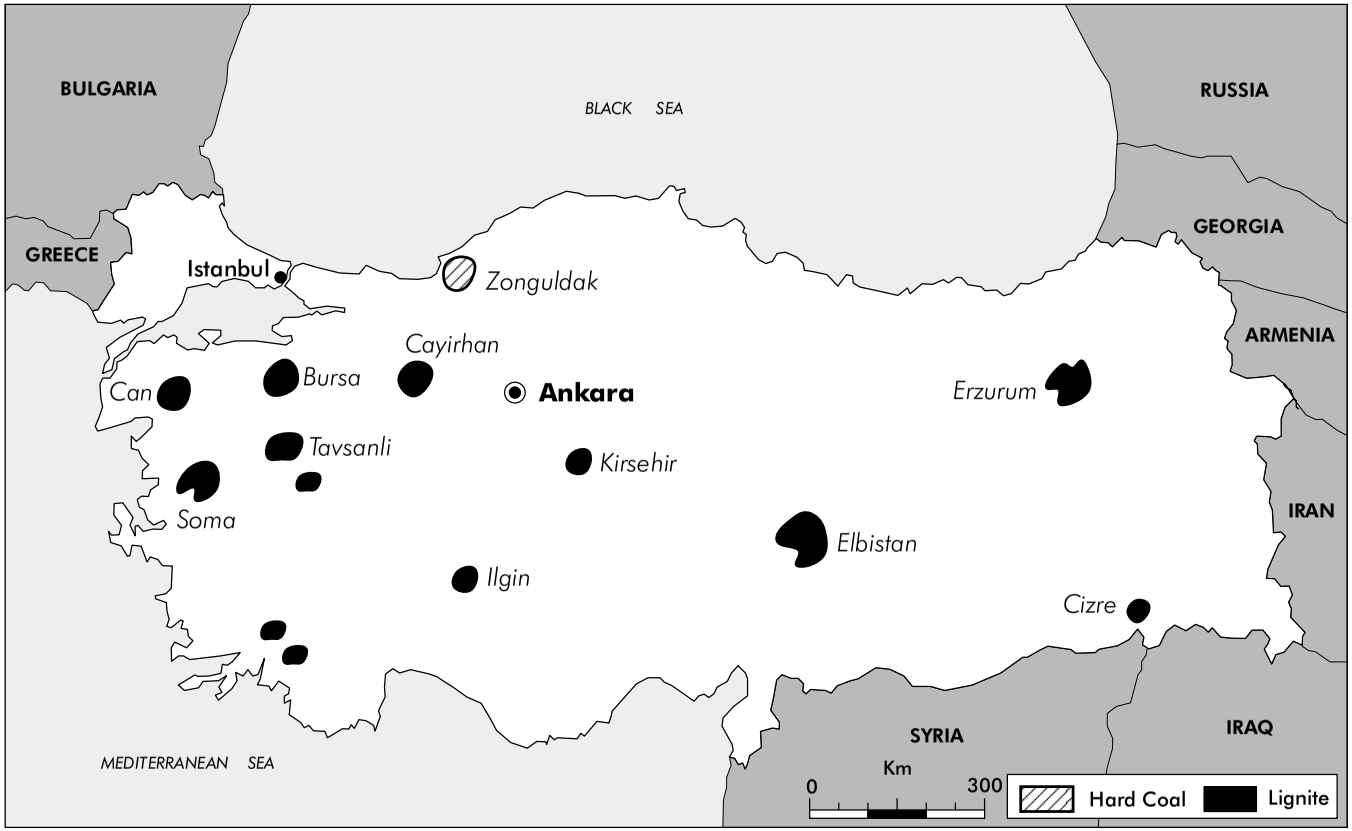
The majority of TTK's hard coal production is sold to the Catalagzi thermal power plant. Hard coal production has declined since the mid-1980s, falling from 2.7 million tonnes in 1990 to 2 million tonnes in 1999. TTK is trying to reverse this trend and aims to increase production to 3 million tonnes and then to maintain that level. TTK believes that by leasing to third parties some of its small mines it cannot operate economically itself, it can increase coal production to 4.5-4.8 million tonnes per annum. In 2000, TTK produced 2.4 million tonnes of hard coal.

Lignite is found in almost all regions of the country. The most important reserves are in the Afsin-Elbistan, Mugla, Soma, Tuncbilek, Seyitömer, Beypazari and Sivas regions. About 40% of Turkey's lignite resources, or 3.4 billion tonnes, are situated in the vast Afsin-Elbistan basin in the south-eastern part of the country. Much of the remainder and over half of all lignite production are located in the western parts of Turkey. About 90% of lignite production is open-cast, but low-cost open-cast mines are nearing depletion. There are also asphaltite reserves of 82 million tonnes in the Sirnak and Silopi areas.

The fully state-owned enterprise Turkish Lignite Enterprise (TKI) was responsible for about 56% of lignite production in 1998. Private companies produce about 10% of the total. The remainder is produced by two open-cast lignite mines that are owned by the state-owned electricity company TEAS and supply lignite to

26. Down to a depth of 1,200 metres.

Figure 10
Coal Deposits in Turkey, 2000



Sources: TKI and General Directorate of Mineral Research and Exploration of Turkey.

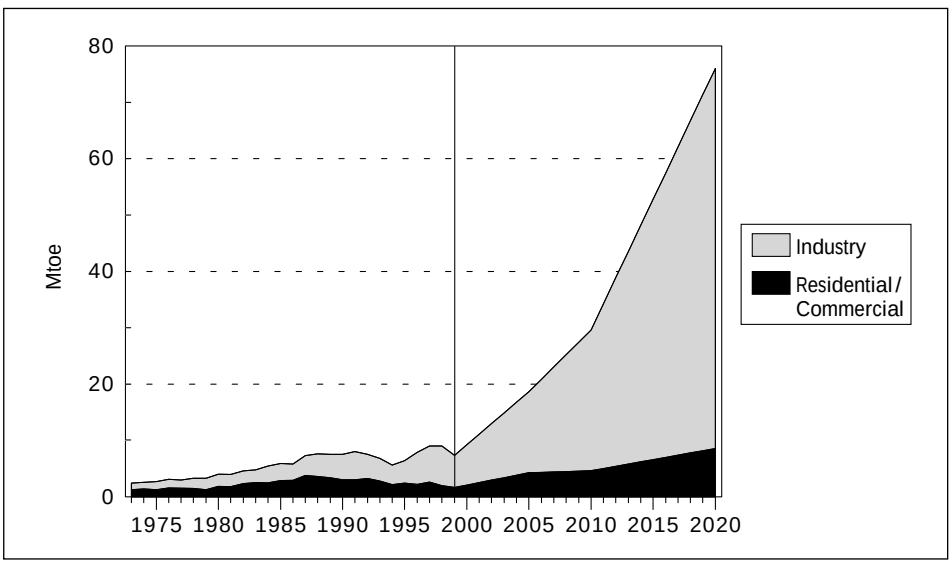
three lignite-fired power plants, Sivas-Kangal, Afsin-Elbistan and Cayirhan. Eventually, the government intends to privatise these power plants in some form. Lignite production increased throughout the 1990s, expanding by 3.8% per annum from 44.4 million tonnes in 1990 to 66.3 million tonnes in 2000 and compensating the decline in hard coal production.

Turkey imported nearly 6.7 Mtoe of coal in 1999, about 33% of primary coal supply. Almost all of this was hard coal; lignite imports were negligible. Between 1990 and 1999, hard coal imports rose by more than 6% per year. Low-sulphur coal is imported for residential use and in order to meet the requirements of the iron and steel industry. Hard coal imports for heating purposes have decreased because of the increasing use of natural gas in the residential sector. Total coal supply in 1999 was 20.1 Mtoe.

In 1999, coal supply amounted to 28.5% of TPES and coal consumption to 14.2% of TFC. The power sector accounts for the largest coal demand and consumes mainly lignite. Almost 80% of lignite production is used in power plants. In contrast, less than 9% of hard coal supply is used for power generation.

Next in size is the industrial sector. The largest consumer is the iron and steel sector, with about one-third of total industrial coal consumption. Industry is the main consumer of hard coal, absorbing almost 80% of final hard coal supply. Industry uses very little lignite. There is still sizeable residential/commercial consumption of coal, mainly lignite, amounting to some 1.5 Mtoe, i.e. about 15% of total coal consumption in this sector.

Figure 11
Coal Consumption by Sector, 1973 to 2020



Sources: IEA, *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000, and country submission.

The government expects that coal use, and with it coal production and supply, will increase dramatically over the next two decades. Its expects total coal supply to rise from 20.1 Mtoe in 1999 to 118.4 Mtoe in 2020, more than five times current figures. The main sources for this drastic expansion are thought to be a near-tripling of domestic lignite production and a 15-fold increase of hard coal imports. As noted above, the government also expects to increase domestic hard coal production to about 2.4 times its 1999 value. At about 147 million tonnes of hard coal and 184 million tonnes of lignite, hard coal would then amount to 44% of primary supply, up from under 15% today.

Behind this increase lies the expectation of tremendous growth in hard coal and lignite-fired power generation, and in industrial use of coal. The government expects demand in these three sectors to be almost 18 times, 3 times and 17 times their values in 1999.

State Aid

The government subsidises production of indigenous hard coal. The stated reason is that the use of domestic resources is important in order to maintain security of supply. TTK and TKI report directly to the MENR. Investment decisions and production programmes are proposed by the companies and discussed with the MENR. The State Planning Organisation takes final decisions.

TTK and TKI set the prices of hard coal and lignite for their customers, but these prices are subject to approval by the MENR. These prices do not allow TTK, the Turkish Hard Coal Enterprise, to recover its costs. As a result, the company incurs heavy losses, which are borne by the government. In contrast, TKI, the Turkish Coal Enterprise, does not benefit from direct subsides any more. Since 1995, the company has been able to cover its costs and make a profit.

Following the Producer Subsidy Equivalent (PSE) method, total subsidies paid by the Turkish Treasury to TTK amounted to Turkish lira 72 trillion ($171 million) in 1999. This represents a decline from the 1995 value of $263 million, but is still much higher than the $68 million paid in 1990. Table 4 details PSE paid in recent years. It shows that both PSE, which includes government coverage of operating losses, and assistance not benefiting current production increased substantially in 1995 and continued to grow afterwards.

Table 4
IEA Estimate of Assistance to Turkish Hard Coal Producers (TTK)

	1991	*1995*	*1996*	*1997*	*1998*	*1999*	*2000p*
Production, million tce	2.69	1.88	1.97	1.94	1.64	1.47	1.67
Aid per tce in thousand Turkish lira	637	6,487	8,031	12,371	27,212	63,976	138,078
Aid per tce in $	151.6	142.0	98.8	81.6	104.5	155.8	220.0

p = provisional.
tce = tonne of coal equivalent.
Source: IEA: *Coal Information 2001*, IEA/OECD Paris, 2001.

Reforms in the Coal Industry

For a number of years, the government has tried to increase productivity in the coal industry. Beginning in 1993, government programmes have aimed at increasing productivity and reducing overstaffing in TTK. In 1995, the least productive mines were closed. Between 1992 and 1999, TTK reduced its workforce by 13,315 through an early retirement programme. As a result, TTK's production costs decreased from $128 per tonne in 1990 to $104 per tonne in 1995, but they were still twice the price of imported hard coal. Prices for Turkish steam coal for electricity generation continued to decline by about 11% on average between 1995 and 1999 – domestic coal prices for industry remained stable – but in the same period, average prices for internationally traded coal fell by 26%[27].

However, in early 2000, TTK hired 4,012 new workers for underground mining. The stated purpose was refreshment of the workforce especially with respect to skills. Of this number, 3,012 were direct surface workers. The earlier workforce cuts had led to the reduction of coal output to just under 2 million tonnes in 1999, shown in Table 5. Since the government plans to expand hard coal production, it considered new hiring and upgrading of skills to be necessary.

Table 5
Production and Workforce in TTK and TKI

	TTK				*TKI*	
	Production (million tonnes)	*Number of Workers*			*Production (million tonnes)*	*Number of Workers*
		Underground	*Surface*	*Total*		
1990	2.245	21,024	13,325	34,349	36.859	29,644
1993	2.789	16,592	11,837	28,429	..	..
1997	2.320	12,277	6,397	18,674	..	..
1998	2.136	11,684	5,722	17,406	..	..
1999	1.990	10,898	5,282	16,180	38.644	18,967
2000	2.340	13,255	5,002	18,257	39.180	17,408

.. not available.

Sources: TTK, TKI, MENR.

27. *Coal Information 2000*. IEA/OECD Paris, 2000.

There are attempts to increase labour productivity in TKI. Table 5 also shows employment and production in TTK and TKI. Between 1990 and 1995, the workforce of TKI had been more than halved, from 29,644 to 12,192. It was then increased. Overall productivity in TTK increased from 98 to 124 tonnes per person-year between 1993 and 2000, and in TKI it increased from about 2,037 to 2,134 tonnes per person-year between 1999 and 2000. TKI estimates that in 2000, production expanded slightly within stable workforce.

The government is considering privatisation of TTK and TKI in the medium to long term in the framework of its long-standing privatisation programme. The government also had plans to transfer the operating rights of the most profitable lignite mines to the private sector, especially those owned by TEAS, which deliver coal to mine mouth power plants. Four mines were to be privatised in 1997, and the transfer of operating rights (TOOR) of up to 20 individual mines was to occur in the medium term. However, privatisation has actually occurred in only one case, the Cayirhan power plant, through a TOOR procedure. Following difficulties in concluding TOOR contracts with the private sector, the end of the TOOR programme in the power industry and the possibility for outright privatisation opened by constitutional amendments, no further transfers of individual coal mines can be expected.

OIL

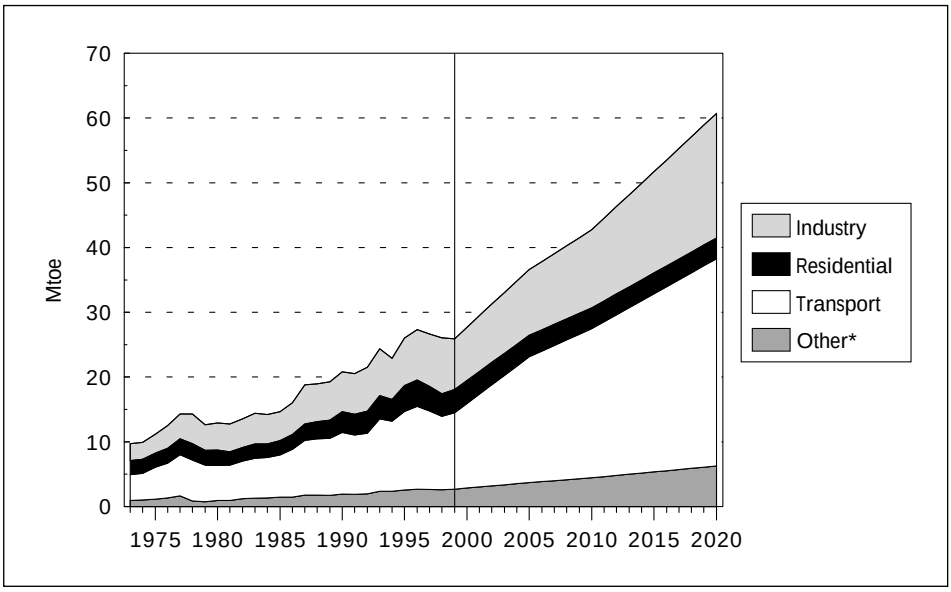
Industry Overview

Oil Demand

In line with developments in most other IEA countries, the importance of oil in the energy economy has declined. In 1973, oil accounted for 51.4% of TPES and 51.4% of electricity generation. By 1999, these shares had fallen to 41.8% of TPES (29.38 Mtoe) and 6.9% of electricity generation. Only in total final consumption did the share of oil remain unchanged – it was 48.5% in 1973 and 49.8% (25.92 Mtoe) in 1999. This is essentially due to the growth of oil use in transport, which was responsible for more than half of all oil use in 1973 as well as in 1999.

Oil demand grew at an annual average rate of 4.1% between 1979 and 1990. In the following decade, the growth slowed somewhat, and the government expects lower growth rates in the vicinity of 3% per annum until 2010. The government expects oil consumption to increase fastest in the transport sector, leading to a near-tripling of demand by 2020. Industrial demand is also expected to more than double by 2020. In the commercial/residential sector, oil consumption is expected to continue to increase, although less rapidly, especially because of growing demand in agriculture. Figure 12 shows past oil consumption, as well as expected future demand.

Figure 12
Final Consumption of Oil by Sector, 1973 to 2020



* includes commercial, public service and agricultural sectors.

Sources: *IEA, Energy Balances of OECD Countries*, IEA/OECD Paris, 2000, and country submission.

Turkey is the fourth-largest European consumer of liquefied petroleum gas (LPG) after Italy, France and Spain. LPG consumption increased on average by about 8% per year over the past decades. Recently, LPG consumption has increased drastically, since the government started subsidising LPG intended for household (cooking) use. Tax exemptions pushed the price of LPG below gasoline or diesel. As normal car engines cannot use LPG, the government expected that its use in cars would remain limited, except for taxi drivers, who in large cities such as Istanbul and Ankara were encouraged to use LPG because it causes less air pollution than diesel or gasoline. An underground industry then developed to convert gasoline and diesel engines to LPG. With a payback period of less than two years, the operation was sufficiently simple and cheap for drivers to convert massively to LPG use. Alerted by the resulting loss of tax revenue, the government began to phase out the tax break at end-2000. The new tax regulations on LPG have brought the use of LPG back under control.

Production and Exploration

The Turkish Petroleum Corporation (Türkiye Petrolleri Anonim Ortakligi, TPAO), the state economic enterprise (SEE) is responsible for petroleum exploration and production in Turkey. TPAO does not have any statutory monopoly in the upstream market. Twenty-five companies, including three Turkish companies, are active in the upstream petroleum sector in Turkey. But TPAO has the largest market share. In

1999, ten companies, of which two are domestic and eight foreign, were involved in production, either individually or as joint production companies. 74.4% of total oil production was from TPAO, followed by the Dutch company Perenco N.V. (20.4%). The remaining 5.2% was produced by the other Turkish and foreign companies. Table 6 shows crude oil production in 1999 by company.

Table 6
Crude Oil Production in Turkey, 1999

Company	*Production (thousand tonnes)*
TPAO	2,187
Perenco N.V.	599
Arco	36
Petrom (Dorchester)	81
Others	37
Total	2,940

Source: PIGM.

TPAO's oil production rose gently in the 1950s, levelled off after 1969, and then peaked sharply in 1991. Since then, it has declined, as some of the fields are beginning to near depletion. The government expects Turkey's total domestic oil production to be slightly more than one-third of today's value in 2010, and to decline further thereafter. The Directorate-General for Petroleum Affairs (PIGM) estimated Turkey's remaining petroleum reserves at 296 million barrels of crude oil and 8.8 billion cubic metres of natural gas on 1 January 2000. Table 7 provides further details on reserves. At current rates of production, Turkey's known oil reserves will last another 14 years.

Table 7
Petroleum Reserves in Turkey, 1 January 2000

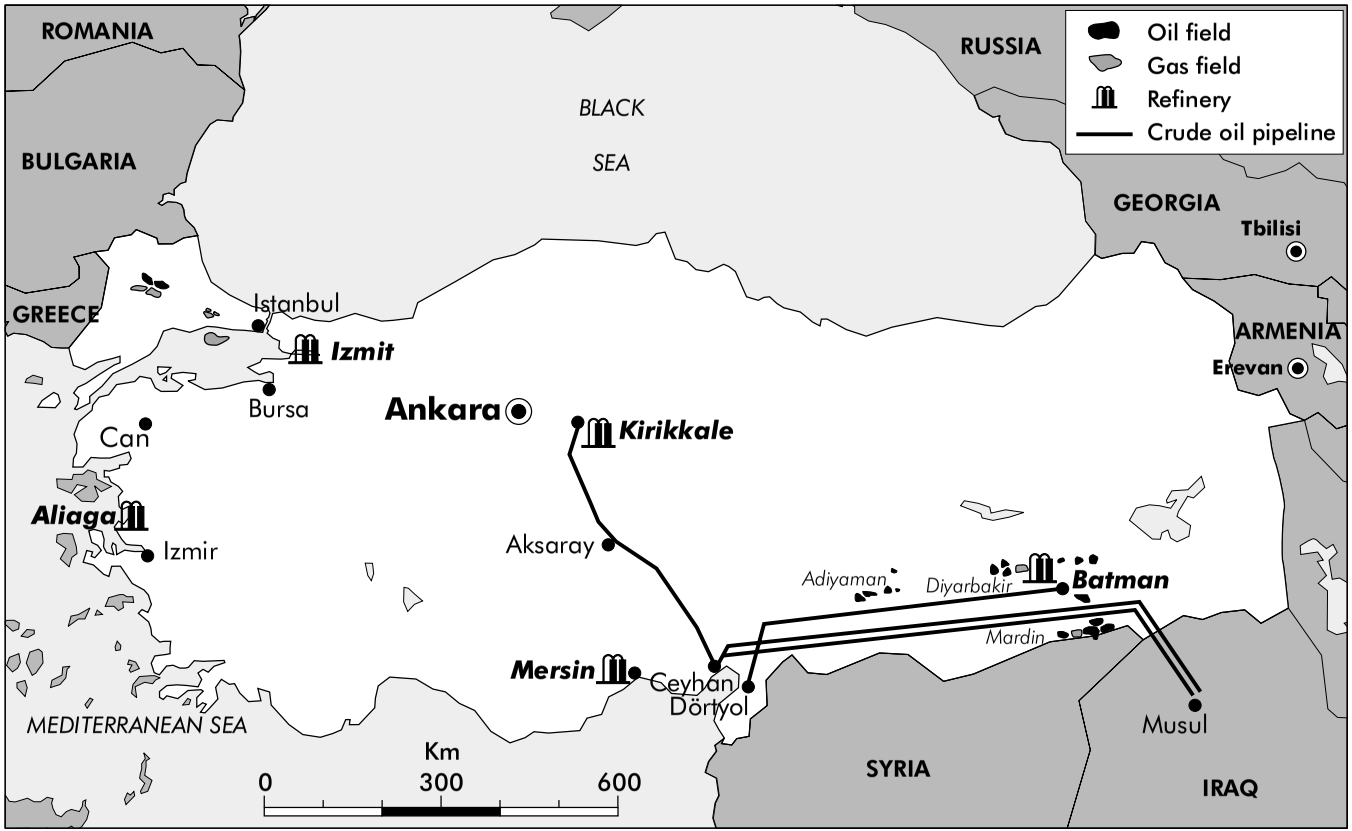
	Reserves in Situ	*Recoverable Reserves*	*Cumulative Production*	*Remaining Reserves*
Oil (million barrels)	6,582	1,070	774	296
(million tonnes)	966.5	152.6	109.5	43.1
Gas (bcm)	19.0	13.1	4.3	8.8

Source: PIGM.

