International Energy Agency

Energy Policies of IEA Countries

TURKEY

2009 Review

Energy Policies of IEA Countries

TURKEY 2009 Review

Turkey will likely see the fastest medium to long-term growth in energy demand among the IEA member countries. It has a young and urbanising population and energy use is still comparatively low. Therefore, ensuring sufficient energy supply to a growing economy remains the government's main energy policy concern. Turkey has also progressed significantly in all other areas of energy policy over the past few years.

Large investments in energy infrastructure, especially in electricity and natural gas, are needed to avoid bottlenecks in supply and to sustain rapid economic growth. To attract that investment, the country needs to continue reforming its energy market. Power sector reform is well under way, but in the natural gas sector reform has been slower and needs to be accelerated.

Improving energy efficiency is essential for responding to Turkey's energy policy challenges, and considerable potential remains in all sectors. In a country where private cars are rapidly becoming more common and where significant new construction is foreseen, transport and buildings merit particular long-term attention from the decision makers. Energy-related CO_2 emissions have more than doubled since 1990 and are likely to continue to increase rapidly over the medium and long term, in parallel with energy demand. The IEA urges Turkey to intensify efforts to further develop its approach concerning its post-2012 regime to combat climate change, and to consider setting a quantitative overall target for limiting emissions.

This review analyses the broad range of energy challenges facing Turkey and provides critiques and recommendations for further policy improvements.

(61 2009 06 1 P1) €75
ISBN 978-92-64-06041-8

International
Energy Agency

Energy Policies of IEA Countries

TURKEY

2009 Review

INTERNATIONAL ENERGY AGENCY

The International Energy Agency (IEA), an autonomous agency, was established in November 1974. Its mandate is two-fold: to promote energy security amongst its member countries through collective response to physical disruptions in oil supply and to advise member countries on sound energy policy.

The IEA carries out a comprehensive programme of energy co-operation among 28 advanced economies, each of which is obliged to hold oil stocks equivalent to 90 days of its net imports. The Agency aims to:

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

IEA member countries:

Australia
Austria
Belgium
Canada
Czech Republic
Denmark
Finland
France
Germany
Greece
Hungary
Ireland
Italy
Japan
Korea (Republic of)
Luxembourg
Netherlands
New Zealand
Norway
Poland
Portugal
Slovak Republic
Spain
Sweden
Switzerland
Turkey
United Kingdom
United States

The European Commission also participates in the work of the IEA.

International Energy Agency

International Energy Agency
9 rue de la Fédération
75739 Paris Cedex 15, France

TABLE OF CONTENTS

PART IV: ANNEXES

List of Figures, Tables and Boxes

FIGURES

TABLES

BOXES

EXECUTIVE SUMMARY AND KEY RECOMMENDATIONS

EXECUTIVE SUMMARY

Turkey will likely see the fastest medium- to long-term growth in energy demand among the IEA member countries. It has a young and urbanising population and energy use is still comparatively low. Therefore, ensuring sufficient energy supply to a growing economy remains the government's main energy policy concern. As one of the government's primary policy goals, energy security has attracted more focus than market reform and environmental protection. However, Turkey has progressed greatly in all areas of energy policy since the 2005 in-depth review and there are clear signs of a better future balance among the three primary energy policy goals.

Affordable energy is essential for increasing the living standards of the Turkish people. Large investments in energy infrastructure, especially in electricity and natural gas, are needed over the coming years to avoid bottlenecks in supply and to sustain rapid economic growth. Turkey will rely largely on the private sector as the source for such large energy investments.

To attract investments, the country needs to continue reforming its energy market. In the past few years, power sector reform has progressed significantly and comprised moving to cost-reflective wholesale tariffs; privatising distribution companies; launching a programme for privatising generation assets; and setting a date for full market opening. The May 2009 Electricity Market and Security of Supply Strategy outlines the way forward. The IEA congratulates Turkey for these reforms and urges it to pursue further reforms with relentless vigour. Turkey must see through its plans to increase competition and overall economic efficiency and to further reform tariffs. The plans exist; they now need to be implemented in full.

Closely intertwined with economic growth, energy use in Turkey is expected to roughly double over the next decade, and electricity demand is likely to increase even faster. Growth at this pace requires not only large investments but also measures to ensure energy security, especially in the electricity sector. The government rightly sees increasing domestic energy supply as part of the response. Turkey has large coal reserves and expects to multiply their use over the next decade to provide electricity for the growing population and expanding economy. The government is also determined to utilise Turkey's large remaining potential for hydro and wind power. Moreover, it has extensive plans for solar and geothermal energy, and aims to introduce nuclear power to

further diversify its power generating capacity. Indicative targets for improving security and sustainability of the electricity sector are determined in the May 2009 Electricity Market and Security of Supply Strategy.

In the natural gas sector, reform has been slower, largely owing to security of supply concerns, and needs to be accelerated. Turkey should urgently implement a revitalised package of gas market reforms to effectively unbundle BOTAŞ, the incumbent, in order to establish an independent gas transmission operator; ensure that recent progress in eliminating import-export restrictions is sustained; and reduce BOTAŞ's significant market share. All this would help attract investment and, in the end, ensure sufficient gas to improve gas supply security and flexibility.

Turkey imports practically all the oil and gas it uses and these imports may almost double over the next decade. A key part of Turkey's policy is energy diplomacy with the supplier countries in the region, which together hold more than 70% of the proven oil and gas reserves of the world. Turkey has been quite successful, as is evidenced by agreements with Russia, Iran, Iraq, Egypt, the Caspian region (Azerbaijan) and Central Asia (Turkmenistan). These agreements and the related projects also strengthen Turkey's role as a transit country, an energy corridor between its neighbouring supplier regions and the European and other international markets. Ceyhan on the Mediterranean coast is developing as a major oil terminal in the region. Turkey's proactive stance benefits both the country itself and the wider international community. The IEA acknowledges the responsibility Turkey has shown in improving global energy security.

In addition to securing oil and gas from diversified sources, the country should also focus on expanding its oil and gas storage capacity. In particular, the IEA encourages the government to develop a comprehensive long-term plan to increase emergency oil reserves and natural gas storage capacities to this effect. It should also improve the institutional capacity, possibly by swiftly establishing a stockholding agency to further improve compliance with the IEA 90-day oil stockholding obligation.

Large potential for energy efficiency improvements remains in all sectors. In a country where cars are becoming more and more popular and where significant new construction is foreseen, transport and buildings merit particular long-term attention from the decision makers.

Turkey remains on a trend towards the same unsustainable car- and oil-based transport system that is all too common in the other IEA member countries. Crucially, Turkey can change the current trend by decisive action. A more sustainable transport system would help save energy, avoid congestion, improve air quality and, as transport is the largest oil-consuming sector and relies on oil for almost all of its energy needs, increase oil security. Good examples in this regard are the ongoing projects to build high-speed rail

connections between the major cities, and to substantially improve the public transport system in Istanbul. Turkey should intensify its efforts to develop, adopt and implement a holistic strategy covering transport, energy and urban development.

Buildings are another key sector where efficiency measures would bring multiple benefits. Peak demand for electricity is gradually increasing, because of the growing use of appliances for heating and cooling. This demand could be reduced by more efficient appliances and by reducing the need for heating and cooling through better insulation and by using light colours for roofs and pavements, as well as natural shading. The recent programme of energy labelling of buildings is an important step towards improving energy efficiency in the buildings sector. Air-conditioning should be a focus of particular attention, also in light of climate change projections. Reducing electricity use for air-conditioning would save money that the government is spending on the electricity sector. Heat pumps look particularly attractive as a technology option for providing both energy-efficient cooling and heating, and the government should consider stronger incentives for their uptake.

Energy-related CO_2 emissions have more than doubled since 1990 and are likely to continue to increase fast over the medium and long term, in parallel with significant growth in energy demand. Turkey is a Party to the United Nations Framework Convention on Climate Change (UNFCCC) and became a Party to the Kyoto Protocol in 2009. However, as a rapidly developing economy with low emissions per capita, Turkey has preferred not to set a quantitative overall target to limit emissions. This exemption is based on the decision 26/CP.7 of 2001 by the Parties to the UNFCCC. Turkey is the only Annex-I country that has not (by May 2010) set mitigation targets for the post-2012 period or proposed mitigation actions to support them, as required under the Copenhagen Accord. It is also the only OECD country that does not have a national emission target for 2020.

Turkey's approach is to implement policies and measures to protect the climate system on the basis of equity and in accordance with common but differentiated responsibilities and respective capacities. Turkey sees that its special circumstances and differences from other Annex-I Parties are not addressed in the Copenhagen Accord. Nevertheless, Turkey has been working on further developing its post-2012 approach and determining its commitments. For example, it has set a unilateral quantitative target for CO_2 emissions from the energy sector (-7% from the reference scenario level in 2020), as defined in its 2009 National Climate Change Strategy. The IEA urges Turkey to intensify efforts to further develop its approach concerning the post-2012 regime and encourages it to set a quantitative overall target for limiting emissions. A target would provide an important signal to other countries of Turkey's commitment and intent. Turkey's approach on the post-2012 climate policy regime has implications on how much the country can

draw on the international sources for financing the new energy technology it will need both for limiting emissions and for increasing energy supply.

KEY RECOMMENDATIONS

The government of Turkey should:

- *Implement the 2009 Electricity Market and Security of Supply Strategy, and accelerate efforts to reform the natural gas market.*
- *Continue to ensure security of oil and gas supply, including by further co-operation with countries and companies in the region, expansion of natural gas storage capacity and further compliance with the IEA oil stockholding requirements.*
- *Intensify efforts to further improve energy efficiency as a means to supporting economic growth, energy security and environmental protection.*
- *Further develop its approach on the post-2012 climate policy regime and consider setting a meaningful quantitative overall target for emissions, while taking into account the advantages and disadvantages of such a target.*

PART I

POLICY ANALYSIS

Figure 1

Map of Turkey

The boundaries and names shown and the designation used on maps included in this publication do not imply official endorsement or acceptance by the IEA.

COUNTRY OVERVIEW

The Republic of Turkey (population 71 million, area 783 562 km^2) forms a natural bridge between Europe and Asia. Owing to its size and geography, the country's climate varies substantially by region. Turkey has a relatively young population, which has grown by more than 10% since 2000. Istanbul, with a population of almost 13 million, is one of the largest cities in Europe. Ankara, the capital, is the country's second-largest city, with more than four million inhabitants.

Turkey is a rapidly growing economy, and over the past decade, its GDP has increased at an exceptional rate compared to other OECD countries. Turkey is the 17th largest economy of the world. From 2000 to 2007, the economy expanded on average by 4.9% a year. As a result of the international financial crisis, the growth rate slowed down to 0.7% in 2008, and the economy contracted by 4.7% in 2009. It is expected to recover in 2010. The unemployment rate is expected to lie around 14% in 2010, while per-capita GDP (USD 13 054 in purchasing power parity in 2009) is expected to rise.

As in all developed economies, services constitute the largest economic sector (64% of GDP in 2009). The major activities in industry (26% of GDP) are construction; textiles and clothes manufacturing; vehicle manufacturing; and food-processing. The primary sector (mostly agriculture) accounts for a relatively high 10 % of GDP.

Turkey has been a republic since 1923. Its unicameral parliament (Türkiye Büyük Millet Meclisi) has 550 members and is directly elected for a four-year term. The present government is formed by the Justice and Development Party (AKP) and headed by Prime Minister Recep Tayyip Erdogan. The next general election is planned for July 2011. The Head of State is President Abdullah Gul, elected in August 2007.

Turkey has applied for membership to the European Union and has been in accession talks since 2005. In the energy sector, the EU membership bid manifests itself in growing harmonisation with EU legislation. The screening process related to the energy chapter was concluded in 2006 by the European Commission.

SUPPLY AND DEMAND

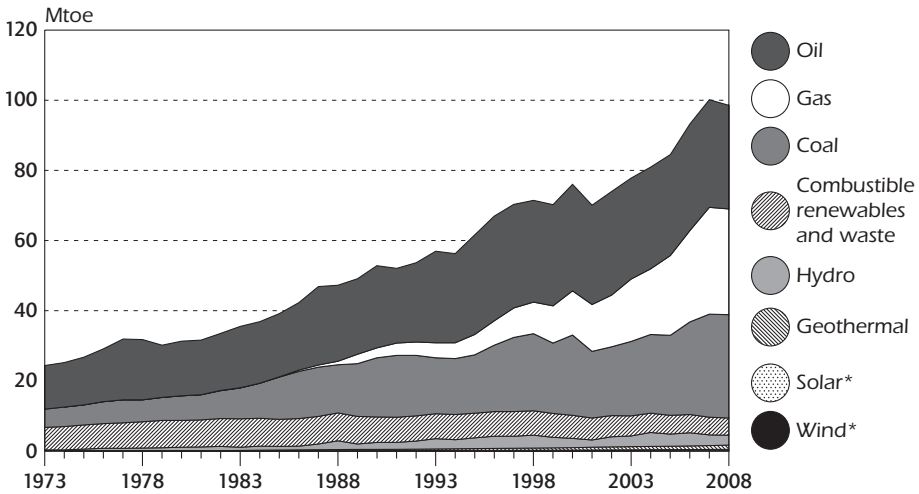
SUPPLY

Turkey's total primary energy supply (TPES) was 99 million tonnes of oil equivalent (Mtoe) in 2008 (see Figure 2). From 1990 to 2008, TPES increased

by 87%, while the economy doubled. Reflecting a change in economic conditions, energy supply decreased by 1.5% from 2007 to 2008, marking the first annual decline since 2001. Turkey depends on imports for 72% of its TPES, including for practically all oil and natural gas and most coal.

Figure 2

Total Primary Energy Supply, 1973 to 2008



* negligible.

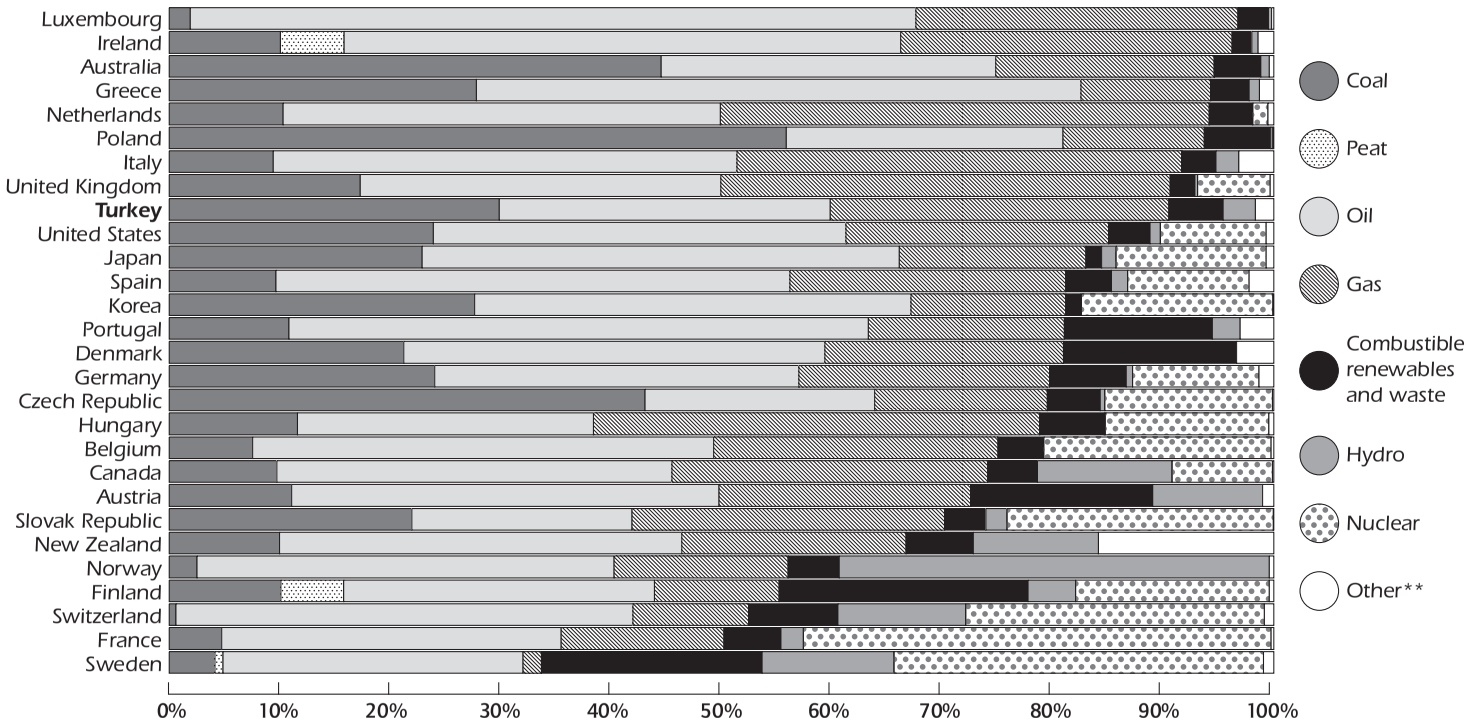
Source: *Energy Balances of OECD Countries,* IEA/OECD Paris, 2009.

Fossil fuels accounted for 90% of TPES in 2008, a rather high share among the IEA member countries (see Figure 3). Oil, coal and natural gas together provided 30% of the total, while renewable energy sources provided the remaining 10%. Since 2000, the increase in TPES can be attributed to the growing use of just two fuels: natural gas, up by 18 Mtoe, and coal, up by close to 7 Mtoe. The other primary energy sources remained practically unchanged with the exception of traditional biomass (firewood), the use of which inevitably declines as the economy develops.

As in many other countries, natural gas has become the fuel of choice for power generation in Turkey. It is also replacing more inefficient and polluting sources for heating. Another fast-growing source for electricity is coal. From 2000 to 2009, gas-fired generation grew by 48 TWh, accounting for 72% of total incremental power generation. Coal-fired grew by 17 TWh, accounting for a quarter of the incremental demand. Hydropower generation varies according to annual hydrological conditions, and increased by 5 TWh from 2000. Oil-fired generation peaked in 2002 and is steadily declining.

Figure 3

Breakdown of Total Primary Energy Supply by Source in IEA Member Countries, 2008



* *other* includes geothermal, solar, wind, and ambient heat production.
Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2009.

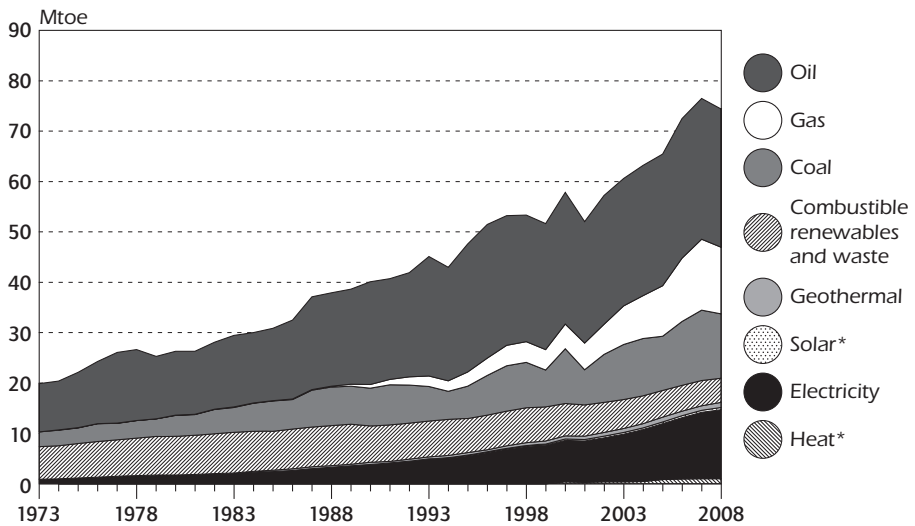
In the government's business-as-usual scenario, reflecting the demand forecasts done before 2008, TPES was projected to increase by 120% from 2008 to 2020. Supply of all existing forms of energy would expand considerably, led by coal and followed by oil and gas. Nuclear energy would be introduced to the supply. These forecasts will be revised in the future taking into account the impact of the economic downturn in 2008/09 and the targets regarding the generation mix included in the 2009 Electricity Market and Security of Supply Strategy.

DEMAND

In 2008, Turkey's total final consumption of energy (TFC) was 74 Mtoe, up by 86% from 1990 (see Figure 4). Industry and the residential sector were the largest users, accounting for almost a third each. Transport's share was 20% and the other sectors (services and the primary sector) used around 17% of the total. For comparison, the IEA averages in 2008 were close to a third each for industry, transport and other sectors. Over the past two decades, the sectoral breakdown of TFC in Turkey has remained remarkably stable.

Figure 4

Total Final Consumption by Source, 1973 to 2008



* negligible.

Source: *Energy Balances of OECD Countries,* IEA/OECD Paris, 2009.

As regards energy source, oil provided 37% of TFC in 2008, electricity and natural gas 18% each, coal 17%, biomass and waste 7% and the other sources 3%. The share of natural gas has increased significantly since 1990,

and that of electricity has grown markedly from 10% in the mid-1990s (see Figure 4). Reflecting the diversification of the energy mix, oil has lost ground, down from 50% in the early 1990s. Traditional biomass is also declining. In its projections made before the economic downturn, the government foresaw TFC more than doubling from 2008 to 163 Mtoe in 2020, with most growth coming from the use of coal, oil and electricity.

INSTITUTIONS

The **Ministry of Energy and Natural Resources (MENR)** is responsible for the preparation and implementation of energy policies, plans and programmes in co-ordination with its affiliated institutions and other public and private entities.

The **General Directorate of Energy Affairs (EİGM)** is the main policy-making body within the MENR. It executes national energy policy. It carries out studies on general energy policies, energy markets, renewable energy, fossil fuels, energy efficiency and environment. EİGM is responsible for the co-ordination of the electricity and natural gas reform programmes. It also deals with the consequences of the past efforts to bring private investments into the electricity sector.

The **General Directorate of Petroleum Affairs (PİGM)** is responsible for the regulation of exploration and production activities in the oil and natural gas sectors. It is also delegated by the MENR to deal with oil stockholding.

The **Electrical Power Resources Survey and Development Administration (EIE)** of MENR carries out various activities in relation to energy efficiency and renewable energy resources.

The **Energy Market Regulatory Authority (EMRA)** was established as the independent regulatory authority for electricity by the Electricity Market Law in February 2001. After the enactment of the Natural Gas Market Law (May 2001), the Petroleum Market Law (December 2003) and LPG Market Law (2005), EMRA was also given responsibilities in the natural gas, oil and liquefied petroleum gas (LPG) markets. EMRA's decision-making body is its board. EMRA's board assumed duty in the third quarter of 2001. It is composed of nine members, including a chairperson and a vice chairperson.

The **Competition Authority** has rights to issue the authorisations with respect to any merger or acquisition to be carried out in the market.

The **State Planning Organisation (DPT)** is an under-secretariat of the Prime Ministry. It is an advisory body, assisting the government in determining economic and social objectives and the policies to be adopted. In practice, its major activities concerning the energy sector are the preparation of the

national development plans together with the MENR and industry, evaluating public investment projects, allocating and supervising funds and monitoring implementation.

The **Turkish Atomic Energy Authority (TAEK)** is the regulatory body responsible for the licensing of the activities related to the site selection, construction, operation and decommissioning of nuclear installations and other activities involving nuclear or radioactive materials. TAEK also executes and supports nuclear R&D.

KEY POLICIES

Turkey's energy policy broadly follows the strategic objectives shared by the IEA member countries, *i.e.* energy security, economic growth and environmental protection. Although the country does not have a specific national energy strategy document, its energy policy objectives are outlined in the institutional strategic plan 2010-2014 of the Ministry of Energy and Natural Resources.