Turkey's three main known petroleum reserves lie near Hamitabat in Thrace in the European part of the country and in south-eastern Anatolia near Adiyaman and Diyarbakir/Batman, as shown in Figures 13 and 14. TPAO held 196 oil concessions

Figure 13

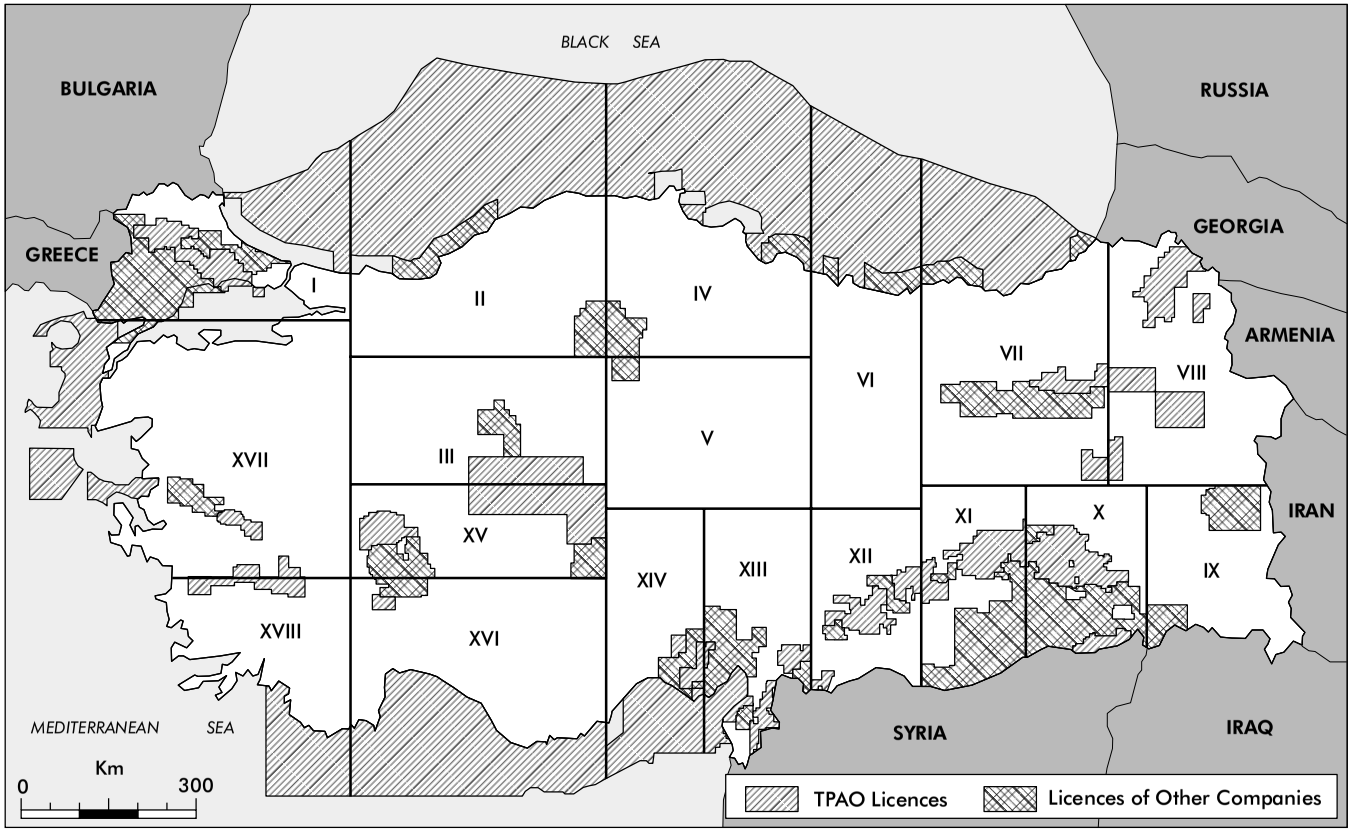
Petroleum Reserves and Infrastructure in Turkey, 1999



Source: BOTAS.

Figure 14

Petroleum Licences in Turkey, 1999



Source:TPAO.

in Turkey in 1999, covering more than 23 million hectares. Of these, 149 were exploration concessions; the remainder were production concessions. Two of the latter were international joint ventures with Perenco and Arco. TPAO carries out onshore exploration in various areas in Turkey, especially in the south-eastern part of the country. Offshore exploration focuses on the Black Sea. In 1999, exploration activities in the Western Black Sea, carried out jointly with Arco, encountered only non-commercial gas deposits. In April 1999, TPAO and BP Amoco were granted exploration licences in the Eastern Black Sea. Offshore exploration is also carried out in the Mediterranean Sea, in the Antalya, Mersin and Iskenderun bays. To encourage exploration, the government plans to lower royalties, which amount to 12.5%. The new royalties are to be progressive, i.e. smaller fields will enjoy a lower royalty rate.

Trade, Transportation and Transit

Turkey's oil reserves are minor. The country covered about 10% (3.09 Mtoe) of its primary oil demand (29.38 Mtoe TPES) through its own production in 1999; the remainder had to be imported. As oil demand shows momentous growth, net crude oil and oil products imports also increased at a 4.1% annual average growth rate since 1990. As indigenous production is expected to decline and demand is expected to keep growing, oil imports will have to increase substantially in future.

Table 8 shows Turkish crude oil imports by country of origin. Before 1990, Iraq was the largest oil supplier. In 1990, after the UN sanctions against Iraq, Turkey increased its crude oil purchases from Saudi Arabia and Iran. Beginning in December 1996, limited oil imports from Iraq were once more allowed, under UN Resolution 986. From that time, Turkish oil imports from Iraq have continued and even grown slightly.

Table 8
Turkish Crude Oil Imports by Country of Origin
(Mtoe)

Country of Origin	*1990*	*%*	*1998*	*%*	*1999*	*%*
Saudi Arabia	2.9	14.4	5.4	22.8	3.6	15.7
Iraq	6.8	33.8	3.1	13.1	4.8	20.9
Iran	3.5	17.4	4.5	19.0	4.8	20.9
Libya	2.6	12.9	3.3	13.9	3.6	15.7
Russia	2.0	10.0	0.9	3.8	2.5	10.8
Syria	0.3	1.5	2.2	9.3	2.1	9
Other	2.0	10.0	4.3	18.1	1.6	7.0
Total	**20.1**	**100.0**	**23.7**	**100.0**	**23**	**100.0**

Source: PIGM.

Turkey imports oil products through seaports such as Ceyhan and by truck. The country has no oil product pipelines. In 1999, net oil product imports amounted to about 11% of total final oil consumption.

Turkey has three major crude oil pipelines. These pipelines, as well as gas pipelines, are owned and operated by the fully state-owned Petroleum Pipeline Corporation (Boru Hatlari Ile Petrol Tasima A.S., BOTAS). BOTAS was established on 15 August 1974, but remained a subsidiary of TPAO until 8 February 1995, when it was restructured as a State Economic Enterprise. Until recently, BOTAS had a *de facto* dominating position in gas transportation in Turkey, as it was the only company allowed to import natural gas.

Crude oil produced in petroleum districts near Batman is transported to the port terminal at Dörtyol by means of the Batman-Dörtyol crude oil pipeline, which was constructed by TPAO in 1967 and transferred to BOTAS in 1984. Crude oil is transported by marine tankers from Dörtyol to the refineries at Izmir and Izmit, as well as to the refinery run by the private company ATAS. Crude oil produced in the Selmo oil field is transported to Batman by means of the Selmo-Batman crude oil pipeline. The crude oil pipeline linking Yumurtalik and Kirikkale was built to carry oil to the Orta Anadolu Refinery. Its ownership rights were transferred from TPAO to BOTAS in 1983, and it began operating in 1986.

The Turkey-Iraq crude oil pipeline consists of two parallel pipes and runs to the major oil terminal of Ceyhan. The first pipeline started operation in May 1977 and the second in August 1987. Economic sanctions against Iraq in 1990 led to the closure of these two pipelines. After the UN vote on Resolution 986, which allowed Iraq to sell oil worth $2 billion over a period of six months, the pipeline was opened again in December 1996. Meanwhile, the limit on oil exports was lifted. In 1990, the two parallel Turkey-Iraq pipelines carried far larger amounts of oil (about 350 million barrels) than the three others together. As of 1997, oil transport resumed, and in 1999 the pipelines again carried over 300 million barrels.

Turkey has far-reaching plans to bring new oil supplies to Western markets from the Caspian region, especially Azerbaijan and Kazakhstan. The Baku-Tbilisi-Ceyhan project is designed to transport crude oil produced in the Caspian Basin by pipeline to the Ceyhan port terminal. As the Ceyhan terminal has a capacity of 120 Mtoe per year and can receive very large crude carriers (VLCC), the oil could be shipped to world markets by tanker. The Turkish government expects that the pipeline will have an approximate length of 1,730 km, will carry 1 million barrels of crude oil per day, and will come into service in 2004 or 2005. From its starting point in the Azeri city of Baku on the shore of the Caspian Sea, the pipeline is to cross the territory of Azerbaijan and Georgia, enter Turkey near the city of Ardahan, run westwards to Sivas and then dip south to Ceyhan. For this reason, many parties are involved in negotiating this international project, which has been under consideration for a decade.

Negotiations are also complex because there is an alternative, "northern" route from Baku via the Russian port of Novorossiysk, and then by tanker through the Black Sea

and the Bosporus Strait. Unlike Ceyhan, Novorossiysk cannot handle super tankers, but a crude oil pipeline has existed between Baku and Novorossiysk since 1993, and the investment cost is therefore estimated around $60 million. Estimates for the Baku-Ceyhan option range from $1.8 billion to $4 billion: the Turkish government assumes that the cost will be in the order of $2.5 billion. Other competing proposals include construction of a pipeline from Baku to the Georgian sea port Supsa at a cost of about $250 million, and a swap arrangement with, or pipeline through, Iran. Like Novorossiysk, the Supsa option would be restricted to smaller tankers, because among other things of the need to pass through the Bosporus Strait, which already has extremely dense tanker traffic[28]. Moreover, weather conditions in winter can constrain navigation on this route. Figure 15 shows the alternative pipeline options.

The World Bank sponsored a feasibility study, an environmental impact assessment and a detailed route study for the Baku-Tbilisi-Ceyhan project; these were completed in 1998. Following numerous additional studies, an Intergovermental Agreement (IGA) was signed between Turkey, Azerbaijan and Georgia during the OSCE Summit in Istanbul on 18 November 1999. The IGA sets forth the mutual obligations of the three governments with respect to the project.

A number of additional documents were also developed for signature after the IGA was ratified by the parliaments of Azerbaijan, Georgia and Turkey. In the Host Governments Agreement, the three governments committed themselves to establishing a harmonised legal, economic and administrative structure for investors in the project. The turnkey agreement establishes BOTAS as the contractor for the Turkish section of the pipeline, and foresees 6 months for basic engineering studies, 12 months for detailed engineering and 32 months for construction, with commissioning in 2004. The Government Guarantee is a guarantee by the Turkish government to bear all costs exceeding the $1.4 billion that the government has estimated for the Turkish section of the pipeline. Ratification of the IGA occurred on 26 May 2000 in Azerbaijan, on 29 May 2000 in Georgia, and on 22 June 2000 in Turkey.

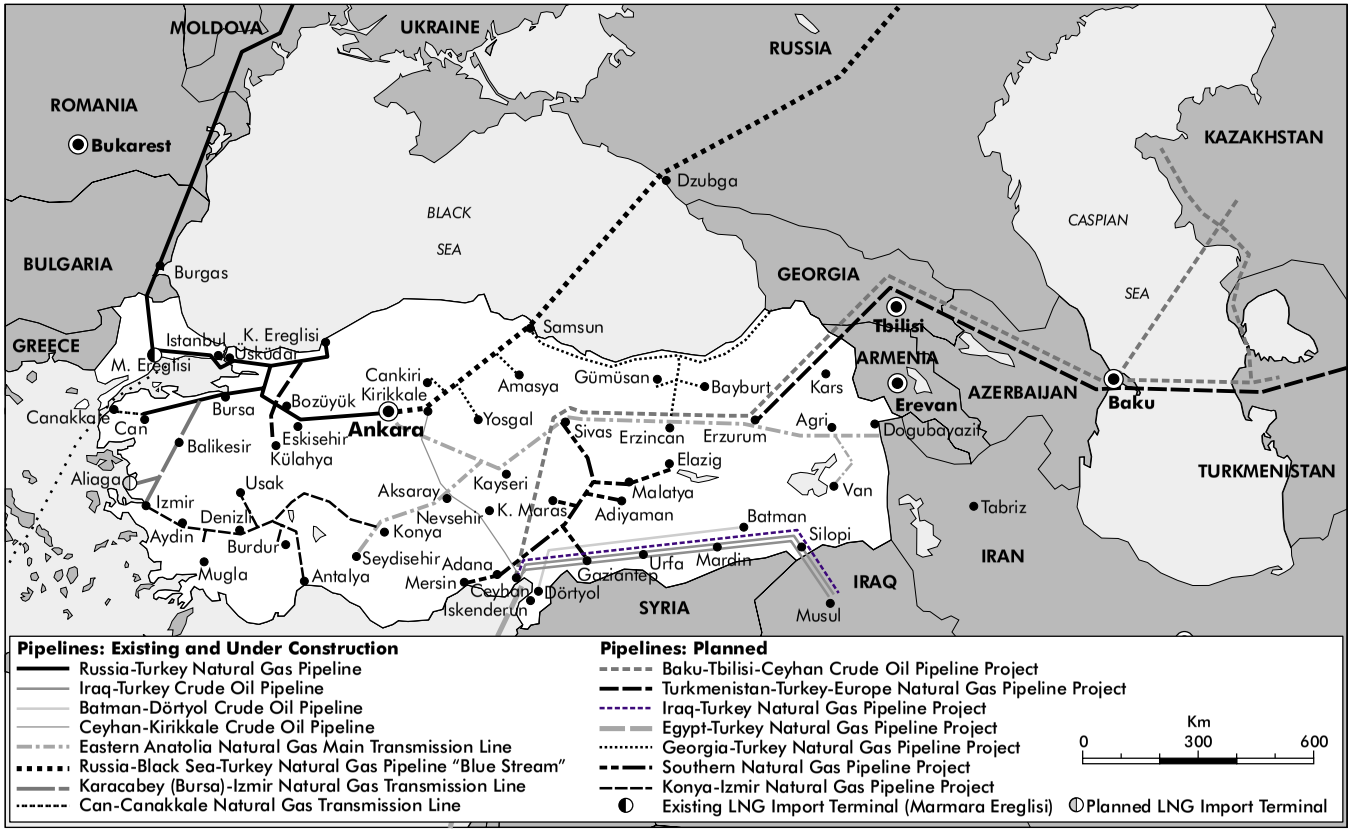
With the framework of required intergovernmental treaties now in place, the project can be submitted to investors. The most important aspect in terms of the economic viability of the pipeline concerns the volumes of crude oil that can be committed to it. Industry analysts estimate that to succeed the pipeline must carry 1 million barrels per day of crude oil. Attempts are under way to commit oil volumes to the project in co-operation with Azeri and Kazakh oil companies. TPAO is playing a major role in this respect:

- TPAO has held a 6.75% share in the Azerbaijan International Operating Company (AIOC) since 1994. On 20 September 1994, an agreement was signed between a consortium of companies, the state-owned Azeri oil company Socar and the Azeri government to produce oil from the “Mega Project”. The agreement covers the Chirag and Azeri fields and the deepwater part of the Guneshly field

28. See box on p. 37.

Figure 15

Existing Oil and Gas Pipelines and New Transit Routes



Sources: BOTAS, IEA.

in the Azerbaijan sector of the Caspian sea. AIOC was established following this agreement. Besides TPAO, the shareholders are BP, Unocal, Socar, Lukoil, Statoil, Exxon-Mobil, Pennzoil, Itochu, Ramco, and Delta-Hess. BP is the largest shareholder with about 34%, followed by Unocal, Socar and Lukoil with about 10% each. The project is currently in the early oil production phase: in 2001, production from the project's 11 wells reached 120,000 barrels per day. The main production phase, which is to bring total production to around 400,000 barrels per day, is under development, but is not expected to begin until the first quarter of 2005. Estimated reserves in the Mega Project total about 4.6 billion barrels of oil.

- TPAO is involved in three other similar joint ventures in the Azeri part of the Caspian Sea. The company became part of the Shahdeniz project in October 1996, the Kurdashi project in July 1998, and the Alov project in December 1998.
  - The Shahdeniz project has six shareholders, the largest of which are BP and Statoil with 25.5% each. TPAO's participation is 9%. A significant gas discovery was made in this field in June 1999, and agreements for marketing the gas were signed on 21 March 2001. The estimated reserve is reported to be about 875 billion cubic metres of natural gas.
  - The Kurdashi project has five shareholders, of which SOA (50%) and AGIP (25%) are the largest. TPAO holds 5%. The first exploration well was drilled in June 2000. Two more exploration wells are to be drilled during the three-year exploration period.
  - The Alov project has six shareholders. SOA (40%) is the largest, followed by Statoil, BP and Exxon-Mobil with 15% each. TPAO holds 10%, and AEC the remaining 5%. The first exploration well is to be drilled in 2002.

- TPAO's activities in Kazakhstan are carried out through an oil exploration company it formed in 1993 with the Kazakh Ministry of Geology and Energy. The joint venture, in which TPAO holds a 49% share, is called Kazakhturkmunay (KTM). Production from three commercial discoveries commenced in 1999, yielding a total of around 4,500 barrels per day. Studies are under way to increase production.

In March 2001, a Memorandum of Understanding was signed between the governments of Azerbaijan, Georgia, Kazakhstan and Turkey providing a legal framework for oil producers in Kazakhstan to join the Baku-Tbilisi-Ceyhan pipeline project. This opens the possibility in principle that oil from the Kazakhi Tengiz (Kashagan) field, produced by Tengizchevroil, may be committed to the pipeline.

Refining and Retailing

There are five oil refineries in Turkey with a total capacity of 32 million tonnes. Four of them are owned by the state-owned company TUPRAS: the Izmit, Izmir, Kirikkale and Batman refineries. The refining capacity of TUPRAS is currently 27.6 million tonnes per year, or 86% of Turkey's total refining capacity.

The fifth refinery is owned by the private company ATAS and is situated near Mersin on the Mediterranean coast. ATAS was established in 1962 with an annual capacity of 3.2 million tonnes. It is a joint venture of Mobil (51%), Shell (27%), BP Amoco (17%) and the local company Marmara Petroleum (Marmara Petrol ve Rafineri Isleri AS, 5%). The ATAS refinery, a simple hydro-skimming facility, was expanded to 4.4 million tonnes annual capacity in 1969. No further upgrades have been carried out.

Table 9
Refinery Capacity in Turkey

Refineries	*Capacity (million tonnes per year)*
Izmit	11.5
Izmir	10.0
Kirikkale	5.0
Atas	4.4
Batman	1.1
Total	**32.0**

Source:TUPRAS.

In 1999, 26.2 million tonnes of crude oil were processed, yielding 25.4 million tonnes of products. During the same period, 5.6 million tonnes of products were imported while 2.5 million tonnes of products were exported.

With crude oil processing capacity of 11.5 million tonnes per year, the Izmit (Körfez) refinery is the largest refinery in Turkey. It is located on the Gulf of Izmit, approximately 80 km south-east of Istanbul. It serves the Istanbul market and the markets along the Black Sea and Marmara coast. The Izmit refinery is adjacent to several industrial complexes and various oil product distribution companies. The refinery was upgraded with the construction of a hydro cracker and CCR complex in 1997.

The refinery was damaged during the earthquake of 17 August 1999, whose epicentre was near the town of Gölcük, only a few kilometres away. The main damage occurred at the newest crude distillation unit, which was rendered inoperable. As a direct result of the earthquake, several fires erupted at the Izmit refinery, most significantly in the pipe rack, tank farm and warehouse. There were simultaneous fires at four naphtha storage tanks, spreading to two nearby smaller tanks. Approximately 30,000 tonnes of naphtha in six storage tanks burned, representing 1% of oil stocks. Office buildings, fresh water pipelines, waste water treatment systems, cooling towers and two of the wharf facilities were also affected. Repairs began shortly after the earthquake. The loss of refining capacity at the

Izmit refinery was compensated by increased throughput at the other TUPRAS refineries, as well as by imports of oil products. Turkey did not experience any shortage of products following the earthquake. TUPRAS completed the repairs on or ahead of schedule. The refinery was back to more than half of its original capacity in January 2000, and reached its full capacity on 21 September 2000. The damaged naphtha storage tanks were rebuilt by 17 August 2000.

The Izmir refinery is the second-biggest refinery in Turkey. It was upgraded with the construction of a vacuum distillation tower, visbreaker and hydro cracker complex in 1993. The Kirikkale refinery is located approximately 80 km south-east of Ankara, and serves the markets of Central Anatolia. It was upgraded with the construction of a hydro cracker complex in 1993. The Batman refinery is the smallest and oldest refinery in Turkey. It processes indigenous crude oil exclusively.

The government is striving to meet EU fuel standards for gasoline and diesel by the end of 2005. The refining companies had to make additional investments to meet increasingly stringent standards for oil products, including the production of unleaded gasoline. Since 1989,TUPRAS has invested $1 billion in refinery upgrades. Construction worth another $700 million is under way, and a further $100 million are to be invested in the coming years. The growing demand for unleaded premium gasoline is met through the completion of an isomerisation and CCR-reformer complex at the Izmir refinery in July 2001. An isomerisation unit at the Izmit refinery and several reformer revamp projects were scheduled to be completed in the year 2000.

Following the completion of the Kirikkale refinery near Ankara in 1986, the Turkish refinery sector was characterised by overcapacity, resulting in low capacity factors at all refineries. In recent years, capacity factors have increased, and in the light of oil product demand growth, the MENR expects that new refinery capacity will be needed around 2005. TUPRAS imports oil products in order to meet seasonal demand swing and production deficiencies. LPG is the only oil product for which the domestic refining cannot satisfy domestic demand. Therefore, LPG has the largest share of imported oil products.