SECURITY OF SUPPLY

Ensuring sufficient energy to a growing economy has been and remains the government's main energy policy concern. Turkey imports practically all the oil and gas it uses and these imports may more than double over the next decade. A key part of Turkey's policy is energy diplomacy with the supplier countries in the region, which have more than 70% of the proven oil and gas reserves of the world. Turkey has been quite successful, as is evidenced by the supply agreements with Russia, Iran, Iraq, Egypt, the Caspian region (Azerbaijan) and Central Asia (Turkmenistan). These agreements and the related projects also strengthen Turkey's role as a transit country, an energy corridor and terminal between its neighbouring supplier regions and the European and other international markets.

In addition to diversifying the sources of oil and natural gas, Turkey is also improving security of supply by ambitious projects to increase domestic energy production. The country has large reserves of lignite and significant untapped potential for hydropower. It is also aiming to build 20 gigawatts (GW) of wind power capacity and harness its solar and geothermal potential to supply energy. Furthermore, Turkey is also moving to introduce nuclear power as a new source in its energy supply mix.

Turkey has been marginally in compliance with the IEA oil stockholding obligations since March 2007, with the exceptions of December 2007 and October 2009. A draft law on establishing a stockholding agency is under discussion in the MENR. As regards natural gas security, Turkey plans to increase its natural gas storage capacity over the next years.

MARKET REFORM

Turkey has been reforming its power and gas sectors since the enactment of the 2001 Electricity Market Law. It has created an independent energy regulator (EMRA) and implemented a licensing regime.

In the electricity sector, Turkey has unbundled the government-owned incumbents into different business activities (transmission, generation, distribution, wholesale trading and retail supply). It has also started to privatise the state-owned distribution and generation businesses. Turkey has taken steps to create competitive wholesale and retail markets, and aims to open the market for all customers by 2015. It has also raised retail tariffs and moved to a cost-reflective retail tariff system. The Electricity Market and Security of Supply Strategy, endorsed in 2009, outlines the next steps towards further competition in the market, with indicative targets pertaining to the use of resources in the generation mix.

In the natural gas sector, progress has been slower. Since the adoption of the 2001 Natural Gas Market Law, secondary legislation has been issued on a wide range of sectors, and the law has been amended in July 2008, liberalising both spot and long-term imports of liquefied natural gas (LNG). Despite these efforts, BOTAŞ, the state-owned vertically integrated gas utility, continues to occupy a dominant position in the wholesale market and in pipeline exports of gas, and the number of new entrants has remained low.

ENVIRONMENTAL PROTECTION

Turkey has been a Party to the UNFCCC since 2004 and to the Kyoto Protocol since August 2009. However, as a rapidly growing economy with low per-capita energy use and greenhouse gas (GHG) emissions, Turkey has gained a special status within the Annex-I Parties to the UNFCCC: it does not have a quantitative emissions reduction target. Consistent with this special status, Turkey is the only Annex-I country that has not (by April 2010) set mitigation targets for the post-2012 period or proposed mitigation actions to support them, as required under the Copenhagen Accord. It is also the only OECD country that does not have a national emission target for 2020. Turkey underlines that a definition of mitigation commitments solely based on the distinction of Annex-I and non-Annex-I Parties ignores Turkey's special circumstances and differences from other Annex-I Parties.

Turkey's approach is to implement policies and measures to protect the climate system on the basis of equity and in accordance with common but differentiated responsibilities and respective capacities. The recently adopted National Climate Change Strategy is comprehensive, and initial implementation action includes the energy sector. Efforts to limit energy-related GHG emissions focus on promoting renewable energy, energy

efficiency, nuclear power, fuel switching and sustainable transport. In view of the post-2012 climate change regime, Turkey has been working to further develop its approach on the basis of its special circumstances.

In recent years, Turkey has improved its policies to control air pollution. For example, old coal-fired power plants are being equipped with flue gas desulphurisation units, and in the transport sector, environmental performance has improved thanks to several new regulations on emissions from motor vehicles and quality standards for motor fuels. Air pollution control will continue to require attention, especially in light of the expected rapid growth in fossil fuel use.

TAXATION

Turkey levies an 18% value-added tax (VAT) on all energy products. Generally, taxes are used for fiscal purposes and do not include a specific environmental component. Excise taxes are fixed per unit of energy and vary according to the quality and the content of energy and also according to end-user group. Excise taxes on gasoline and diesel are relatively high and they have traditionally had an important fiscal function (see Chapter 5 on Oil). Electricity is subject to VAT only, and the tax system favours the use of fuels for electricity generation rather than for competing purposes.

CRITIQUE

Turkey has made substantial progress since the last IEA in-depth review (2005) in developing an energy sector more compatible with one of the world's fastest growing economies since 2001. Except for abundant coal and hydropower, major factors in its energy security, Turkey covers almost three-quarters of its energy needs by imports to meet its rapidly growing energy needs. With high economic growth expected to resume after the 2008/09 financial crisis, and without sustained policy shifts in the meantime, Turkey faces the prospect of risks related to electricity security and limited access to competitive oil and gas supplies, significantly reducing its growth potential. In response to this challenge, the government has embarked on a path of difficult and enlightened policy reforms built around ambitious legislation and regulations, backed by an independent regulator, EMRA. These reforms have already resulted in concrete and vital steps to encourage sufficient electricity capacity in a more competitive and sustainable fashion. Turkey has courageously raised electricity prices to reach cost-reflective levels and increased access and incentives for private investment in generation and distribution. This has resulted in private power generation already accounting for close to half of Turkey's electricity generation and the issuance of licences for the construction of new generating capacity that should cover the major growth in Turkey's electricity consumption expected over the next decade.

Alongside its hydropower, of particular note is Turkey's major commitment to wind power. Turkey has legislation in place guaranteeing the purchase of electricity generated from renewable sources (renewable electricity) at set feed-in tariffs, along with construction incentives, to advance the ambitious target of 20 GW of wind power by 2020. If this shift towards a prominent role for wind in the energy mix is realised, it would put Turkey among the forefront of nations pursuing sustainable energy solutions, with considerable benefits for energy security and the environment.

Despite significant tangible progress to date, the reform process is still in progress, and considerable energy policy challenges remain, in particular for the natural gas sector. Structures for broad meaningful reform are in place, but effective results will depend on relentless implementation and avoidance of backtracking on key principles.

Turkey is a major natural gas importer and well located to be a major transit country. But considerable investment will be needed to meet rapidly expanding demand over the next decade. The government's reform plans, started in 2001, have advanced slowly, and need to be accelerated urgently. The right to import LNG was recently extended to all foreign and domestic companies, which is a very positive step. In developing and implementing further reform, Turkey should give more emphasis to competition as a means to enhance its energy security. Turkey should develop a more competitive gas market to improve its energy security.

Coal, in particular domestically produced lignite, makes an important contribution to Turkey's energy sector and power mix; its role in power generation is set to expand alongside rapid growth projected in electricity demand. The development of indigenous resources is a priority for the government, but mining and use of coal/lignite are accompanied by risks in terms of air pollution and greenhouse gas emissions, which will need to be addressed carefully in government policy.

As a rapidly growing importer of oil, Turkey has effectively used its close proximity to around 75% of the world's oil reserves to foster key pipeline links, notably the Baku-Tbilisi-Ceyhan (BTC) crude oil pipeline from the Caspian region and the Kirkuk-Ceyhan crude oil pipeline from Iraq. In addition, there are plans to build a pipeline from the port of Samsun which would bypass the Turkish Straits. Ceyhan is the terminus for all these pipelines and thus could play a major role in the future. Turkey's leadership role in developing its oil transit routes for nearby oil producers can serve as a model for the country's plans to develop a role as a major transit route and a competitive trading hub for gas.

In light of the need for considerable investment in energy infrastructure to underpin economic growth, energy security and environmental protection, the government should streamline and significantly shorten the approval and

licensing process for electricity generation, including renewable energy, gas supply and energy infrastructure projects.

In the past few years, Turkey has put major legislation and regulations in place to increase energy efficiency and advance environmental objectives, including limiting growth of carbon emissions. However, there has been insufficient time to judge whether there will be adequate support and resources backing these regulations to ensure a substantial impact. As Turkey promotes its energy efficiency and environmental policy goals, it is important to place these two objectives on an equal footing with energy security concerns, to reinforce energy security by energy efficiency and sustainable development.

Turkey is now developing its national approach for the international post-2012 climate policy framework. It aims to integrate and reflect its position, which differs from that of other Annex-I Parties, in the new agreement (through 26/CP.7). Its recent ratification of the Kyoto Protocol signals the country's increasing determination to participate in efforts to mitigate climate change. As a rapidly growing country, it plans to do this on the basis of equity and in accordance with common but differentiated responsibilities and respective capacities. Turkey considers access to finance as a critical issue concerning the climate change related efforts. For preparing its future policies on climate change, Turkey should update its energy scenarios without delay and focus on cost-effectiveness as a criterion to help prioritise the various policies and measures.

Turkey has set a unilateral quantitative target for CO_2 emissions from the energy sector (-7% from the reference scenario level in 2020), as defined in its 2009 National Climate Change Strategy. However, it should also consider setting an overall quantitative target for its greenhouse gas emissions. Such a target would provide a clear indication to other countries of Turkey's commitment and intent.

Turkey will need to expand government resources for market reform, environment and energy efficiency programmes to realise the objectives it has adopted. Also, as Turkey moves towards a more competitive and private sector-oriented market, the Turkish Competition Authority will need to devote substantially more resources to energy-related issues. The government should ensure sufficient resources to implement the complex energy policy agenda.

RECOMMENDATIONS

The government of Turkey should:

- *Continue to pursue vigorously electricity and natural gas market reform.*

- *Streamline and significantly shorten the approval and licensing process for electricity generation, including renewable energy, gas supply and energy infrastructure projects.*
- *Update its energy scenarios without delay and prepare an integrated energy and climate strategy, with a focus on cost-effectiveness as a criterion to help prioritise the various policies and measures.*
- *Ensure sufficient resources to implement the complex energy policy agenda, including monitoring and evaluation of policies and programmes.*

CLIMATE CHANGE

OVERVIEW

Turkey has been a Party to the United Nations Framework Convention on Climate Change (UNFCCC) since 2004 and to the Kyoto Protocol since 2009, but it does not have a target for emissions reduction. Linked to rapid economic growth, Turkey's total emissions of the six greenhouse gases (GHGs) have increased strongly since 1990. According to the Turkish national inventory submission to the UNFCCC, total GHG emissions in 2007 amounted to 373 million tonnes of carbon dioxide equivalent (Mt CO_2-eq), which is 119% more than in 1990. In 2007, CO_2 accounted for 82% of GHGs, methane (CH_4) for 15%, nitrous oxide (N_2O) for 3% and the F-gases (hydrofluorocarbons, perfluorocarbons and sulphur hexafluorides) for 1% (see Table 1).

Table 1

Greenhouse Gas Emissions, 1990 to 2007

Emissions (Mt CO_2-eq) *GHG*	*1990*	*1995*	*2000*	*2005*	*2006*	*2007*
Carbon dioxide (CO_2)	139.6	171.9	223.8	256.4	273.7	304.5
Methane (CH_4)	29.2	42.5	49.3	49.3	50.3	54.4
Nitrous oxide (N_2O)	1.3	6.3	5.7	3.4	4.6	9.7
Hydrofluorocarbons (HFCs)	0	0	0.8	2.4	2.7	3.2
Perfluorocarbons (PFCs)	0	0	0	0	0.4	0
Sulphur hexafluorides (SF_6)	0	0	0.3	0.9	0.9	0,9
Total	**170.0**	**220.7**	**280.0**	**312.4**	**332.7**	**372.6**
Breakdown by gas (%)	***1990***	***1995***	***2000***	***2005***	***2006***	***2007***
CO_2	82	78	80	82	82	82
CH_4	17	19	18	16	15	15
N_2O	1	3	2	1	1	3
HFCs	–	–	0	1	1	1
PFCs	–	–	–	–	0	–
SF_6	–	–	0	0	0	0
Total	**100**	**100**	**100**	**100**	**100**	**100**
Index of emissions (1990 = 100)	***1990***	***1995***	***2000***	***2005***	***2006***	***2007***
CO_2	100	123	160	184	196	218
CH_4	100	146	169	169	172	186
N_2O	100	503	456	273	365	768
Total	100	130	165	184	196	219

Source: Turkey's 2009 national inventory submission to the UNFCCC.

CO_2 EMISSIONS FROM FUEL COMBUSTION

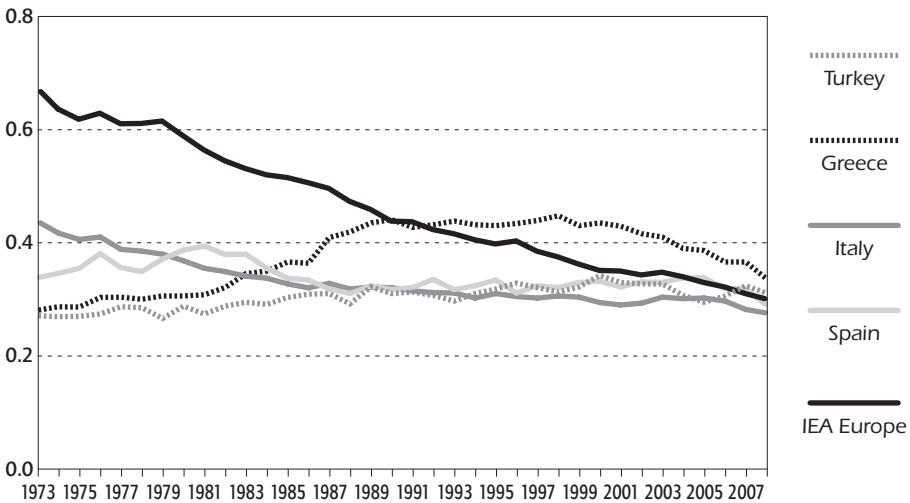
According to IEA data, CO_2 emissions from fuel combustion increased by 109% from 1990 to 2007, to 265 Mt. Fuel combustion accounted for 75% of all GHG emissions in Turkey in 2007.[1]

The CO_2 intensity of the Turkish economy has remained virtually flat since the late 1980s. In 2007, Turkey emitted 0.32 kg of CO_2 per thousand USD of GDP (in 2000 prices and purchasing power parities), roughly equalling the IEA Europe average (see Figure 5). GDP doubled from 1990 to 2007, but its positive impact on CO_2 intensity was offset by increased electricity generation, the only energy-using sector in which emissions grew faster than

Figure 5

Energy-Related CO_2 Emissions per GDP in Turkey and in Other Selected IEA Member Countries, 1973 to 2008

(tonnes of CO_2 emissions per thousand USD/GDP using 2000 prices and purchasing power parities)



Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2009 and *National Accounts of OECD Countries*, OECD Paris, 2009.

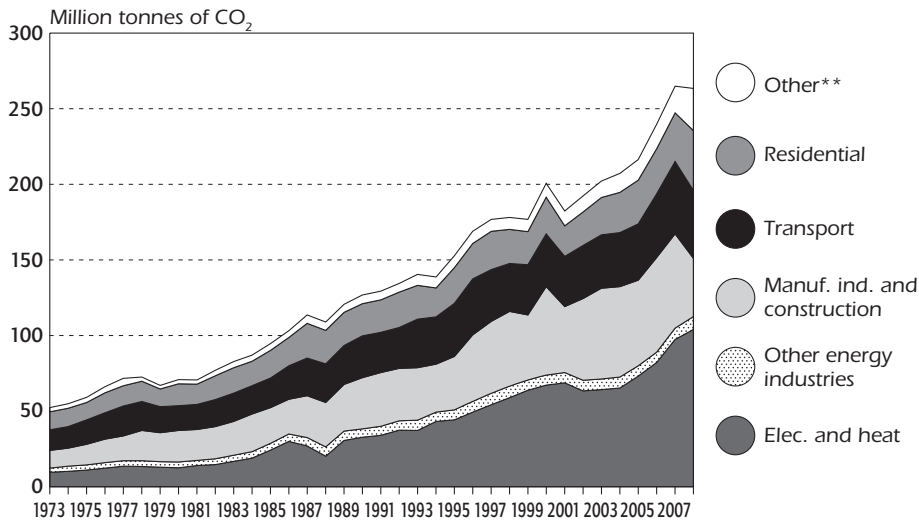
1. The analysis in this section is based on estimates done by the IEA, using the IPCC default methods and emission factors. In the Turkish submission to the UNFCCC, CO_2 emissions from fuel combustion in 2007 were reported to be 282 Mt.

GDP. Electricity use is coupled with industrialisation, population and economic growth; generation has more than tripled since 1990, while its CO_2 intensity has decreased by only 16%, varying annually according to the hydrological conditions. Turkey's CO_2 emissions per inhabitant, at 3.6 tonnes in 2007, are three-fifths higher than in 1990, but the lowest within the OECD countries. They are roughly half of the OECD Europe level of 7.5 tonnes per capita and below the world average of 4.4 tonnes per capita.

By sector, power and heat generation was the largest emitter of energy-related CO_2 emissions in 2007, accounting for 37% of the total. Manufacturing accounted for 24% of all emissions, transport for 18%, households for 12%, and other sectors for 9% (see Figure 6). Since 1990, emissions from power and heat generation have tripled, while increases in the other sectors have been much smaller, 80% on average.

Figure 6

CO_2 Emissions by Sector*, 1973 to 2008



* estimated using the IPCC Sectoral Approach.

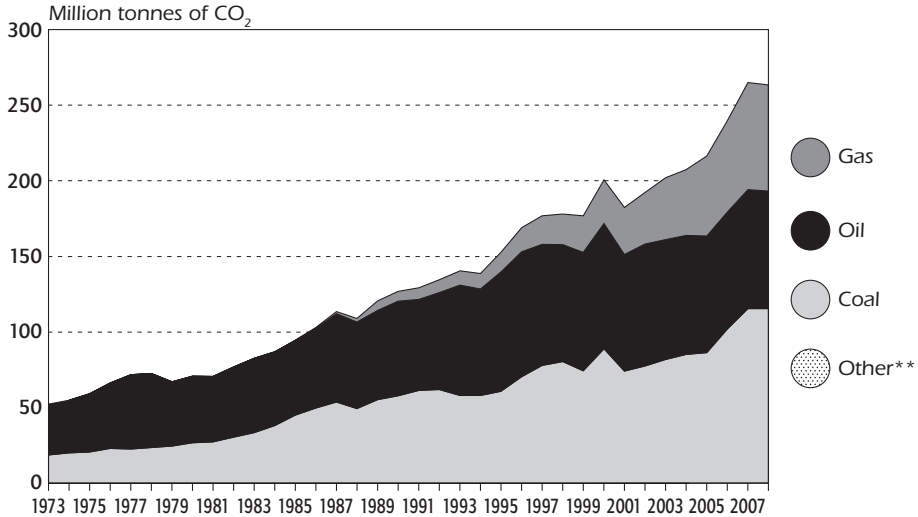
** *other* includes emissions from commercial and public services, agriculture/forestry and fishing.

Source: *CO_2 Emissions from Fuel Combustion*, IEA/OECD Paris, 2009.

On a fuel basis, coal has remained the dominant source of CO_2 since 2003 (see Figure 7). In 2007, it accounted for 43% of emissions, a relatively stable share since 1990. Emissions from oil use (30% of the total) were slightly higher than those from natural gas use (27%). Oil has seen its share decline over the years, while emissions from natural gas use, mostly arising from power generation and residential heating, have increased rapidly following the gasification of the country.

Figure 7

CO_2 Emissions by Fuel*, 1973 to 2008



* estimated using the IPCC Sectoral Approach.

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

Source: *CO_2 Emissions from Fuel Combustion*, IEA/OECD Paris, 2009.

INSTITUTIONS

The **Ministry of Environment and Forestry** is responsible for co-ordinating climate change policies. It chairs the Interministerial Co-ordination Board on Climate Change (CBCC), the body in charge of implementing climate change policies and measures, including the obligations under the UNFCCC. The CBCC includes a Technical Working Commission on Climate Change, which has ten expert working groups. Recently, the Interministerial Co-ordination Board on Economy, chaired by the Deputy Prime Minister and attended by several ministers, has started to convene on climate change.

The **Ministry of Energy and Natural Resources** co-ordinates Working Group 3 (Mitigation of GHGs from the industry, buildings, waste management and service sectors) and Working Group 4 (Mitigation of GHGs from the energy sector, which includes power generation).

POLICY

Turkey has been a Party to the UNFCCC since 2004 and to the Kyoto Protocol since August 2009, and maintains its non-Annex B status. However, it does not have a quantified obligation to limit or reduce its GHG emissions. This exemption is based on the decision 26/CP.7 of 2001, whereby Parties to the

UNFCCC recognised the special circumstances of Turkey in contrast to other Annex-I countries. Turkey's economy will continue to grow to catch up with the other countries in that group, implying that energy use and GHG emissions are set to increase, although from a low per-capita level. Turkey's approach is to implement policies and measures to protect the climate system on the basis of equity and in accordance with common but differentiated responsibilities and respective capacities.

As a Party to the UNFCCC, Turkey submitted its first National Communication in January 2007. It has been working on the second National Communication since late 2009, but by the time of writing (April 2010) had not yet submitted it to the UNFCCC.

Turkey's approach towards future mitigation activities in all the emitting sectors is outlined in the National Climate Change Strategy document. This 19-page document was prepared under the co-ordination of the Ministry of Environment and Forestry in December 2009. It covers the short-, medium- and long-term actions (up to ten years) and also includes some targets, such as reducing the carbon intensity of the economy from the 2004 level by 2020 and reducing CO_2 emissions in the energy sector by 7% from the reference scenario level in 2020. The reference scenario is included in the first National Communication to the UNFCCC submitted in 2007 and it projects total energy-related CO_2 emissions to increase to 604 Mt by 2020 from 126.7 Mt in 1990. The strategy supports improving the efficiency of the supply chain as well as increasing the use of renewable energy resources.

After the launch of the strategy, work now focuses on developing a Climate Change Action Plan. Turkey's Ninth National Development Plan (2007-2013) envisages preparation of a National Action Plan that sets forth the policies and measures for reducing greenhouse gas emissions. The Action Plan is being prepared in a project co-ordinated by the Ministry of Environment and Forestry, foreseen to be finalised by the end of 2010.

Efforts to limit energy-related GHG emissions focus on promoting renewable energy, energy efficiency, nuclear power, fuel switching and sustainable transport. As explained in Chapter 8 on Renewable Energy, Turkey has very large untapped potential for hydropower, wind power and solar and geothermal energy. It also has large potential for energy efficiency improvements, especially in buildings and industry. In the power and heat sector, switching to natural gas from oil and coal reduces carbon intensity, and the government is also planning to develop nuclear power capacity. The Electricity Market and Security of Supply Strategy of 2009 includes indicative targets which will help reduce the carbon intensity of the power sector.

To limit GHG emissions from transport, Turkey plans to intensify efforts to increase the use of railways and maritime transport (see Chapter 4 on Energy Efficiency for details); prepare sustainable urban transportation strategies

and plans; expand the public transportation facilities; improve fuel quality; promote the use of alternative fuels and new technology engines; and provide incentives to renew the vehicle fleet.

International efforts to establish a post-2012 climate policy regime continue and Turkey is actively participating in these efforts. On a general level, the country's stated plan before the 15th Conference of the Parties (COP15) in December 2009 was to implement nationally appropriate mitigation actions (NAMAs), adopt voluntary targets to limit emissions and shift to a low-carbon economy through technology transfer and multilateral financial support.