TUPRAS has for a long time been slated for privatisation. TUPRAS's shares were transferred to the Privatisation Administration, Turkey's main executive body for the privatisation of government assets, as early as July 1990. In May 1991, shares equivalent to 2.5% of the company's capital were offered to the public and listed on the Istanbul Stock Exchange (ISE). At end-December 1999, 3.58% of TUPRAS's shares were held by private investors. In late 1999, further privatisation was scheduled for April 2000, and a global equity offering of TUPRAS's shares was set in motion.

Initial plans called for a domestic and international public offering of 15% of the shares from 5 through 7 April 2000. However, demand was such that the share offer was three times oversubscribed during the registration period. When the offer closed on 12 April 2000, it became clear that this sale of TUPRAS's shares was the largest privatisation ever conducted in Turkey, reaching a transaction volume of

about $1.24 billion. By April 2000 34.24% of TUPRAS's capital had been sold following a second public share offering. The Privatisation Administration intends to maximise the sales value by selling further tranches of TUPRAS's shares subject to market conditions.

The retail market has also long been characterised by dominance of a state-owned company, Petrol Ofisi (POAS). POAS was established in 1941 as a government institution to ensure the storage, marketing and distribution of petroleum products in Turkey. In 1981, Petrol Ofisi was transferred to Türkiye Petrol Kurumu (PETKUR), a government agency responsible for all government-related petroleum matters. In 1983, POAS was corporatised and became a limited liability company under Law No. 233 on State Economic Enterprises. Its ownership was transferred to TPAO. As part of Turkey's privatisation programme, under Law No. 3291, ownership of POAS was transferred to the Public Participation Administration (PPA), the predecessor of the Privatisation Administration, in 1990. At present, approximately 6.7% of POAS's shares are traded on the ISE, and the Privatisation Administration owns approximately 93.3% of the shares.

POAS has no statutory monopoly, but is the leading distributor of petroleum products in Turkey. In 1999, POAS had a 40% share of the products market. POAS's fuel products are distributed through a nationwide network of 5,259 sales outlets. Of these, POAS owns 47 retail service stations, although they are operated by independent licensees. The remaining 4,589 POAS service stations are owned and operated by independent dealers under long-term supply and operating agreements. POAS sells products directly to government agencies, State Economic Enterprises, industrial users, the Turkish military and NATO. With a 77% share, POAS is the leading supplier of aviation fuel to international and domestic airlines in Turkey. Through an annually renewed protocol, POAS has exclusive civil usage of the NATO West trunkline that is connected to the Izmit refinery and owned by NATO.

Apart from POAS, the Turkish retail market for oil products comprises 12 companies. The number of retailers has increased since 1989, when regulation of the oil market was eased. Table 10 shows oil product retailers and their market shares in 1999.

On 12 December 1994, the Privatisation High Council (PHC), a ministerial body that has the ultimate decision-making power concerning privatisation, took the decision (Decision 94/9 PHC) to privatise POAS. A first tender for the block sale of 51% of POAS's public shares was issued in March 1998. Seven proposals were included in the final tender. PHC approved the block sale to a consortium for $1,160 billion. However, the Administrative Court of Ankara (Danistay) cancelled the tender in 1999. The POAS tender was then cancelled by the PHC.

A new tender was opened on 17 November 1999. Four proposals were included in the final tender on 3 March 2000. The highest bid of $1.260 billion was submitted by a Turkish financial consortium. Following a favourable review by the Turkish Competition Board on 10 March 2000, the result of the tender was

approved by the PHC in April 2000. The sale became effective on 21 July 2000. This sale attributes the majority of shares and voting rights to the new owners, within the limits of a Preferential Share currently held by the Privatisation Administration. The latter has announced that it reserves the right to sell the remaining 42.3% of the shares of the company at any time in one or more further block sales, public offerings, international offerings, or by sale to company employees and/or sale on the Istanbul Stock Exchange.

Table 10
Oil Retailers and their Shares in the Turkish Market, 1999

Company	*Sales (million tonnes)*	*Market Share (%)*	*Number of Sales Outlets*
Petrol Ofisi (POAS)	7.0	40	5,259
Turcas	1.3	7	769
Shell	1.8	10	572
BPAO	3.1	17	926
Total	0.9	5	339
Selyak	0.5	3	135
Opet	1.4	8	439
Tu-Ta *	0.1	1	166
Petline	0.3	2	179
Turkuaz	0.3	2	186
Bölünmez	0.1	1	58
Aytemiz	0.6	4	112
Delta**	..	..	10
Total	**175.4**	**100**	**9,150**

* TABAS and TURCAS merged their downstream activities in 1999.

** Delta was established in 1999.

Emergency Preparedness

Turkey appeared to have established the conditions for remaining permanently above the 90-day IEP stockholding commitment by the late 1990s. However, on 17 August 1999 a major earthquake caused much destruction at the Izmit refinery and associated storage facilities. The refinery throughput dropped to 25% of total capacity in November 1999 but returned to 55% in March 2000 and is now close to normal.

The earthquake resulted in fires at three locations at the refinery: the crude distillation unit, the naphtha tankage area and the stationary warehouse. Fire at the storage area demolished six naphtha storage tanks and other processing equipment sustained additional damage. The 36% of Turkey's total storage capacity located at the Izmit refinery and in the Marmara region were greatly affected.

TUPRAS management prepared a refinery repair schedule and start-up plan soon after the earthquake. The naphtha storage tanks were rebuilt and the others repaired during a six-month period. Turkey was commended by the IEA for rapid and efficient repair of oil storage tanks and related facilities.

Turkish oil stocks were successfully replenished and compliance was achieved in the second quarter of 2000. However, stocks later declined to the equivalent of 83 days of net oil imports as of 1 July 2001.

Government Intervention and its Reform

The Turkish oil market, which had been heavily regulated, underwent significant liberalisation from 1989 through 1990. Before 1954, petroleum operations were classified as public service operations under Petroleum Law Number 792 of 1926. The operations were state-owned and were integral parts of the general government budget.

In 1954, a more liberal Petroleum Law (No. 6326) was enacted. This law, which was in force until 2001, provided for private-sector activities throughout the upstream oil and gas sectors and the downstream oil market, although it also foresaw government regulation of exploration, production, refining and transportation. No provisions were made regarding oil and gas distribution. Oil product retailing was not restricted. Foreign companies were required to act through Turkish subsidiaries, to have a minimum storage capacity and to own a minimum number of service stations. The Petroleum Law also forms the legal basis of the natural gas industry (see section below).

Under this law, until 1990 domestic oil producers had to sell their production to TUPRAS. Oil product prices were set by the government. The law contained a third party access provision for pipelines. TPAO was established through Law No. 6327 to operate like a commercial company. The Directorate-General of Petroleum Affairs (PIGM), a part of the MENR, was assigned to enforce the Petroleum Law.

Under Law No. 79 of 1989, importers, refineries and oil distribution and retailing companies were allowed to set prices freely for crude oil and petroleum products. However, the same law enabled the government to determine "fundamental principles of purchase, sale and distribution of crude oil and petroleum products, considering the developments of international markets". The outcome of this reform was that oil producers were allowed to sell 35% of their production from

new oil fields to others than TUPRAS. Oil product imports and exports were also liberalised in 1989; all refineries and retailers with minimum storage capacities were granted import licences. However, the government continued to prescribe annual oil import programmes with the stated purpose of matching refinery requirements in terms of quantity and quality. TUPRAS's ex-refinery prices for oil products also remained subject to government approval. Through repeal of Article 6 of the Petroleum Law (Law No. 6326) in 1994, restrictions on non-producer private-sector participation in ownership or construction of refineries and pipelines were removed.

Between 1 July 1998 and January 2000, the Council of Ministers adopted several measures to improve fuel price stability, including an automatic pricing formula for domestic sales of oil products, indexation of refinery profit margins and a compensatory fuel consumption tax, replacing several other taxes[29]. In October 2001, a new Petroleum Products Law was adopted. Through this law, the automatic pricing formula was abolished. The gas market was liberalised in 2001 through a separate Gas Market Law (see below).

NATURAL GAS

Industry Overview

Natural Gas Demand

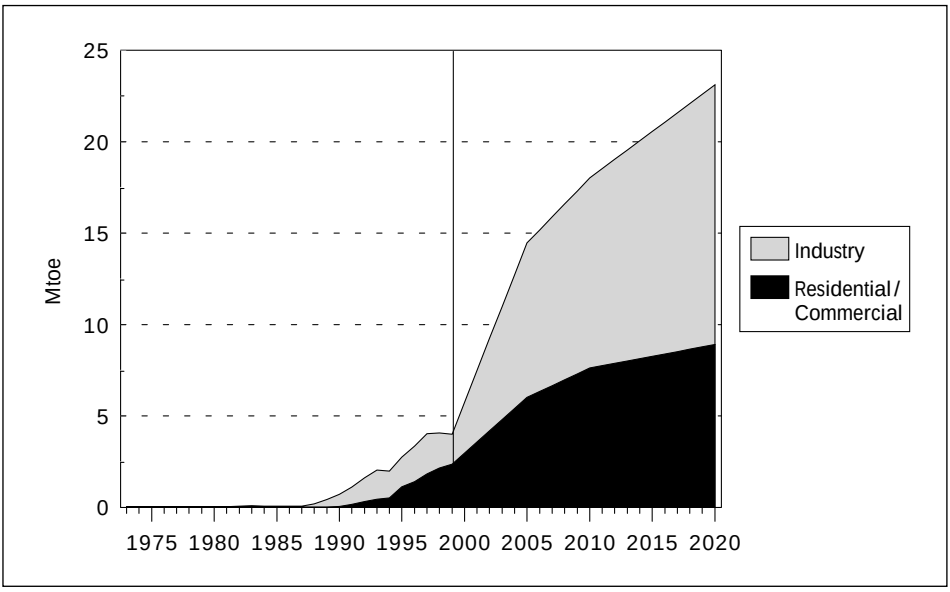
Natural gas production and use in Turkey began in 1976. Starting in 1987, gas demand began to grow rapidly. Between 1990 and 1998, average annual primary gas demand growth rates reached 15.3%, and even 18.4% in 1999. The government expects very high gas demand growth of almost 26% per annum between 1999 and 2005, followed by more restrained growth of 3.5% to 4% in the following 15 years.

This growth would mean that gas TPES would be more than seven times as high in 2020 as it was in 1999 (10.6 Mtoe in 1999), and TFC more than five-and-a-half times as high (40.4 Mtoe in 1999). At these growth rates, gas would increase its share of TPES from today's 15.1% to over 25%. Gas's share in TFC would also rise, but much more moderately, from 7.8% to 10.8%, although reaching 15-16% between 2005 and 2010. Based on these figures and current supply contracts, the Turkish government expects a supply shortfall of 16-18 bcm in 2010.

The reason for this growth is that the largest increase in gas use is anticipated in power generation, where gas demand is expected to double between 2001 and 2010. With a demand of slightly under 8 bcm in 1999, the power industry accounted for 64% of total primary gas demand, followed by residential demand with slightly under 2.9 bcm and industry with 1.4 bcm. In all consuming sectors, gas has replaced oil and coal. The government has encouraged the use of natural gas to replace lignite in the residential sector to reduce urban pollution. Figure 16 illustrates demand developments.

29. See the taxation section of Chapter 3.

Figure 16
Natural Gas Consumption, 1973 to 2020



Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000, and country submission.

Production

Turkey has limited gas resources. The country's total natural gas reserves are estimated at 19.2 bcm (*in situ*), and recoverable gas at 13.1 bcm. As of end-1999, cumulative production of natural gas was 4.3 bcm, with 8.8 bcm of recoverable gas remaining. In 1999, about 670,000 tonnes of oil equivalent (731 mcm) or 6% of primary gas supply was produced. The government expects this amount to be a blip: throughout the 1990s, production was less than a third of this figure, and it is expected that it will fall back to or below that lower level in the near future.

There are 14 gas fields, two of which have been producing since the 1970s. These fields include: Hamitabat, Umurca, Karacaoglan, Karacali, Degirmenköy, Kuzey Marmara (offshore), Silivri, Camurlu, Ardic, Kumrular, Havrabolu-Gelindere, Tekirdag-Sig and Derin-Barbes. The Camurlu field is in south-eastern Turkey. All the others are in Thrace. TPAO owns the first ten fields in the above list.

The Kuzey Marmara field in the Marmara Sea was Turkey's first offshore field. Production began in 1997. The field is comparatively large, and essentially responsible for the production blip: in 1999, production from the Kuzey Marmara field amounted to 496 mcm. Its depletion, and that of the Degirmenköy field, is expected by 2004. The Kuzey Marmara and Degirmenköy fields are then to be used for underground storage with an annual storage capacity of 1.6 bcm. Table 11 shows natural gas production in Turkey by producer.

Table 11
Natural Gas Production by Producer, 1999

Operator	*Production (mcm)*
TPAO (public)	718
Perenco N.V.	9
TGT	3
TGT-HTI	1
Total	**731**

Source: PIGM.

Transportation and Trade

The fully state-owned company BOTAS became active in the gas business in 1987, when it took over those functions from TPAO. Since then, it has been the sole entity with the right to carry out oil and gas pipeline transportation[30]. BOTAS also has a monopoly of gas import and export and wholesale trading. Figure 15 shows BOTAS's existing transmission grid, pipelines under construction, as well as the various new pipelines being planned.

At present, Turkey has only one operating pipeline. This pipeline originates in the Russian Federation, runs through a number of countries that take gas from it, and enters Turkey from Bulgaria near the town of Malkoclar, currently ending in Ankara. It was built between 1986 and 1988 to carry Russian gas supplies to Turkey starting in 1987 and building up to 5-6 bcm per year over six years ending in 1993. The contract signed with Soyuzgazexport is for 25 years. The pipeline's transmission capacity is around 8.6 bcm; augmentation of capacity to 14-15 bcm is expected. On the 842 km stretch from Malkoclar to Ankara, the pipeline supplies power plants, several large industries and the cities of Ankara, Istanbul, Izmit, Eskisehir and Bursa.

In 1996, the transmission pipeline was extended to the western Black Sea region via the Izmit-Karadeniz Eregli line (209 km); the main customer is an iron and steel plant. In the same year, it was extended to Can via the Bursa-Can line (208 km).

In order to diversify gas supply, BOTAS signed a 20-year supply agreement for 2 bcm of liquefied natural gas (LNG)[31] per year with the Algerian gas company Sonatrach in 1988. Construction of the corresponding LNG terminal at Marmara Ereglesi, near Istanbul, began in 1989; the plant entered commercial service in 1994. The terminal has storage capacity of 255,000 cubic metres in liquefied form and an economic send-out capacity of 439,000 cubic metres per hour in gaseous form. Peak send-out capacity is 695,000 cubic metres per hour.

30. See also the Oil section above.

31. The figure corresponds to the natural gas equivalent of liquefied natural gas.

Two supply agreements were concluded in 1995 to increase the supply of LNG through the Marmara Ereglesi terminal. The first agreement signed with Sonatrach called for 2 bcm of imports; under an amendment signed in 1996, the volume was doubled to 4 bcm in 1999. The second agreement was with Nigeria for the delivery of 1.2 bcm of LNG as from 1999, increasing the total amount of gas delivered to the LNG terminal to 5.2 bcm in 1999.

Turkey has also begun to top up its long-term contracts with spot deliveries. The first spot LNG was from Australia within the scope of an agreement signed with North West Shelf LNG in 1995. Spot LNG was also purchased from Qatar and Algeria under two different agreements signed with Qatar Gas and Sonatrach in 1998. The Russian Federation was the main natural gas supplier in 2000 with 69.7 % (9.9 bcm) of total imports, followed by Algeria with 25.2 % (3.6 bcm) and Nigeria with 4.9 % (0.7 bcm).

In line with the expected strong demand growth, BOTAS is contracting for more gas and extending the transmission network further from Can to Canakkale and from the Bursa-Can branch to Izmir. The Izmir pipeline is expected to come on stream at the beginning of 2002. Several supply agreements and infrastructure projects are under discussion or at various stages of development. Under most of these projects, part of the gas is to be consumed in Turkey and the remainder is to transit from the Caspian region to Western markets:

- Under an agreement signed in February 1998, 8 bcm/year of natural gas are to be delivered over a period of 23 years from the Russian Federation by Turusgaz, a joint venture by BOTAS (35%), Gazprom (45%), and the Turkish company Gama A.S (20%). Full delivery is to commence in 2002. The supplies are to be carried via the existing pipeline. The necessary upgrades are proceeding, although more slowly than anticipated.

- According to a sales agreement with the Russian Federation signed on 15 December 1997, 16 bcm/year would be imported via a pipeline under the Black Sea, the "Blue Steam" pipeline. This pipeline is to run from the Russian city of Izobilnoje to Dzhubga, through the Black Sea to Samsun on the Turkish coast, and then on to Ankara to link with the existing pipeline system. The pipeline has a total length of 1,250 km. A 380 km section is to lie on the bed of the Black Sea at a depth of up to 2,150 metres, which would make it the deepest gas pipeline in the world. The cost of the project was estimated at $3 billion.

  A Memorandum of Understanding (MoU) was signed between the Italian Company ENI and Gazprom to form a 50/50 joint venture, the Blue Steam Pipeline company, for the construction of the pipeline. First deliveries were expected by 2000, but this date slipped. At present, construction works on the Russian territory are proceeding. The Turkish government believes that commercial, technical and financial issues have been solved by the Russian side for the Black Sea offshore section, which is to be completed by the end of 2001. Construction of the Samsun-Ankara section is about to be completed. It is not yet clear whether sufficient quantities of gas have been committed to the pipeline to make it economic.

- Turkey and Iran signed a 23-year natural gas sale and purchase contract on 9 August 1996 for delivery of 3 bcm/year, increasing to 10 bcm/year during the plateau period. The agreement was amended in August 2000. In this amendment, the beginning of the plateau period was fixed at 30 July 2001, with a duration of 25 years. A dedicated pipeline (the Eastern Anatolia Natural Gas Transmission line) running between Dogubayazit on the Turkish-Iranian border and Ankara/Seydisehir (Konya) is to be completed at end-2001, after some delay. Iran had completed its leg at end-1999. Once the main line is in place, there are plans to construct branch lines to Izmir, Usak and Antalya.

- A framework agreement was signed on 26 December 1996 between Iraq and Turkey for the purpose of piping 10 bcm/year of Iraqi gas to Turkey following the development of the gas fields in Iraq. On the Turkish side, BOTAS, TPAO and TEKFEN are involved in this project. ENI was designated as co-ordinator for the upstream activities. Project studies are under way.

- A Memorandum of Understanding was signed with Egypt on 22 June 1998 for the supply of 10 bcm/year of gas via a planned offshore pipeline from Egypt. On 26 February 1999, a protocol was signed regarding possible onshore transportation of Egyptian gas. It is expected that the gas will be landed in the Iskenderun bay near Ceyhan. The natural gas purchase agreement is ready for signature, but still requires approval by the new regulator for gas.

- On 29 October 1998, the governments of Turkey and Turkmenistan signed a framework agreement according to which Turkmenistan would deliver 30 bcm of gas per year, of which 16 bcm are to be consumed in Turkey and the remainder transported to Europe. This was followed by a sales agreement signed on 21 May 1999 and signature of an intergovernmental declaration by Turkey, Turkmenistan, Azerbaijan and Georgia during the Istanbul OSCE Summit on 18 November 1999. On 19 February 1999, the Turkmen government commissioned project studies to a consortium comprising PSG-General Electric Capital and Bechtel. Shell joined this consortium on 6 August 1999.

  This project involves the construction of a pipeline from Turkmenistan to Turkey, running in parallel to the Baku-Tbilisi-Ceyhan crude oil pipeline until it joins the Eastern Anatolia Natural Gas Transmission line near Erzurum. Gas imports are to begin between 2002 and 2004. TPAO is conducting relevant studies to join the international consortium that will develop and produce gas from six dedicated gas fields (including the Körpece, Zeagli, Darvaza, Garacaovlak and Malay fields) to feed the Trans-Caspian gas pipeline. Turkmenistan's proven natural gas reserves are estimated at over 2.8 trillion cubic metres. Meanwhile, the mandate of the PSG consortium for preparatory work has expired and has so far not been extended by the Turkmen government.

- Following the discovery of the Shahdeniz field in the Azeri part of the Caspian Sea, Azerbaijan emerged as a potential supplier of gas to Turkey, up to 16 bcm/year. A 15-year natural gas sales and purchase agreement and an

intergovernmental agreement were signed on 12 March 2001 for the delivery of 6.6 bcm/year during the plateau period. Delivery of gas is planned to start in 2005.

Further negotiations with other countries are under way to increase diversification of suppliers and security of supply. However, these negotiations are less advanced.

Increasing gas storage capacity is considered important to enhance security of supply and to address seasonal demand fluctuations. Salt caverns at Tuz Gölü will be used for underground gas storage. Feasibility studies are being carried out for other underground storage facilities, including the use of TPAO's Northern Marmara and Degirmenköy gas fields. In this context, a natural gas storage and services agreement was signed between TPAO and BOTAS in July 1999. Additional extensions of the national transmission grid are also planned, e.g. in south-eastern Anatolia.

Distribution and Supply

City distribution of natural gas is carried out by local distribution companies, i.e. EGO in Ankara (since 1988), IGDAS in Istanbul (since 1992), IZGAZ in Izmit (since 1996) and by BOTAS in Bursa (since 1992) and Eskisehir (since 1996). The local distributors are owned or co-owned by the municipalities they serve, except in Bursa and Eskisehir.

Gas supply is still restricted to limited areas in the western part of Turkey, but it is planned to extend the system and connect numerous new customers in the coming years. In 1999, tenders were launched to extend the gas networks of Bursa and Eskisehir, with the purpose of supplying a total of 35,000 new customers in those two cities.

Government Intervention and its Reform

With adoption of the new Natural Gas Market Law (Law No. 4646) on 2 May 2001, the regulation of the gas industry is about to change. The aim of the law is to establish a competitive gas market where all legal entities can carry out import, export, wholesale trade, transportation, distribution and storage under licence from a new energy market regulator. The law also has the purpose of harmonising Turkish legislation with EU law. The act foresees a 12-month transition period that can be extended once by six months by the Council of Ministers. The following are core provisions of the law:

- Natural gas supply, transmission and distribution are to be unbundled. BOTAS is to be split into two State Economic Enterprises after the year 2009, one responsible for trading, the other for transmission. The two local distributors owned by BOTAS in Bursa and Eskisehir are to be corporatised and privatised subsequently.

- No importer will be allowed to import more than 20% of Turkey's gas consumption during any one year. BOTAS will be required to sell part of its gas import contracts to comply with this provision. Gas export will be allowed under an export licence.

- Only gas producers will be allowed to sell more than 20% of annual gas consumption in the domestic market. Gas companies will not be allowed to establish another company in the same field of activity, but will be allowed to integrate vertically to up to 50% of the shares of the companies concerned.

- To ensure security of supply, gas importers and wholesalers must inform the government about the source and security of their gas imports, and they must store 10% of the gas they import in five years.

- BOTAS as owner and operator of the national transmission network, as well as other owners and operators of LNG and storage facilities, is to offer services under a system of non-discriminatory, regulated and published tariffs and access conditions. These tariffs and access conditions are to be regulated by a new regulatory agency. Third parties will also be allowed to build pipelines. BOTAS and other potential grid operators are to undertake investment in accordance with government plans and programmes. The regulatory agency is to control this investment, as well as service quality.

- Private companies will be able to engage in wholesale and retail trading. These companies have to obtain a licence from the regulatory agency. Wholesale transactions regarding natural gas, oil and oil products, deliveries from independent pipelines and other services will not be regulated, and prices will be formed in the market in freely negotiated contracts.

- Eligible consumers will be free to select a supplier of their choice. Eligibility is to be determined by the regulator.

- Distribution rights for cities and municipalities are to be awarded under a franchise bidding system. Once a distributor has won a franchise, his prices and conditions will be reviewed every five years by the regulator. Distributors have to construct, operate and extend distribution equipment as specified in an authorisation contract with the regulator. Once the franchise for a distribution area has been awarded, the selected operator has to allow the local government to participate to up to 20% in the company capital. The size of public participation, to be remunerated at nominal share price, is to be determined by the regulator.

The regulator will develop four different categories of gas prices: for connection, transmission/storage, wholesale and retail sales. Prices for connection will be determined between the regulator and distribution companies. Network tariffs will be based mainly on distance and volume. Storage tariffs will be freely determined between storage companies and users. Transmission and storage companies will have an obligation to prove to the regulator that their services are economical and safe. Wholesale prices are to be negotiated by the trading parties, but the regulator maintains some oversight of wholesale prices. The distribution companies must prove that they provide gas from the cheapest source and they must operate efficiently and safely during their licence period. Distributors' retail sales prices for

captive consumers are subject to rate-of-return regulation. They are reviewed annually by the regulator at the end of October, and the revised prices are to come into force by 31 December each year.

CRITIQUE

Coal

Coal mining in Turkey appears to be economically viable for the more efficient, low-cost lignite mines, but not for the country's one hard coal mine run by TTK. The amount of production is small and productivity is comparatively low. The hard coal company TTK has been steadily operating at a loss, requiring heavy government subsidies; it is unlikely ever to be profitable, even though efficiency improvements and staff reductions have improved the situation. Between 1993 and 1999, TTK underwent an austerity programme involving a drastic decrease in the workforce, the postponement of new investments, and the depreciation of most of the capital stock. This austerity programme, and price increases for electricity generation, improved the situation considerably. But even these drastic measures never came close to turning TTK into a competitive coal producer.

The situation of TTK resembles in many aspects that of many state-owned and government-run coal producers in the process of being phased out for lack of economic viability, and receiving subsidies to render the transition socially acceptable. However, recent developments point in a different direction. The government plans to increase domestic hard coal production and in 2000 hired a massive number of new workers, thus undoing 40% of the labour reductions achieved since the beginning of the last decade at considerable pain. Whereas this action has so far not stopped the trend of increased labour productivity, it requires additional subsidies and increases the strain on the government's budget. This runs counter to Turkey's long-term plans for increased sector-specific efficiency, sustainable fiscal policy and reduction of inflation.

The expected increase in expensive domestic hard coal production would reinforce this unfavourable trend. To be sure, using only imported coal to meet the tremendous growth in hard coal demand forecast by the government would put Turkey's trade balance under strain.

However, the main question is whether the forecast growth is likely to occur. This is questionable. As far as the electricity supply industry is concerned, the coal forecast is based on the large expected power demand growth. Turkey has rapid power demand growth at present, but the forecasts suggest demand growth between 6% and 10% per annum for the next two decades. Experience in other countries suggests that this sort of growth is unlikely over such a long period, even if Turkey emerges as a newly-industrialised, prosperous nation during that time span.

Moreover, the past and present growth is still based on subsidised prices in the framework of a state-owned and state-run, centralised power industry with a limited extent of private investment. Through the latest reforms, the power sector will soon undergo much more profound reform than ever before, leading to the introduction of competition and increasing private involvement. These reforms are being implemented because it has become clear that they are necessary, if adequate power supply is to be ensured. In this context, heavy subsidisation of power consumption or individual supply options will become unsustainable.

It can be expected that more cost-reflective power prices will dampen demand growth while encouraging the construction of capacity, thus alleviating Turkey's reliability problems. Competitive power markets also move quickly towards the cheapest supply options. The question arises as to what the cheapest supply option may be. At present, the average output cost of lignite-based power generation appears competitive[32] – much more so than of hard coal generation – but it is not clear whether this is due to efficient lignite prices. This may be the case, since lignite is mined mainly in open-cut operations, where costs are low compared to underground coal mines. On the other hand, the lignite company TKI is one of the most profitable firms in Turkey, whereas the national power company TEAS that absorbs more than 83% of Turkey's lignite production is a chronically loss-making operation. There may be many reasons for TEAS's unfavourable results. It is not clear whether lignite receives implicit subsidies, but if there are any, they should be phased out, as should any purchasing requirements or preferential treatment. Even if lignite were fully competitive today, it is questionable whether it will be in future. Turkey has far-reaching plans for new gas and oil pipelines. The main reason for constructing these pipelines appears to be transit of oil and gas from central Asian production areas to Western markets, but they will also make it possible for Turkey to access new supplies.

Selling gas to large Turkish consumers, especially power generators, will greatly increase the profitability of the pipeline projects. New gas plants, especially combined-cycle gas turbines, have lower capital costs than new coal plants and can be installed quickly and in small increments. Private operators in competitive power markets needing new capacity have shown a marked preference for CCGTs wherever natural gas was available.

And, last but not least, CCGTs have tremendous advantages compared to coal regarding air emissions. They cause lower greenhouse gas emissions and particularly lower pollutant emissions than coal. Turkey has significant air pollution problems and few retrofits of flue gas desulphurisation (FGD) equipment have been carried out so far. Therefore, it appears highly unlikely that private investors would embark upon costly installation or retrofit of FGD equipment when they can reduce a multitude of air emissions simply by building a CCGT. Turkey is actively seeking direct foreign investment in its power generation sector, and, for all the above reasons, investors would probably opt for natural gas rather than lignite where gas is available.

32. See Chapter 7, and in particular Table 14.

The government should carefully revise its expectations of high coal demand growth to make them more realistic. The commendable strategy of reducing subsidies and overstaffing in the coal industry should not be abandoned, especially now that the energy market is undergoing reform. That strategy is more likely than ever to yield benefits, and more necessary than ever to enable the economically viable parts of the domestic coal industry to survive.

Oil

The Turkish government has sought greater private-sector participation in the oil industry for decades, beginning with the 1954 Petroleum Law. Several further reform initiatives were taken over time, notably in 1989/90, and another is currently under way. So far, the liberalisation efforts have had mixed success. Turkey's fully state-owned upstream oil company TPAO has been able to form joint ventures with seven foreign companies for petroleum exploration in Turkey. Oil production is open to private companies, but TPAO still dominates the sector with a 72% market share. Pipeline transport remains in full state ownership through BOTAS. A private joint venture has a market share of 14% in refining, and operators other than POAS account for 60% of retailing.

Full privatisation of the upstream sector is still infeasible under Turkish law, and there are no plans to privatise BOTAS's pipeline assets or TPAO. Therefore, the only scope for more private initiative is in refining and retailing. The reform of the Petroleum Law under preparation reflects this situation and focuses on downstream reform. It is not clear yet what the new law will provide for. It remains to be seen whether producers will be able to sell to a refinery of their choice.

But the amount of private investment is not the only factor that determines how efficiently the oil market functions. Of greater immediate importance is how much freedom existing operators have to conduct their business, how much government intervention they encounter, and what the purpose of such intervention is. Under the old Petroleum Law, the government had relatively broad authority to intervene in the industry. The government occasionally used this authority to force oil product prices below cost and restrict exports, even though oil prices and oil trade were liberalised in principle in 1989/90. The situation was exacerbated because the downstream oil business was dominated by two state-owned companies.

This situation is now much improved. The price-setting formula established by the government in 1998 can contribute to a more stable, transparent and predictable pricing policy for oil and oil products. It screens out very short-term, erratic price fluctuations but allows major oil price changes to be passed on to consumers. Considering Turkey's high inflation rates and the great exchange rate variability, this seems to be a reasonable way of providing some planning security for Turkey's consumers until the underlying problem – Turkey's monetary instability – has been resolved.

The progress made in 2000 with the privatisation programme – especially the majority privatisation of Petrol Ofisi (POAS), but also the significant augmentation of private ownership in TUPRAS – completes the favourable picture. The government's overall strategy of establishing a more transparent and stable regulatory framework for the oil industry and of increasing private ownership and initiative is laudable and should be continued. The government should ensure that the recent macro-economic instability does not derail this programme.

Turkey's plans for oil transit are an equally important issue. The international treaties concluded and ratified in 2000 have brought the Baku-Tbilisi-Ceyhan crude oil pipeline an important step closer to realisation, and have increased the probability that this pipeline will be built, rather than the various alternatives. As Turkey has a proven track record in handling international projects, this pipeline may represent an advantage in terms of security of supply, both for Turkey and for the international market. In any case, the security of supply aspects of new pipeline projects should be given adequate consideration. The pipeline will also have environmental benefits, since the most significant alternatives rely on tanker transport through the already congested and accident-prone Bosporus.

However, if this project is to be realised, more work lies ahead. The oil volumes currently committed to the project are insufficient to make it profitable. Further supplies must be secured and concrete commitments must be obtained. The Kazakh government has promised additional but so far unspecified volumes of oil. The March 2001 MoU between Azerbaijan, Georgia, Kazakhstan and Turkey was a significant step in the right direction, but the momentum must be kept up if oil supplies are to be available when the pipeline is completed. The Turkish government should intensify its negotiations with the governments and companies involved to obtain concrete commitments.

Natural Gas

Even in the context of the high-growth Turkish energy market, the gas industry stands out as particularly fast-growing. In the preceding chapter, doubts were expressed whether gas demand will really increase five-and-a-half times over the next two decades – given that subsidies and below-cost pricing are to be phased out in the power industry and elsewhere. What is clear, however, is that Turkey will need much more gas in the next few years, as amply demonstrated by the tremendous growth in gas demand during the 1990s.

Fortunately, the country is seen as an attractive market, and pipeline projects abound, both for supply to Turkey and for transit of gas and oil from the Caspian region to European markets as well as farther afield. Turkey is actively promoting many of these projects, and numerous intergovernmental agreements have been signed over the past decade, as have memoranda of understanding with commercial consortia.

Yet projects that started with great impetus have repeatedly slowed down at a later stage. The energy corridor between the Caspian Sea and Europe that Turkey aspires to broker is useful and will contribute to security of supply in a vast region, including in Turkey itself. This energy corridor crosses several countries, and obtaining agreement among governments is both necessary and difficult.

However, it is important not to neglect the commercial side of the transaction. None of the governments in the region will be able to finance the infrastructure themselves, and without the participation of international investors, the projects will not materialise. The Turkish government would be well advised to promote the conclusion of commercial and financing contracts for those of its international projects that are nearing realisation as soon as feasible.

Since a large part of the gas will actually be used in Turkey itself, contributing to the economic viability of the projects, the state of the Turkish gas market is an important factor for attracting investors in the projects. With the reform of the gas market, Turkey is taking a vital step in the right direction. The new Natural Gas Market Law should be implemented according to schedule. The government should continue along the path of liberalisation.

It is particularly important that the government intends to separate its roles as regulator of the market and owner of market assets in the course of this reform. Outright privatisation is the clearest way to separate ownership interests from legislative and regulatory concerns, and the government has that objective in the longer term. This is commendable. But care should be taken to separate these interests even before privatisation is achieved. The regulator should be fully independent from business interests and from government, should have clearly defined rights and responsibilities and should be insulated from political pressure. The regulator should be given the necessary means to carry out its tasks, including budgetary independence and skilled staff.

Since serving the fast-growing Turkish market will require much new investment, a careful balance will have to be struck between investors' rights to recoup their investment and consumers' rights to enjoy competitively-priced services. Much care will therefore have to be given to developing appropriate network pricing methods for the use of the regulatory agency, and these pricing methods must be fully transparent.

Increasing the use of natural gas in power generation as well as in space heating in Turkey would bring large environmental benefits. Greater gas penetration in the space heating market will require massive extension of the distribution grid, which is still restricted to a few locations in north-western Turkey. Hence, it is appropriate that the new Natural Gas Market Law gives much attention to the distribution and retailing sector. The approach chosen, competitive franchise bidding combined with regulation after predefined time lags, is a relatively efficient one that should lead to the establishment of distribution networks at relatively low cost. The regulator should ensure that appropriate quality and prices are maintained over time. The requirement for a certain amount of municipal ownership of the gas business

appears to be an add-on with no clear purpose beyond raising revenue for local governments. Although many details remain to be worked out, the current changes represent a major achievement.

RECOMMENDATIONS

The government should:

Coal

- Continue the restructuring process of the coal mining sector and the privatisation of viable mines. Consider outright privatisation of the mines that have not been transferred through the TOOR procedure.

- Clarify the process by which the prices for hard coal and lignite are determined. Suppress all subsidies on hard coal and eliminate residual subsidies on lignite, both explicit and implicit, as well as any purchasing requirements or preferential treatment. Social issues should be considered independently from energy prices.

- Promote the adoption of clean technologies for coal use in electricity generation.

Oil

- The government should pursue the strategy of more transparent, stable and efficient regulation and greater private participation in the oil sector. In particular:
  - Ensure full transparency of oil product price setting, and refrain from any intervention besides the automatic pricing formula.
  - Enforce the existing provisions for third party access to the oil pipeline system and the gas grid.
  - Complete the privatisation of the oil sector. Complete the privatisation of TUPRAS. To reduce its dominant role in the refining market, refrain from building new refineries under TUPRAS's ownership before privatisation. Ensure that TPAO can integrate vertically into the upstream and downstream market and that it can eventually be privatised.
- Accelerate upgrading of existing refineries to increase the production of oil products that meet international standards, including those for sulphur and lead content.

- Pursue the possibilities of crude oil transit through Turkey. Redirect attention to the commercial feasibility of the project. In particular, seek to ensure further supplies for shipping. Give high priority to security of supply when establishing new pipelines.

Natural Gas

- Attach greater priority to the commercial and financial side of international gas supply and pipeline projects.

- Continue along the path of liberalisation of the natural gas market. Prevent any delays in the introduction of competition. Create a favourable market environment for investment. Take measures to ensure a smooth transition to competition.

- Unbundle BOTAS, as foreseen. Ensure that BOTAS's transmission and marketing activities are fully separated and that its trading activities can eventually be privatised. Establish clear, transparent, non-discriminatory prices for grid services, and similar conditions for grid access.

- Ensure that the regulator is effective and fully independent from business interests and from government, that it has clearly defined rights and responsibilities and that it is insulated from political pressure. The regulator should be given the necessary means to carry out its tasks.

- Strive to make natural gas available to smaller gas consumers via extended distribution grids.

7

ELECTRICITY

INDUSTRY OVERVIEW

Turkey's electricity supply industry is dominated today by large, publicly-owned companies. The industry dates back to 1902, when a 2 kW dynamo was connected to a water mill in Tarsus. The first larger-scale power plant was built in Istanbul in 1913. In 1935, several government institutions with authority relating to electricity production were established. These included the Electric Power Resources Survey and Development Administration (Elektrik Isleri Etut Idaresi, EIEI), which still exists today. EIEI carries out surveys and preparatory work to identify hydro potential, and plans and prepares dam and hydro plant projects. EIEI is also involved in studying energy conservation and the use of new and renewable energy resources.

Construction of power plants began on a larger scale, by both private and publicly-owned entities in the 1950s. At the beginning of the decade, installed capacity was about 408 MW. The main private operators at the time, operating under state concession, were Cukurova Electric Company (CEAS), which supplied the regions of Adana and Icel, and KEPEZ Electric Company, which supplied the south-western region of Antalya. Among the publicly-owned entities were Iller Bankasi, a state-owned bank, as well as a number of municipalities and trade unions.

By 1970, installed capacity had increased to about 2,235 MW, and both growing power consumption and the government's electrification plans required more coherent organisation of the power industry. At that time, only 7% of all villages were electrified. As a consequence, the government established the Turkish Electricity Authority (Türkiye Elektrik Kurumu,TEK) as a fully state-owned and state-run entity that year. All electricity activities were concentrated within TEK, although CEAS, KEPEZ, the municipalities and Iller Bankasi retained ownership of their assets. In 1982, electrification had reached 61% of all villages, and installed capacity had grown to 6,639 MW. All plants and networks owned by municipalities and unions were transferred to TEK that year.

Following the reform programme and the opening of the Turkish economy in 1983, TEK's statutory monopoly was abolished by the 1984 Electricity Act (Law 3096 of December 1984), and it became possible for private companies to engage in power generation, transmission and distribution under the BOT system (see next section). TEK was corporatised, with a new legal status as a State Economic Enterprise (SEE). Between 1988 and 1992, CEAS and KEPEZ were once more allowed to operate their generation, transmission and distribution equipment, and to sell electricity in their service areas. During the same years, ten new entities obtained geographically limited licences for generation, transmission, distribution and supply. Today, CEAS

has seven power plants, of which six are hydro plants totalling 580 MW and one is a 100 MW oil-fired plant. KEPEZ Elektrik operates four hydro plants totalling 127 MW in the western Mediterranean region.

During one of the waves of privatisation and reform, a decree (Law No. 513 of 13 August 1993) made TEK subject to privatisation legislation. As a result, TEK was split into two separate state-owned companies: Turkish Electricity Generation-Transmission Corporation (Türkiye Elektrik Üretim-Iletim A.S., TEAS) and Turkish Electricity Distribution Corporation (Türkiye Elektrik Dagitim A.S., TEDAS). TEAS is responsible for generation from thermal power plants, including operation and dispatch of all plants, as well as the construction of thermal power plants.

Most hydroelectric plants are planned by EIEI and designed, constructed and operated by the Directorate-General of State Hydraulic Works (Devlet Su Isleri, DSI). Once completed, the plants are run by TEAS. TEAS's responsibilities also include transmission, system planning and expansion, wholesale trade, and imports and exports.

In 1999, Turkey's installed power generation capacity reached 26,117 MW, and 99.9% of its population was connected to the electricity grid. Since 1984, foreign private investors have been invited to participate in the Turkish power industry to help address the country's strong power demand growth, with mixed success. As a result, TEAS owned 82% of installed capacity in 1999, concessionaires like CEAS and KEPEZ 2%, industrial autoproducers 10% and other production companies 6%. In 1999, TEAS accounted for almost 64% of all generation in Turkey.

Further reform efforts are under way in order to introduce competition in the power industry, with the purpose of attracting investment, providing competitively-priced electricity to consumers, preparing for EU accession, and ensuring compliance with IMF and World Bank support programmes. On 3 March 2000, the Council of Ministers issued a Decree (Law No. 310) that provides for TEAS to be split into three separate companies: Turkish Electricity Transmission Company (Türkiye Elektrik Iletim A.S.), Electricity Generation Company (Elektrik Üretim A.S.) and Turkish Electricity Trading and Contracting Company (Türkiye Elektrik Ticaret ve Taahhüt A.S.). On 20 February 2001, a new Electricity Market Act was adopted, laying the foundation for a competitive power market.

Electricity Demand

Demand for power in Turkey is growing rapidly. Annual growth rates of power consumption have for decades been 8% or higher. Turkey had about 27 GW of installed generating capacity in 2000, but for years has had problems supplying the rapidly growing demand, leading to frequent power cuts during peak times. The winter peak season 2000/2001 was expected to see a shortfall of available generating capacity of up to 7 TWh, because of the combined effects of renewed strong growth in economic activity and electricity demand after the

severe 1998/99 recession, a spring drought that left low water levels in Turkey's dams, and the delays experienced in attracting new private investment in generating capacity (see below).

The government responded to this supply shortfall by preparing a decree that stipulates changes in work shifts in government operations, cancellation of lunch breaks in government offices to make optimal use of daylight, reduction of street lighting and measures to combat electricity pilferage, which is estimated to amount to some 10% of power generation. The government is also seeking to import more electricity from Bulgaria, and to address short-term supply problems through the use of "mobile", barge-mounted power plants. Owing to the frequent power cuts, a sizeable number of Turkish citizens own household-sized generating units fuelled by diesel.

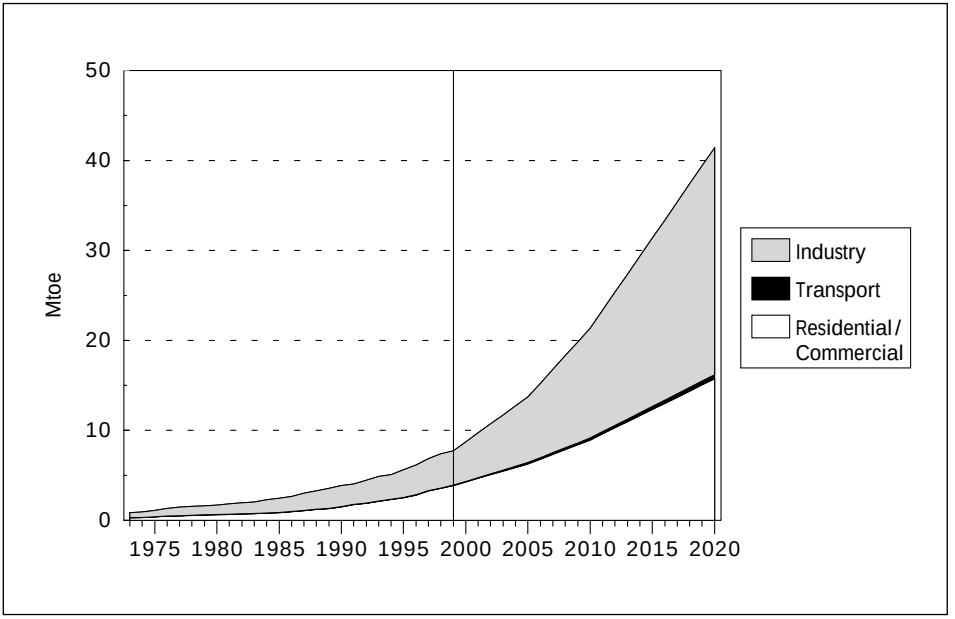
Because of the economic crisis in winter 2000/2001, the expected supply shortfall has not yet materialised. Instead, Turkeys' power demand decreased, and the expected growth rate of power consumption is 0% for the first half of 2001 and 3% for the second half of 2001. Capacity augmentation in the order of 1,600 MW (mostly hydro) is expected in 2001. However, water levels in the dams are low, and according to DSI, Turkey is going through a period of relatively dry years that could last for the next four to five years. For these reasons, it seems possible that a power supply shortfall may still occur at a later stage.