Turkey supports the developments achieved under the Copenhagen Accord, but underlines that a definition of mitigation commitments solely based on the distinction of Annex-I and non-Annex-I Parties ignores Turkey's special circumstances and differences from other Annex-I Parties.[2] Access to sufficient, predictable and sustainable financial resources is considered important, given the differences of Turkey from other Annex-I Parties.

LOCAL AIR POLLUTION

GENERAL LEGISLATION

Turkey continues to harmonise its legislation on air quality standards with the European Union. The main legal instrument for this is the By-law on Ambient Air Quality Assessment and Management (BAQAM), which entered into force in June 2008. Consistent with the EU Air Quality Framework Directive (96/62/EC) and its four daughter directives (1999/30/EC, 2000/69/EC, 2002/3/EC and 2004/107/EC), BAQAM sets air quality standards for 13 pollutants. EU air quality limit values are to be reached gradually by 2019.

STANDARDS FOR POWER PLANTS

Emission standards for large power plants remain significantly less stringent than in the EU (see Table 2). For example, the nitrogen oxides (NO_x) limit value for new solid fuel-fired power plants with more than 300 megawatts (MW) of capacity is 800 mg/m^3 in Turkey, but 200 mg/m^3 in the EU. The sulphur dioxide (SO_2) limit value for a 100 MW to 300 MW solid fuel-fired power plant was tightened to 1 300 mg/m^3 from 2 000 mg/m^3, which still leaves it 6.5 times higher than the EU level.

2. UNFCCC website: http://unfccc.int/resource/docs/2010/awglca10/eng/misc02.pdf

Table 2

SO_2 Emission Standards for Large New Power Plants, 2007

(mg/m^3)

Plant capacity	*Solid fuel*		*Liquid fuel*		*Gas*	
	Turkey	*EU*	*Turkey*	*EU*	*Turkey*	*EU*
>300 MW	1 000	200	800	200	60	35
100 to 300 MW	1 300	200	1 700	200-400	60	35
50 to 100 MW	2 000	850	1 700	850	100	35

Source: *OECD Environmental Performance Reviews: Turkey*. OECD, Paris, 2008.

Emission standards for large power plants are becoming more stringent through harmonising Turkish legislation with the EU Directive 2001/80/EC on Large Combustion Plants. The By-law on Large Combustion Plants is in preparation with participation of stakeholders. The new limit values will apply to new facilities from the date of enforcement, but old plants will have a transition period of ten years, during which the 2009 By-law on the Control of Air Pollution Arising from Industry will apply. Efforts to reduce emissions from the coal-fired power plants are explained in more detail in Chapter 7 (see Efficiency and Pollution Control).

Turkey has also enacted the following by-laws in order to control air pollution:

- By-law on Air Pollution Control Arising from Heating (January 2005, amended in 2007 and 2009);
- By-law on Controlling Exhaust Gases from Motorised Land Vehicles (July 2005, amended in 2009);
- By-Law on Reducing the Percentage of Sulphur in Certain Types of Fuel Oil (2009).

STANDARDS FOR VEHICLES

Turkey has substantially revised regulations for emissions from motor vehicles, with EU requirements providing important benchmarks. For example, the Euro IV fuel standard has been applied since January 2008 for new vehicles and since 2009 for vehicles registered before 2008.

Regulations on fuel quality have also been revised, in line with the EU Directive on the Quality of Petrol and Diesel Fuels. The sulphur content of diesel oil was restricted to 50 mg/kg from 1 January 2007 and to 10 mg/kg from 1 April 2009. Sulphur content limits for unleaded gasoline will be lowered to 10 mg/kg in 2010 in line with the EU directive.

Fuel quality is monitored by more than 600 inspectors in 81 cities by the regulatory authority EMRA. Compliance with the regulation on emissions

from motor vehicles is evaluated and certified through bi- or tri-annual inspections conducted at authorised stations under the 2005 Regulation on Establishment and Operation of Roadworthiness Test Stations.

MONITORING OF AIR QUALITY

The Ministry of Environment and Forestry (MoEF) measures the concentrations of SO_2 and particulates (PM_{10}) at automatic measurement stations in 81 provincial centres and in several industrial zones. In Istanbul and Izmir, concentrations of SO_2, PM_{10}, carbon monoxide (CO), ozone (O_3) and nitrogen oxides (NO_x) are measured by the municipalities with fully automatic measurement stations, and in Ankara by the Refik Saydam Hygiene Centre. In total, Turkey has 116 air quality monitoring stations.

Data on SO_2 and PM concentrations are provided to the Turkish Statistical Institute (TurkStat), which evaluates them and then publishes them in monthly, winter and annual news bulletins. All bulletins and the air quality database are available on the TurkStat website. MoEF also posts data on SO_2 and PM concentrations on its website and also provides them directly to the media by e-mail.

CRITIQUE

Climate change is a serious global energy-related environmental problem, and is also a challenge in Turkey. Largely because of exceptionally strong economic growth, total CO_2 emissions more than doubled from 1990 to 2007, and are expected to almost double again from 2007 to 2020 in a business-as-usual scenario included in the first National Communication to the UNFCCC.

Turkey is a Party to the UNFCCC and commendably prepared its first National Communication in 2007. In December 2009, the government published a Climate Change Strategy document and it is now preparing a National Climate Change Action Plan and the second National Communication to the UNFCCC. The IEA encourages the government to maintain the momentum in climate change policy and finalise these two documents swiftly.

Turkey has gained a special status within the Annex-I Parties to the UNFCCC: it does not have a quantitative emissions reduction target. Consistent with this special status, Turkey is the only Annex-I country that has not (as of May 2010) set mitigation targets for the post-2012 period or proposed mitigation actions to support them, under the Copenhagen Accord.

Turkey emphasised that under current formulation, its special circumstances and differences to other Annex-I Parties were not addressed in the Copenhagen Accord. Turkey emphasised the need for access to sufficient, predictable and

sustainable financial resources. On this basis, Turkey has been working on further developing its post-2012 approach and determining its commitments, in accordance with common but differentiated responsibilities and respective capacities. Decisions on future commitments have implications on how much Turkey can draw on international sources for financing the new technology it will need for limiting emissions. Cost-effective measures to mitigate climate change would also help Turkey improve both its energy security and environmental performance.

In practice, Turkey has two options: maintaining its status as an Annex-I Party without an emission target, or adopting a target like other Annex-I Parties. Without an emission target, Turkey is still eligible for funds outside the UNFCCC framework, such as funds from the World Bank or funds from the private-sector entities engaged in carbon offsets. However, Turkey should assess the prospects for adopting an emission target in order to gain access to more carbon market revenues, *e.g.* through the Kyoto Protocol's Joint Implementation device.

Turkey could also argue its status as a developing country under the Bali Action Plan and, thus, its eligibility for using supported nationally appropriate mitigation actions (NAMAs) and possible other mechanisms. Indeed, this has been the country's position since the beginning of the climate regime. However, the rules for the use of NAMAs or any other possible mechanisms remain to be defined.

More pragmatically, Turkey should in any case consider developing domestic policy frameworks such as the establishment of a carbon market, which could direct finance towards low-carbon energy developments, but also facilitate linking to other such mechanisms in other countries or regions. This would be especially useful for power generation, the fastest growing source of CO_2 emissions in Turkey, to avoid a high risk of carbon "lock-in". Nevertheless, it is advisable to carry out a regulatory impact assessment as Turkey's development indicators tend to remain much below the OECD averages, and the cost implications of any policy framework should be considered carefully.

The recently accepted comprehensive National Climate Change Strategy emphasises the energy sector for the initial implementation action. The IEA notes the efforts of Turkey in dealing with the energy-climate relationship and urges Turkey to further develop its approach on the post-2012 regime. The IEA encourages Turkey to develop policies and measures together with a meaningful quantitative overall target for emissions, taking into consideration the advantages and disadvantages of such a target. This would provide an important signal to other countries of Turkey's commitment and intent. It is worth noting that several non-Annex-I countries have national or sectoral GHG targets to 2020. In developing policies and measures to limit energy-related CO_2 emissions, it is important to address cost-effectiveness and to increase efforts in introducing economic instruments. As all other OECD countries,

Turkey should also ensure sufficient co-ordination in climate and energy policies across all relevant government bodies.

In recent years, Turkey has improved its policies to control air pollution. For example, old coal-fired power plants are being equipped with flue gas desulphurisation units, and in the transport sector, environmental performance has improved thanks to several new regulations on emissions from motor vehicles and quality standards for motor fuels. However, more needs to be done, especially in light of the expected rapid growth in fossil fuel use. The government should increase efforts to reduce local air pollution. It should continue to strengthen standards for air emissions and fuel quality, and ensure that these standards are implemented effectively and efficiently. The highest available standards should be set for new plants and cars, whereas for existing large combustion plants, clear targets and road-maps are necessary. The government should also allocate sufficient resources for monitoring and enforcing air pollution standards.

RECOMMENDATIONS

The government of Turkey should:

- *Further develop its approach on the post-2012 climate policy regime.*
- *Finalise, without delay, a nationally appropriate climate change action plan and the second National Communication to the UNFCCC.*
- *Consider developing policies and measures together with a meaningful quantitative overall target for emissions in order to limit GHG emissions and encourage international carbon finance for projects in Turkey, while taking into account the advantages and disadvantages of such a target.*
- *Focus on cost-effectiveness and increase efforts to introduce economic instruments when developing policies and measures to limit energy-related CO_2 emissions.*
- *Ensure sufficient co-ordination in climate and energy policies across all relevant government bodies.*
- *Continue and increase efforts to reduce local air pollution by strengthening standards for air emissions and fuel quality, and ensure that these standards are implemented effectively and efficiently.*

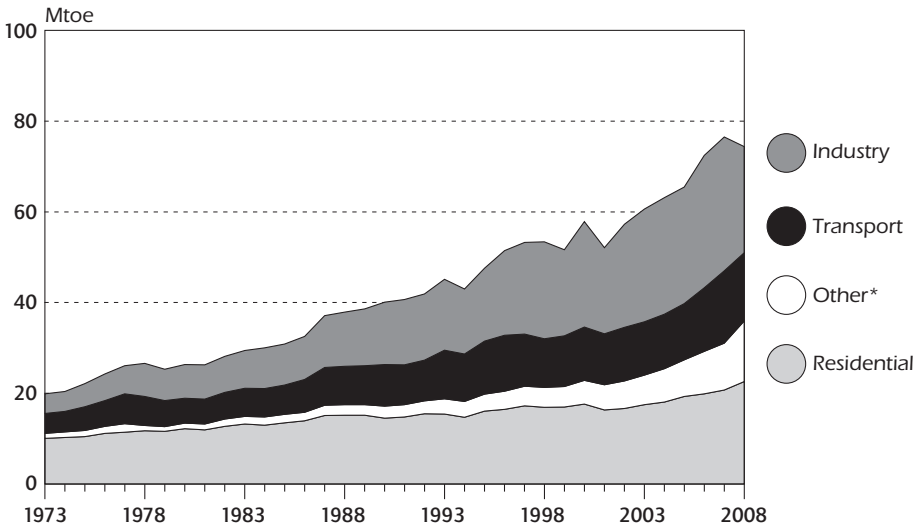
OVERVIEW

Turkey's total final consumption of energy (TFC) was 76.5 Mtoe in 2007, up 91% from 1990. Industry was the largest user, accounting for 39% of the total. The residential sector used 27% of TFC and transport 21%, while services and the primary sector accounted for 13% of the total. In comparison, the IEA averages in 2007 were 36% for transport, 26% for industry, 21% for the residential sector and 17% for services and the primary sector. Since 1990, the share of services and the primary sector in Turkey has doubled and that of industry increased slightly, while transport and residential have seen their share moderately decline. In absolute terms, energy use in all sectors has increased substantially over the past two decades (see Figures 8 and 9), reflecting strong economic growth.

In projections made before the economic slow-down, the government expects TFC roughly to double from 2007 to 2020, with above-average growth in industry and the residential sector. To reflect faster-than-expected growth in several sectors, for example in services, but also to include the impact of the economic slow-down, the government is planning to update the projections in 2010.

Figure 8

Total Final Consumption by Sector, 1973 to 2008

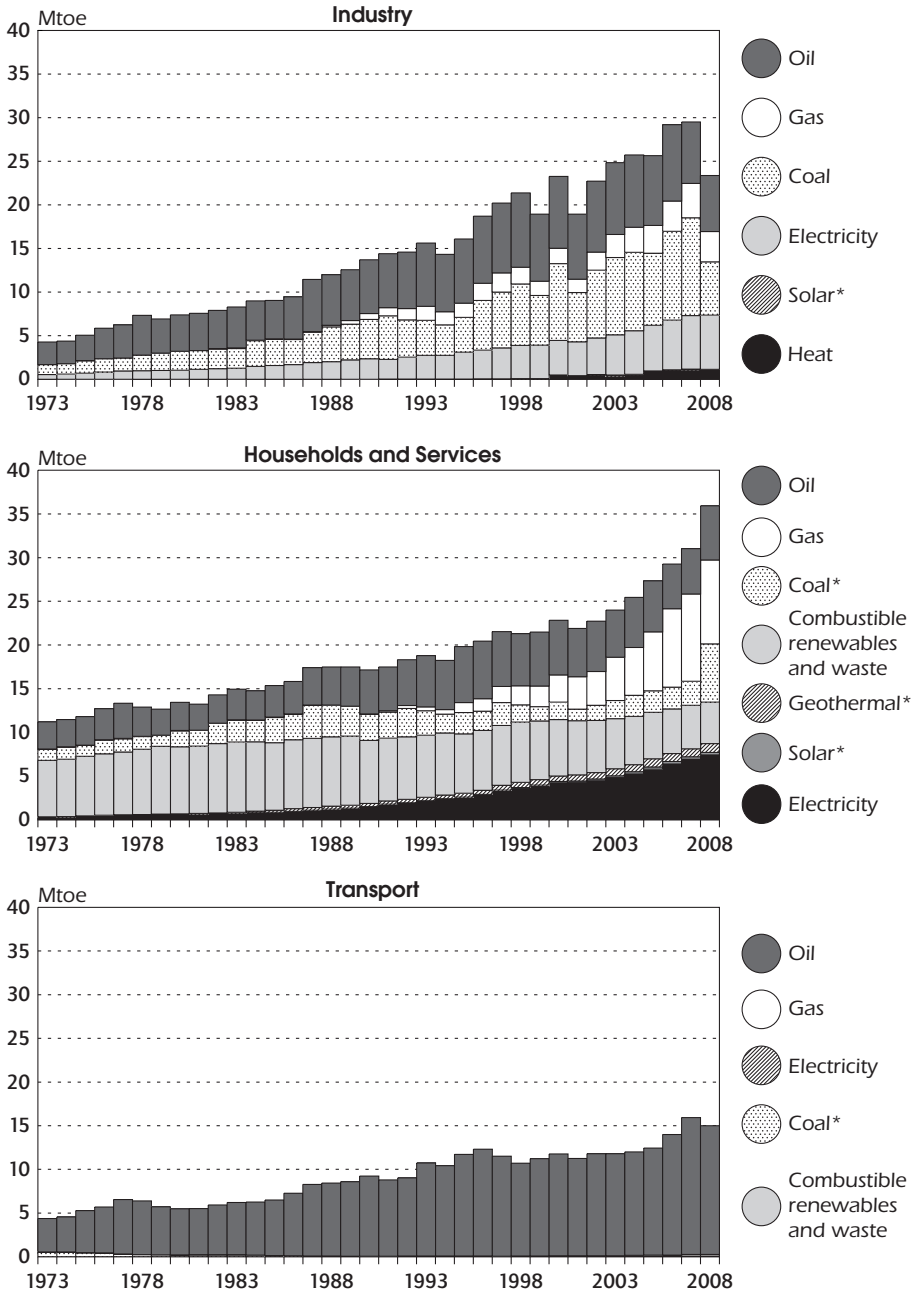


* *other* includes commercial, public service, agricultural, fishing and other non-specified sectors.

Source: *Energy Balances of OECD Countries,* IEA/OECD Paris, 2009.

Figure 9

Total Final Consumption by Sector and by Source, 1973 to 2008



* negligible.

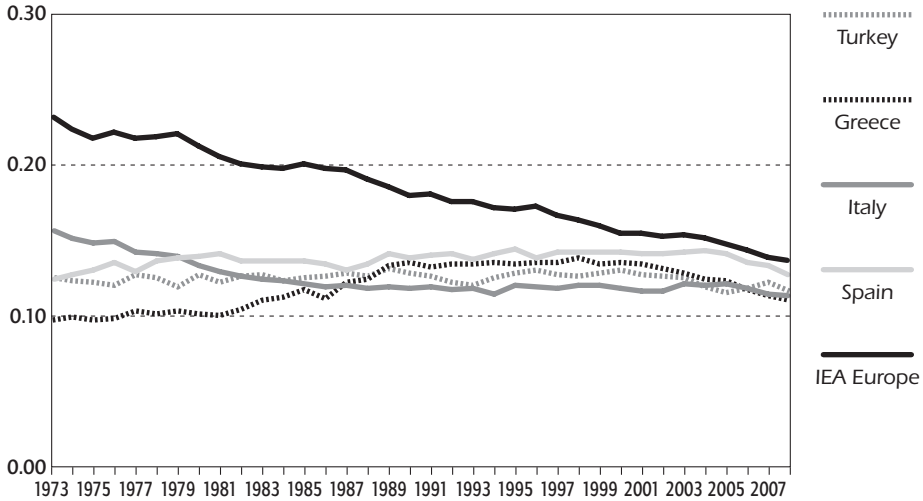
Source: *Energy Balances of OECD Countries,* IEA/OECD Paris, 2009.

Turkey's energy intensity has remained relatively stable over the past decades. In 2008, for each thousand USD of gross domestic product (GDP), the country needed 0.11 tonnes of oil equivalent (toe) of primary energy, 12% less than the IEA Europe average (see Figure 10). Energy intensity has been reduced by faster growth in services than in the more energy-intensive industry, but this reduction has been offset by the expanding energy use linked to the increasing wealth of the country's growing population.

Figure 10

Energy Intensity in Turkey and in Other Selected IEA Member Countries, 1973 to 2008

(toe per thousand USD at 2000 prices and purchasing power parities)



Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2009 and *National Accounts of OECD Countries*, OECD Paris, 2009.

INSTITUTIONS

The Ministry of Energy and Natural Resources (MENR) has the overall responsibility for energy efficiency policy in Turkey. Within the ministry, this work is delegated to the Electrical Power Resources Survey and Development Administration (EIE).

An important multi-stakeholder body is the Energy Efficiency Co-ordination Board (EECB). It was set up in 2007 and has three main areas of responsibility: it prepares national energy efficiency strategies, plans and programmes; it monitors their implementation and assesses their effectiveness; and it steers energy efficiency studies carried out by the EIE.

EECB includes senior members from the following sixteen bodies: Ministry of Energy and Natural Resources, Ministry of Finance, Ministry of Transport, Ministry of Industry and Trade, Ministry of Internal Affairs, Ministry of Environment and Forestry, Ministry of Public Works and Settlement, Ministry of Education, State Planning Organisation, Turkish Treasury, Energy Market Regulatory Authority, Turkish Standard Authority, The Scientific and Technological Research Council of Turkey (TÜBİTAK), Union of Chambers of Turkish Engineers and Architects, Union of Turkish Municipalities, Union of Chambers and the Commodity Exchange of Turkey.

POLICIES AND MEASURES

OVERVIEW

Turkey's energy efficiency policy is guided by the 2007 Energy Efficiency Law and the subsequent by-laws. These, in turn, meet the 2004 Energy Efficiency Strategy's goal of harmonising Turkey's energy efficiency legislation with that of the European Union. The 2004 strategy includes the general principles and tools for developing a national energy efficiency policy. An update of the Energy Efficiency Strategy is under preparation.

The 2007 law aims to reduce energy intensity by 15% below the reference scenario projections by 2020 and targets the largest energy-using sectors: manufacturing industry, transport, services and buildings, as well as the power sector (generation, transmission and distribution). The law has four pillars: administrative structure and tasks for delivering energy efficiency services across sectors; training and awareness; penalties for misconduct (typically fines); and incentives to increase energy efficiency and renewable energy use. Secondary legislation under the 2007 law is detailed in the following sectoral policies and measures.

BUILDINGS

The 2007 Energy Efficiency Law and the following four by-laws set the legal framework for energy efficiency in buildings: *i)* the By-law on Sharing the Heating and Domestic Hot Water Expenses in Central Heating and Hot Water Systems in Buildings (issued by the Ministry of Public Works and Settlement in April 2008); *ii)* the By-law on Improving Energy Efficiency for the Utilisation of Energy and Energy Resources (Ministry of Energy and Natural Resources, October 2008); *iii)* the By-law on Energy Performance of Buildings (Ministry of Public Works and Settlement, December 2008); *iv)* Regulation on Appointment of Energy Managers in Schools (Ministry of National Education, April 2009).

Measures on new buildings focus on energy performance requirements. These requirements were adopted in December 2008 by the Ministry of Public Works

and Settlement and superseded the Regulation on Heat Insulation for New Buildings after a one-year transition period. The by-law sets minimum standards on the energy performance of new buildings and buildings that are subject to major renovation, and includes a common methodology for calculating the energy performance. The requirements cover energy needs for space and water heating, cooling and lighting. The by-law also mandates regular inspections of boilers and centralised air-conditioning systems. All these requirements largely follow EU rules that are laid out in the Directive on the Energy Performance of Buildings (2002/91/EC). The concept of an integrated building design and a new calculation tool is planned for introduction to architects, engineers and relevant authorities through seminars and training sessions by July 2010.

All new buildings must have an energy performance certificate indicating their energy performance class. Existing buildings will be required to have an energy performance certificate by May 2017. New buildings with a floor area of 1 000 m^2 or more must have central heating and use systems that allow the distribution of heating costs according to the quantity of heat consumption. The metering systems for existing buildings must be installed within five years from 2008.

Furthermore, the 2007 Energy Efficiency Law obliges large energy users to appoint or contract an energy manager and to report annually on energy consumption to the EİE. Failure to comply with this obligation will lead to fines. These obligations also apply to commercial and service buildings which use at least 500 toe per year or have at least 20 000 m^2 of floor area. As per the provision of the Regulation on Improving Energy Efficiency for the Utilisation of Energy and Energy Resources, public buildings which use at least 250 toe per year, or have at least 10 000 m^2 of floor area, must undergo an energy audit and prepare an energy efficiency project within three years from October 2008.

Public buildings have specific obligations under the Prime Minister's circulars 2008/2 and 2008/19 on the Efficient Usage of Energy in Public Sectors. As per the requirement of the circular, 1.8 million incandescent lamps in public organisations, municipalities and chambers of profession with the status of public institutions were replaced with compact fluorescent lamps.

APPLIANCES

Mandatory energy labelling of domestic appliances is harmonised with the EU directives. It covers lamps, ovens, refrigerators, freezers, washing machines, tumble-dryers and dishwashers. Appliances are classified from A to G, where class A is for the most energy-efficient appliances. Producers and importers are required to include energy consumption information in a separate section of operating manuals. Since the end of January 2010, refrigerators, freezers and their combinations are classified from A++ to G.

Turkey is also harmonising its legislation with the EU to introduce minimum energy efficiency standards for appliances. These standards will be based on EU regulations under the Ecodesign Directive (2005/32/EC) and will become effective over the next several years. Since autumn 2008, the EU Commission is gradually proposing such standards for close to 20 product groups. The EIE and the Ministry of Industry and Trade have already jointly prepared minimum energy performance standards for industrial and domestic boilers, electric motors, air-conditioners, electrical home appliances and light bulbs.