According to forecasts prepared by the Ministry of Energy and Natural Resources, the country will need about 60 GW of capacity by 2010, and about 105 GW by 2020. Gross power generation is expected to have to rise from about 116 TWh in 1999 to more than 555 TWh in 2020, about a fourfold increase. This implies power demand growth rates of at least 8% per annum for the coming decade and at least 6% per annum for the following decade. Figure 17 shows past and expected future development of electricity demand in Turkey by sector.

The experience of other countries offers reason to doubt whether the anticipated high growth rates will be sustained over such a long period. In a recent review, the State Planning Organisation (DPT) argued that the forecasts were too high and that less capacity was needed than forecast by the MENR and contracted for by TEAS. Whereas the MENR expects that between 2000 and 2005 about 70 TWh of new generation will be required, DPT estimates that only 55 additional TWh are needed. The World Bank supports the DPT assessment. However, it is clear that there is a need for rapid build-up of new capacity, which may well be in the order of 3 GW per year for at least several years. The government has estimated that this would require investment of between $3.5 and 5 billion per year.

MENR and TEAS may in fact have over-contracted BOT capacity because they are aware that relatively few projects are eventually built. From this plethora, DPT selects projects according to its demand forecasts. Only projects with DPT approval are able to find financing. As explained in more detail in the section

Figure 17
Electricity Consumption by Sector, 1973 to 2020



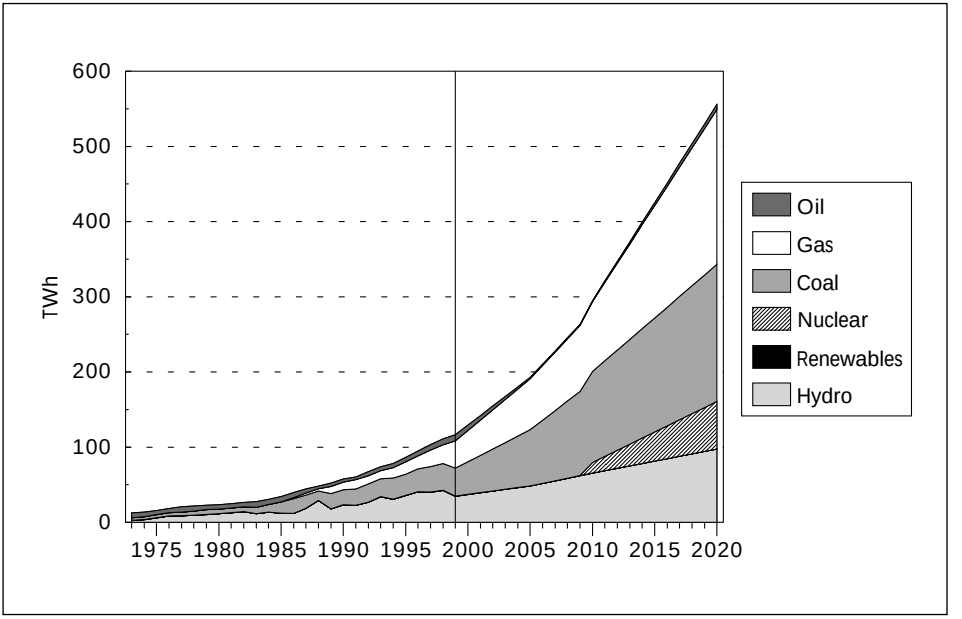
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000, and country submission.

"The Path of Reform" below, MENR has selected 29 BOT projects for the time period 2000-2004. DPT has approved all of them under the condition that they must be completed by 2002. After that, Turkey will pass to the new, competitive power market regime.

Generation

Turkey's electricity generation is based on hydro power and fossil generation. The share of hydroelectric generation in gross electricity output stood at about 40% throughout the 1990s, but is expected to decline in future, and is subject to fluctuations in proportion to rainfall. Its share in 1999 was 29.8% (34.7 TWh), down from 38% the preceding year. Coal accounted for 31.8% (37 TWh), oil for 6.9%, and gas for 31.2% (36.4 TWh). Nearly all coal used in power generation is domestic lignite (29.1% out of 31.8%); imported hard coal accounts for only 2.7%. Renewables have only very minor shares in power generation in Turkey: geothermal accounts for 0.1% or 12 TWh, and combustible renewables for about 0.2% or 24 TWh. Figure 18 shows the development of electricity generation by fuel between 1973 and 2020.

Figure 18
Electricity Generation by Source, 1973 to 2020



Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000, and country submission.

Turkey's installed capacity in August 2000 totalled 26,938 MW. Of this capacity, slightly less than 41% was hydro, 59% was fossil, and 0.07% was wind.

Hydro Power

In 1999, there were 114 hydroelectric power plants in operation in Turkey. Total hydroelectric power plant capacity in Turkey was 10,820 MW, with estimated mean annual generation of 39 TWh. In addition, some 37 hydro plants with a total capacity of 4,057 MW are under construction, corresponding to about 13.4 TWh of additional annual power generation. The Turkish government hopes that hydro capacity will expand to 35,000 MW by the year 2020.

DSI and EIEI estimate Turkey's remaining economic hydro potential to be about 69.8 TWh per year. Planning for the use of this potential includes a preliminary study (4,935 MW), a master plan (3,503 MW), a feasibility study and final project design (11,274 MW). The government expects the construction of 332 more hydro plants in the long term to make use of the potential remaining hydro sites. This would bring the number of hydro plants to 485, and add more than 19 GW of

capacity to the hydro system. Construction of these plants would cost more than $30 billion.

Turkey's hydro generating capacity includes the huge South-east Anatolia Project (GAP). GAP is an integrated hydroelectric and irrigation project. Once completed, it will be one of the largest hydro developments ever undertaken. It is situated in the lower reaches of the Euphrates and Tigris rivers and in the plains between them. The project covers an area of almost 74,000 km^2, equalling the land surface of nine provinces and one-tenth of Turkey's total land surface. This area includes a population of 6.15 million. Upon completion, GAP will have an installed capacity of 7,476 MW or 22% of Turkey's total estimated economic hydro potential. The project would produce 27.3 TWh of hydroelectricity annually and irrigate 1.7 million hectares of land. Among the objectives of the project is the reduction of Turkey's regional disparity in economic prosperity, employment and infrastructure.

According to original plans conceived in 1977, 22 dams and a vast network of tunnels and irrigation canals were to be built. Nineteen of the dams were to be equipped with generators having various capacities. The total cost of the project was estimated at $32 billion, and at end-1998, almost 43% of the sum had been expended. Several of the plants constructed before 1998 were built as BOT (build-own-transfer) projects, but declining support from the State Planning Organisation has since led to other forms of financing for these projects.

The three largest dams are the 2,400 MW Atatürk dam, the sixth-largest rock fall dam in the world, on the main trunk of the Euphrates; the 1,800 MW Karakaya dam; and the 1,200 MW Ilisu dam, the largest hydro project on the Tigris river. Table 12 shows the status of the GAP project in 2000: 64% of the total planned generating capacity had been completed, an additional 10% was under construction, and another 19% was at various stages of planning. In contrast, only about 11% of the irrigation schemes were completed by 2000.

Turkey's downstream neighbours Syria and Iraq have expressed concern that the project might reduce their water supplies. All three countries lie in one of the driest regions of the world, and their combined claims on water from the Euphrates and Tigris rivers exceed the capacity of these rivers. The GAP dams on the Tigris are used mainly for power production and will not reduce water flow to a major extent. The dams on the Euphrates are mainly for irrigation and will reduce water flows. However, Turkey signed an agreement with Syria in 1987 that guarantees, depending on hydrological conditions, a flow-through of 500 cubic metres per second in the Euphrates at the border during the filling of the Atatürk dam and until the final allocation of the water of the Euphrates among the three riparian countries. So far, Turkey has scrupulously respected this agreement. Turkey maintains that the dam system will stabilise water supplies as it will help regulate the highly erratic water flow in the Tigris. Because of the water rights issues, the World Bank has declined to co-finance any of the GAP projects. Construction of the three largest dams has led to the displacement of some 40,000 persons and to the immersion of archaeological artefacts.

Table 12
The GAP Project, 2000

Name of Dam/Power Plant	*No.*	*Status*	*Capacity (MW)*
Karakaya	1	In operation	1,800
Atatürk	2		2,400
Kralkizi	3		94
Dicle	4		110
Batman	5		198
Karkamis	6		189
Total in operation			**4,791**
Birecik	1	Under construction	672
Kayacik	2		-
Sanliurfa	3		50
Total under construction			**722**
Erkenek	1	Preliminary research	7
Garzan	2		90
Silvan	3		240
Adiyaman	1	Master plan	195
Ilisu	1	Planned, with credit	1,200
Cizre	2		240
Total planned			**1972**

Source: Ministry of Energy and Natural Resources.

Nuclear Power

Turkey's experience with nuclear power dates back to the 1960s – a nuclear research reactor has been operating in Istanbul since 1962 – and successive governments have had plans to introduce commercial nuclear power to the country for three decades or more. By 1972, plans had advanced to the point that site selection studies for a nuclear power plant were carried out. Following these studies, TEK was granted a site licence by the Turkish Atomic Energy Authority (TAEK) in 1976 for the construction of a nuclear power plant at Akkuyu in southern Turkey. The Turkish Atomic Energy Authority is in charge of regulation and control of all activities in the nuclear field, including safety inspections and issuance of licences. It reviews the documents prepared for nuclear capacity tenders and also carries out nuclear R&D. Akkuyu lies near the town of Gülnar on the Mediterranean Sea. The site was selected for several reasons, including the facts that bulky materials can be transported there by sea; that it is located near the major electricity demand centres of Adana, Konya, Antalya and Mersin; and that it is seismically the most stable region in earthquake-prone Turkey.

The 1980s saw two unsuccessful attempts to construct a nuclear power plant. An international tendering procedure was launched in the late 1970s and two companies were chosen for construction of the plant and the turbine, and for fuel

procurement. However, negotiations with the two enterprises failed in 1980. Two other nuclear power plant projects at Sinop on the Black Sea and at Akkuyu were abandoned in the 1980s, also owing to the impossibility of reaching agreement with the bidders. This was partly because the projects were initially planned as turnkey projects, but were subsequently altered from turnkey to BOT, with the bidders requiring state treasury guarantees for their investment, which the government was not willing to grant.

The Akkuyu nuclear power plant project was inserted once more into the State Investment Programme in 1993. Following the release of revised bid specifications, an international tender was opened on 17 December 1996 for a fully credit-financed turnkey plant. The main offer that bidders were expected to submit was for a nuclear plant with a minimum capacity of 800 MW and a maximum of 1,400 MW + 5%, in one or two units above or equal to 600 MW, to be built at Akkuyu. Bidders were required to fully finance the plant themselves by loans, and to submit corresponding letters of intent from governmental agencies or financial institutions with their bid. A second, optional tender for two or four units of at least 600 MW each, totalling at most 2,800 MW + 5%, modelled on the main offer, was also opened. Here, proof of financing was required 18 months after conclusion of the contract. The start-up date for Turkey's first nuclear power plant was set at 2005/2006. Offers were received from three different consortia on 15 October 1997. The consortia were:

- AECL of Canada, Kuarner John Brown, and Hitachi of Japan, with participation of Güris, Gama and Bayindir of Turkey.

- Westinghouse and Mitsubishi (U.S. and Japan), with participation of Enka and MNG of Turkey.

- Nuclear Power International (NPI), comprising Siemens, Framatome, GEL-A, Campenon Bernard, Hochtief (France and Germany), with participation of Simko, Garanti Koza, STFA, and TEKFEN of Turkey.

After reception of the bids, selection of the winning vendors was delayed repeatedly. At the request of TEAS, bidders extended the validity period of their bids several times. As the result of a Cabinet meeting held on 25 July 2000, the Turkish prime minister announced indefinite postponement of the nuclear programme, until economic conditions were better. The project had met with resistance on environmental grounds, but industry analysts believe that the main cause of its failure was the Turkish Treasury Department's refusal to provide a sovereign financial guarantee for the loans being taken by vendor country governments for the nuclear plant – worth between $2.5 billion and $4 billion, depending on the number of reactor blocks. In April 2000, the Treasury had announced its decision, supported by the World Bank, to change the Akkuyu nuclear power plant project from turnkey to BOT and to decline financial guarantees during construction.

In spite of the fact that there is currently no nuclear power project, the Ministry of Energy and Natural Resources expects Turkey's first nuclear power plant of about

2,000 MW to come on stream by 2015. According to the MENR's latest forecast, Turkey is to construct 8,000 MW of nuclear capacity by 2030.

Transmission and Trade

The state and layout of Turkey's transmission and distribution grids contribute to the supply problems the country is experiencing. The main demand centres lie in the western and north-western parts of the country, whereas a sizeable amount of generating capacity is in the east and south-east. These areas include some two-thirds of Turkey's largest power plants, notably the huge GAP project. As a consequence, transmission is mainly designed to handle large power flows along a diagonal path across the country, as can be seen in Figure 19. At end-1999, the country had 13,720 km of 380 kV lines, all of which were owned by TEAS. The secondary transmission grid at 154 kV comprised more than 28,000 km of lines, 92% owned by TEAS.

The long distances between the main consuming areas and the main electricity generation areas cause high line losses. At about 3% in 1999, transmission line losses are higher than in most other IEA countries, although not dramatically so. However, distribution losses of over 15% are very significant and higher than in other IEA countries. Disturbingly, both transmission and distribution losses have increased since the late 1980s/early 1990s, after having fallen for decades, a sure sign that outmoded equipment is straining under power transfers near maximal capacity. The government recognises that the electricity grid is as much in need of investment as is the generation side of the industry.

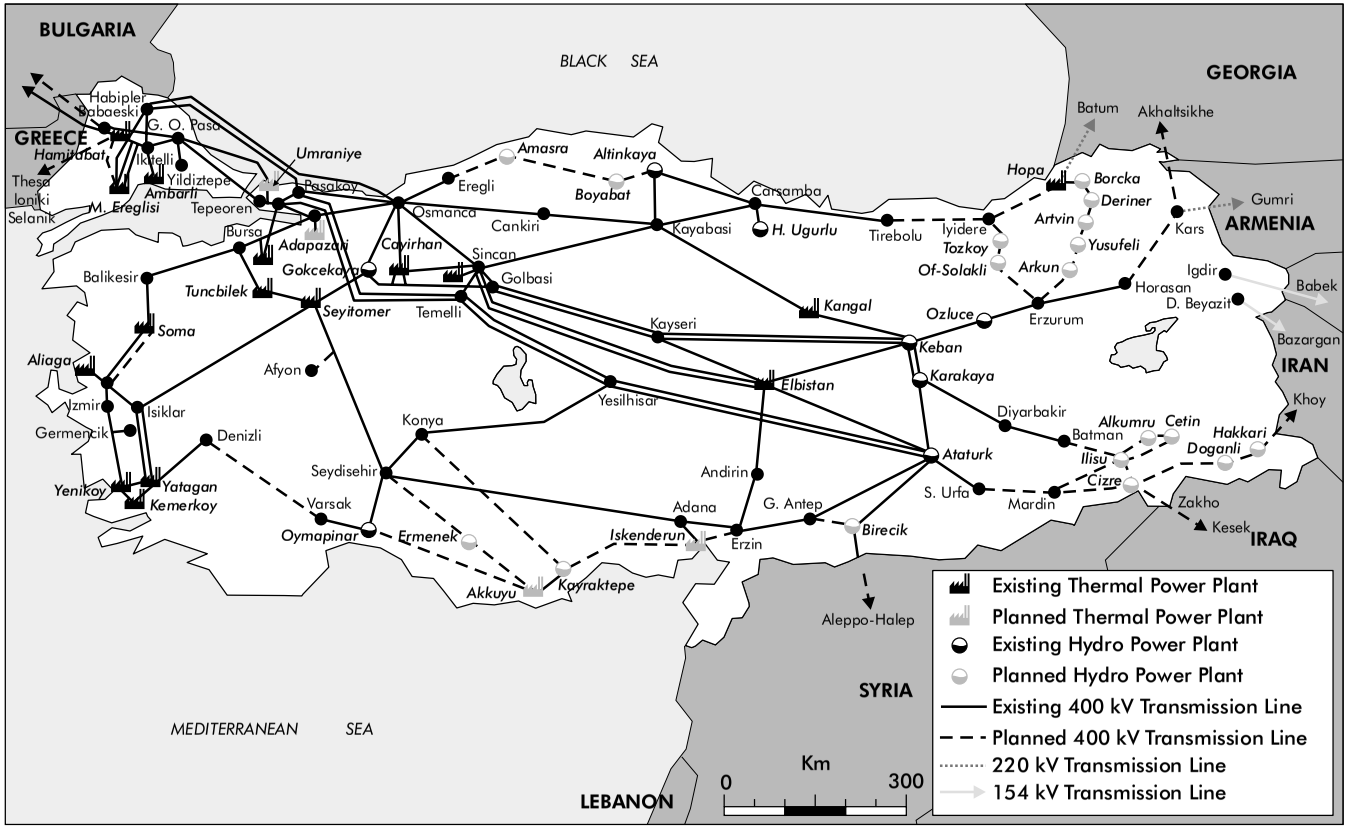
Turkey is a net importer of electricity. Owing to the country's strong power demand growth, net electricity imports have increased considerably since 1996, reaching an all-time peak of 3 TWh in 1998. In 1999, imports were slightly more than 2 TWh. Turkey's main supplier is Bulgaria, which delivered 2.3 TWh net in 1998 and almost 1.8 TWh net in 1999. On 15 May 1999, TEAS signed a long-term contract with the state-owned Bulgarian power utility NEK-EAD for the delivery of increasing quantities of electricity until 2008. Starting at a level of 2 TWh in 1999, deliveries are to increase to 2.2 TWh in 2000, 3.5 TWh in 2001, and then plateau at 4 TWh between 2002 and 2008. The contract also provides for the construction of a second interconnection between Hamitabat in Turkey and Maritsa in Bulgaria (see Table 13). Turkey exports small amounts of electricity to Azerbaijan.

However, compared to total power supply levels, Turkey's power imports are insignificant (< 2%). There are few links with neighbouring countries, and Turkey's system is not synchronously interconnected with neighbouring systems. Power imports (and the very small amount of exports) are carried out via island operation: Turkey's importing regional grids are run synchronously with the network of the exporting country, but isolated from the remainder of the Turkish grid.

As this mode of operation is cumbersome and inefficient, Turkey is striving for synchronisation with neighbouring countries and is co-operating in various

Figure 19

Turkey's Transmission Network and Major Power Plants



Source:TEAS.

international forums to establish large interconnected systems involving several regions. These include the "five-countries" interconnection (Egypt, Iraq, Jordan, Syria and Turkey), the Balkan grid, and the Mediterranean ring, all of which are under study, as well as smaller projects such as the Turkey-Iran-Turkmenistan and Turkey-Azerbaijan-Georgia projects. Turkey eventually wishes to interconnect with the West European UCTE grid, via interconnection with Greece and the Balkan grid, and TEAS has recently been invited by the UCTE to participate in its South-eastern Europe *ad hoc* working group for this purpose.

Table 13
Existing and Planned Electricity Interconnections

	Capacity (MW)	*Voltage (kV)*
Existing		
Babaeski-Dimodichev (Bulgaria)	500	400
Hopa-Batum (Georgia)	300*	220
Kars-Leninakan (Armenia)	300*	220
PS3-Zakho (Iraq)	500	400
Aralik-Sederek (Azerbaijan)	10	34.5
Igdir-Babek (Azerbaijan)	100*	154
Dogubeyazit-Bazargan (Iran)	100*	154
Cag-Cag-Kamisli (Syria)	40*	66
Planned		
Hamitabat-Maritsa (Bulgaria)	750	400
Babaeski-Philippi (Greece)	750	400
Baskale-Khoy (Iran)	600	400
Cizre-Kesek (Iraq)	500	400
Birecik-Aleppo (Syria)	750	400
Kars-Akhaltsikhe (Georgia)	600	400

* limited capacity owing to restrictions in transformer capacity and regional transmission grid.

Source: TEAS.

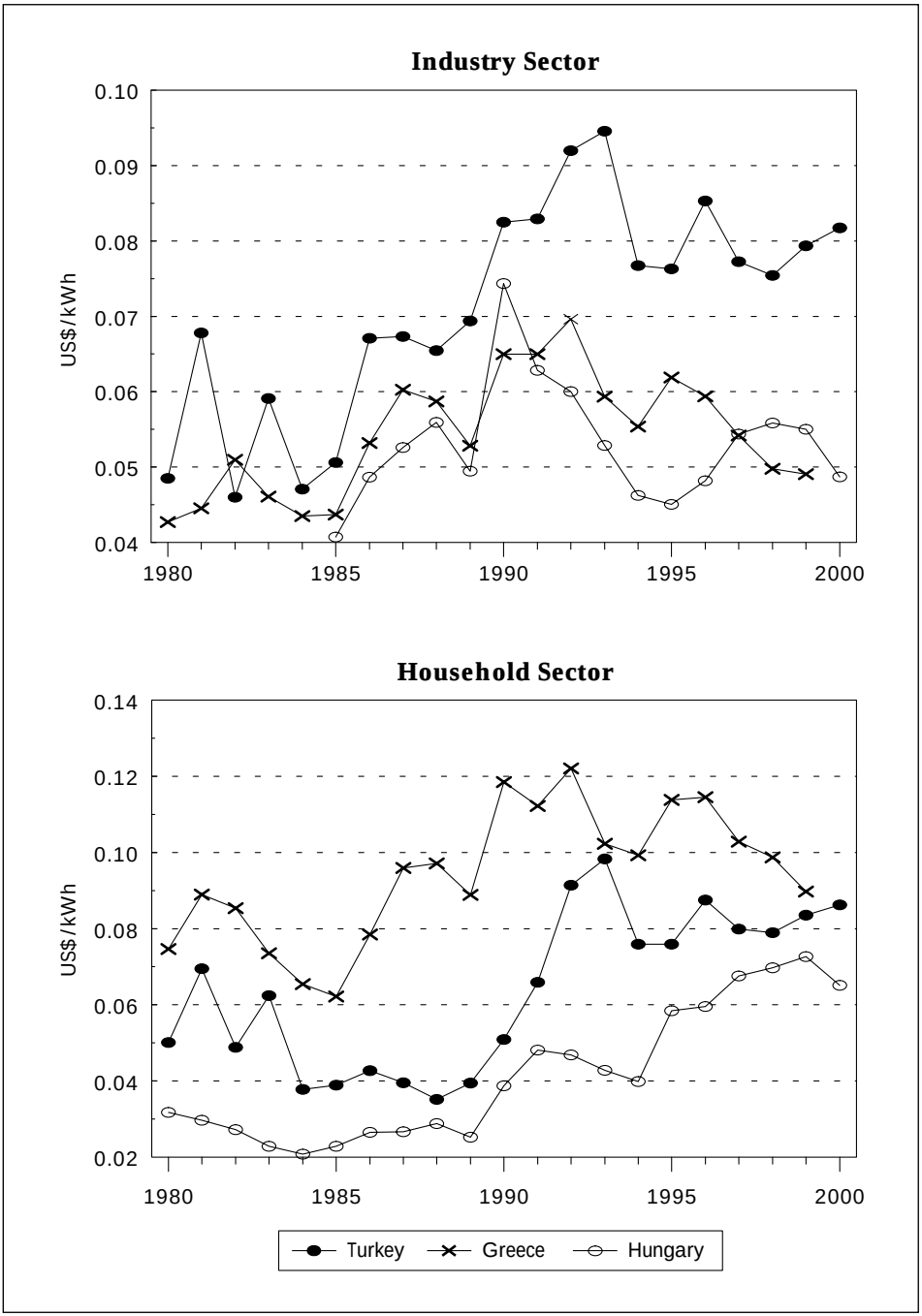
Costs and Prices

Figure 20 shows the development of nominal electricity prices for industrial and residential customers over the last two decades in US cents per kWh. Note that following rapid increases between 1985 and 1993, prices have fallen again. This is partly because of insufficient inflation adjustment and falling real prices.

Note also that prices for industrial consumers are almost exactly as high as for residential consumers. As the cost of supplying residential consumers is much higher than that of supplying industry, this is a sure sign of cross-subsidies in favour of residential customers. This is confirmed by the international comparison in Figure 21, which shows that Turkey ranks fourth-highest in industrial electricity prices but fifteenth in residential prices.

Figure 20

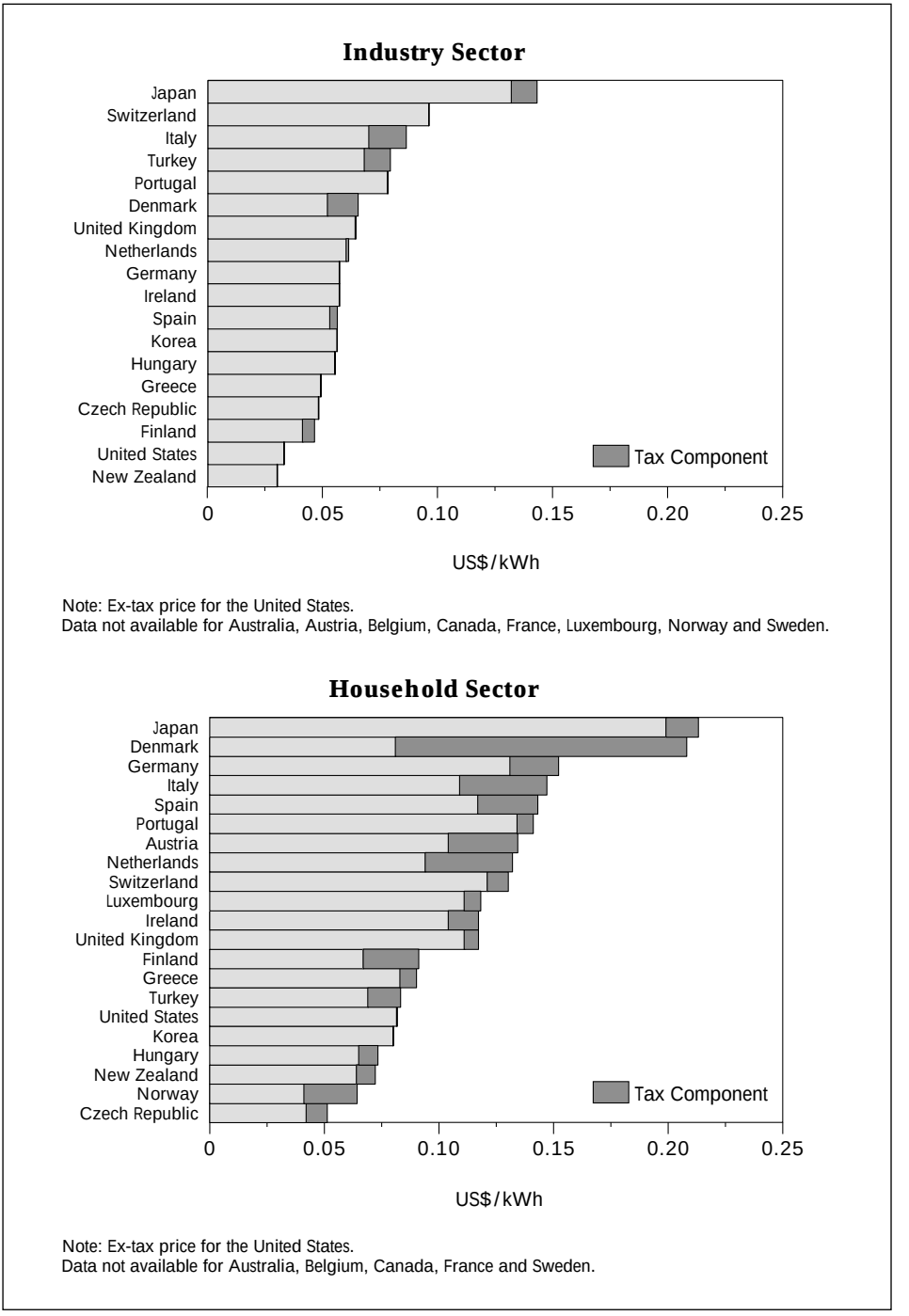
Electricity Prices in Turkey and in Other Selected IEA Countries, 1980 to 1999



Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2000.

Figure 21

Electricity Prices in IEA Countries, 1999



Note: Ex-tax price for the United States.
Data not available for Australia, Austria, Belgium, Canada, France, Luxembourg, Norway and Sweden.

Note: Ex-tax price for the United States.
Data not available for Australia, Belgium, Canada, France and Sweden.

Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2000.

TEAS publishes its end-1999 direct sales prices per kWh for industrial customers as US cents 6.87 for high-voltage customers and US cents 7.15 for intermediate and low-voltage customers, whereas its sales prices to distributors are in the range of US cents 4 per kWh, and sales prices to TEDAS are around US cents 3.5 per kWh[33].

However, the gap between cost and prices is likely to be much larger than suggested by these data. Whereas TEAS states that its average net generating costs are as indicated in Table 14, the cost of purchasing additional electricity from BOT, BOO and TOOR generators (see below) is much higher (except for diesel peaking plants), and can reach US cents 11-12 per kWh. Since these plants are urgently needed because of the lack of supply capacity, and are therefore dispatched frequently, TEAS's full costs are likely to be significantly higher than the average cost listed in Table 14.

As a consequence, TEAS's income statements have long shown significant losses; in 1999, losses amounted to more than 61 billion Turkish lira[34]. These losses are eventually borne by TEAS's shareholder, the Republic of Turkey, thus contributing to the government budget deficit, and, eventually, to inflation.

Table 14
Net Power Generating Cost by Energy Input, TEAS and DSI, 1999

Fuel Input	*Cost (US cents per kWh)*
Hard coal	4.37
Lignite	2.99
Fuel oil	3.14
Diesel	16.24
Geothermal	2.46
Natural gas	3.86
Average thermal (TEAS)	**3.56**
Dam	0.14
Lake	1.11
Run-of-river	0.68
Average hydro (DSI)	**0.16**
Average TEAS + DSI	**1.96**

Source: TEAS: *Electricity Generation-Transmission Statistics of Turkey, 1999,* Ankara, 2000.

33. TEAS: *Electricity Generation-Transmission Statistics of Turkey, 1999,* Ankara, 2000.
34. TEAS: *Annual Report 1999,* Ankara, 2000.

Privatisation and Foreign Ownership

Until recently, the notion of privatisation was incompatible with Turkey's constitution. However, since the first wave of the liberalisation process began in the early 1980s, the country has been keen to attract direct foreign investment in infrastructure. Consequently, mechanisms were used that allowed private and foreign participation in the power industry without outright privatisation. One was the so-called build-operate-transfer (BOT) model. Turkey was among the first countries to introduce the BOT system in 1984, through the Electricity Act (Law No. 3096). The BOT system is not restricted to electricity or energy projects; it is also used for other infrastructure investment such as motorways, bridges, tunnels or water treatment plants.

Under this model, private investors build and operate power plants. After remaining in private ownership for a number of years corresponding to the economic lifetime of the investment (typically 15 to 20 years), these power plants are transferred to state ownership, i.e. to TEAS under current arrangements. But between 1984 and 1996, only six power plants with a total capacity of slightly less than 400 MW were actually built under this system: five small hydro plants and one combined-cycle gas turbine (CCGT).

In the early 1990s, the continued vigorous growth in electricity demand reinforced the government's interest in encouraging BOT construction projects. To this end, the 1984 Electricity Act was complemented by the 1994 BOT Law (Law No. 3996). The BOT Law contains a number of provisions that were designed to encourage BOT investment. These include exemptions from customs duties and deferral of VAT payments on certain types of imported equipment. Most importantly, the law provides that the Turkish Treasury can back up the power purchase contracted between the BOT investor and TEAS or TEDAS with a Treasury guarantee.

At the end of 1999, despite a large number of plans for BOT projects and numerous applications by foreign investors, only 14 BOT power plants with a total capacity of about 1,600 MW were operating; a further nine projects with a combined capacity of some 990 MW were under construction, vastly less than anticipated. As noted in the previous section, Turkey's project for a first nuclear power plant at Akkuyu, launched repeatedly under BOT design, failed three times.

The reasons for this failure are complex. Under Turkish law, private investment in public utilities is considered a government concession. According to the constitution, all government concessions were until recently based on public administrative law, not private law, and subject to review by Turkey's Administrative High Court, the Danistay (sometimes also referred to as the Council of State). Under Turkish law, the Danistay is also responsible

for dispute settlement. All types of BOT projects listed in the 1994 BOT Law were automatically defined as concessions.

These legal arrangements significantly reduced the number of foreign-financed BOT projects, compared to the government's expectations, and the number of applications by investors. Not only did review by the Administrative High Court slow down the approval process, which could be very long – obtaining the Danistay's approval could take years. The Danistay could also revise contracts. In numerous cases, the Danistay fundamentally changed contracts that foreign investors had spent years negotiating. A number of projects also received unfavourable assessments by the Court. Following an unfavourable Danistay assessment, the State Planning Organisation would block the Treasury guarantee, which would generally lead to investor withdrawal and, ultimately, to failure of the project. This was the case for the Akkuyu nuclear power plant, as well as for other energy projects, including three wind farms, in 1998.

Main Stages of BOT Projects

Following a tendering procedure or an unsolicited bid, the MENR awards a preliminary agreement to a local and/or foreign investor or consortium. A Turkish company is established by the vendor or consortium. This is followed by the signature of a Memorandum of Understanding (MoU) between the company and the MENR.

The vendor establishes the legal structure of the project, including equipment and fuel supply contracts, and finalises its financial structure. This stage includes negotiation of the power purchase agreement (PPA) with TEAS, guaranteeing minimum sales and prices for the duration of the contract. The price has to be agreed with the MENR. The electricity price is set in US dollars and payments are made in Turkish lira. The PPA includes price escalation clauses. To become effective, the PPA must undergo Danistay review. The Danistay's approval is essential for the approval of the State Planning Organisation, which in turn determines whether or not the Treasury will guarantee TEAS's payments to the vendor.

Following construction and start-up of the plant, generation costs can vary owing to changes in fuel prices, labour costs, tax law, etc. These are passed on to consumers through the electricity price, and can also be compensated through an electricity fund, which is financed through a tax on electricity consumers. The main purpose of the fund and the tax is to ensure security in electricity prices by providing an additional state guarantee to BOT schemes and by moderating sudden changes in electricity prices paid by TEAS by averaging this price on a yearly basis.

Transferral of the plant to TEAS ownership is provided for after the depreciation period (generally after 15 or 20 years).

Another major obstacle in establishing successful foreign BOT projects was the fact that their legal classification as a Turkish government concession rendered third-party arbitration under international conditions impossible. However, international arbitration is a key requirement for obtaining international financing. A number of secondary issues, including disparities in *force majeure* clauses, as well as regulatory and exchange rate risks, also hampered development of these projects.

To increase the number of successful BOT energy projects, the Turkish government sought to eliminate the concession classification. Among its initiatives was an amendment to the BOT Law that eliminated energy projects from the list of BOT projects classified as concessions. This amendment was overruled as unconstitutional by Turkey's Constitutional Court in 1996. In its ruling, the Constitutional Court established that generation, transmission and distribution of electricity constitute a public service, and that they were therefore subject to public-law government concessions.

Following this, the government submitted a Build-Operate-Own (BOO) Law (Law No. 4283) to parliament. Under the BOO arrangement, investors do not transfer ownership of the plant to the government at the end of the contract period but maintain their ownership. The BOO Law was enacted in July 1996, and in 1997, a tendering round was opened to collect bids for BOO projects. However, in December 1999, the Centre for the Development of State Enterprises filed a lawsuit against the BOO Law. The case is still pending.

Main Features of BOO Projects

The MENR launches a tender procedure that defines the terms of reference, including prices, and selects the vendor. In contrast with BOT, a Memorandum of Understanding is signed between the private company, which must be a joint venture with a Turkish company, and the MENR.

A Power Purchase Agreement is signed between TEAS and the private company. The electricity price is set in US dollars, and payments are made in Turkish lira. Electricity produced through BOO models can be sold to TEAS, to distribution companies or directly to consumers through TEAS or distributors at a negotiated price. The MENR calculates transmission fees. If the electricity is sold to TEAS, the Treasury guarantees TEAS's payments in their totality.

The private operator retains ownership of the plant throughout its entire technical life, and is free to sell it. Hydro, geothermal and nuclear power plants are not part of the BOO scheme.

When it became clear that the lack of international arbitration was unacceptable to foreign financiers, and that the needed foreign investment in power plants would not occur in the existing legal context, the government decided to change the constitution. On 13 August 1999, three amendments were made to Turkey's constitution via Law No. 4446, changing Articles 47, 125 and 155. The effects of the amendments are as follows:

- A new paragraph inserted into Article 47 establishes the legal basis for privatisation for the first time. It also allows, upon enactment of an enabling law by the legislature, for public services to be performed under private law.

- Article 125 now allows local or international arbitration of disputes arising in the context of public service contracts. International arbitration is possible only if the public service contracts involve a foreign element. There are no clear definitions of what a foreign element is or how international arbitration is defined.

- Article 155 has the effect of limiting the Danistay's role to reviewing and advising on concession contracts, with a time limit of two months. It is currently not clear, however, whether an unfavourable opinion would be legally binding or not.

In parallel to the constitutional amendments, Law No. 2572 governing the Danistay, and Law No. 2577 on administrative trial procedures were amended through Law No. 4492. These amendments limit the Danistay's authority for dispute settlement to cases where arbitration is not allowed. The BOT Law was amended through Law No. 4493; it now explicitly includes electricity projects but states that they are governed by private law.

Under Law No. 4501, passed on 21 January 2000, the constitutional amendments apply to all new BOT projects as well as retroactively to all projects which had been completed or reached the stage of approval before the law's entry into force. This meant that BOT operators could, within one month following the enactment of the law, apply to the Ministry of Energy and Natural Resources for conversion of their concession contract into private law and/or inclusion of an international arbitration clause.

Of 46 companies concerned by the changed legislation, 25 requested to change their contracts to private law, whereas four companies retained the public law status but requested the insertion of arbitration clauses. The corresponding contractual clauses could then be negotiated within four months. Following this, 17 applications were submitted to the Council of Ministers. At end-2000, 12 applications had been granted approval; five were awaiting a decision. Table 15 shows the BOT projects at end-2000 and their development status at that time. Total BOT installed capacity was 4,885 MW. The number of proposals submitted and at various stages of consideration had increased substantially compared to earlier years, especially in the area of wind projects.

Table 15
BOT Power Plants in Turkey, December 2000

	Number of Plants	*Installed Capacity (MW)*	*Average Generation (GWh)*
HYDRO POWER PLANTS			
In service	16	846	3,220
Under construction	4	293	1,074
Agreements signed	17	1,814	6,134
HYDRO TOTAL	**37**	**2,953**	**10,428**
THERMAL POWER PLANTS			
In service	4	1,445	10,600
Under construction	0	0	0
Agreements signed	2	470	3,000
THERMAL TOTAL	**6**	**1,915**	**13,600**
WIND POWER PROJECTS			
In service	2	17	50
OVERALL TOTAL	**45**	**4,885**	**24,078**

Source: MENR.

However, as noted in Chapter 3, Turkey is required to phase out the use of Treasury guarantees under its 1999 stand-by agreement concluded with the IMF to attain sustainable fiscal policies and reduce inflation. Following the banking crisis that erupted in late 2000 and the IMF's emergency support measures, implementation of these policies received renewed impetus. On 10 January 2001, the Turkish Treasury confirmed that only 29 BOT projects that had already received approval from the State Planning Organisation (DPT) in May 2000 would be eligible for sovereign guarantee, and that no new guarantees would be given. Moreover, the sovereign guarantee would be given only if the power plants actually began operating before 2002. The 29 plants are listed in Table 16[35].

Following the BOO tendering procedure, the Ministry of Energy and Natural Resources selected five large-scale BOO power plants to begin operating between 2002 and 2005. Table 17 shows these power plant projects. Power purchase agreements for these projects have been signed, and Treasury guarantees have been secured. Three of the plants, the Gebze, Adapazari and Aliaga combined-cycle power plants, are currently nearing completion. They are expected to start operating in December 2001. The Ankara BOO power plant has suffered a delay of 8 months and is currently on hold.

35. Table 15 above does *not* contain these 29 BOT projects.

Table 16
BOT Projects Eligible for Treasury Guarantee

Start of Operation	*Fuel Type*	*No.*	*Project*	*Capacity (MW)*
2001	Wind	1	Kocadag-I	50
		2	Canakkale	30
		3	Bozcaada	10
		4	Mazy-I	39
		5	Intepe	30
		6	Mazy-II	90
		7	Mazy-III	40
		8	Akhisar	30
		9	Kocadag-II	26
2002	Natural Gas	10	Eskisehir	199
		11	Karadeniz Eregli	206
		12	Kirklareli	75
		13	Yalova 25	306
	Geothermal	14	Germencik	25
	Hydro	15	Yukari Akcay	2
		16	Aryt	9
		17	Pamuk	20
		18	Keklicek	17
	Wind	19	Bandyrma	15
		20	Datca	29
		21	Cesme	12
		22	Aksihar	12
		23	Yalykavak	8
		24	Gökceada	5
		25	Kapydag	35
		26	Belen	34
	Hydro	27	Susehri HEPP	12
		28	Aksu-Akdeniz HEPP	6
		29	Mursal HEPP	7

Sources: US Department of Energy, Tebahaber.

Table 17
BOO Power Plant Projects in Turkey, 2000

Name	*Fuel Type*	*Location*	*Installed Capacity (MW)*
Adapazari	Natural gas	Adapazari	770
Gebze	Natural gas	Gebze	1,540
Ankara	Natural gas	Ankara	770
Aliaga	Natural gas	Izmir	1,540
Iskenderun	Imported coal	Iskenderun	1,210
Total capacity			**5,830**

Source: MENR.

Another concept for privatisation in Turkey is transfer of operating rights (TOOR). TOOR allows private-sector operation of energy infrastructure, but not private-sector ownership. Under this concept, the MENR transfers rights to operate electricity infrastructure in a region for 20 or 30 years. In Turkey, TOOR is used for thermal generating plants and distribution/retailing operations. Like the BOT system, the TOOR model is based on the 1984 Electricity Act (Law No. 3096), and was initiated under the Privatisation Law of 1994 (Law No. 4046) and Law No. 4047 of the same year.

Preparations for the transfer of operating rights of power stations have been under way since 1994. By 1999, tenders for eight thermal power plants had been issued, bids received, and six consortia selected. These eight plants are shown in Table 18 (Yeniköy and Kemerköy were transferred together). Of these, only one, the two-block Cayirhan power plant, was transferred to private operation in July 2000, and a power purchase agreement signed.

The principal objective of the TOOR model is refurbishment and increased operational efficiency of the equipment. The Ministry of Energy and Natural Resources expects that through the transfers, plant availability and capacity factor will increase. An increase in total generation capacity of 5,000 GWh (or 16% of capacity at the moment of transfer) is expected for the eight power plants in the first year after transfer, with additional increases of 9,000 GWh each year as of the second year. The MENR hopes that after 20 years, power generation will increase by 175 TWh. This cannot be achieved through efficiency increases alone and will require additional capacity investment.

Table 18
TOOR Power Plants in Turkey, 2000

Name	*TOOR Estimated Value (million $)*	*Installed Capacity (MW)*	*Annual Production (GWh)*
Cayirhan	185	620	4,030
Kangal	125	457	2,970
Orhaneli	90	210	1,365
Çatalagzi	75	300	1,950
Tunçbilek	100	429	2,789
Yatagan	160	630	4,095
Yeniköy	100	420	2,730
Kemerköy	150	630	4,095
Soma	255	1,034	6,721
Total	**1,240**	**4,730**	**30,745**

Source: MENR.

The TOOR concept was also used for regional distribution systems. In 1994, division of TEDAS's distribution operations into regional districts began, with the purpose of transferring them to private operators. In 1996, TEDAS's distribution

Figure 22

Transfer of Operating Rights for Distribution Regions, September 2001

Source: MENR.