INDUSTRY

Energy efficiency measures in industry are based on the 2007 Energy Efficiency Law and two related by-laws published in October 2008: the By-law on Improving Energy Efficiency for the Utilisation of Energy Resources and Energy, and the By-law on Supporting Energy Efficiency of Small and Medium-sized Enterprises (SMEs) including Training, Audit and Consultancy Services.

Energy efficiency measures in manufacturing industry focus on energy management, financial support, voluntary agreements, monitoring, and training and awareness. In power generation, the measures focus on managing demand; improving efficiency of power plants (also by setting minimum efficiency requirements for new plants), transmission, distribution and public lighting; utilising waste heat of thermal power plants; and utilising alternative fuels.

The EIE provides investment support for energy efficiency projects with a maximum payback period of five years. This support covers at most 20% of eligible project costs up to a maximum of TRL 500 000[3]. For industrial establishments that have volunteered to reduce their energy intensity by 10% on average over three years, the EIE will reimburse up to 20% of their energy costs (to a maximum of TRL 100 000) for the first year.

As of May 2009, 55 industrial establishments have applied for financial support for a total of 72 energy efficiency projects; these projects are expected to save some 16 ktoe of energy. For 2009, TRL 5 million was allocated in financial support, with TRL 4 million for improving the energy efficiency of electric motors, and TRL 1 million for projects improving energy efficiency. For 2010, TRL 5 million is allocated for financial support to energy efficiency improvements in industry. Moreover, 24 industrial plants have applied to enter into voluntary agreements to reduce their energy intensity and 11 of them were selected for support under voluntary agreements. Requests for both project subsidies and voluntary agreements are evaluated by expert commissions and approved by the EECB. Recently, the EECB has decided to grant financial support for 17 energy efficiency projects of 12 industrial establishments.

3. On average in 2009, one Turkish lira (TRL) = USD 0.647.

The 2007 Energy Efficiency Law requires industrial plants consuming at least 1 000 toe per year to nominate one of their employees as the energy manager. Plants consuming more than 50 ktoe per year must set up an energy management unit, and so must specific industrial zones. The companies are obliged to report on their energy management activities to EIE. Industrial plants consuming more than one ktoe per year and power plants with at least 100 MW of installed capacity must also report on energy consumption to the EIE.

Support to SMEs for improving energy efficiency is also provided by KOSGEB, an institution connected to the Ministry of Industry and Trade. These subsidies can be used to cover up to 70% of the costs for feasibility and other technical studies.

According to the World Bank, energy efficiency in industry (including iron and steel, cement, textiles, chemicals) could be significantly improved by replacing equipment and using new process technologies. For example, consumption in steel plants could be cost-effectively reduced by 22% and in cement plants by 28%.

The government is working to raise the status of energy efficiency to become a priority for the Turkish private sector. Development of know-how and experience, and access to finance are critical for improving energy efficiency in the private sector. The 2007 Energy Efficiency Law addresses these by setting the legal framework for energy efficiency consultancy companies which could provide third-party financing in end-use sectors while conducting energy efficiency services. In this context, Eİ E has authorised 12 energy efficiency consultancy companies as of the beginning of 2010. Turkey is also working with several international financial institutions to improve access to energy efficiency finance. Turkish private banks have also started to offer several credit options for private projects to improve energy efficiency.

TRANSPORT

Private cars became the dominant form of passenger travel in Turkey in the first half of the past decade and have continued to increase in popularity faster than public transport (see Table 3). Turkey has now some 3.5 million more passenger cars than in 1995. Car density has risen from 51 in 1995 to 92 per 1 000 inhabitants in 2007, well below the EU15 average of 500.

According to the Ministry of Transport, traffic volume by passenger cars tripled from 1990 to 2007, while passenger-kilometres by buses and coaches increased by around 8%. Railway use for passenger transport has declined by 31% since 1990. As regards freight, road transport accounted for 95% of all tonne-kilometres in 2007, while rail accounted for 5%. Freight volumes are closely linked to developments in the overall economy.

The road network is set to be expanded substantially in the coming years. According to the International Transport Forum, the density of the Turkish

road network, excluding urban roads, is around 47 km per 100 km². In comparison, the EU25 average is 110 km per 100 km².

Turkey now has more than 2 000 km of motorways, seven times more than in 1990, and the country's medium- and long-term motorway construction programme envisages more than doubling the length of the current network.

The arterial railway network, at 9 111 km, is rather old and only 736 km has been built since 1980, but a high-speed rail network is now being developed to connect Turkey's main cities. The high-speed railway between Ankara and Eskişehir has been in operation since March 2009, and operations will commence in the following routes in the next years: Istanbul-Ankara-Sivas, Ankara-Afyonkarahisar-Izmir and Ankara-Konya. On these routes, train will become a faster travel option than the currently dominating private car. Shorter in length, but in many aspects more challenging to implement is the Marmaray project in Istanbul that will connect the European and Asian parts of the city through two railway tunnels. The project includes constructing tens of new stations and upgrading the commuter train system, and will help to reduce congestion in one of Europe's largest cities.

Table 3

Breakdown of Passenger Travel by Mode, 2008

Mode	*Car*	*Bus and coach*	*Train*
Share, %	56	42	2

Source: Ministry of Transport and Communication, 2009.

Diesel and gasoline cost more in Turkey than in almost any other IEA country (see Chapter 5), mostly a result of fiscal policy. High prices, especially relatively to income, have given strong incentives for efficient use of transport fuels. More recent measures were introduced in the By-law on Improving Energy Efficiency in Transport which was issued by the Ministry of Transport in June 2008. They focus on reducing specific fuel consumption for domestic vehicles; improving energy efficiency standards; promoting public transport; and installing advanced signalling systems.

Vehicle labelling was introduced by the January 2009 By-law on Informing Consumers on Fuel Economy and CO_2 Emissions of New Passenger Cars, and applies to passenger cars produced after 1 January 2009.

Turkey has also introduced a cash-for-clunkers incentive for pre-1979 heavy duty vehicles (*i.e.* those weighing more than 3.5 tonnes) and passenger transport vehicles (with at least 16 seats including the driver's seat). The incentive is based on vehicle weight and varies according to the model year as follows: *a)* for 1973 and older model heavy-duty vehicles, TRL 0.7 per kg; *b)* for 1974, 1975 and 1976 models, TRL 0.9 per kg; and *c)* for 1977, 1978

and 1979 models, TRL 1 per kg. An additional TRL 750 is available for these vehicles, if their operating licence was registered before February 2009. With this incentive, the government expects to remove 160 000 old and inefficient vehicles from the market.

PUBLIC AWARENESS

The October 2008 By-law on Improving Energy Efficiency for the Utilisation of Energy and Energy Resources obliges several public entities to contribute to raising awareness of energy matters. First, on a general level, public-sector agencies and institutions have to promote awareness, either in co-ordination with the EIE, or by contributing to the activities of the EIE. The specific measures are listed on the EIE website. The measures taken have to be reported to EIE in March every year. Examples of measures include distributing energy-efficient light bulbs to the citizens (4.8 million by February 2009); an awareness campaign for promoting energy-efficient motor systems in industry; and an awareness campaign for shopping centres to empower customers and staff. Information programmes on energy efficiency are widely used in schools and in public media in order to increase public awareness.

Secondly, electricity and natural gas retailers and other suppliers must provide on-line detailed information to their customers on the volume and cost of their monthly consumption, on their peak consumption and a comparison with the average values in their consumer category. Retail suppliers of electricity must also include average daily consumption figures in the invoices to their customers.

Thirdly, the Ministry of National Education, the Ministry of National Defence and related public agencies and institutions are obliged to provide energy information in the curricula of higher education institutions, training programmes for public agencies and institutions, and in the course and education programmes of military schools and soldier training centres. The areas to be covered include basic concepts of energy and energy efficiency; general energy status of Turkey; energy resources; energy generation technology; efficient use of energy in daily life; and the role of energy efficiency in climate change and environmental protection.

The 2007 Energy Efficiency Law mandates organising an Energy Efficiency Week in the second week of January every year. The 2009 Energy Efficiency Week included the First National Energy Efficiency Forum (15-16 January 2009 in Istanbul), with national and international experts participating. The Second National Energy Efficiency Forum was organised on 13-14 January 2010 in Istanbul.

CRITIQUE

Turkey will likely see the fastest medium- to long-term growth in energy demand among the IEA member countries. It has a young and urbanising population and TFC per capita is still low. Cars and appliances will continue

to become more popular in coming decades and the country will also see significant new construction.

Ensuring sufficient energy to a growing economy has been and remains the government's main energy policy concern. Commendably, Turkey has in recent years started to pay closer attention to the benefits of energy efficiency for securing energy supplies, reducing pollution and saving money.

The IEA applauds the 2007 Energy Efficiency Law and the subsequent by-laws and encourages Turkey to mobilise all the resources needed for enforcing them. More generally, Turkey should take advantage of the best practices of other countries to avoid locking itself into unsustainable energy consumption patterns. Turkey's experience in promoting energy efficiency will offer valuable guidance for other emerging economies and the IEA encourages Turkey to share its lessons learned in advancing energy efficiency.

Turkey is aiming to reduce its energy intensity by at least 15% below the reference scenario projections by 2020 and has wide-ranging plans for further improvements in energy efficiency. Priority policies and programmes include an energy efficiency service market; supporting energy efficiency projects in various sectors; and raising public awareness. The government should review and adjust its policies and measures, as necessary. For this purpose, the IEA encourages the government to improve statistics on sector-specific energy consumption and efficiency.

To help prepare for future work on energy efficiency in a structured and coherent manner, Turkey should revise the 2004 Energy Efficiency Strategy without delay. It should also regularly review and update its energy efficiency legislation for securing the predictability and transparency of policies. In this context, the government should also consider setting more ambitious targets, at least on an indicative level.

On a horizontal level, Turkey should continue and intensify its efforts to address the need for financial resources and mechanisms, technical knowledge and qualified staff in the area of energy efficiency. Furthermore, it should examine possibilities for economic incentives to accelerate energy efficiency gains and continue to increase public awareness of energy efficiency as a means to improve energy security, save money and mitigate climate change.

In the buildings sector, Turkey has recently set minimum performance standards for building components. This is laudable. Over the coming years, the government should regularly update these standards as more efficient components and solutions become cost-effective. The government should also consider incentives for high-efficiency building components for both new and existing buildings.

Rising living standards imply more appliances. Turkey is likely to follow the EU in setting minimum energy performance standards for appliances and lighting but, where applicable, it could go even further and set these standards according to international best practice.

Air-conditioning should be a focus of particular attention. Energy demand for air-conditioning is likely to continue to grow, also in light of climate change projections. There are several low-cost measures that the government should consider for limiting this demand, such as natural shading and the use of light colours for roofs and pavements. As these measures would reduce the consumption of electricity for air-conditioning, they would also save money that the government is spending on subsidising both electricity generation and consumption. Heat pumps are a particularly attractive technology for providing both energy-efficient cooling and heating, and the government should consider stronger incentives for their uptake.

Industry is one of the focus areas of the 2007 Energy Efficiency Law and the subsequent by-laws. This is logical, as the sector is also the largest consumer of final energy and has substantial potential for efficiency gains. Turkey has successfully established an energy management system for industry, the largest end-use sector (39% of TFC in 2007). Hundreds of certified energy managers have been trained in the programmes envisaged by the law. Many energy efficiency measures have a short payback time and the government has therefore commendably opted for helping industry to go and pick the low-hanging fruit itself. Energy services companies (ESCOs), third-party financing and training are all aimed for that purpose. As this is a new approach, the government should continue to raise awareness of the business rationale for energy efficiency, in both industry and the finance sector.

As in most other IEA member countries, almost all passenger and freight transport is by road, in vehicles driven by inefficient internal combustion engines. Car ownership is still low, but rapidly increasing, and freight transport will likely continue to expand in tandem with GDP. In short, Turkey is on its way to locking itself in the same unsustainable car- and oil-based transport system that is all too common in the other IEA countries. Crucially, Turkey is not there yet and can still avoid this scenario by decisive action.

The government recognises the need to change the unsustainable character of the current transport system. The IEA in particular applauds Turkey's plans for developing a high-speed rail network and increasing the use of railways in general. It will help reduce the dominance of private cars in passenger travel, and will thus bring environmental and energy security benefits. The IEA also welcomes Turkey's recent initiatives for replacing old and inefficient vehicles as well as for improving fuel efficiency standards.

More should be done, however, to ensure a sustainable transport future. In the fast-growing urban areas, the government should consider intensifying policies across several areas, including land-use planning, parking supply and pricing, road pricing, public transport and non-motorised transport. In freight and long-distance passenger transport, rail should continue to be promoted over road. Turkey should also set ambitious fuel economy standards for vehicles and regulate non-motor components that affect vehicle energy

efficiency (*e.g.* tyre rolling resistance and tyre pressure). Taxation should be used to favour the purchase of more efficient vehicles.

Changing the current trend would help save energy, avoid congestion, improve air quality and, as transport is the largest oil-consuming sector and relies on oil for almost all of its energy needs, increase oil security. Turkey should develop, adopt and implement a holistic transport strategy to this effect.

To improve energy efficiency, the IEA also urges the government to continue its work in making its national policies fully consistent with the energy efficiency policy recommendations the IEA presented to the Group of Eight (G8). The IEA energy ministers endorsed the initial 16 measures in 2007. Since then, nine new recommendations have been added (Box 1).

Box 1

IEA G8 Energy Efficiency Recommendations

At the Group of Eight* (G8) Summit in 2005 in Gleneagles, Scotland, the G8 countries asked the IEA to assist in developing and implementing energy efficiency policies. Responding to this request, the IEA subsequently prepared a set of energy efficiency policy recommendations covering 25 fields of action across seven priority areas: cross-sectoral activity, buildings, appliances, lighting, transport, industry and power utilities. These 25 recommendations were presented to the summit of the G8 in Hokkaido, Japan in July 2008. The fields of action are outlined below.

1. The IEA recommends action on *energy efficiency* across sectors. In particular, the IEA calls for action on:
   - Measures for increasing investment in energy efficiency.
   - National energy efficiency strategies and goals.
   - Compliance, monitoring, enforcement and evaluation of energy efficiency measures.
   - Energy efficiency indicators.
   - Monitoring and reporting progress with the IEA energy efficiency recommendations themselves.
2. *Buildings* account for about 40% of energy used in most countries. To save a significant portion of this energy, the IEA recommends action on:
   - Building codes for new buildings.
   - Passive energy houses and zero-energy buildings.
   - Policy packages to promote energy efficiency in existing buildings.
   - Building certification schemes.
   - Energy efficiency improvements in glazed areas.

3. *Appliances and equipment* represent one of the fastest growing energy loads in most countries. The IEA recommends action on:
   - Mandatory energy performance requirements or labels.
   - Low-power modes, including stand-by power, for electronic and networked equipment.
   - Televisions and set-top boxes.
   - Energy performance test standards and measurement protocols.
4. Saving energy by adopting efficient *lighting* technology is very cost-effective. The IEA recommends action on:
   - Best-practice lighting and the phase-out of incandescent bulbs.
   - Ensuring least-cost lighting in non-residential buildings and the phase-out of inefficient fuel-based lighting.
5. About 60% of world oil is consumed in the *transport* sector. To achieve significant savings in this sector, the IEA recommends action on:
   - Fuel-efficient tyres.
   - Mandatory fuel efficiency standards for light-duty vehicles.
   - Fuel economy of heavy-duty vehicles.
   - Eco-driving.
6. In order to improve energy efficiency in *industry*, action is needed on:
   - Collection of high-quality energy efficiency data for industry.
   - Energy performance of electric motors.
   - Assistance in developing energy management capability.
   - Policy packages to promote energy efficiency in small and medium-sized enterprises.
7. *Energy utilities* can play an important role in promoting energy efficiency. Action is needed to promote:
   - Utility end-use energy efficiency schemes.

Implementation of IEA energy efficiency recommendations can lead to huge cost-effective energy and CO_2 savings. The IEA estimates that, if implemented globally without delay, the proposed actions could save around 8.2 Gt CO_2/yr by 2030. This is equivalent to one-fifth of global energy-related CO_2 emissions in 2030 under the IEA Reference Scenario, in which no new policies are adopted or implemented. Taken together, these measures set out an ambitious road-map for improving energy efficiency on a global scale.

---

* The Group of Eight is an international forum for the governments of Canada, France, Germany, Italy, Japan, Russia, the United Kingdom and the United States.

RECOMMENDATIONS

The government of Turkey should:

- *Revise the 2004 Energy Efficiency Strategy without delay.*
- *Continue to develop statistics on sector-specific energy consumption and energy efficiency indicators in order to develop and evaluate energy efficiency policies and measures.*
- *Continue to increase public awareness of energy efficiency as a means to improve energy security, save money and mitigate climate change.*
- *Examine possibilities for economic incentives to accelerate energy efficiency gains, especially in the building and industry sectors.*
- *Set efficiency standards according to international best practice.*
- *Adopt and implement a holistic transport strategy to avoid locking the country in an oil-based transport system dominated by passenger cars.*

PART II

SECTOR ANALYSIS

SUPPLY AND DEMAND

SUPPLY

In 2008, Turkey's oil supply amounted to 29 Mtoe, or 30% of TPES. The share of oil in TPES has been in slow decline from the record of 46% in 1995, and is well below the IEA average (37% in 2008). In absolute terms, oil supply has remained virtually flat since the mid-1990s (see Figure 11). The relative decline of oil use has been brought about by the rapid expansion in the use of natural gas, which, in 2008, for the first time surpassed that of oil.

Domestic crude oil production provided 2.1 Mt (42 thousand barrels a day) in 2008 and imports 21.7 Mt (435 kb/d), or 91% of total demand. In the same year, crude imports came from nine countries, of which Iran had the largest share (35% of total imports), followed by Russia (32%), Saudi Arabia (16%) and Iraq (9%). The Organization of the Petroleum Exporting Countries (OPEC) provided 60% of all imports. Domestic crude oil production provided 2.4 Mt (48 kb/d) in 2009.

Turkey is also a net importer of oil products. In 2008, imports amounted to 13.6 Mt (273 kb/d), 68% of which was diesel, and exports to 7.6 Mt (152 kb/d), mostly gasoline and fuel oil. Turkey imported oil products from more than 20 countries and exported them to more than ten countries.

PRODUCTION

Oil is produced mainly in the south-east of the country, but also in the north-west. Since its peak in 1991, domestic oil production has been declining owing to the depletion of resources. While Turkey produced 2.9 Mt (58 kb/d) of oil in 1999, production was 2.4 Mt (48 kb/d) in 2009. Turkey's recoverable proven oil reserves were 44.4 million tonnes at the beginning of 2009 (see Table 4). Turkish Petroleum Corporation (TPAO) accounts for around 76% of production.

The government offers several types of tax breaks to encourage exploration and production, including deductions in corporate tax, exemptions from import duties for material and equipment, and exemption from VAT for exploration activities. By March 2010, it had granted 415 exploration licences, covering an area of 381 845 km^2, to 48 oil companies. TPAO holds 151 licences, 36% of the total.

Since the last in-depth review, TPAO has been active in exploration and production activities. The company's Black Sea studies deserve particular attention in this context. TPAO works with different foreign oil companies to intensify capital- and technology-related co-operation in oil exploration studies.

Table 4

Oil Reserves in Turkey, January 2009

	Reserves	*Recoverable reserves*	*Cumulative production*	*Remaining recoverable reserves*
Million barrels	6 786	1 239	939	300
Million tonnes	994	177	133	44

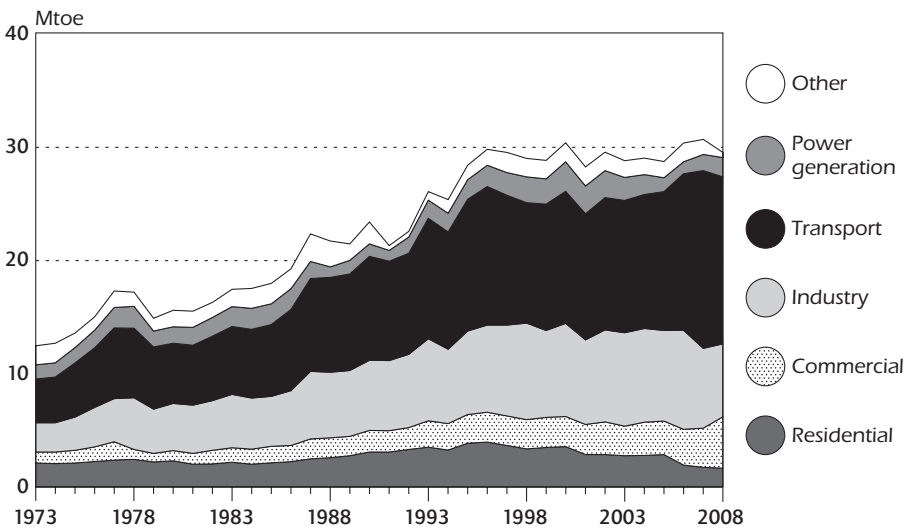
Source: MENR, General Directorate of Petroleum Affairs.

DEMAND

Transport is by far the largest oil user (49% of the total in 2008) and it is also the only sector where oil consumption has grown strongly, up by 32% from 2000 to 2008. Within the transport sector, diesel and LPG use have been rising. In 2008, diesel accounted for almost 59% of all road transport fuels, LPG for 14.4% and gasoline for around 15.7%. Diesel vehicles' share of all new vehicle registrations was 56% in 2007. The economic slow-down has, however, reversed this upward trend for oil use in transport. According to the Turkish Petroleum Industry Association, diesel use decreased by 2.7 % and gasoline use fell by 3.9 % from 2008 to 2009.

Figure 11

Oil Supply by Sector*, 1973 to 2008



* TPES by consuming sector. Other includes other transformation and energy sector consumption. Industry includes non-energy use. Commercial includes commercial, public services, agriculture/forestry, fishing and other final consumption.

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2009.

Industry accounted for 23% of oil use in 2007 and the service sector for 11%. Oil use in households, 6% of the total in 2007, has diminished by more than half from its peak in the mid- and late-1990s, reflecting the gasification of the country. Oil use for power generation accounted for 5% of the total, and the primary sector (agriculture, forestry and fishing) used the remaining 4%. The government projections until 2020, dating from before the current economic downturn, see oil use increase by four-fifths from 2007, mostly in transport. In the power sector, oil-fired power plants continue to be replaced by other forms of power plant technologies.

INFRASTRUCTURE

PIPELINES

Turkey has two domestic crude oil pipelines, both owned and operated by BOTAŞ. The 448 km Ceyhan-Kırıkkale pipeline has a capacity of 135 kb/day. The 511 km Batman-Dörtyol pipeline has a capacity of 86.4 kb/day. In addition, Turkey has two major international oil pipelines, the Iraq-Turkey (or Kirkuk-Ceyhan) pipeline and the Baku-Tbilisi-Ceyhan (BTC) pipeline. There is also one major pipeline in the planning stage, running from Samsun on the Black Sea coast southwards to Ceyhan (the Samsun-Ceyhan pipeline) and one major oil transportation challenge relating to the volume of oil traffic through the Turkish Straits.

The Iraq-Turkey oil pipeline was commissioned in 1976 and the first tanker was loaded in Ceyhan in May 1977. A first expansion project, completed in 1984, increased annual transportation capacity from 35 Mt (0.7 mb/d) to 46.5 Mt (0.9 mb/d). A second pipeline parallel to the first was commissioned in 1987, bringing total annual capacity to 70.9 Mt (1.4 mb/d). Following conflict in Iraq, deliveries were resumed in February 2004 but have remained well below full capacity. In 2009, around 23.3 Mt (0.47 mb/d) were transported from Iraqi oilfields to Ceyhan. A Memorandum of Understanding concerning the renewal of "Crude Oil Pipeline Agreement between the Government of the Turkish Republic and the Government of the Iraqi Republic" was signed on 15 October 2009 between Turkey and Iraq. Studies are ongoing in this respect and the new agreement is expected to be concluded soon.

The first tanker with crude oil from the BTC pipeline was loaded in Ceyhan on 4 June 2006. This pipeline provides a route to international markets for oil from the Caspian region, primarily from Azerbaijan and the giant ACG field complex in the offshore Caspian. Furthermore, since October 2008 oil from Kazakhstan has also been transported along this route. BTC pipeline is considered as the pioneer of the East-West Energy Corridor and Terminal Concept, where Turkey has been an active contributor.

The pipeline route is from the Sangachal terminal in Baku, Azerbaijan via Georgia to the Turkish Mediterranean coast at Ceyhan. The total length of the pipeline is 1 760 km and the original capacity was 1 mb/d. As of 2009, this capacity has been increased to 1.2 mb/d with the use of drag-reducing agents. A further increase in capacity is possible in light of potential increase in Kazakhstan's demand for transportation capacity through the southern Caucasus, although this has not yet been agreed. By the end of 2009, around 110 Mt of oil has been transported along this pipeline route, filling over 1 017 tankers at Ceyhan.

A key benefit of the route from Baku to Ceyhan via Georgia is that it avoids the delivery of additional volumes of Caspian oil to Black Sea ports, which in turn increase the volumes seeking transit through the Turkish Straits around Istanbul. According to the Ministry of Transport and Communication, between 130 and 140 Mt of crude oil and oil products were transported annually through the Turkish Straits from 2004 to 2008 (2.6 to 2.8 mb/d). The Straits are less than 700 metres wide at their narrowest point and form one of the busiest chokepoints for international oil transit. Turkey has therefore raised concerns about navigational and environmental safety.

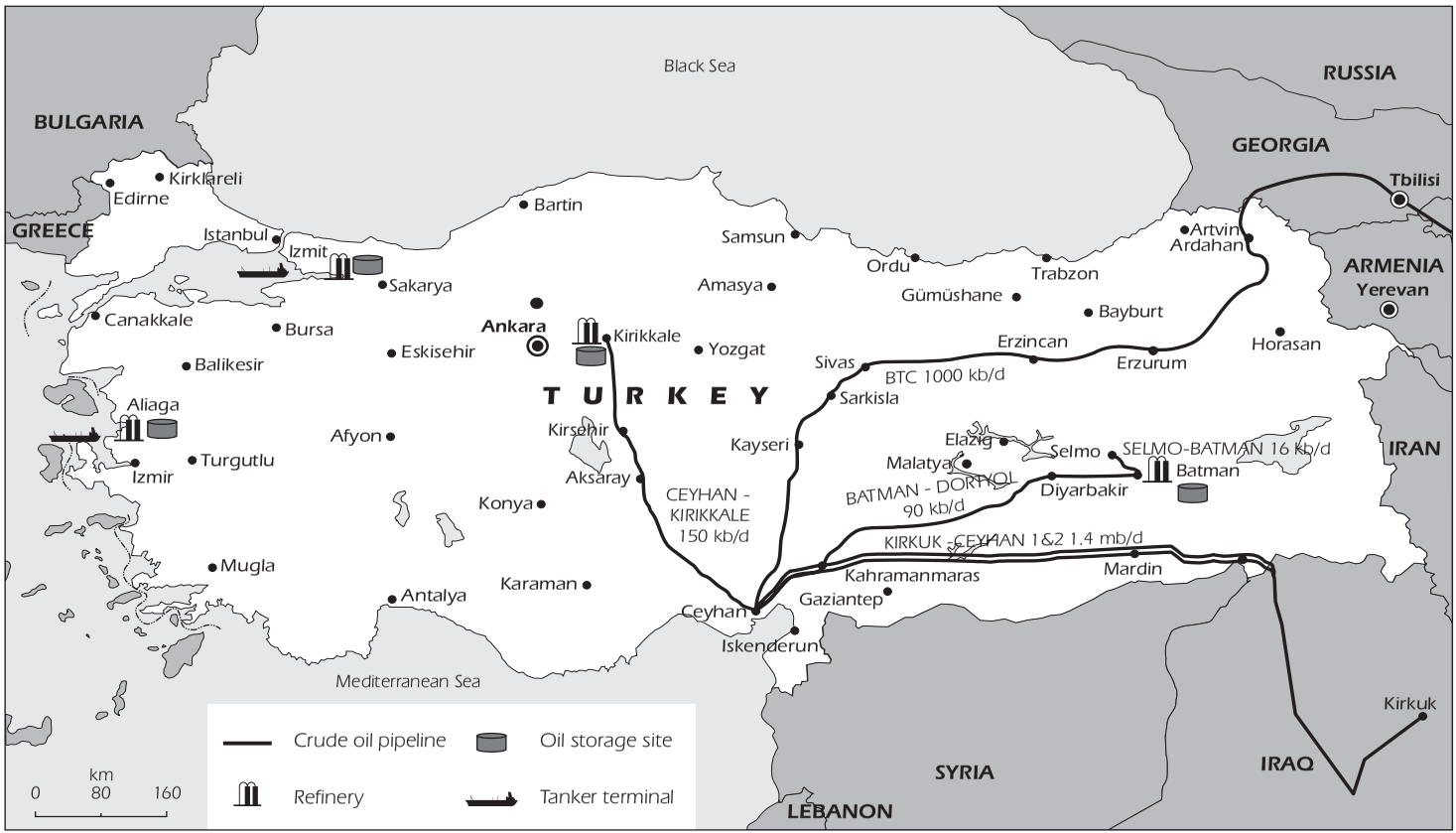
The prospect of increasing volumes of oil from the Caspian region seeking access to international markets, combined with concerns about traffic through the Turkish Straits, has generated a number of additional pipeline projects that would bypass the Straits. One of these is already built, namely the Odesa-Brody pipeline in Ukraine, but this is currently operating in reverse mode, *i.e.* delivering additional volumes into the Black Sea port of Odesa. Others are in different stages of development and include the Pan-European Oil Pipeline from Constanza to Trieste, the AMBO pipeline from Bourgas in Bulgaria to Vlore in Albania, another pipeline from Bourgas to Alexandroupolis in Greece, and two potential pipeline routes through Turkey. One of these is a project that would link Kiyiköy and Ibrikbaba but the front-runner among the Turkish projects is the Samsun-Ceyhan pipeline project.

For the realisation of the Samsun-Ceyhan pipeline project, studies began in 2003, and in October 2005 an international company (Eni from Italy) joined the project. An advantage of the route is that it runs entirely within Turkey, thereby avoiding the need for any intergovernmental agreements. The project which has major strategic significance for Turkey and the surrounding region will provide the safe transportation of Russian and Kazakh crude oil from the Black Sea to Ceyhan.

Although full construction of the Samsun-Ceyhan pipeline has yet to start, the perspectives for the project brightened in 2009 as the Russian Federation indicated its support for the project. The Samsun-Ceyhan pipeline was subsequently included in the 2010 investment plan by Russia's pipeline company Transneft. A Memorandum of Understanding was signed between Turkey and the Russian Federation in May 2010 to support the realisation of the project. The initial capacity of this 555-km pipeline from the Black Sea to the Mediterranean is envisaged at 1 mb/d (50 Mt per year) with the possibility to expand this to 1.5 mb/d (75 Mt per year).

Figure 12

Map of Turkey's Oil Infrastructure, 2008



The boundaries and names shown and the designation used on maps included in this publication do not imply official endorsement or acceptance by the IEA.

Source: *Oil Information*, IEA/OECD Paris, 2009.

REFINERIES AND STORAGE

There are four refineries in Turkey, with a total refining capacity of 28.1 Mt per year (567 kb/d). The refineries of İzmit and İzmir are located on the western coast and both have an annual capacity of 11 Mt. The two other refineries, Kırıkkale (5 Mt) and Batman (1.1 Mt) are located inland. All four refineries are owned by TÜPRAŞ, a former government monopoly which was fully privatised in January 2006 when the government sold its remaining 51% share to Enerji Yatırımları A.Ş., a joint venture of Koç Holding and Shell. Koç Holding is one of Turkey's largest industrial conglomerates and the majority shareholder, while Shell has 2% of the joint venture's shares.

In 2007 and 2008, EMRA, the regulatory authority, has received applications for several new refineries from half a dozen companies, but the reduction in oil demand and deterioration in credit conditions since 2008 have put these projects on hold.

Most storage facilities are in urban areas close to the four refineries: İzmit, Izmir, Batman and Kırıkkale. Storage facilities owned by distributors are widely dispersed across the country. Facilities in İçel, İzmir and İzmit account for about 60% of the total capacity by the distributors. According to EMRA's Oil Sector Report 2009, as of the end of 2009, the companies with storage obligations had a total storage capacity of 60.9 million barrels (8.3 million cubic metres). TÜPRAŞ is the largest storage owner, with 29.9 million barrels (4.1 mcm) of capacity, while licensed storages and distributors have a total storage capacity of 31 million barrels (4.2 mcm).

MARKET STRUCTURE

By April 2009, the number of distributors had increased to 51, but the five largest companies dominated about 90% of the market. The level of competition in distribution has been a concern, and was the focus of two inquiries by the Competition Authority in 2008: the Liquid Fuel Sector Report and a Preliminary Inquiry Report on the activities of TÜPRAŞ and the five largest distributors (Petrol Ofisi, Shell Turcas, BP, Opet and Total).

The Competition Authority concluded that serious structural barriers to competition exist in the liquid fuel sector. The level of competition is not satisfactory and the distribution companies are avoiding price competition. Ex-tax prices are high by international comparison and price decreases in the international oil products market are weakly reflected in Turkey.

To improve the situation, the Competition Authority recommended restricting the duration of long-term agreements; stop limiting distribution companies' supply to their own retail network (now limited to 15% of total supply); remove the ban on white flag stations; increase the competition in the refining

sector; and abandon the limit on market share (now at 45%) for distribution companies. Additionally, there are some symptoms of overregulation, causing excess workload for EMRA and creating an undesirable business climate for companies.

The largest distributors are also the most prominent retailers. In 2008, Petrol Ofisi had roughly a third of the oil products market, Shell Turcas a fifth, Opet 16%, BP 13% and Total 5%. Petrol Ofisi also had the most filling stations at the end of 2008, 3 140 stations out of roughly 14 400. Petrol Ofisi is a former government monopoly that was privatised in 2000 and is now owned by Doğan Holding (54.17%), OMV of Austria (41.58%), while 4.25% of the shares are free float in Istanbul Stock Exchange. The second most extensive network of filling stations is that of Shell Turcas, comprising around 1 200 stations. Opet is the leading fuel oil distributor, and 40% owned by TÜPRAŞ.

The problem of fuel smuggling has been largely solved with the introduction in January 2007 of a national marker system. A chemical marker is used to determine the origin of fuel and prevent untaxed fuel from being distributed to filling stations. EMRA is responsible for monitoring the marker system and has inspection and sanction powers.

PRICES AND TAXES

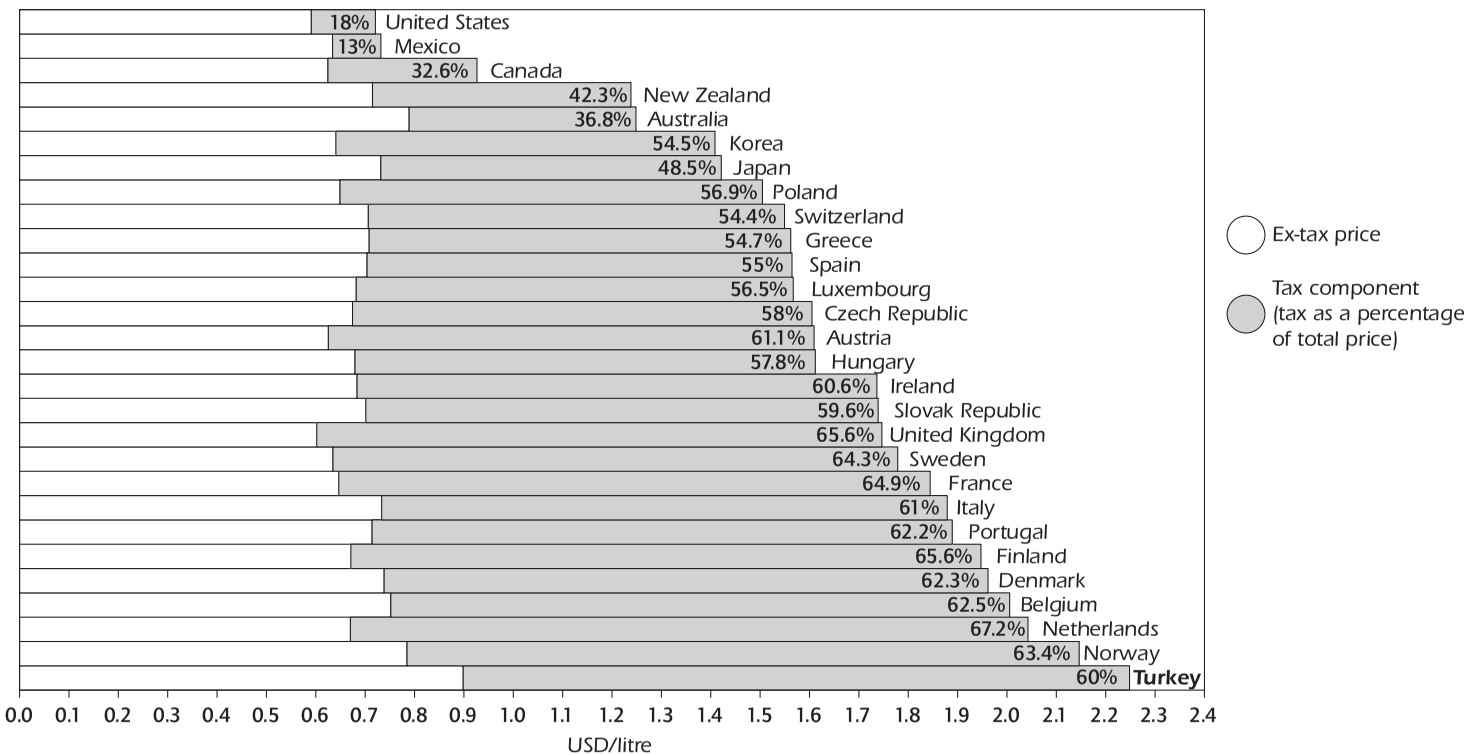
Gasoline, diesel and heating oil are expensive in Turkey. In the fourth quarter of 2009, Turkey had the highest gasoline prices and light fuel oil prices for households and the second-highest diesel prices among the IEA member countries (see Figures 13 to 15). In comparison to disposable income, oil products are far more expensive in Turkey than in any other IEA member country and this also partly explains the low level of car ownership in the country (see Chapter 4).

Turkey's retail prices have increased relatively fast since 2005, when they were close to the IEA average. In the beginning of 2005, the government removed the price caps, which led to an increase in ex-tax prices, but also in distribution margins, as measured by the difference between the ex-tax prices and the CIF import prices. According to PFC Energy, a consultancy, distribution margins in Turkey are about twice as high as the EU average, reflecting the impact of limited competition.

Turkey has a long tradition of rather high taxes on oil products to generate budget revenue, which is reflected in the level of retail prices. As of May 2010, excise tax for diesel, TRL 1.3045 per litre, is markedly lower than for gasoline, TRL 1.8915 per litre, as the government intends to promote the use of the more energy-efficient fuel. The excise taxes are the same for commercial and non-commercial users. In addition to excise taxes, all oil products are levied 18% VAT.

Figure 13

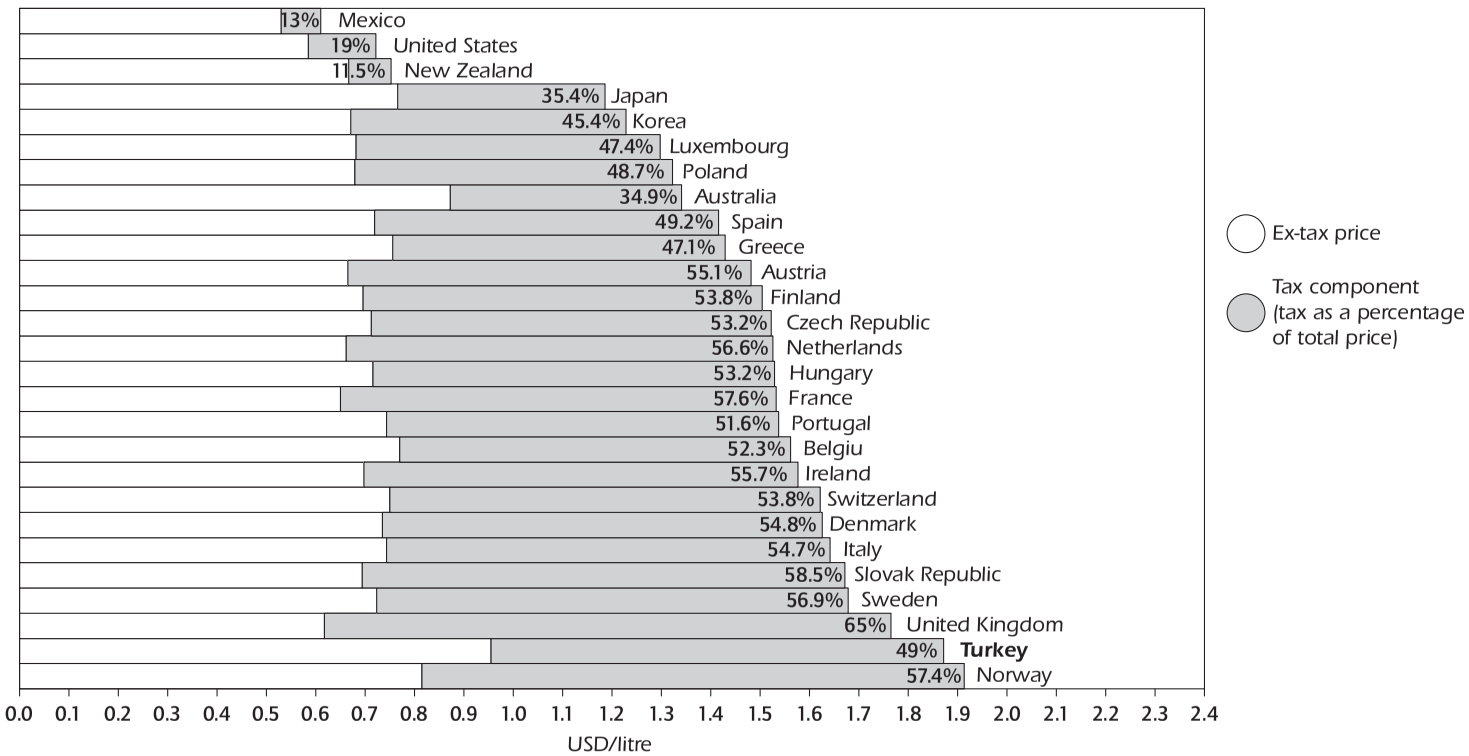
OECD Unleaded Gasoline Prices and Taxes, Fourth Quarter 2009



Note: data not available for Germany and Iceland.
Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2010.

Figure 14

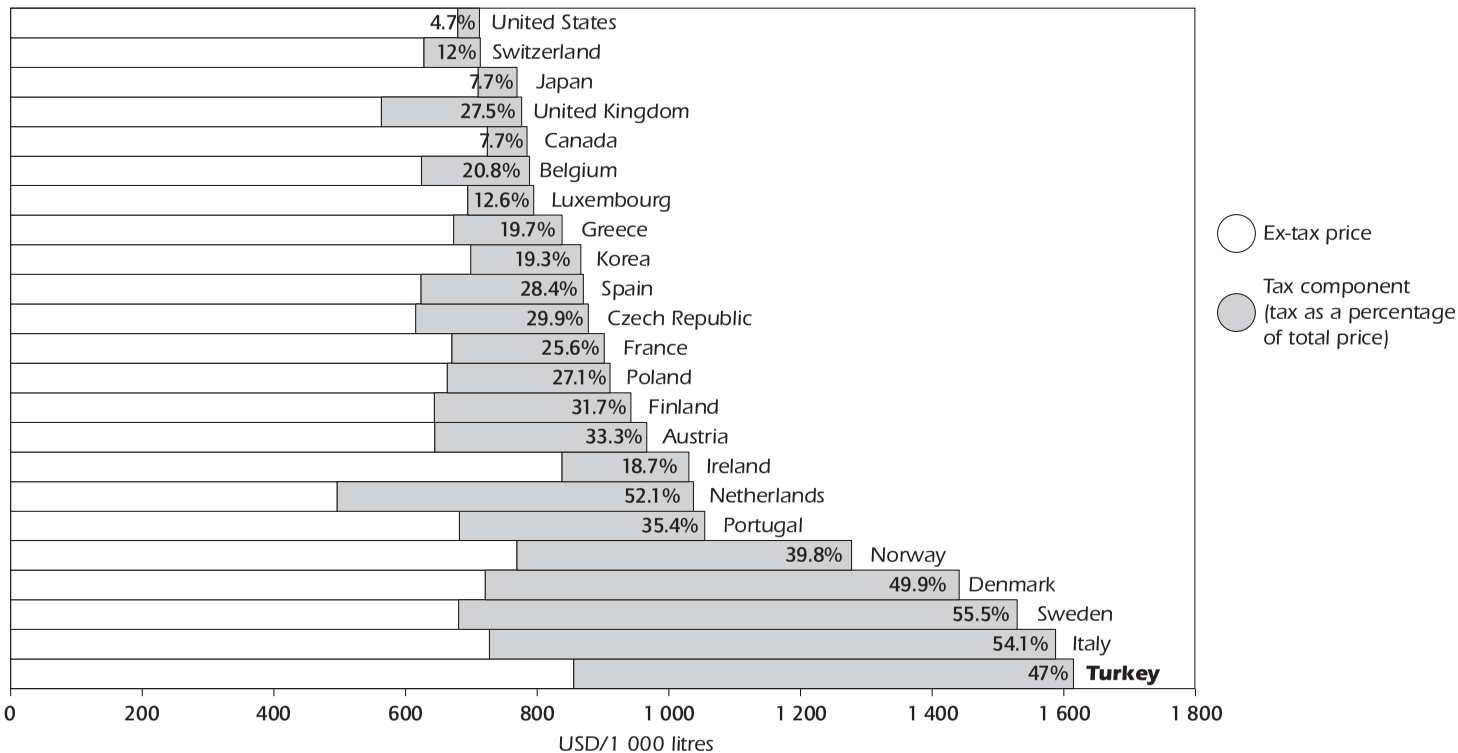
OECD Automotive Diesel Prices and Taxes, Fourth Quarter 2009



Note: data not available for Canada, Germany and Iceland.
Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2010.

Figure 15

OECD Light Fuel Oil Prices and Taxes for Households, Fourth Quarter 2009



Note: data not available for Australia, Germany, Hungary, Iceland, Mexico, New Zealand and the Slovak Republic.
Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2010.

STOCKHOLDING REGIME AND LEGAL INSTRUMENTS

Turkey meets its IEA stockholding requirement (equalling 90 days net imports of the previous year) by placing a minimum stockholding obligation on industry. At present, the legal basis for oil security measures is established by the Petroleum Market Law (see Table 5). Turkey does not have a stockholding agency to control oil stocks, but it has plans to establish one; a draft law has been presented to the Ministry of Energy and Natural Resources (see Box 2).