Table 19

TOOR Applications for Distribution Regions, September 2001

No. in Map	*Region*	*Company*	*Status*	*TOOR Revenue (million $)*
1	Adana-Mersin-Hatay-Osmaniye	CEAS	Under evaluation	..
2	Antalya	KEPEZ	Under evaluation	..
3	Tekirdag-Kirklareli-Edirne		Cancelled by Danistay	
4	Bursa-Yalova		Cancelled by Danistay	
5	Canakkale	..	Under evaluation	..
6	Isparta	GÖKDERE	Under evaluation	20
7	Denizli-Mugla-Aydin	AYDEM	Transfer in progress, private law	110
8	Eskisehir-Bilecik	TEKTAR	Under evaluation	65
9	Afyon-Usak-Burdur	..	Under evaluation	..
10	Kayseri	KAYSERI	Transferred, concession	..
11	Kocaeli-Gebze	CEDAS	To be transferred, private law	155
12	Sakarya-Bolu	SBD	Transfer in progress, private law	70
13	Ankara-Kirikkale	AKEDA	Arbitration	175
14	Konya-Karaman	..	..	..
15	Amasya-Kastamonu-Corum		Cancelled by MENR	
16	Istanbul (Anatolian side)	AKTAS	Transferred, concession	..
17	Samsun-Ordu-Sinop	PARKUR	Transfer in progress, concession	50
18	Kirsehir-Nevsehir-Nigde-Aksaray	ANDAS ANADOLU	Transfer in progress, private law	40
19	Yozgat-Sivas-Tokat	KIZILIRMAK	Transfer in progress, private law	50
20	Trabzon-Rize-Artvin-Gümüshane-Giresun		Cancelled by Danistay	
21	Erzurum-Agri-Kars-Ardanan-Erzincan-Bayburt-Igdir		Cancelled by MENR	
22	Elazig-Malatya-Tunceli-Bingöl	GAP	Transfer in progress, concession	60
23	Kahramanmaras-Adiyaman	AKEDAS	Transfer in progress, concession	60
24	Gaziantep-Kilis		Cancelled by MENR	
25	Sanliurfa	SUREDAS	Transfer in progress, concession	45
26	Diyarbakir-Mardin		Cancelled by MENR	
27	Van-Hakkari-Mus-Bitlis-Sirnak-Siirt-Batman		Cancelled by MENR	
28	Zonguldak-Cankiri-Bartin Karabük	BATI KARADENIZ	Transfer in progress, concession	60
29	Istanbul (Thracian side)		Cancelled by Danistay	
30	Izmir	SENKOM	Under evaluation	300
31	Kütahya	..	Under evaluation	..
32	Balikesir	BEST	Under evaluation	60
33	Manisa	..	Under evaluation	..

Source: MENR.

grid was divided into 29 regional sectors. By 2000, the operating rights of four of those sectors had been transferred to the private sector. Of the remaining 25 regions, five had their TOORs cancelled because the bids received were judged unattractive by the MENR. Of the 20 TOORs up for tenders, 15 had concession agreements that went to the Danistay for approval, and all 15 received approval. In 2001, the 29 regions were divided further to form 33 TOOR regions. Figure 22 shows all 33 distribution regions. Table 19 provides further information on their status.

The Introduction of Competition

The developments described so far were superseded by the adoption of the new Electricity Market act on 20 February 2001 by the Turkish Grand National Assembly. This Act fundamentally changes the structure of the Turkish power industry and ends the use of BOT and TOOR schemes in Turkey. The Electricity Market Act of 2001 is to come into force in early 2003, following a two-year transition period. It aims at creating a competitive, transparent and financially strong electricity market that encourages private investment without government guarantees, provides sufficient, reliable and low-cost electricity to consumers and is compatible with the European Union Electricity Directive.

A competitive electricity market is to be established, based on bilateral contracts between market participants. Within two years of entry into force of the act, i.e. in March 2003, customers consuming more than 9 GWh will be eligible for competition. A short-term market will be created to allow system balancing. If market conditions permit, distribution and retailing activities will be separated.

TEAS will be divided into three different companies: a generation company, an independent transmission operator, and a wholesale trading company. The establishment of the three companies had already been provided for by Decree No. 310 of 3 March 2000 and will now be put into effect. The electricity generation company is to retain all power plants not yet transferred from TEAS via the TOOR procedure. It will also operate the nuclear power plants that the government still expects to come on stream by 2008, as well as "strategic" power plants. The transmission company will be responsible for transmission and non-discriminatory dispatch of all power plants. The wholesale trading company is to be responsible for buying and selling electricity at wholesale level. It will succeed TEAS in the power purchase agreements concluded with the BOT and BOO facilities under the old system, as well as with the one TOOR plant. It will also take TEAS's place in the power supply contract concluded between TEDAS and the TOOR distributors. Other market participants will include private-sector generators, industrial autoproducers, private wholesale and retail traders, and eligible consumers.

A new regulatory framework will be put in place to allow the market to function properly. An independent regulatory authority is to be established, governed by its own board, to apply non-discriminatory, transparent, stable and consistent regulation without day-to-day interference by the government. The regulatory authority will have the following functions:

- It will determine eligible consumers within the framework set by the act.
- It will apply and oversee a new licensing framework for market participants.
- It will enforce regulated third party access to transmission and distribution grids and develop and apply a new transmission and distribution code.
- It will regulate prices for any remaining captive consumers and oversee the transition towards the competitive market.

The Ministry of Energy and Natural Resources will retain the function of monitoring the market at macro level, especially with respect to security of supply. The ministry is expected to take remedial action if market participants fail to take security of supply into account in their contracting, and if the supply situation deteriorates. The government as a whole is responsible for adequate staffing and funding of the regulatory agency, as well as for creating a favourable investment climate. Further privatisation of assets is anticipated.

CRITIQUE

Turkey's greatest challenge in the framework of a predominantly state-owned electricity sector is to meet its fast-growing electricity demand while at the same time achieving a stable budget surplus and limiting foreign debt, as required under agreements with the IMF and the World Bank. Turkey's power sector is in the same situation as those in many developing and emerging economies. Along with much-needed economic development, electricity demand is growing very rapidly. Power cuts are already frequent. Maintaining even the current unsatisfactory reliability levels while keeping up with the rapid demand growth will be difficult, as this entails financing far beyond the capabilities of the government, let alone the state-owned monopoly utilities. Below-cost power sales to final consumers, especially households, exacerbate both demand growth and the dearth of finance for investment.

The inadequacy of power supply is such that it has already caused economic agents to help themselves: hardly a major office building is without a back-up generator in its basement, and many Turkish households have equipped themselves with small diesel generators. This, and the draconian electricity savings measures that the government has enacted, including the switching-off of street lighting, suggest that electricity supply problems are themselves now burdening the economy with a sizeable cost, and hampering economic development.

In such an environment, private investment is often the only way to rebalance the situation. In the long run, Turkey can only gain from private, and foreign, investment. Along with finance, private-sector involvement can bring market-oriented skills, access to advanced technology, and usually faster build-up of supply

capacity than would be the case under public-sector management. By easing the burden on government budgets, private investment also allows governments to redirect scarce public funds towards other needs of the country that do not attract private investment.

However, to obtain international financing, investors must be confident that they will recoup their investment and make a return that at least equals its opportunity cost. A number of factors favour investment in Turkey. The country has a liberal investment regime in which foreign investors are treated the same as Turkish investors, and foreign investors perceive Turkey as an attractive market, because of its large growth rates in GDP and power consumption. However, factors working against investment in Turkey are equally significant. Financiers perceive investment in Turkey as carrying high political/regulatory and exchange rate risk, the former owing to the frequent changes of government (eleven governments in the last nine years) and the associated risk of drastic policy changes, and the latter mainly owing to the chronically high inflation. For these reasons, investors are rarely prepared to finance projects without Treasury guarantees.

These risks are partly why the BOT and TOOR models for private participation have not worked as anticipated. The models were used for two main reasons. First, Turkey's constitution did not allow outright privatisation of state-owned assets. Second, conventional models of financing infrastructure projects designed for government ownership would have increased the government budget deficit and foreign debt by a very substantial amount, especially if the MENR's estimate of annual power investment needs in the order of $3.5-5 billion proved to be accurate. This would have been impossible under the successive stand-by agreements with the IMF, as it would have jeopardised the reduction of inflation.

It is clear that the government's room for manoeuvre has long been extremely limited. In the last two years it has virtually disappeared, especially after the renewed economic crisis at the end of 2000. As long as investors were not given full control and ownership rights over their investment, they required Treasury guarantees for power sales in US dollars as insurance against exchange rate fluctuations induced by unsustainable monetary and fiscal policies, the possibility that the loss-making and indebted TEAS might be unable to pay, and the danger that Turkish authorities and courts might force power sales prices down to levels that would yield inadequate return on investment. In the case of Turkey, adequate rates of return for investors include a significant risk premium. However, Treasury guarantees create further potential budget outflows. As unsustainable fiscal policies are the main cause of the high inflation in Turkey, it was clear that the latter had to be phased out, as required by the IMF. Hence, if Turkey wanted to avoid a situation in which the scarcity of electricity itself throttled economic growth, it needed to find a way of attracting sufficient private and foreign investment without Treasury guarantees.

What was required was much more fundamental reform of the power industry and of the energy market as a whole. Outright privatisation was required, beyond the

irresolute BOT and TOOR models that were marred by legal insecurity, administrative obstacles and Security Council investigations. The somewhat smoother development of the BOO projects demonstrates that granting investors more control over their investment can have a tremendously beneficial impact on the actual development of the projects. Under the BOO schemes, investors at least have the choice of ending their engagement in Turkey and selling their capacity if it is unprofitable. Consequently, the five large-scale projects that are envisaged were easier to finance and have proceeded much more swiftly than BOT projects. Four of the five plants are actually under construction, and most are expected to come on stream as planned.

It was also necessary to design a market from which the government had withdrawn sufficiently to instil investors with confidence that they could operate on a free and level playing field. Ideally, this required competition. One of the reasons why competition was necessary was that it was by no means clear that the BOT projects already established were actually least-cost. The State Planning Organisation at least appears to have had doubts, and the World Bank supported its views. In a stable, undistorted market, investors' risk premium is lower than in a market characterised by high regulatory and political risk. If, in addition, the market is competitive, investors have a strong incentive to minimise cost. To be sure, BOT, BOO and TOOR projects have long been selected on the basis of competitive bidding. But full competition for retail customers is much more effective than competitive bidding.

With the adoption of the new Electricity Act, Turkey has now taken a first and decisive step to cut through the Gordian knot. Much work remains to be done and many details remain to be clarified before a functional competitive market is established. Far from being a quick fix, competitive markets require well-established and highly competent governmental institutions if they are to function effectively. These include an independent regulator, independent grid operators, and a functional competition authority.

One of the most important ingredients of successful competitive power markets is a set of clear, transparent and non-discriminatory prices and conditions of access to the transmission grid. The creation of a separate grid company will be an essential and very positive step in this direction. Even so, the new grid company's tariffs and access conditions must be developed with great care to ensure that a sufficient amount of generating and transmission capacity is created in the appropriate locations. Because any lack of attention to this issue can skew the playing field and deter investors, the government should make clear how transmission tariffs will be determined, with a view towards improving price transparency and productive efficiency. Transmission tariffs should be based on a clear, transparent and non-discriminatory price formula. These tariffs must provide effective incentives for the establishment of production and transmission capacity, including interconnections, to meet future demand.

In the same vein, the separation of natural monopoly activities from the competitive parts of the industry should also be extended to distribution and retailing. It is

commendable that the government is already considering separation of retailing and distribution in the long run. In the interim, and to guarantee a level playing field all the way to ultimate consumer service, the government should require the regional distribution monopolies to unbundle their accounts for these activities. Following this, work should begin soon to specify the terms and conditions under which further separation is to occur, including divestiture of retailing operations. To enhance cost transparency, DSI's accounts for hydro power activities should also be unbundled from irrigation activities.

The market must contain a sufficiently large number of players at each level. All market players must learn how to operate in a competitive environment, and must build up the required organisational framework, including an adequate spot market. In order to facilitate this, the government should consider expanding access to the competitive market beyond the current limits in the Electricity Act, and should develop a timetable for the admission of further eligible customers.

Below-cost electricity sales and cross-subsidies must be phased out across the board, including for captive consumers, if TEAS's successor companies and the regional distributors/retailers are to survive in the long run. The macro-economic framework must also be sufficiently stable to allow the market to operate without major disturbances.

Privatisation is now possible under Turkish law, and the new Electricity Act provides for it, but the government needs to clarify how this is to happen – through outright sale of the shares of TEAS's three successor companies and the distributors, or at the margin through private construction of new generating capacity. Since the new law does not foresee further privatisation of TEAS's generating assets via the TOOR procedure, competitive entry will essentially occur at the margin, through new power plants. Given the high demand growth rates, this could lead to a relatively rapid build-up of the competitive and private segment of the generation market, provided the detailed market design is sound and convinces investors that Turkey is as attractive a market as it appears. This is also a promising opportunity to improve power plant technology, productive efficiency and conversion efficiency, and should lead to significant improvements in reliability in due course. Eventually, these developments should benefit security of electricity supply and the environment. The government should assist this natural tendency of efficient markets by giving utmost attention to designing unbiased rules for an open market, by monitoring the outcomes and by adapting emissions standards, including those for existing plants. Should further privatisation occur, the government would be well advised to ensure that environmental retrofits are carried out, not only for environmental reasons but also to ensure that competition is not skewed.

Last but not least, eligible consumers must become acquainted with their new freedom and how to make good use of it. All this will take time and much work. The Electricity Act rightly acknowledges that the changes envisaged will require a transition period of two years. Full adaptation of the market to the new rules of the game, and the new possibilities they engender, will take longer still. It is

important that during the transition period, when a competitive and a captive market coexist, no distortions occur between the two. In particular, utilities must be prevented from cross-subsidising the competitive market component from the regulated one. Therefore, the government and the new regulatory authority should separate the competitive market from the captive market during the transition period.

The Government of Turkey has opted for the most promising – if not the only – way out of its current difficulties. The IEA very much welcomes this development. If the detailed design of the new competitive power market is carried out efficiently, Turkey might at last be able to establish effective and reliable power supply.

RECOMMENDATIONS

The government should:

☐ Take all necessary steps as soon as possible to implement the new competitive power market. In particular:

- Separate TEAS vertically as soon as possible. Unbundle distributors' accounts for distribution and retailing, and separate DSI's accounts for hydro power activities from irrigation activities, to enhance cost transparency.
- Establish an independent regulator and independent system operators. Prevent any delays in the introduction of competition. Take measures to ensure a smooth transitional period. Separate the competitive market from the captive market during the transition period.
- Establish transmission tariffs based on a clear, transparent and non-discriminatory price formula. These tariffs must provide effective incentives for the establishment of production and transmission capacity, including interconnections, to meet future demand.
- Allow the market to determine when, where and what type of power plants are built without government interference. Base the choice of nuclear power on sound and clear economic criteria, including all related externalities. Clearly define nuclear technology choices and waste disposal options before building nuclear power plants. Increase transparency in communication with the public on these issues.
- Clarify the mechanism by which the generating assets of TEAS, and possibly DSI, will be privatised over time, and establish a clear timetable for doing so. In particular, clarify whether the assets are to be placed under private control through transfer of operating rights or through outright sale.

- Take measures to ensure that the development of the electricity sector and its transition to competition lead to improvements in security of electricity supply, productive efficiency and environmental performance of power plants.

☐ In parallel with implementation of the new Electricity Act, consider expanding access to the competitive market beyond the limits currently set in the act, according to a clear timetable.

☐ Expend all possible efforts to facilitate and enhance international co-operation in the area of electricity trade and interconnection. Create a favourable market environment for investment.

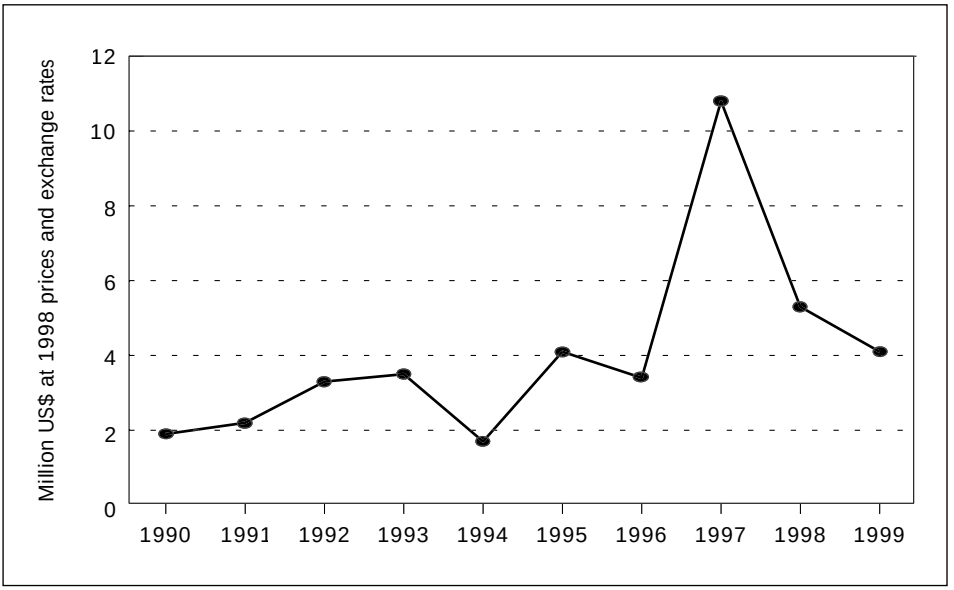
8

TECHNOLOGY, RESEARCH AND DEVELOPMENT

OVERVIEW

Energy R&D spending by the Turkish government in 1999 totalled 1,406 billion Turkish lira, or 0.002% of the country's GDP. Government spending on energy R&D is thought to represent more than two-thirds of the total, the rest being made up by business R&D expenditure. Hence, overall energy R&D efforts as a percentage of GDP are much lower in Turkey than in other IEA countries. The trends in government energy R&D spending, in nominal terms, show an increase until 1997 and a decrease afterwards. The fall in spending is magnified when the data are converted into constant dollars, because of flaring inflation in the last three years.

Figure 23
Total Turkish Government Energy R&D Spending, 1990 to 1999



Source: Turkish submission to the IEA.

The patterns of government spending on R&D are erratic. No clear set of R&D spending priorities emerges from the breakdown in Figure 24: while research on fossil fuels seemed very important in 1990 and 1995, in one year research focused on oil and gas, and in another year coal research was favoured. In 1999, on the other

hand, renewables attracted more research funding than before. It is noteworthy, though, that the erratic pattern in government energy R&D spending conforms to the general pattern of R&D spending in Turkey, and with the development of the Turkish economy in general. However, the high R&D expenditure for 1997 was due mostly to Turkish refineries' (TUPRAS) R&D projects

On 13 December 2000, the Supreme Council for Science and Technology, which is chaired by the prime minister, mandated the Scientific and Technical Research Council of Turkey (TUBITAK) to draw up an "Energy Technologies R&D Programme and Action Plan". Work was launched on 5 January 2001 by the first meeting of a study group comprising a wide variety of experts and scholars from all concerned institutions.

Figure 24
Breakdown of Turkish Government Energy R&D Expenditures: 1990, 1995 and 1999

Source: IEA database on government energy R&D expenditures.

The stated objective of the Turkish government R&D programme is to secure medium- and long-term energy supply through the clean use of domestic coal and renewable sources such as geothermal, solar and wind energy, and to encourage energy efficiency and conservation, particularly in energy-intensive industries. Current priorities in energy R&D are:

- Energy efficiency: R&D and demonstration projects on energy-efficient and clean technologies in the industrial and transport sectors, in collaboration with industrial partners.

- Renewables: assessment of renewable energy resources and definition of plans to increase their use; R&D and demonstration projects on renewable energy technologies, especially small hydro, wind, biomass and solar.

- Clean coal: advanced technologies for clean coal supply and use.

Specific examples of interesting projects in these areas are:

- Solar and photovoltaics: development of selective surface coatings to increase the efficiency of solar collectors; demonstration projects on integration of passive solar systems in existing buildings; design of low-cost solar collectors, photovoltaic (PV) and thermal systems integrated with the architecture of buildings to meet heating, cooling and lighting needs; solar refrigeration technologies (liquid absorption and vapour jet systems) for storage of agro- and food industry products; capacity building in PV power plant technologies; economic/technical feasibility studies for hybrid thermal plants, using both natural gas and solar energy.

- Biomass: cost-effective power production from municipal wastes and from forest and agricultural residues; development of fluidised bed technology for using biomass/coal blends in thermal power plants; development of technologies to use energy crops as fuel in plants for power/heat production; development of technologies for pyrolisis, gasification and liquid fuel production from biomass.

- Hydro: design of small hydro plants integrated with other economic activities (agriculture, fishery, etc.).

- Wind: development of domestic wind turbine production technologies.

Besides the State Planning Organisation, the main actors involved in the definition of R&D priorities and programmes are the Ministry of Energy and Natural Resources and its related bodies and enterprises (EIEI, Turkish Technology Development Fund, TEAS, etc.), the Ministry of Environment, TUBITAK and universities and private businesses. The Supreme Council for Science and Technology (the highest body for science and technology policy-making) issues periodic plans setting R&D priorities. Targets and priorities have been established by the council for the years 1993-2003. TUBITAK, the main public R&D body, has an advisory role in this process.

Within TUBITAK, the Energy System and Environmental Research Institute (ESERI) created in 1996, has the specific mission to "contribute to Turkey's global competitiveness and sustainable development targets" by developing new and advanced energy technologies and energy conservation measures, by determining the level and sources of environmental pollution, and by developing technologies to prevent and control pollution and remedy polluted sites. ESERI has a staff of 75 people, including 44 researchers. Research is carried out either directly or though "umbrella projects", with the participation of industry and universities. Through its five Strategic Business Units, ESERI benefits from expertise in the broad areas of energy conservation, advanced fuel technologies, environmental monitoring and assessment, environmental management systems, and environmental pollution control.

A new actor, the International Centre for Hydrogen Energy Technologies (ICHET) will soon be established within the legal framework of UNIDO as a scientific institution with operational autonomy. The headquarters of ICHET will be in Istanbul. ICHET will promote and facilitate the introduction of hydrogen energy technologies in participating countries through techno-economic studies, including technology monitoring and forecasting, R&D, technology transfer, training, fellowships and advisory services.

In 1998, the Energy Technology Policy Study Group, with the participation of experts from a wide range of institutions including the MENR and its related institutions, as well as from the private sector and universities, issued a report on "National Energy Technology Policy". The report recommended to promote energy efficiency and renewables through rapid enactment of an energy efficiency law by parliament and the establishment of an advisory committee (with the National Energy Conservation Centre as the secretariat) for selecting the best energy-efficient technologies and facilitating their introduction into the Turkish market. The shift towards renewable energy sources and capacity building in renewable energy technologies was to be promoted through increased R&D efforts, adaptation of existing subsidies to this purpose and implementation of additional financial and fiscal policies and measures. At present, about 15 types of legal and administrative incentives exist to promote R&D, including:

- The Decree on Investment Incentives. The decree covers R&D, environment, quality improvement and small and medium-sized enterprises (SMEs).