Box 2

Draft Law on the Stockholding Agency

Turkey has prepared a draft law aiming to establish a stockholding agency. The draft is under discussion in the Ministry of Energy and Natural Resources. According to the draft, the agency would be a legal entity, with financial autonomy and administrative and regulatory rights regarding national oil stocks. It would assume the relevant responsibilities currently held by EMRA (as described above).

The stocks would consist of existing obligatory industry stocks and newly established complementary stocks. Obligatory stocks would be held by refineries, fuel distribution companies, LPG distribution companies and eligible consumers. The refineries would hold 20 times the daily average amount of the crude oil processed in the previous year. Fuel distributors would also hold 20 times, and LPG distributors 10 times their daily average sales of the previous year. Companies consuming at least 20 kt per year would hold 15 times daily average consumption of the previous year. Complementary stocks would be set by deducing obligatory stocks from the total national oil stock obligation and would be shared among refineries, importing fuel distributors and importing marine bunkers in proportion to their imports. The exact amount of complementary stocks would depend on the amount of obligatory stocks and would be set in by-laws. The supply cost of complementary stocks would be met by the companies, but storage and operational cost would be met by the agency. The payments of the agency for complementary stocks would be met through a levy on retail sales of oil products.

There is no regulation requiring oil stocks to be held in specific categories. Refinery and fuel distribution licensees are obliged to keep a minimum of 20 times the average daily quantity of products supplied. These stocks must

be held at their own storage or licensed storage facilities, but may be stored as a whole or separately, according to the status of the licensee. Consumers that use 20 kilotonnes (kt) or more on an annual basis are obliged to keep 15 days' supply of each type of liquid fuel in their consumption inventory. Turkish refineries retain the remaining portion of stocks needed to reach the national obligation of 90 days of net oil imports. Emergency oil reserves must be held domestically. Thus, Turkey has no bilateral agreements with other countries.

EMRA controls obligatory oil stocks. Thus empowered, EMRA can conduct regularly scheduled on-the-spot inspections. It can also order the companies to provide any data or documents related to their stockholding obligations. Penalties may include fines and cancelling the import licence of an oil product importer, if the company fails to meet its stockholding obligation.

Table 5

Legal Basis for Oil Security Measures in Turkey

Legislation	*Powers*
Petroleum Market Law (2003/5015)	**Emergency response organisations** The law provides the government of Turkey with powers to set up the National Oil Stock Commission (NOSC, that functions as the Turkish NESO), in which the Ministry of Energy and Natural Resources (MENR) has the leading role.
Petroleum Market Law (2003/5015)	**Stockholding** The law stipulates stockholding obligations for oil industry in the following manner: • Refineries and distributors are obliged to keep at least 20 times the average daily amount of products supplied • Large consumers are obliged to keep 15 days of their consumption.
The National Protection Law No. 79 of 1960, as amended in 1980.	**Implementation of emergency measures** The law enables the government to implement a variety of measures in emergency situations.

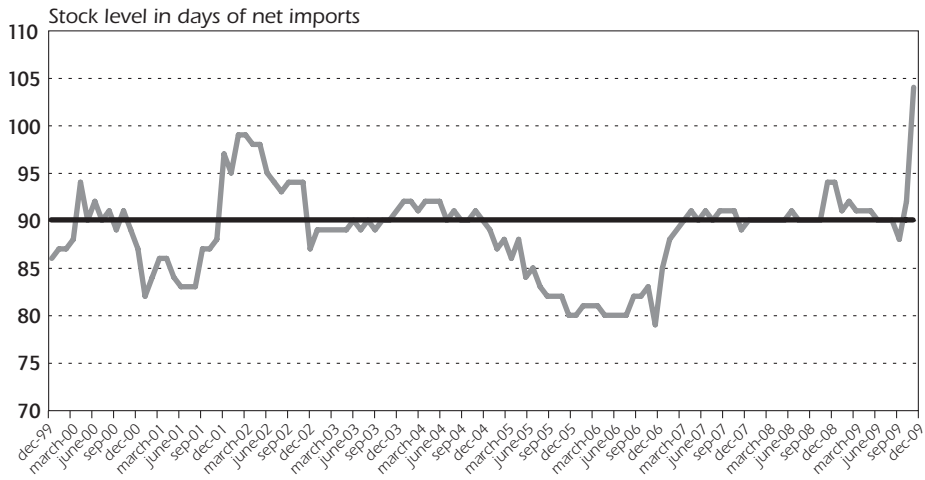
Source: *Oil Supply Security: Emergency Response of IEA Countries 2007*, IEA/OECD Paris, 2007.

DAYS' COVER

Turkey's record of meeting its stockholding obligation has been mixed. Its stocks remained below the 90-day level from January 2005 to March 2007. Since then, Turkey has been marginally compliant with the IEA 90-day obligation, with two dips below this level, in December 2007 and October 2009. Turkey's total oil stock levels stood at 56.5 million barrels (equivalent to 88 days of net imports) at the end of October 2009, of which some 60% was in the form of crude oil. The change in base year for average daily net imports that occurred in December 2009 helped Turkey return to compliance (see Figure 16).

Figure 16

Turkey's Oil Stocks and Compliance with the IEA 90-Day Obligation, December 1999 to December 2009



Source: IEA.

STOCK DRAWDOWN

To date, Turkey does not have detailed stock drawdown regulations. It had intended to conduct a study on stock drawdown procedures after the privatisation of the refineries, but no firm decision has been taken as yet. Once the regulations and procedures are established, however, it is expected that the decision-making procedure on stock drawdown will take 24 hours; another 24 hours will be needed for the release of physical stocks. Thus, stocks would be released in two days, as was the case when Turkey participated in the IEA collective action in September 2005.

Stock release decisions are taken by the National Oil Stock Commission and communicated to EMRA by the General Directorate of Petroleum Affairs on behalf of MENR. This commission is chaired by the Under-Secretary of MENR and it comprises representatives of several other bodies, including the Ministries of Defence, of Interior Affairs, of Finance and of Foreign Affairs as well as EMRA, and the Under-Secretaries of the Treasury and the General Directorate of Petroleum Affairs.

CRITIQUE

Turkey's oil demand is expected to increase significantly in the coming decade, led by transport and reflecting economic growth. It is critical to integrate energy efficiency objectives into transport policy, also for oil security

reasons. Turkey's efficiency policies in the transport sector include promoting public transport, fostering modal changes away from road transport, and technical requirements or fuel specifications for vehicles. The government should increase the efficient use of oil by strengthening demand-side policies, especially in the transport sector and by incorporating the energy dimension in transport and urban development policies.

Turkey has two import pipelines for crude oil: the Kirkuk-Ceyhan pipeline, supplying oil from northern Iraq, and the Baku-Tbilisi-Ceyhan (BTC) pipeline, commissioned in 2006 and supplying oil from Azerbaijan. Since November 2008, the BTC pipeline has also transported Kazakh oil to world markets, and its capacity is being increased to 1.2 mbd, with further increases possible as Caspian oil production rises and seeks routes to the markets. This perspective could also support new pipelines bypassing the Turkish Straits, such as the pipeline project from the Black Sea port of Samsun to the Mediterranean port of Ceyhan. The IEA wishes to commend the government for diversifying transport routes of crude oil in co-operation with its neighbouring countries. Easing the transport pressure in the Turkish Straits enhances oil supply security globally. The IEA notes the prospects for developing Ceyhan as a major oil outlet terminal in the region as well as the significance of these developments in the reduction of risks to the marine environment.

Turkey encourages a policy of strengthening oil supply security by increasing domestic oil exploration and production activities. In recent years, the number of permits granted and the number of companies, both foreign and domestic, operating in this field in Turkey have increased. This is a welcome development, and the government should now ensure an attractive legal framework for exploration and production activities.

The retail oil sector has seen price caps removed in 2005 and new companies enter the market. However, the Competition Authority concluded in 2008 that there is insufficient competition; prices are high by international comparison and they do not sufficiently follow downward price movements in the international oil products market.

The distribution of oil products is dominated by five distribution companies and several barriers to entry exist, such as geographic restrictions and long-term agreements. The Competition Authority recommended in 2008 to restrict the duration of long-term agreements; stop limiting distribution companies' supply to their own retail network (now limited at 15% of total supply); remove the ban on white flag stations; increase competition in the refining sector; and abandon the limit on market share (now at 45%) for distribution companies. Additionally, there are some symptoms of overregulation, causing excess workload for EMRA and creating an undesirable business climate for companies. The IEA encourages the government to move to light-handed regulation in the downstream sector, with the aim of ensuring competition

and sufficient investment to cover increased future needs for refining, transportation and storage capacity.

Introducing the national marker system in January 2007 has proved effective in reducing fuel smuggling. The IEA congratulates Turkey for this success and encourages it to continue monitoring fuel quality in an effective way.

From the last IEA in-depth review in 2005 to March 2007, Turkey was not complying with its 90-day stockholding obligation, a matter continuously addressed by the IEA. Commendably, this matter has been rectified, but there is room for further improvement, as the country's compliance since April 2007 has been only marginal, including two dips below the 90-day level.

Security of oil supply will become more crucial for Turkey, as its net oil imports are forecast to increase by some 90%, from 29.5 Mt in 2007 to 55.6 Mt in 2020. Such a significant growth in net oil imports implies that the level of Turkey's minimum stockholding obligation towards the IEA will also rise sharply and that the country will need to expand oil storage capacity accordingly. The IEA encourages the government to develop a comprehensive long-term plan to increase emergency oil reserves and storage capacities to deal with the expected increase in net imports in the coming decade.

The marginal compliance of Turkey and the expected increase in its net oil imports clearly indicate the necessity to improve the institutional capacity, possibly by establishing a stockholding agency swiftly. The draft law on establishing the stockholding agency is under discussion within the MENR and the creation of the national stockholding agency was included among the strategies in the Strategic Institutional Plan of the MENR dated April 2010. The government should help accelerate the legal process concerning the improvement of the institutional capacity without delay. It should also ensure that the stockholding arrangements, including drawdown procedures, are clear and precise.

RECOMMENDATIONS

The government of Turkey should:

- *Increase the efficient use of oil by strengthening demand policies, especially in the transport sector and by incorporating the energy dimension in transport and urban development policies.*
- *Move to light-handed regulation in the downstream sector, with the aim of ensuring competition and sufficient investment to cover increased future needs for refining, transportation and storage capacity.*

- *Intensify efforts to consistently maintain emergency stocks well above the level of 90 days' net imports and further strengthen emergency response capability by*
  - *accelerating the legal process to improve the institutional capacity, preferably by creating the stockholding agency;*
  - *establishing clear and precise oil stockholding arrangements, including drawdown procedures;*
  - *developing a comprehensive long-term plan to increase Turkey's emergency oil reserves and storage capacities to deal with the expected increase in net imports in the coming decade.*

SUPPLY AND DEMAND

SUPPLY

Natural gas has met a major part of Turkey's rapidly growing energy needs, rising from hardly 6% of TPES in 1990 to 31% in 2008. With that share, it has overtaken oil and become the most important fuel in volume terms. From 2000 to 2009, natural gas supply increased by 127%, making Turkey one of the fastest growing gas markets in Europe. The economic downturn has, however, reduced demand to 35 bcm in 2009 from 37 bcm in 2008, according to EMRA, the regulator.

Turkey imports more than 98% of its gas needs. In 2009, 52% of gas imports came from Russia, followed by Azerbaijan (15%), Algeria (14%), Iran (16%) and Nigeria (3%). Imports from Azerbaijan started in 2007 and have increased rapidly to reach 4.6 bcm in 2008. Turkey has several plans for diversifying its gas supplies further (see section below on Infrastructure). Domestic gas production is small, around 1 bcm per year, and as of spring 2009, remaining recoverable natural gas reserves were close to 6 bcm. TPAO, the state-owned oil company, has in recent years intensified its gas exploration efforts.

DEMAND

Power generation was the largest gas user in 2008, accounting for 55% of total demand. Households consumed 22% of all gas, industry 11%, services 10% and other sectors 2%. Gas has been especially important in the power sector, rising from barely one-sixth of generation in 1990 to more than half in 2008, in absolute terms a tenfold increase (see Figure 17). In the residential and commercial sector, over the same period, gas rose from zero to one-third of demand, mostly for heating. Industrial demand has multiplied by four from 2000 to 2008.

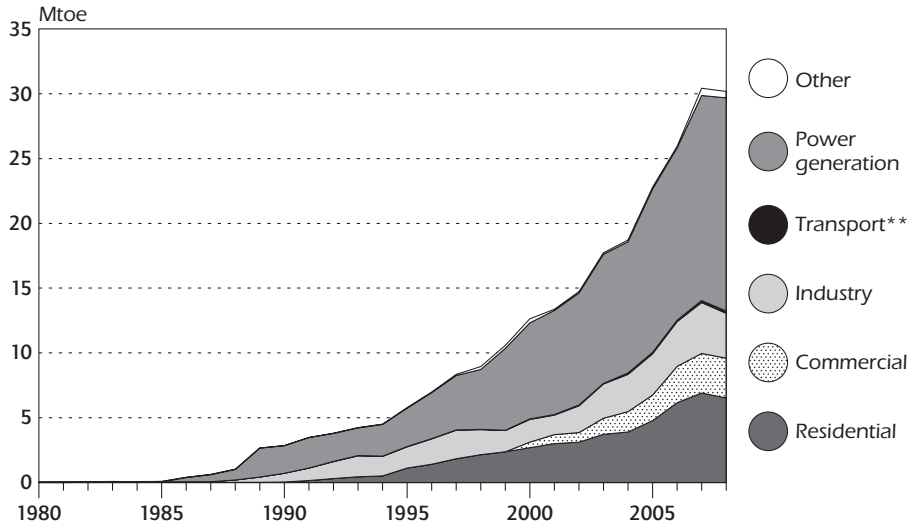
Gas demand peaks in winter when gas use in the residential and power sectors is at its highest. Winter daily demand is typically 30% to 50% higher than summer demand. The residential sector is the main contributor to the growing seasonality of natural gas demand. In 2007, for example, household consumption accounted for three-fourths of the difference between the highest and lowest daily peak demand.

Gas use is expected to continue to increase fast in all sectors over the medium and long term to reach 61 bcm by 2020. The sectoral breakdown of consumption is expected to remain fairly constant, and, in volume terms, power

generation will dominate. Driven by the fast growth of the Turkish economy, increasing population and rising living standards, electricity demand soared more than 50% from 2000 to 2008 and will, according to conservative projections, more than double from 2008 to 2020 to over 400 TWh. This will require at least doubling installed generating capacity which represents an unprecedented challenge among OECD member countries. While the government forecasts the share of gas-fired power to decline, with more coal, hydro, wind and the introduction of nuclear in the mix, it still expects gas-fired power generation to increase in absolute terms from 2008 to 2020. Delays in any of the alternatives will exacerbate increases in gas-fired capacity, which is particularly favoured by private-sector power generators because of its short lead times.

Figure 17

Natural Gas Supply by Sector*, 1980 to 2008



* TPES by consuming sector. *Other* includes other transformation and energy sector consumption. Industry includes non-energy use. Commercial includes commercial, public services, agriculture/forestry, fishing and other final consumption.

** negligible.

Source: *Energy Balances of OECD Countries,* IEA/OECD Paris, 2009.

SUPPLY CONTRACTS

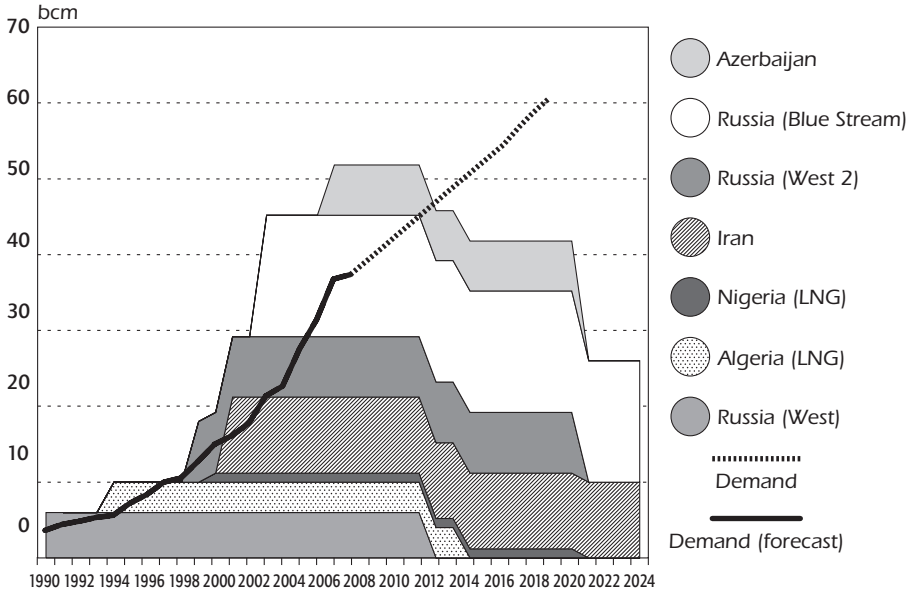
Turkey has signed eight long-term sales and purchase contracts with six different supply sources. In addition to the active contracts shown in Figure 18, Turkey has a 30-year contract with Turkmenistan for annual deliveries of 16 bcm, and these deliveries could potentially begin in a few years, once transit regimes are agreed and the necessary pipelines have been constructed.

To bridge the gap between supply and projected demand, Turkey is actively pursuing additional gas supplies from several countries. In August 2009, it signed an intergovernmental protocol on gas with Russia which includes agreement in principle to extend the contract that currently supplies 6 bcm per year along the western Balkan route through Bulgaria.

The next contract to expire will be the Algerian LNG one in 2014. In October 2009, Turkey signed a Memorandum of Understanding with Qatar that is eventually expected to lead to LNG or pipeline gas imports. Plans to start importing gas from Egypt through the Arab pipeline are at a very advanced stage and the government also considers Iraq as a highly potential supply country (see under Infrastructure).

Figure 18

Long-Term Gas Supply Contracts versus Demand, 1990 to 2025



Source: *Natural Gas Market Review,* IEA/OECD Paris, 2009.

MARKET REFORM

LEGAL BASE

Turkey's ongoing natural market reform is based on the Natural Gas Market Law (no. 4646) of 2 May 2001. The objective of the law was to establish a competitive gas market, reduce the role of the State in the sector and to harmonise the Turkish legislation with EU law. The law meets with the requirements of the 2003 EU Gas Directive (2003/55/EC).

Market reform has been further promoted by secondary legislation on licences, tariffs, internal installations, market certificates, transmission network operation, distribution and consumer services and facilities (infrastructures and equipment). The law was amended in July 2008, liberalising both spot and long-term imports of LNG to allow BOTAŞ, the Petroleum Pipeline Corporation, to make new LNG contracts and private companies to have contracts with countries including those with which BOTAŞ already has contracts.

THE REGULATOR

The key institution in market reform is EMRA, the independent regulator for electricity, natural gas, petroleum and LPG markets (see Chapter 2). Its task is to set up and implement regulatory measures to ensure the establishment of a liberal and competitive natural gas market where all market segments will be open to new entrants. It also regulates and approves transmission and all retail tariffs and, until sufficient competition is achieved, storage tariffs.

MONOPOLY BREAKUP

Crucially, market reform included breaking up the monopoly of the government-owned BOTAŞ on imports, distribution, storage and the sale of natural gas. Full implementation of the 2001 law would leave BOTAŞ with the monopoly on pipeline transmission, and allow private companies to operate in all other sectors of the gas market.

In practice, the 2001 law intended to limit the share of any importer or wholesaler in the domestic market to 20% by 2009. The law leaves BOTAŞ two ways for reducing its share of imports to the 20% level: contract transfer or volume transfer to private companies. The law prioritises contract transfer. In the case of a volume transfer, the importer has to undertake all cross-border liabilities of BOTAŞ and the gas price cannot be lower than in the existing contracts. Also, BOTAŞ was not allowed to sign new contracts until its imports account for less than 20% of demand, but this has been changed for LNG contracts in 2008.

The implementation of the contract release programme has been slow, as suppliers have been reluctant to deal with other counterparties than BOTAŞ. BOTAŞ held the first tender for contract release on 30 November 2005 and concluded it a year later. The tender gave four companies the right to import a total of 4 bcm per year for 15 years (12% of total imports volume). The 4 bcm total was divided by company as follows: Enerco Enerji 2.5 bcm, Bosphorus Gaz 0.75 bcm, Avrasya Gaz 0.5 bcm and Shell Enerji 0.25 bcm. Subsequently, EMRA granted these companies import licences. Shell has been importing 0.25 bcm since 2007, Bosphorus Gaz 0.75 bcm since January 2009 and the other two companies a total of 3.00 bcm since April 2009.

The law also obliges BOTAŞ to unbundle its transmission, storage and trade activities within two years from 2009. Then, the storage and trade businesses of BOTAŞ will have to be privatised. By the time of writing, seven years after the 2001 law took effect, BOTAŞ remains the dominant player. The government is studying options for a draft law to reschedule the market development steps, to define the roles for BOTAŞ, to facilitate new entry into the wholesale market and to provide security of supply.

LICENCE REQUIREMENTS

The 2001 law requires all gas market participants to hold a licence for any market activity. Separate licences are required for each market activity and, in cases where an activity is conducted in more than one facility, for each facility. A licensing process in the natural gas market started in November 2002 and by May 2010, EMRA had granted 198 licences for different natural gas market activities (see Table 6).

As part of the requirements, EMRA obliges the transmission and distribution companies to demonstrate that their operations are cost-efficient, effective and reliable. They also have an obligation to connect all users to the networks. Furthermore, all market actors have to hold separate accounts for different market activities. Transmission companies shall not deal with import and wholesale of natural gas. Additionally, distribution companies may only deal with distribution activity.

Table 6

Number of Companies in the Natural Gas Market by Activity, May 2010

Type of licence	*Number of licence-holders*
Import	23
of which spot LNG	*11*
Wholesale	34
Transmission	1 for pipeline 16 for LNG
Distribution	60
Compressed natural gas	58
Storage	4
Export	2
Total	**198**

Source: Energy Market Regulatory Authority.

NETWORK ACCESS AND OPERATION

Third-party access (TPA) to the transmission and distribution network is regulated and non-discriminatory. Rules for TPA and related tariffs are set in the network code, which entered into force on 1 September 2004. In the case of rejection of TPA, the rejected party can complain to EMRA whose decision is final and binding. TPA tariffs are based on an entry-exit system and subject to EMRA's approval. EMRA regularly reviews TPA tariffs.

The law also regulates TPA to LNG terminals and underground storage, but these provisions still need to be implemented. EMRA is now evaluating the access rules submitted by the owners of the country's two LNG facilities. It is also considering the code of operations for storage facilities.

In addition to rules on TPA and related tariffs, the network code also contains provisions on network operation, capacity allocation and balancing. EMRA amended the network code recently to reflect progress in market reform. Third parties and shippers have the right to demand EMRA to amend the network code.

BOTAŞ as the TSO is responsible for allocating capacity for entry and exit points. It does this for a maximum of one year and a minimum of one month. Capacity transfer is allowed between shippers on a monthly basis. When demand for capacity exceeds supply, capacity is allocated proportionally (*pro rata*). BOTAŞ operates an electronic bulletin board to provide market information, including on reserved and available capacities, flow rates and company-specific information, for example daily imbalances and scheduling charges. It also manages capacity transfers through this bulletin board.

REFORM AND EXPANSION IN GAS DISTRIBUTION

As part of the market reform, gas distribution is to be privatised and the distribution network extended. For this purpose, EMRA has organised tenders for distribution licences in cities which did not have any distribution network. In deciding the result of a tender, EMRA considers the financial strength and experience of the potential licensees. It evaluates the tenders on the basis of the unit service and depreciation charge for supplying one kilowatt-hour of natural gas to consumers. The companies must purchase gas from at least two sources, none of which should provide more than half of the total. As long as BOTAŞ remains the dominant wholesaler, however, complying with this obligation will be very difficult.

Licences are granted for a minimum of 10 and a maximum of 30 years. By April 2009, EMRA had organised tenders for 57 cities and granted licences for 60 cities in total. Six of these licence-holders were privatisations of municipality-owned distributors in Turkey's largest cities, and only Istanbul's and Ankara's

distribution systems remain to be privatised. The other 53 tenders concerned new distribution areas, and include an obligation to build a gas network within five years from receiving the licence. EMRA is planning to organise tenders for 12 more cities.

The companies that were granted a distribution licence in a tender have invested hundreds of millions of US dollars in grid construction and connected hundreds of thousands of customers to the grid in each of the past few years,. The competition for these tenders has been strong despite the fact that for the first eight years of the concession, owners can only charge customers a unit service and depreciation charge which is determined in the tenders in addition to the city-gate gas price. On the other hand, the connection fee (currently USD 180) remains the same in the first five years of the licence term. The investor and the owner, typically a construction company, are banking on the regional monopoly concession of up to 22 years following purchase as well as the income from associated services.

MARKET OPENING

Gas-fired power generators and local natural gas producers are free to choose their supplier. So are customers in the pre-2001 distribution areas with an annual consumption of more than one million cubic metres. In the new distribution areas, this eligibility threshold has been at 15 mcm in the first five years of the licence term. In January 2010 EMRA Board decided to decrease the eligibility threshold from 15 mcm to 0.8 mcm in these new distribution areas after the first five years of the licence term. In total, eligible customers account for around 80% of total gas consumption. EMRA determines the eligibility threshold annually, with the aim of gradually opening the market for all customers. Switching rates are implied by the contract release programme and in 2009 were 11.4% (4 bcm out of an estimated total supply of 35 bcm). The rates remain low as BOTAŞ has no obligation to transfer customers. However, eligible customers are free to choose their supplier.

INFRASTRUCTURE

TRANSMISSION NETWORK

As of February 2010, Turkey's gas transmission system includes 11 294 km of high-pressure grid, seven compressor stations (200 MW in total) and more than 200 pressure-reducing and metering stations. Four more compressor stations are being planned. Transmission grid is owned and operated by BOTAŞ, the TSO.

INTERNATIONAL PIPELINE CONNECTIONS

Turkey's gas grid is connected to several neighbouring countries (see Figure 19). Gas from Russia is imported via the Russia-Turkey West Gas pipeline through Bulgaria and via the Russia-Turkey Blue Stream pipeline that crosses the Black Sea. Imports from Azerbaijan come through Georgia via the Baku-Tbilisi-Erzurum pipeline that was launched in 2007. The pipeline currently has a capacity of 8.8. bcm, but can be increased to up to 20 bcm. Turkey also has a direct connection with Iran, and for export purposes, with Greece. The Turkey-Greece Interconnector was commissioned in 2007, as a first step for the integration of the Turkish natural gas market with the EU internal market. The pipeline is planned to be extended to Italy by 2014 with the Italy-Greece Interconnector (IGI) and to have a capacity of 11.6 bcm per year. A MoU was signed in June 2010 by BOTAŞ, DEPA and EDISON to that effect. Pipeline gas imports totalled 31.6 bcm in 2008, while the existing import pipelines would allow 48.8 bcm. All import pipelines have excess capacity.

Located between Europe and the Middle East/Caspian region, Turkey offers the shortest route from this very gas-rich region and the world's largest gas market area. Although no gas transit projects have yet started operation,[4] the government places strong political importance on Turkey's role as a transit country and is also studying options for developing a competitive gas trading hub in the country.

There are a number of projects in the planning stage that would increase Turkey's international pipeline connections and allow gas sources to be further diversified. This includes the Nabucco pipeline project (see Box 3) and also potential connections with Iraq and Egypt. Realising these projects will improve the security of gas supply for both Turkey and the EU.

The extension of the Arab gas pipeline to Turkey would allow for gas delivery from Egypt to Turkey via Jordan and Syria. Pipeline capacity in the plateau period will be 10 bcm, around one-third of which is allocated to Jordan, some to Lebanon and Syria and the rest to Turkey. The pipeline now reaches Syria, and Turkey and Syria signed a Memorandum of Understanding (MoU) on 20 August 2009 concerning the interconnection of their gas networks by constructing a 230-km pipeline.

The Turkey-Iraq pipeline would give Turkey access to Iraq's considerable gas resources. Turkey and Iraq signed a MoU on 15 October 2009 on setting up a joint working group with the task of finding ways and means for constructing the pipeline. The working group will in due course define the maximum capacity and commissioning timeline for the pipeline. TPAO, BOTAŞ and Shell signed a MoU in November 2008 concerning co-operation in gas exploration, production, transportation and marketing in Iraq.

4. Gas export via the Turkey-Greece Interconnector is provided by Turkey from its gas balance and so is not as such a transit flow.

Figure 19

Map of the Natural Gas System

The boundaries and names shown and the designation used on maps included in this publication do not imply official endorsement or acceptance by the IEA.

Source: *Natural Gas Information*, IEA/OECD Paris, 2009.

Box 3

The Nabucco Pipeline Project

The Nabucco pipeline project aims to open the fourth supply corridor for natural gas into Europe, after the North Sea, North Africa and Russia, enabling new suppliers from the Caspian and Middle Eastern regions to access the European gas market. The 3 300-km pipeline would run from Turkey to Austria via Bulgaria, Romania and Hungary.

Nabucco is a project of a consortium of six gas companies (RWE, OMV, BOTAŞ, MOL, Transgaz and Bulgargaz). The consortium expects to take the final investment decision of the EUR 7.9 billion project in 2010 and start construction in 2011, with first gas transported in 2014. At the first stage, Nabucco would supply 8 bcm, increasing to 31 bcm by 2020.

The project has been postponed several times since its conception in 2004, mainly because of the absence of an upstream player and a clearly identified supply source, along with the difficulty of having different national regulatory regimes. It now seems that these hurdles have been overcome.

The most likely supply sources are Azerbaijan, Turkmenistan and Iraq, but gas could also be sourced from Kazakhstan, Iran, Egypt or Russia. Iran and Egypt are unlikely to be major contributors as pipeline export projects face competition from high domestic gas demand and LNG exports, Kazakhstan does not anticipate having substantial gas available for export until after 2020, while Russia supports the South Stream project that is aiming to supply some of the same markets as Nabucco. First gas for Nabucco is expected to be sourced either from northern Iraq or from the second phase of the Shah Deniz field in Azerbaijan which should produce around 12 bcm starting in 2016. There is competition between several pipelines for access to this Azerbaijani gas – Nabucco, South Stream, the Italy-Turkey-Greece Interconnector and possibly the Trans-Adriatic pipeline, as well as the prospect of increasing gas demand in Azerbaijan itself as well as in Georgia and Turkey.

The Nabucco transit countries (Austria, Hungary, Romania, Bulgaria and Turkey) signed an Intergovernmental Agreement (IGA) in July 2009 to assist in the development of Nabucco. The IGA also establishes the basis for a consistent regulatory transit regime and provides legal and regulatory certainty for building and operating the pipeline. The Project Support Agreement (PSA) is being negotiated between the Nabucco International Company and the respective Nabucco transit countries.

The Nabucco project has received strong political support from the Nabucco countries, the United States and the European Union. This will also be reflected in the project's financing. The European Investment Bank has pledged to finance 25% of the project, around EUR 2 billion, and the EU is providing EUR 200 million from the EU Recovery Plan announced in April 2009. The rest will likely come from the European Bank for Reconstruction and Development, credit export agencies and commercial banks.

The Gas Protocol signed between Russia and Turkey on 6 August 2009 foresees the preparation of feasibility studies for expanding the existing pipeline from Russia to Turkey across the Black Sea and also the construction of new gas pipelines which would ultimately enable the transportation of Russian gas to Turkey and to other destinations via Turkey.

All in all, MENR expects significant increases in supply, demand and transit volumes by 2020. Turkey could have a potential supply of between 116 and 156 bcm, with 30 to 40 bcm coming from both the Caspian region and Iran. Assuming domestic demand of 61 bcm, MENR sees a potential transit volume of 55 to 95 bcm.

UNDERGROUND STORAGE

Turkey has 2.1 bcm of underground storage at two depleted gas fields at Marmara Silivri, close to Istanbul. The storage was taken into use in 2007. It has an injection capacity of 14 mcm per day and a withdrawal capacity of 17 mcm per day. It is owned and operated by TPAO. Also, studies are under way to increase storage capacity to 3.0 bcm and withdrawal capacity to 50 mcm per day.

New underground facilities are planned at Tuz Gölü, 150 km south-east of Ankara. The storage would consist of 12 caverns, initially providing around 1 bcm, but with potential for up to 5 bcm. BOTAŞ is working with the World Bank on a tendering process, expected to be finalised in 2010.

LNG FACILITIES

Turkey has two LNG regasification terminals (see Table 7). The Marmara Ereglisi terminal close to Istanbul is owned by BOTAŞ and in use since 1994. According to its licence, it can operate with a maximum annual capacity of 8.2 bcm and a maximum send-out capacity of 22.05 mcm per day. The terminal works at full capacity in winter season and at 60% capacity in summer. The Aliaga terminal close to Izmir is owned by EGEGAZ, a private company, and in operation since 2006. It has an annual capacity of 6.0 bcm and a maximum send-out capacity of 16.4 mcm per day. It has ample spare capacity, as only 1.1 bcm per year has been contracted by BOTAŞ.

Table 7

LNG Terminals in Turkey

Terminal	*Maximum capacity (bcm per year)*	*Storage, (m^3)*	*Start-up year*	*Owner*
Marmara Ereglisi	8.2	255 000	1994	BOTAŞ
Aliaga, Izmir	6.0	280 000	2006	Egegaz

Sources: *Natural Gas Market Review 2008*, IEA, and company information.

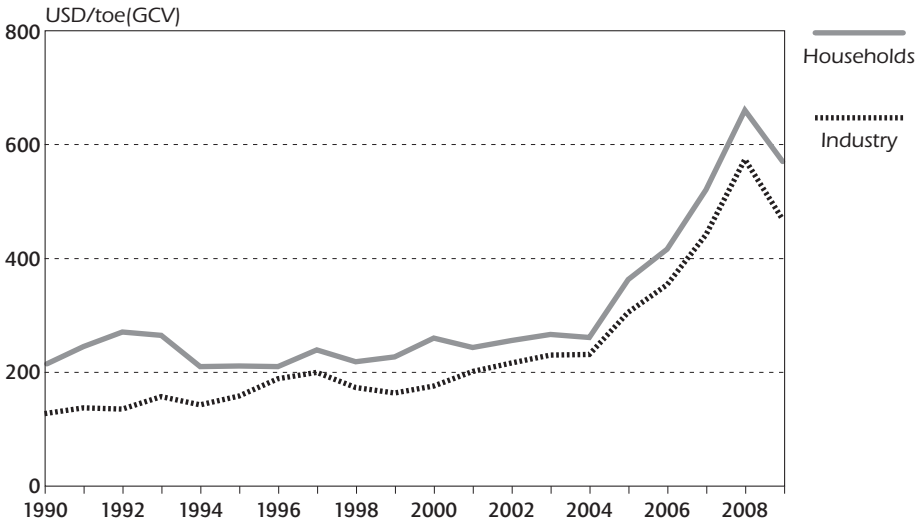
PRICES AND TARIFFS

As part of the gas market reform, Turkey is moving to a fully cost-reflective tariff structure. Since January 2008, wholesale prices are freely set between the buyer and the seller. Retail prices remain regulated by EMRA. Non-eligible customers pay a price composed of the wholesale price and a charge for unit service and depreciation, the level of which is defined by the distribution tender. Eligible customers pay the wholesale price plus a transmission charge set by EMRA. EMRA determines both the transmission and distribution charges by using a price cap method and also applies a price ceiling to storage tariffs.

Natural gas prices for Turkish end-users increased sharply from 2002 to the last quarter of 2008 (see Figure 20). This partly reflects a steep rise in import prices, but also the liberalising of wholesale prices, and, in 2008, strong increases in the regulated end-user tariffs. Changes in import prices are therefore more fully allowed to pass on to consumer prices.

Figure 20

Natural Gas Prices for Industry and Households, 1990 to 2009



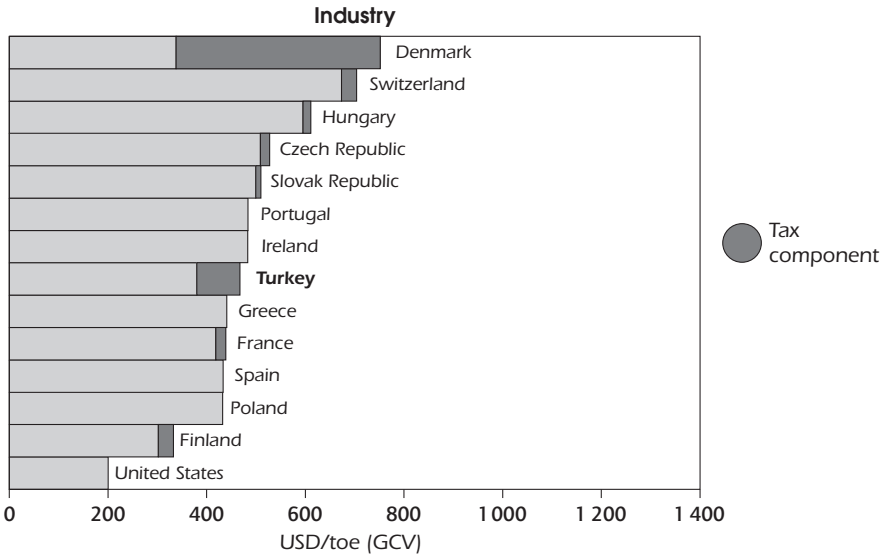
Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2010.

Since the beginning of 2009, as reported by MENR, end-user prices for both residential and non-residential customers are declining, mostly reflecting the movements in crude oil prices. Apart from spot LNG, all gas to Turkey is supplied under long-term take-or-pay contracts and the price of gas is mainly linked to crude oil.

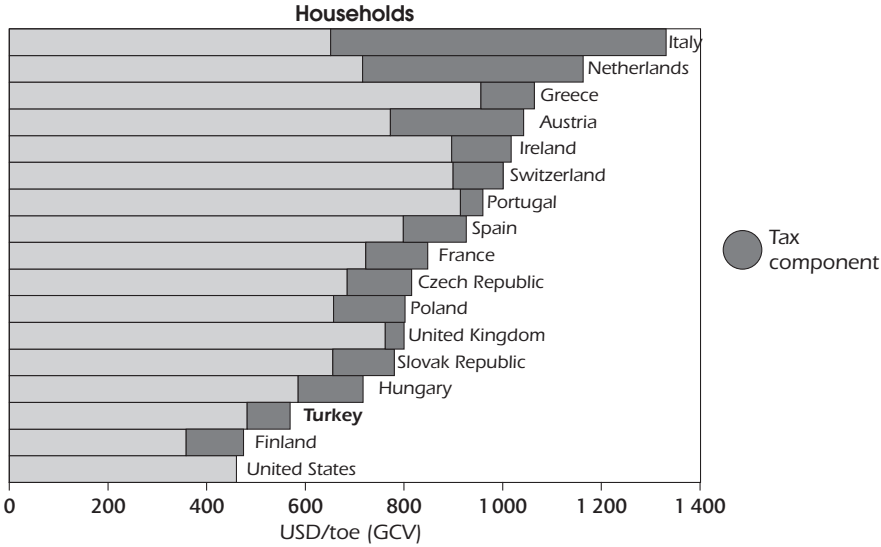
By international comparison, Turkish gas prices for industrial consumers are in the mid-range, whereas those for households are in the lower range (see Figure 21). This reflects relatively low transportation costs for imports, but also the low level of tariffs.

Figure 21

Gas Prices in IEA Member Countries, 2009



Note: Tax information not available for the Poland, Spain and the United States. Data not available for Australia, Austria, Belgium, Canada, Germany, Italy, Japan, Korea, Luxembourg, Netherlands, New Zealand, Norway, Sweden and the United Kingdom.



Note: Tax information not available for the United States. Data not available for Australia, Belgium, Canada, Germany, Italy, Japan, Korea, Luxembourg, New Zealand, Norway and Sweden.

Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2010.

SECURITY OF SUPPLY

Diversifying import sources and routes is the cornerstone of Turkey's gas security policy. As previously mentioned, gas exports from Azerbaijan began in mid-2007 and are expected to start from Turkmenistan and Egypt in the medium term. Spot LNG has added to security of supply. Furthermore, stabilisation of the political situation in Iraq would offer great potential for gas exports owing to its proximity to Turkey and vast gas resources. Facing expectations of a rapidly growing gas demand (61 bcm by 2020), Turkey will have to expand its import infrastructure: several options are envisaged, including increasing imports through the Baku-Tbilisi-Erzurum pipeline from Azerbaijan, connecting to Egypt with the Arab pipeline, or to Iraqi fields as well as increasing Russian imports through Blue Stream.

In recent winters, Turkey has had difficulties with imports from Iran, where high peak winter demand leads to cuts in gas supply. Iran has a fast growing domestic demand and is also rapidly expanding its national gas networks, which has caused many technical and operational problems in cold winters, leading to drops in gas pressure in its export pipelines. In 2008, Iran stopped exports to meet domestic demand after Turkmenistan halted supplies during a pricing disagreement. Deficits in natural gas supply from Iran are offset by importing more Russian gas and, increasingly, spot LNG.

Similar measures provided the response to the fallout of the Russia-Ukraine gas dispute in January 2009, which interrupted gas supplies from Russia to Turkey through Bulgaria. Turkey managed to avoid gas shortage through four types of measures: fuel switching from gas to oil in dual-fired electricity plants; demand reduction at interruptible customers; drawing down its underground storage; and importing spot LNG and increasing imports from Russia via the Blue Stream pipeline.

The 2001 Natural Gas Market Law requires market players to prove to the regulator that their services are economic and safe. In addition, the law obliges gas importers and wholesalers to provide storage for 10% of their imported gas. The companies were given five years to comply but this has proven unrealistic, and the slow progress in building new storage capacity is in effect barring market entry. For balancing the system, Turkey can use around 35 mcm of line-pack. To put this in perspective, daily gas consumption in 2008 ranged from 70 to 140 mcm.

The interrelation between the electricity and natural gas sectors requires close monitoring of electricity and natural gas systems. The MENR regularly co-ordinates the activities pertaining to the linkage between natural gas and power sectors. In case of extreme conditions yielding in major reductions in gas supply, MENR, BOTAŞ and TEIAŞ co-ordinate measures through an emergency action plan. As of January 2010, 19% of gas users are interruptible and can switch to oil.

The network code of the Turkish natural gas system regulates the normal operation of the natural gas system and its operation in exceptional situations, including supply disruptions. These rules are continuously revised and they enter into force with the approval of the EMRA Board, following a consultation process in which representatives of the gas industry and public organisations give their opinion.

CRITIQUE

Turkey's gas demand has grown very fast in the past decade and is set to continue growing. In absolute terms, gas imports were multiplied by 2.5 from 2000 to 2009, and despite the subsequent downturn, energy demand is expected to grow strongly, and gas imports to increase by two-thirds from 2008 to 2020. Meeting this near-doubling of demand for imported gas to 2020 will require very heavy investment in additional pipeline and, possibly, LNG terminal capacity, plus extra commercial storage. Current total storage amounts to only 2.1 bcm per year at one underground storage facility, too small for current demand, let alone to meet the increase in the power sector, with its potentially sharp variations in demand. Even allowing for a decrease in 2009 and slow growth in 2010, this new supply infrastructure is still needed quite soon, given the lead times in the sector. In addition, some existing supply contracts begin to expire in coming years, meaning that new ones need to be concluded again in the next few years.

Fortunately, Turkey is well placed with respect to major gas reserves in Russia, Iran, Iraq, Egypt, the Caspian region (Azerbaijan) and Central Asia (Turkmenistan). LNG supplies are also potentially available, as a near 50% increase in global LNG output is anticipated in the next few years, notably from Qatar (and indeed spot LNG supplies were one means used to alleviate the impact of the interruption of gas supplies in January 2009). Pipelines bringing gas from Middle Eastern or Central Asian sources could be extended further to meet growing demand in Eastern and Western Europe, and diversify supply sources for all countries concerned. Indeed Turkey is a logical, potentially very significant gas transit country. Gas from the Turkish grid already flows to Greece as of late 2007. Thus, looking at the Turkish gas scene, priority needs to be given to stimulating timely investment, from diverse supply sources, and from a diverse range of entities.

Turkey's gas sector is in the process of liberalisation started in 2001. But progress remains slow in contrast to the electricity sector, although there have been some recent important changes. This can be attributed to the unrealistic goals in the 2001 Natural Gas Market Law, and a revitalised gas reform package is necessary for the market to develop further. This is also important for new gas supply to be secured. Progress has been made in allowing prices to move to more market-oriented levels, with prices rising in 2007, and increasing

by some 80% in 2008. BOTAŞ, the state-owned vertically integrated gas utility, continues to occupy a dominant position in the wholesale market, with around 89% of the market.

The situation has slightly improved with the removal of restrictions on importing LNG, effective use of the second LNG terminal (still underutilised), and allowing third parties to import into LNG terminals. Additionally, the Marmara Eregli LNG terminal has been licensed to increase the maximum annual delivery capacity from 5.2 bcm to 8.2 bcm. The previous provisions were detrimental to security of supply; their removal is a positive step.

The market dominance of BOTAŞ, however, and in particular its *de facto* monopoly with regard to pipeline imports and its control over the transmission system, are likely to render these reforms insufficient. According to the 2001 law, BOTAŞ's share of imports was supposed to be limited to 20% by 2009, to be achieved through a gas release programme. The release was postponed several times, to 2006, and only 4 bcm (around 11% of the market) was released. The implementation of the contract release programme has been slow, as suppliers have been reluctant to deal with counterparties other than BOTAŞ. Volume transfer could help overcome this obstacle, as shown by evidence from Austria, France, Germany, Spain and the United Kingdom. The government should consider revising the natural gas market law to give volume transfer preference over contract transfer.

Fortunately, market circumstances offer a major opportunity to press ahead, addressing market reform and security of supply concerns simultaneously. Growing demand over the medium to long term, plus declining contracted import supplies, should allow large new market entrants, such as major Turkish industrial companies, international or national energy companies. There is some surplus capacity at existing LNG terminals, but terminal capacity would need to be expanded to realise the full diversity and security benefits that LNG could provide. For any new entrants to appear, barriers to entry need to be reduced, and new entrants will need to have complete confidence in third-party access to an independently operated transmission network. This implies the full legal separation of BOTAŞ import and trading operations from its transmission/ pipeline operations, a step envisaged in 2001, but yet to be enacted.

Leaving aside LNG imports, additional pipeline capacity will be necessary. Building large long-distance pipelines is capital-intensive and requires long lead times. Such investment will obviously be difficult in the next few years in current financial circumstances. Attracting pipeline investment is most successful where gas regulations, laws and policies are stable, transparent, with the greatest degree of regulatory harmonisation along the pipeline route. This is especially true where pipelines cross several national frontiers (*e.g* those crossing Georgia or Syria) or those transiting to Greece, Bulgaria or further afield.