- A tax credit for R&D expenses that makes it possible to postpone payment of annual corporate taxes for three years without interest up to an amount equivalent to 20% of R&D expenses.

- The government's R&D Assistance Programme for Industrial Companies. This includes a financial contribution by the Scientific and Technical Research Council of Turkey and by the Undersecretariat of Foreign Trade for up to 50% of the total eligible costs incurred over the duration (up to 36 months) of an individual R&D project. Low-interest loans are also provided by the Technology Development Foundation of Turkey within the scope of the decree.

This programme has been very successful with the private sector (accounting for 95% of the R&D project proposals), with SMEs (40% of the R&D project proposals) and in promoting new technologies (informatics, advanced materials, biotechnology, automation, aviation and space). Other positive impacts of the R&D Assistance Programme have been increasing R&D expenditures by the private sector, and an increasing R&D expenditure/GDP ratio. The involvement of universities, industry, R&D institutions was beneficial, as was improved project management and R&D management by firms. To boost the effectiveness of the R&D Assistance Programme, additional tools are needed, including financial contributions, grants, soft loans, and advance payments, as well as venture capital, techno-parks, and an accreditation system.

CRITIQUE

The R&D carried out by the most important Turkish R&D institutions appears to be driven by the desire to cover as much ground as possible. In practice, this results in broad, ambitious goals but too few resources. Public energy research funds are small and continuously eroded by inflation, but a lack of focus, reflected in the large variation in funding for the various technology areas, appears to be one of the main problems.

The resources that the Turkish government can spend on R&D are and will remain limited, whereas concrete results are needed in line with the country's energy policy objectives. Therefore, the focus should be on short- to medium-term R&D, and on the adaptation of new technologies to the specific fuel mix and energy potential of the country. Increasing energy security and reducing energy-related pollution should be the main goals. The research establishment should work with industry to produce innovative solutions and adapt commercially available advanced technologies, including conservation, renewables and cleaner coal technologies, to Turkish circumstances. The research establishment should also provide technical support to government programmes in the areas of energy management, efficiency standards, environmental monitoring and management, and pollution control.

Although some steps have been taken to stimulate private-sector R&D and the involvement of industrial partners in government-sponsored research, more needs to be done in this area. As the focus of private-sector R&D is more on short-term and applied research, government research agencies and universities willing to work more closely with industry may need to focus more on specific issues that are closer to the market.

RECOMMENDATIONS

The government should:

- ☐ Strengthen R&D activities aimed towards the adaptation of new and advanced technologies to Turkey's specific needs and concentrate efforts on a more limited number of activities, particularly in the following areas:
  - Clean coal technologies.
  - Flue gas desulphurisation.
  - Fluidised bed combustion.
  - Fossil fuel combustion efficiency.
  - Wind and solar thermal.
  - Energy efficiency and conservation in all sectors.

☐ Work more closely with industry on R&D.

☐ Increase efforts to demonstrate and deploy new technologies that are relevant to the Turkish market.

☐ Gradually increase the funds for research, demonstration and deployment as the economy grows.

☐ Exploit more fully the opportunities for bilateral and multilateral international co-operation.

A

ANNEX

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	1998	1999	2005	2010	2020
TOTAL PRODUCTION		**15.48**	**25.50**	**28.54**	**26.90**	**34.12**	**47.33**	**70.24**
Coal[1]		5.21	12.41	13.95	13.29	20.69	28.11	31.64
Oil		3.59	3.61	3.19	2.91	1.66	1.14	0.64
Gas		–	0.18	0.47	0.60	0.16	0.14	0.11
Comb. Renewables & Wastes[2]		6.45	7.21	6.99	6.81	5.33	4.42	3.93
Nuclear		–	–	–	–	–	3.66	16.46
Hydro		0.22	1.99	3.63	2.98	4.16	5.62	8.38
Geothermal		–	0.09	0.23	0.20	1.89	3.81	8.25
Solar / Wind / Other		–	0.02	0.10	0.11	0.22	0.43	0.83
TOTAL NET IMPORTS[3]		**8.74**	**27.98**	**43.22**	**43.04**	**95.51**	**124.01**	**228.21**
Coal[1]	Exports	–	–	–	–	–	–	–
	Imports	0.01	4.21	7.85	6.69	14.78	28.69	86.76
	Net Imports	0.01	4.21	7.85	6.69	14.78	28.69	86.76
Oil	Exports	0.86	1.90	2.12	2.47	–	–	–
	Imports	9.68	23.18	28.93	28.87	38.34	45.26	66.26
	Bunkers	0.09	0.12	0.16	0.28	–	–	–
	Net Imports	8.73	21.16	26.65	26.11	38.34	45.26	66.26
Gas	Exports	–	–	–	–	–	–	–
	Imports	–	2.68	8.46	10.06	42.05	50.06	75.19
	Net Imports	–	2.68	8.46	10.06	42.05	50.06	75.19
Electricity	Exports	–	0.08	0.03	0.03	..	..	..
	Imports	–	0.02	0.28	0.20	0.34	..	..
	Net Imports	–	–0.06	0.26	0.18	0.34	..	..
TOTAL STOCK CHANGES		**0.11**	**–0.83**	**–0.07**	**0.39**	**–**	**–**	**–**
TOTAL SUPPLY (TPES)		**24.32**	**52.65**	**71.69**	**70.33**	**129.63**	**171.34**	**298.45**
Coal[1]		5.15	16.94	21.99	20.07	35.46	56.80	118.41
Oil		12.50	23.61	29.55	29.38	40.01	46.40	66.89
Gas		–	2.86	8.94	10.59	42.21	50.19	75.30
Comb. Renewables & Wastes[2]		6.45	7.21	6.99	6.81	5.33	4.42	3.93
Nuclear		–	–	–	–	–	3.66	16.46
Hydro		0.22	1.99	3.63	2.98	4.16	5.62	8.38
Geothermal		–	0.09	0.23	0.20	1.89	3.81	8.25
Solar / Wind / Other		–	0.02	0.10	0.11	0.22	0.43	0.83
Electricity Trade[4]		–	–0.06	0.26	0.18	0.34	–	–
Shares (%)								
Coal		*21.2*	*32.2*	*30.7*	*28.5*	*27.4*	*33.2*	*39.7*
Oil		*51.4*	*44.8*	*41.2*	*41.8*	*30.9*	*27.1*	*22.4*
Gas		*–*	*5.4*	*12.5*	*15.1*	*32.6*	*29.3*	*25.2*
Comb. Renewables & Wastes		*26.5*	*13.7*	*9.7*	*9.7*	*4.1*	*2.6*	*1.3*
Nuclear		*–*	*–*	*–*	*–*	*–*	*2.1*	*5.5*
Hydro		*0.9*	*3.8*	*5.1*	*4.2*	*3.2*	*3.3*	*2.8*
Geothermal		*–*	*0.2*	*0.3*	*0.3*	*1.5*	*2.2*	*2.8*
Solar / Wind / Other		*–*	*–*	*0.1*	*0.2*	*0.2*	*0.3*	*0.3*
Electricity Trade		*–*	*-0.1*	*0.4*	*0.3*	*0.3*	*–*	*–*

0 is negligible. – is nil, .. is not available.

Please note: All forecast data are based on the 1996 submission.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	1998	1999	2005	2010	2020
TFC	**19.99**	**40.20**	**53.74**	**52.00**	**90.79**	**120.32**	**214.13**
Coal [1]	2.94	7.57	9.05	7.36	18.65	29.62	75.99
Oil	9.70	20.80	26.05	25.92	36.59	42.74	60.70
Gas	0.04	0.72	4.11	4.04	14.47	18.03	23.12
Comb. Renewables & Wastes [2]	6.45	7.21	6.90	6.71	5.33	4.42	3.93
Geothermal	–	0.02	0.15	0.13	1.82	3.74	8.17
Solar / Wind / Other	–	0.02	0.10	0.11	0.22	0.43	0.83
Electricity	0.85	3.87	7.38	7.72	13.71	21.35	41.39
Heat	–	–	–	–	–	–	–
Shares (%)							
Coal	*14.7*	*18.8*	*16.8*	*14.2*	*20.5*	*24.6*	*35.5*
Oil	*48.5*	*51.7*	*48.5*	*49.8*	*40.3*	*35.5*	*28.3*
Gas	*0.2*	*1.8*	*7.7*	*7.8*	*15.9*	*15.0*	*10.8*
Comb. Renewables & Wastes	*32.3*	*17.9*	*12.8*	*12.9*	*5.9*	*3.7*	*1.8*
Geothermal	–	–	*0.3*	*0.3*	*2.0*	*3.1*	*3.8*
Solar / Wind / Other	–	*0.1*	*0.2*	*0.2*	*0.2*	*0.4*	*0.4*
Electricity	*4.3*	*9.6*	*13.7*	*14.9*	*15.1*	*17.7*	*19.3*
Heat	–	–	–	–	–	–	–
TOTAL INDUSTRY [5]	**4.30**	**13.71**	**21.45**	**19.03**	**40.81**	**60.53**	**128.04**
Coal [1]	1.14	4.52	7.06	5.71	14.38	24.99	67.42
Oil	2.60	6.16	8.65	7.84	10.15	12.06	19.24
Gas	0.00	0.67	1.92	1.64	8.45	10.40	14.20
Comb. Renewables & Wastes [2]	–	–	–	–	–	–	–
Geothermal	–	–	–	–	0.40	0.64	1.47
Solar / Wind / Other	–	0.01	0.02	0.02	0.14	0.25	0.52
Electricity	0.55	2.35	3.80	3.82	7.29	12.19	25.20
Heat	–	–	–	–	–	–	–
Shares (%)							
Coal	*26.5*	*33.0*	*32.9*	*30.0*	*35.2*	*41.3*	*52.7*
Oil	*60.5*	*44.9*	*40.3*	*41.2*	*24.9*	*19.9*	*15.0*
Gas	*0.1*	*4.9*	*8.9*	*8.6*	*20.7*	*17.2*	*11.1*
Comb. Renewables & Wastes	–	–	–	–	–	–	–
Geothermal	–	–	–	–	*1.0*	*1.1*	*1.1*
Solar / Wind / Other	–	*0.1*	*0.1*	*0.1*	*0.3*	*0.4*	*0.4*
Electricity	*12.9*	*17.2*	*17.7*	*20.1*	*17.9*	*20.1*	*19.7*
Heat	–	–	–	–	–	–	–
TRANSPORT [6]	**4.49**	**9.58**	**11.37**	**11.87**	**19.58**	**23.26**	**32.47**
TOTAL OTHER SECTORS [7]	**11.21**	**16.91**	**20.92**	**21.10**	**30.40**	**36.54**	**53.61**
Coal [1]	1.28	3.03	1.99	1.65	4.27	4.63	8.58
Oil	3.15	5.11	6.10	6.29	7.01	7.67	9.46
Gas	0.04	0.05	2.16	2.37	6.02	7.62	8.91
Comb. Renewables & Wastes [2]	6.45	7.21	6.90	6.71	5.33	4.42	3.93
Geothermal	–	0.02	0.15	0.13	1.42	3.10	6.70
Solar / Wind / Other	–	0.01	0.08	0.09	0.08	0.18	0.31
Electricity	0.29	1.49	3.55	3.87	6.27	8.92	15.73
Heat	–	–	–	–	–	–	–
Shares (%)							
Coal	*11.4*	*17.9*	*9.5*	*7.8*	*14.0*	*12.7*	*16.0*
Oil	*28.1*	*30.2*	*29.2*	*29.8*	*23.1*	*21.0*	*17.7*
Gas	*0.3*	*0.3*	*10.3*	*11.2*	*19.8*	*20.9*	*16.6*
Comb. Renewables & Wastes	*57.5*	*42.6*	*33.0*	*31.8*	*17.5*	*12.1*	*7.3*
Geothermal	–	*0.1*	*0.7*	*0.6*	*4.7*	*8.5*	*12.5*
Solar / Wind / Other	–	*0.1*	*0.4*	*0.4*	*0.3*	*0.5*	*0.6*
Electricity	*2.6*	*8.8*	*16.9*	*18.3*	*20.6*	*24.4*	*29.3*
Heat	–	–	–	–	–	–	–

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	1998	1999	2005	2010	2020
ELECTRICITY GENERATION[8]							
INPUT (Mtoe)	**2.77**	**11.08**	**20.93**	**22.24**	**47.58**	**67.36**	**118.82**
OUTPUT (Mtoe)	**1.07**	**4.95**	**9.55**	**10.01**	**16.56**	**25.33**	**47.79**
(TWh gross)	12.43	57.54	111.02	116.44	192.61	294.53	555.69
Output Shares (%)							
Coal	*26.1*	*35.1*	*32.1*	*31.8*	*38.7*	*41.2*	*32.8*
Oil	*51.4*	*6.9*	*7.1*	*6.9*	*0.9*	*0.3*	*1.2*
Gas	*–*	*17.7*	*22.4*	*31.2*	*35.2*	*31.5*	*37.1*
Comb. Renewables & Wastes	*1.6*	*–*	*0.2*	*0.2*	*..*	*..*	*..*
Nuclear	*–*	*–*	*–*	*–*	*–*	*4.8*	*11.4*
Hydro	*20.9*	*40.2*	*38.0*	*29.8*	*25.1*	*22.2*	*17.5*
Geothermal	*–*	*0.1*	*0.1*	*0.1*	*0.0*	*0.0*	*0.0*
Solar/Wind/Other	*–*	*–*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
TOTAL LOSSES	**4.03**	**11.58**	**17.50**	**18.13**	**38.84**	**51.02**	**84.32**
of which:							
Electricity and Heat Generation[9]	1.70	6.13	11.39	12.22	31.02	42.03	71.03
Other Transformation	1.32	2.89	1.59	1.53	2.86	3.03	4.22
Own Use and Losses[10]	1.00	2.56	4.53	4.38	4.96	5.96	9.07
Statistical Differences	**0.30**	**0.88**	**0.45**	**0.19**	**–**	**–**	**–**

INDICATORS

	1973	1990	1998	1999	2005	2010	2020
GDP (billion 1995 US$)	68.39	144.57	200.84	190.76	275.23	398.81	769.99
Population (millions)	38.45	56.20	64.79	65.82	69.83	74.12	81.79
TPES/GDP[11]	0.36	0.36	0.36	0.37	0.47	0.43	0.39
Energy Production/TPES	0.64	0.48	0.40	0.38	0.26	0.28	0.24
Per Capita TPES[12]	0.63	0.94	1.11	1.07	1.86	2.31	3.65
Oil Supply/GDP[11]	0.18	0.16	0.15	0.15	0.15	0.12	0.09
TFC/GDP[11]	0.29	0.28	0.27	0.27	0.33	0.30	0.28
Per Capita TFC[12]	0.52	0.72	0.83	0.79	1.30	1.62	2.62
Energy–related CO_2 Emissions (Mt CO_2)[13]	56.8	138.3	185.0	182.8	346.8	467.0	818.2
CO_2 Emissions from Bunkers (Mt CO_2)	0.4	0.9	2.0	2.4	..	..	..

GROWTH RATES (% per year)

	73–79	79–90	90–98	98–99	99–05	05–10	10–20
TPES	3.7	5.2	3.9	–1.9	10.7	5.7	5.7
Coal	4.1	9.0	3.3	–8.7	9.9	9.9	7.6
Oil	3.1	4.2	2.8	–0.6	5.3	3.0	3.7
Gas	–	–	15.3	18.4	25.9	3.5	4.1
Comb. Renewables & Wastes	3.1	–0.7	–0.4	–2.5	–4.0	–3.7	–1.2
Nuclear	–	–	–	–	–	–	16.2
Hydro	25.7	7.6	7.8	–17.9	5.7	6.2	4.1
Geothermal	–	–	13.0	–10.6	45.2	15.0	8.0
Solar/Wind/Other	–	–	21.5	14.0	11.9	14.1	6.7
TFC	4.1	4.2	3.7	–3.2	9.7	5.8	5.9
Electricity Consumption	*11.3*	*8.2*	*8.4*	*4.7*	*10.0*	*9.3*	*6.8*
Energy Production	*1.9*	*3.6*	*1.4*	*–5.7*	*4.0*	*6.8*	*4.0*
Net Oil Imports	*5.1*	*5.5*	*2.9*	*–2.0*	*6.6*	*3.4*	*3.9*
GDP	*4.5*	*4.5*	*4.2*	*–5.0*	*6.3*	*7.7*	*6.8*
Growth in the TPES/GDP Ratio	*–0.8*	*0.6*	*–0.3*	*3.3*	*4.2*	*–1.8*	*–1.0*
Growth in the TFC/GDP Ratio	*–0.4*	*–0.3*	*–0.5*	*1.9*	*3.2*	*–1.8*	*–0.8*

Please note: Rounding may cause totals to differ from the sum of the elements.

Footnotes to Energy Balances and Key Statistical Data

1. Includes lignite.

2. Comprises solid biomass, biogas, industrial waste and municipal waste. Data are often based on partial surveys and may not be comparable between countries.

3. Total net imports include combustible renewables and waste.

4. Total supply of electricity represents net trade. A negative number indicates that exports are greater than imports.

5. Includes non-energy use.

6. Includes less than 1% non-oil fuels.

7. Includes residential, commercial, public service and agricultural sectors.

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 public utilities and autoproducers. For non-fossil-fuel electricity generation, theoretical losses are shown based on plant efficiencies of 10% for geothermal and 100% for hydro.

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 1995 prices and exchange rates.

12. Toe per person.

13. "Energy-related CO_2 emissions" specifically means CO_2 from the combustion of the fossil fuel components of TPES (i.e. coal and coal products, peat, crude oil and derived products and natural gas), while CO_2 emissions from the remaining components of TPES (i.e. electricity from hydro, other renewables and nuclear) are zero. Emissions from the combustion of biomass-derived fuels are not included, in accordance with the IPCC greenhouse gas inventory methodology. Also 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 1999 and applying this factor to forecast energy supply. Future coal emissions are based on product–specific supply projections and are calculated using the IPCC/OECD emission factors and methodology.

B

ANNEX

INTERNATIONAL ENERGY AGENCY "SHARED GOALS"

The Member countries* of the International Energy Agency (IEA) seek to create the conditions in which the energy sectors of their economies can make the fullest possible contribution to sustainable economic development and 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 they 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** is 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 where practicable have regard to the Polluter Pays Principle.

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

* Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States.

IEA Members 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 encourage 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 their 4 June 1993 meeting in Paris.)

C

ANNEX

GLOSSARY AND LIST OF ABBREVIATIONS

In this report, abbreviations are substituted for a number of terms used within the International Energy Agency. While these terms generally have been written out on first mention and abbreviated subsequently, this glossary provides a quick and central reference for many of the abbreviations used.

bcm	billion cubic metres.
b/d	barrels per day.
CCGT	combined–cycle gas turbine.
CERT	Committee on Energy Research and Technology of the IEA.
CFCs	chlorofluorocarbons.
CHP	combined production of heat and power; sometimes, when referring to industrial CHP, the term "co–generation" is used.
CNG	compressed natural gas.
CO	carbon monoxide.
CO_2	carbon dioxide.
cm	cubic metre.
DSO	distribution system operator.
EFTA	European Free Trade Association: Iceland, Norway, Switzerland and Liechtenstein.
EIA	environmental impact assessment.
ETSO	European Transmission System Operators Group.
EU	The European Union, whose members are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom.
Euro	European currency (€).
FCCC	Framework Convention on Climate Change.
GDP	gross domestic product.
GNP	gross national product.
GEF	Global Environmental Facility.
GJ	gigajoule, or 1 joule $\times 10^9$.
GW	gigawatt, or 1 watt $\times 10^9$.

GWh	gigawatt × one hour, or one watt × one hour × 10^9.
IAEA	International Atomic Energy Agency.
IEA	International Energy Agency whose Members are Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States.
IEP	International Energy Program, one of the founding documents of the IEA.
IGCC	integrated coal gasification combined cycle plant.
IPCC	International Panel on Climate Change.
ISO	independent system operator.
J	joule; a joule is the work done when the point of application of a force of one newton is displaced through a distance of one metre in the direction of the force (a newton is defined as the force needed to accelerate a kilogram by one metre per second). In electrical units, it is the energy dissipated by one watt in a second.
kV	kilovolt, or one volt × 10^3.
kWh	kilowatt–hour, or one kilowatt × one hour, or one watt × one hour × 10^3.
LDC	local distribution company.
LNG	liquefied natural gas.
LPG	liquefied petroleum gas; refers to propane, butane and their isomers, which are gases at atmospheric pressure and normal temperature.
mcm	million cubic metres.
Mt	million tonnes.
Mtoe	million tonnes of oil equivalent; see toe.
MW	megawatt of electricity, or 1 Watt × 10^6.
MWh	megawatt–hour, or one megawatt × one hour, or one watt × one hour × 10^6.
NATO	North Atlantic Treaty Organisation.
NEA	Nuclear Energy Agency of the OECD.
negTPA	negotiated third party access.
Nm^3	cubic nanometre, or 10^{-18} cubic metres.
NO_x	nitrogen oxides.
OECD	Organisation for Economic Co–operation and Development.

OSCE	Organisation for Security and Co-operation in Europe.
PJ	petajoule, or 1 Joule $\times 10^{15}$.
ppm	parts per million.
PPP	purchasing power parity: the rate of currency conversion that equalises the purchasing power of different currencies, i.e. estimates the differences in price levels between different countries.
regTPA	regulated third party access.
R&D	research and development, especially in energy technology; may include the demonstration and dissemination phases as well.
SLT	Standing Group on Long–Term Co–operation of the IEA.
SO_2	sulphur dioxide.
tce	tonne of coal equivalent.
TFC	total final consumption of energy; the difference between TPES and TFC consists of net energy losses in the production of electricity and synthetic gas, refinery use and other energy sector uses and losses.
toe	tonne of oil equivalent, defined as 10^7 kcal.
TOP	take–or–pay contract.
TPA	third party access.
TPES	total primary energy supply.
TSO	transmission system operator.
TW	terawatt, or 1 watt $\times 10^{12}$.
TWh	terawatt $\times$ one hour, or one watt $\times$ one hour $\times 10^{12}$.
UGTE	union for the Co-ordination of Transmission of Electricity. This organisation co-ordinates the interests of transmission system operators in 20 European countries, serving 400 million people.
UGS	underground storage (of natural gas).
UN	the United Nations Organisation.
UNIDO	United Nations Industrial Development Organisation.
VAT	value-added tax.
VOCs	volatile organic compounds.
WANO	World Association of Nuclear Operators.

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