Distortions between pipelines serving domestic needs and transit should be avoided. Pipeline tariffs need to be cost-based, kept to a minimum, and third-party access available to facilitate multiple market-based entrants and users. In addition, Turkey has legitimate aspirations to create a liquid gas trading market (supplementing its role in oil) with the flexibility and competitiveness benefits that this would entail. Such operations are most successful where the above trading conditions are met, namely multiple sources (including storage) and markets, easy access to transport, and low transaction costs, within a stable, non-discriminatory regulatory framework. In short, non-commercial risks must be minimised, and the differences between gas and oil clearly recognised.

Under these circumstances, it should be possible to address long-term security of supply in Turkey through the classical means of diversity of sources and routes; short-term security issues should be addressed through a suite of emergency style measures. Other OECD countries have utilised these approaches very successfully, such as Spain, limiting the market share of individual suppliers, and rapidly developing a diverse group of LNG suppliers and terminals, supplementing existing and expanding pipelines, giving a resilient, flexible, secure, competitive supply base. Incentives for LNG terminal development (possibly through the regulatory system) could assist this process in Turkey.

Short-term loss of supply should be met through measures such as using the fuel switching flexibility in the power or industrial sector, or interruptible supplies, or spot LNG. Increased commercial storage could also be important here. Careful evaluation of the large-scale interruption of gas supplies from Russia via Bulgaria in January 2009 would yield further insights into how Turkey might continue to cope in the future. In particular, advance preparation by the government, large users (such as the power sector), distribution companies and all interested parties is an important lesson from January 2009. A flexible power sector which can switch fuel in response to market or other signals is especially useful; thus, Turkey's high level of gas-fired power can be turned from a vulnerability to an opportunity.

RECOMMENDATIONS

The government of Turkey should:

- *Urgently implement a new revitalised package of gas market reforms to*
  - *effectively unbundle BOTAŞ;*
  - *ensure an independent gas transmission operator;*

- *ensure that the recent progress in eliminating import-export restrictions is sustained;*
- *reduce BOTAŞ's market dominance.*

- *Ensure security of supply through a balance of long-term measures to encourage diverse supply and storage investment, and a suite of short-term measures to increase system flexibility, such as fuel switching, increased storage and spot LNG.*
- *Continue to work co-operatively with countries and companies along the gas transport chain to facilitate the trans-border pipeline investment and to develop new supply and transit routes.*

SUPPLY AND DEMAND

SUPPLY

Coal use in 2008 accounted for 29.5 Mtoe, or 29.9% of TPES. This compared to 29.4 Mtoe in 2007 (29.4% of TPES). Domestic production covered around 57% of the total in 2008 and 50% in 2007. Turkey produces both hard coal and lignite. Of the two, lignite is by far more important, with significant reserves and production spread through almost all regions of the country. Turkey produces all the lignite it uses, but imports around 90% of its hard coal needs. Russia is the largest single source of steam coal (55% of imports in 2008), while coking coal is imported mainly from Australia and the United States.

Table 8

Coal Production by Type of Coal, 2000 to 2008

(thousand tonnes)

	2000	*2004*	*2007*	*2008 (estimate)*
Hard coal	2 392	1 946	2 462	2 601
Lignite, including asphaltite and sub-bituminous coal	60 876	44 431	72 902	76 801

Source: Ministry of Energy and Natural Resources.

Lignite production fell to under 45 million tonnes (Mt) in 2004 but increased rapidly in the years to 2007 (see Table 8). Recent growth in output has been driven by significant increase in electricity demand and, in particular, by demand from two new lignite-fired power stations, Çan 18 Mart and Afşin Elbistan B, and in part by capacity reductions at hydropower plants caused by poor hydrological conditions. Lignite production is projected to rise significantly in the future, to 210 Mt by 2020, according to MENR.

Production of hard coal has also increased since 2004 to an estimated 2.6 Mt in 2008, just 12% of Turkey's hard coal consumption of 21.6 Mt in the same year. Hard coal is found and mined in only one location, the Zonguldak coal basin on the Black Sea coast. The Zonguldak coal basin has a very complex geological structure which makes mechanised coal production impossible and requires instead labour-intensive conventional production methods.

Reserves of lignite are extensive, with proven reserves of 7 946 Mt (see Table 9). The largest deposits are found in the Afşin-Elbistan basin in south-eastern

Anatolia and the second-largest in the Soma basin, while other important deposits are located in the Tunçbilek, Seyitömer, Bursa, Çan, Muğla, Beypazari and Sivas basins (see Figure 23). Almost 90% of Turkey's total lignite production is from opencast mines. However, there are some underground mining activities, mainly in the Soma, Tuncbilek and Beypazari basins.

A project on the Development of Existing Mineral and Geothermal Reserves and Exploration of New Deposits was initiated in 2005[5] to explore new lignite deposits within 20 regions, to carry out research and prospecting studies across 30 000 km^2 in total and to do 170 500 m of drilling from 2005 to 2010. This project has added 4 billion tonnes to the total lignite reserve figure, pushing this up to 11 507 Mt (see Table 9). Total reserves of hard coal are much smaller at 1 335 Mt of which 535 Mt are proven.

Table 9

Lignite and Hard Coal Reserves, 2008

(million tonnes)

	Lignite	*Hard coal*
Possible	262	368
Probable	1 345	432
Proven	9 900	535
Total	**11 507**	**1 335**

Note: The calorific value of lignite reserves varies between 1 000 and 4 200 kcal/kg (two-thirds of reserves are between 1 000 and 2 000 kcal/kg), and of hard coal between 6 200 and 7 200 kcal/kg.

Source: Ministry of Energy and Natural Resources.

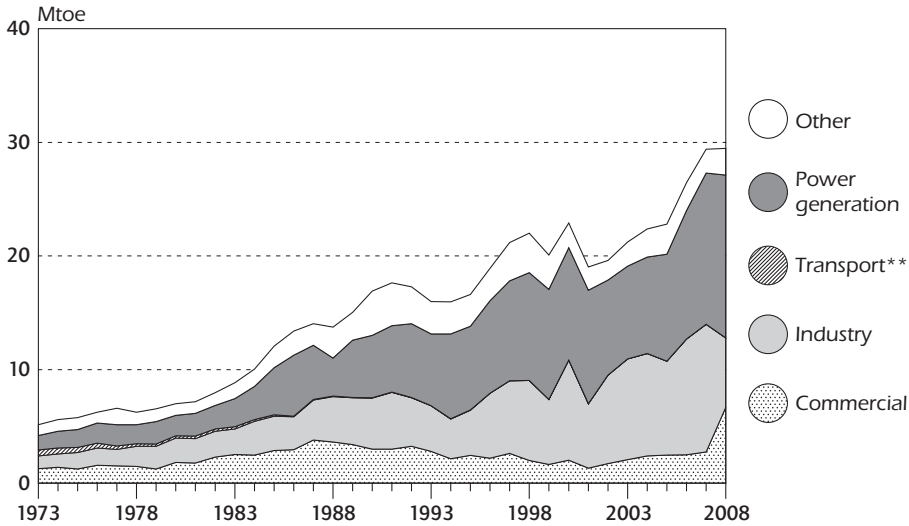
DEMAND

Around 87% of domestic lignite is used for generating electricity, with the remainder being split more or less equally between heating needs and industrial processes. By contrast, industry, including coke ovens and blast furnaces, accounted for around three-quarters of hard coal consumption in 2007, with the steel industry making up close to 30% of the total. The power sector used a quarter of hard coal. In total, of the combined lignite and hard coal consumption in 2007, power generation accounted for around 46%, industry (including coke ovens and blast furnaces) 44% and households 9%.

5. The scope of this project, conducted by the State Mineral Reserves MTA, was since expanded and renamed the "Development of Mine and Geothermal Spring Reserves and Determination of New Deposits".

Figure 22

Coal Supply by Sector*, 1973 to 2008



Note: Data for 2008 are provided from the results of an improved questionnaire. Significant changes occur in consumption patterns within the iron and steel industry, coal mining as well as across industry, residential and commercial/public services for other bituminous coal. Some coal used in cement kilns is reported under construction instead of non-metallic minerals in 2008. Historical data may be revised in future issues.

* TPES by consuming sector. *Other* includes other transformation and energy sector consumption. Industry includes non-energy use. *Commercial* includes residential, commercial, public services, agriculture/forestry, fishing and other final consumption.

** negligible.

Source: *Energy Balances of OECD Countries,* IEA/OECD Paris, 2009.

Coal, mainly lignite, accounted for over a quarter of total electricity generation in 2008 (57.7 TWh out of a total of 198.4 TWh). The share of lignite in power generation was as high as 47% in 1986 but decreased steadily thereafter until 2004 before rebounding as two new lignite-fired power stations came on line. Of the 57.47 TWh of coal-fired power generation in 2008, domestic coal accounted for 45.1 TWh and imported coal for 12.6 TWh. In 2008, Turkey had some 9 800 MW of installed lignite and coal-fired capacity, around one-quarter of the total (see Chapter 9 on Electricity).

Currently there are 15 sites with coal-fired power plants, and the Energy Market Regulatory Authority (EMRA) has approved applications for an additional 46 coal-fired units, most of which are industrial boilers with less than 20 MW of capacity. Not all these applications will result in investment decisions and new capacity, but Turkey still stands out among OECD countries in foreseeing a large expansion in coal-fired power generation to meet rapid growth projected in electricity demand.

Figure 23

Location of Coal Fields and Coal-Fired Power Plants, 2009

Source: IEA.

POLICY

Turkey is a candidate for EU membership and is moving to harmonise its legislation on coal with EU legislation, while increasing indigenous supply. In accordance with national energy policy, coal policy is based on developing the exploration and exploitation of coal and its economic, secure, reliable and environment-friendly use as one of the country's main indigenous resources. Restructuring of the coal sector has been under way since the 1990s.

The priorities in Turkey's coal sector policies are:

- developing existing indigenous resources;
- utilising known lignite and hard coal reserves through to 2023 for electricity generation;
- increasing the use of domestic coal at power plants;
- restructuring the coal mining sector;
- privatising some inefficient and currently inactive coal mines; and
- promoting the adoption of clean coal technologies in the utilisation of coal in thermal power plants, households and industry.

There are no legal restrictions on private-sector operations and the coal sector is open to foreign investment.

As a party to the Kyoto Protocol, the Turkish government is committed to the global fight against climate change, in accordance with its special circumstances. In this context, Turkey is planning to adopt nationally appropriate mitigation actions and voluntary targets to limit emissions growth and move to a low-carbon energy economy in an economically sustainable manner.

SUBSIDIES

The lignite sector in Turkey does not receive subsidies. The main state-owned lignite producer, Turkish Coal Enterprises (TKI), has since 1995 been able to recover its costs and make a profit.

By contrast, the hard coal sector, with relatively small reserves as compared to the lignite sector, receives very significant state support (see Table 10). Production costs of hard coal from Turkish Hard Coal Enterprises (TTK) were at an average of USD 289 per tonne in 2008; however, the selling prices – set by TTK at levels that reflect import prices – on the domestic market were significantly lower at an average of USD 100 per tonne. The price for iron and steel producers was USD 180 per tonne and USD 50 to 55 per tonne of hard coal used in power generation. Treasury performs capital injection to TTK as a

government subsidy, mainly to recover the cost of labour. In 2008, this subsidy was on average around USD 250 per tonne.

Table 10

State Aid to Turkish Hard Coal Enterprises (TTK), 2004 to 2008

	2004	*2005*	*2006*	*2007*	*2008*
Production *(thousand tonnes)*	1 881	1 666	1 523	1 675	1 586
Total aid *(TRL million)*	382	380	571	399	517
Total aid *(USD million)*	267	282	397	305	398
Aid per tonne *(TRL)*	203	228	375	238	326
Aid per tonne *(USD)*	142	169	261	182	251
No. of employees TTK	12 552	11 249	10 611	10 565	9 697
Aid per employee *(USD)*	21 311	25 054	37 434	28 878	41 053

Source: Under-Secretariat of Treasury, TTK.

EFFICIENCY AND POLLUTION CONTROL

The actual efficiencies of selected large coal-fired power plants are shown in Table 11. They show a significant improvement by the new lignite-fired power plants Çan 18 Mart and Afşin Elbistan B that were commissioned in 2005. They also show, in part, the effects of rehabilitation and modernisation work that was started in 2005. The aim of these rehabilitation projects is to increase the performance and life span of existing power plants.

Higher environmental standards and pollution controls have been put in place in Turkey since the last in-depth review; applicable Turkish legislation now largely follows the EU Large Combustion Plants Directive, albeit with higher current emission limits. The most recent coal-fired power plants have been built either with fluidised-bed technology (Çan 18 Mart) or with flue-gas desulphurisation (FGD) (Afşin Elbistan B). These technologies reduce SO_2 emissions; fluidised-bed technology also reduces NO_x emissions. In addition, several coal-fired plants are being rehabilitated with FGDs, electrostatic precipitators and improvements in ash-handling, although not all coal-fired plants are covered by this initiative because of resource constraints. Privatisation of the generation segment of the electricity market is considered an important tool to improve productivity and environmental performance of existing plants. In this context, it is planned that further environmental upgrades will be incorporated into requirements for new owners, as coal-fired plants are privatised.

Table 11

Large Coal-Fired Power Plants in Turkey, with Thermal Efficiencies of Selected Plants

Name	*Owner*	*Capacity, MW_e*	*Units, MW_e (commissioned)*	*Pollution control*	*Plant efficiency, % LHV, net output*					
					2003	*2004*	*2005*	*2006*	*2007*	*2008*
Afşin Elbistan A	EÜAŞ	1 355	3 x 340 (1984-86) 1 x 335 (1987)		28.9	27.3	27.2	30.2	31.1	30.4
Afşin Elbistan B	EÜAŞ	1 440	4 x 360 (2005)	FGD	–	–	–	34.5	35.7	37.3
Biga	Icdas AS	135	1 x 135 (2006)	CFBC						
Çan 18 Mart	EÜAŞ	320	2 x 160 (2005)	CFBC	–	–	–	41.5	39.5	39.1
Çatalağzi B	EÜAŞ	300	2 x 150 (1989/91)		32.0	30.9	30.7	27.4	28.2	27.6
Çayirhan	EÜAŞ (Operated by Park Termik Elektrik under Transfer of Operating Rights Agreement)	620	2 x 150 (1987) 2 x 160 (1998/99)	FGD						
İskenderun (Sugozu)	Evonik Steag AG / Oyak Group (Build-Operate Model)	1 320	2 x 660 (2003)	FGD/LNB						
Kangal	EÜAŞ	457	2 x 150 (1989/90) 1 x 157 (2000)	FGD (unit 3)	30.0	30.6	30.4	29.7	29.5	29.2
Kemerköy	EÜAŞ Subsidiary	630		FGD	33.1	33.2		34.9	34.2	32.9
Orhaneli	EÜAŞ	210	1 x 210 (1992)	FGD	38.2	39.1	38.5	35.9	33.9	35.2
Soma A	EÜAŞ Subsidiary	44	2 x 22 (1957/58))		30.5	28.6	27.5	27.5	28.7	28.3
Soma B	EÜAŞ Subsidiary	990	2 x 165 (1981/82) 2 x 165 (1985/86) 2 x 165 (1991/92)		32.5	30.8	29.2	30.4	31.5	30.3

... / ...

Table 11

Large Coal-Fired Power Plants in Turkey, with Thermal Efficiencies of Selected Plants (continued)

Name	*Owner*	*Capacity, MW_e*	*Units, MW_e (commissioned)*	*Pollution control*	*Plant efficiency, % LHV, net output*					
					2003	*2004*	*2005*	*2006*	*2007*	*2008*
Seyitömer	EÜAŞ	600	2 x 150 (1973) 2 x 150 (1977/89)		33.4	33.2	32.8	34.1	32.6	34.2
Tunçbilek A	EÜAŞ	65	1 x 65 (1956)		30.8*	33.0	34.9	31.2	35.6	33.2
Tunçbilek B	EÜAŞ	300	2 x 150 (1977/78)							
Yatağan	EÜAŞ Subsidiary	630	3 x 210 (1982-84)	FGD	32.6			33.2	31.6	33.0
Yeniköy	EÜAŞ Subsidiary	420	2 x 210 (1986/87)	FGD	35.5			39.2	35.8	37.3
Zonguldak A	Eren Holding	(160)	1 x 160 (to be commissioned in 2010)	CFBC						
Zonguldak B	Eren Holding	(1 200)	2 x 600 (to be commissioned in 2010-11)	CFBC						
TOTAL, all coal-fired plants		**9 836**								

CFBC – circulating fluidised-bed combustor; FGD – flue-gas desulphurisation; LHV – lower heating value (net calorific value); LNB – low-NOx burners.

*The efficiency figures for Tunçbilek represent average values of A and B units.

Sources: Ministry of Energy and Natural Resources; Energy Market Regulatory Authority, IEA Clean Coal Centre CoalPower5 database and EÜAŞ.

INDUSTRY STRUCTURE

The key lignite producers, namely Turkish Coal Enterprises (TKI) and Electricity Generation Co. Inc (EÜAŞ), are state-owned. The private-sector share in production has increased since 2005 and now accounts for around 10% of total production. Private companies have rights to some TKI and EÜAŞ production through mechanisms including leasing, transfer of operating rights, and contractor mining.

TKI receives no direct subsidies and its restructuring continues, with the aims of improving productivity, consolidating TKI's operational units and facilities, and increasing the involvement of private-sector utilities by offering loss-making small mines and leasing currently unexploited reserves suitable for electricity generation to the private sector.

Production at eight small TKI mines ceased; they were leased to the private sector between 2002 and 2006. One unexploited deposit (Çankiri-Orta) was sold to the private sector and three mines (Bolu-Göynük, Tekirdağ-Saray and Bursa-Davutlar) were leased to the private sector to produce coal for electricity generation. The Energy Market Regulatory Authority awarded Bolu-Göynük a licence for power generation and the environmental impact assessment of the project was approved. However, Tekirdağ-Saray and Bursa-Davutlar failed to secure approval of an environmental impact assessment.

At the beginning of 2008, TKI had 15 active, 10 leased and 18 inactive mines with operating licences. The policy of leasing unexploited deposits to the private sector, or transferring the licences back to the government office if not successfully tendered, continues.

In March 2007, the Elbistan-Çöllolar lignite deposit was tendered to the private sector by EÜAŞ to supply coal for the Afşin Elbistan B power station. A tender for Afşin Elbistan C and D power stations was made in June 2008, with the following major incentives provided to investors:

- the State will finance all expropriation costs, *i.e.* the costs related to the purchase of land for use, except the cost for power station location; and
- the State will guarantee purchases for 15 years for power plants that will start operation at the latest in 2014.

EÜAŞ cancelled the tender, upon evaluation of the bids. Studies are under way for a new tender.

Following the 2004 Mining Law, TTK is also able to transfer its rights to private undertakings under a royalty payment arrangement and some mines have indeed been transferred to private undertakings. Private companies have increased their share in hard coal production, from 23% in 2005 to nearly 40% in 2008.

CRITIQUE

In 2008, coal accounted for 29% of TPES, slightly over half of which was domestic production. Turkey produces both hard coal and lignite, but lignite production of almost 77 Mt makes a far more substantial contribution to security of energy supply. Lignite production in Turkey has risen since the last in-depth review, driven by the increase in demand from the power sector, in particular from two new lignite-fired power stations, Çan 18 Mart and Afşin Elbistan B. Domestic production of hard coal, at 2.6 Mt, covers less than 12% of total hard coal consumption and relies on large subsidies to compete with imports.

Turkey stands out among OECD countries in foreseeing a large expansion in coal-fired power generation to meet rapid growth in electricity demand. The development of indigenous resources is a priority for the Turkish government. The use of coal (and especially of lignite) increases energy security, but also creates risks of both local environmental pollution and in terms of overall greenhouse gas emissions. Environmental and climate change issues should be fully taken into account when assessing the competitive position of lignite/coal in the power generation mix. Defining policy on carbon pricing will be important to give clear signals to private investors in the sector.

The government has taken commendable steps since 2005 to increase the efficiency of EÜAŞ's existing coal-fired plants and to introduce tighter environmental standards. It will be an imperative to continue and intensify these efforts, and to accelerate the development and deployment of cleaner coal technologies.

Carbon dioxide capture and storage is a key option that Turkey should explore, building on its long-standing experience of using CO_2 for enhanced oil recovery from the Bati Raman heavy-oilfield near Diyarbakir. For example, prudent steps can be taken today at low cost that would enable the future retrofit of capture technologies at new coal-fired power plants, once the technologies are proven and affordable. Given the projected growth in lignite production, technologies developed in Germany and Australia to dry this fuel, and thus increase its calorific value, should be examined to assess their suitability and cost-effectiveness for application in Turkey.

Turkish Coal Enterprises (TKI), the state-owned company that produced 48% of domestically mined lignite in 2008, receives no direct subsidies and since 1995 has been able to recover its costs and make a profit. To increase the efficiency of mining operations, Turkey has commendably allowed the private sector to participate through leasing, transfer of operating rights and contractor mining. However, state support to Turkish Hard Coal Enterprises (TKK) reached almost USD 400 million in 2008 – more than USD 40 000 for each member of the TTK workforce – with marginal benefits to security of energy supply.

In a positive development, the State Planning Organisation and the Under-Secretariat of Treasury have introduced new measures to improve the financial viability of state-owned energy enterprises, and TTK has made efforts to structure its activities to increase productivity. More recently, an action plan study was launched with the participation of MENR.

Yet, although always politically difficult, phasing out subsidies is the recommended line to take for the hard coal sector. The economic resources can be used for other purposes to the greater benefit of the Turkish economy. The Turkish authorities should move in this direction as soon as practicable, drawing on similar experience in a number of IEA member countries. The world coal market is competitive and liquid, and relying on imported hard coal would not affect the reliability of coal-fired power generation. Separately, the government can continue to grant substantial aid to alleviate the social impacts of a shrinking hard coal industry.

RECOMMENDATIONS

The government of Turkey should:

- *Continue to pursue efficiency improvements at existing coal-fired plants; ensure the strict observance of environmental regulations governing the operation and restoration of mine sites and emissions from coal-fired power plants.*
- *Use the licensing regime and, where applicable, international mechanisms to reduce greenhouse gas emissions to encourage take-up of more efficient generation technologies for new coal-fired generation capacity, including lignite-drying technologies and measures to ensure that carbon capture and storage (CCS) technologies can be retrofitted, when available and economically reasonable.*
- *Reduce subsidies for hard coal production and set a date for their complete elimination, as part of the action plan for the restructuring of TTK; replace subsidies with assistance to alleviate the social impacts of restructuring the hard coal industry.*

SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

Primary supply of renewable energy has been on a downward trend since peaking in the mid-1990s, from more than 11 Mtoe to 9 Mtoe in 2008. This decrease has resulted from the decline in the traditional use of fuelwood for heating, as the country has switched to more modern forms of energy, and from the rapid growth in primary energy demand. The share of renewable energy in TPES has also decreased, falling from around 17% in the mid-1990s to 9.5% in 2008 (see Figure 24), putting Turkey in the 10th position among the 28 IEA countries (see Figure 25). For comparison, renewable energy sources account for more than 40% of TPES in Norway (mainly hydropower) and around one-third in New Zealand and Sweden. In Turkey, biomass continues to provide a good half of the total renewable energy supply, while hydropower accounts for most of the rest. Renewable energy production thus varies depending on the hydrological conditions. The share of geothermal, wind and solar energy are small, but expected to rise fast.

ELECTRICITY GENERATION

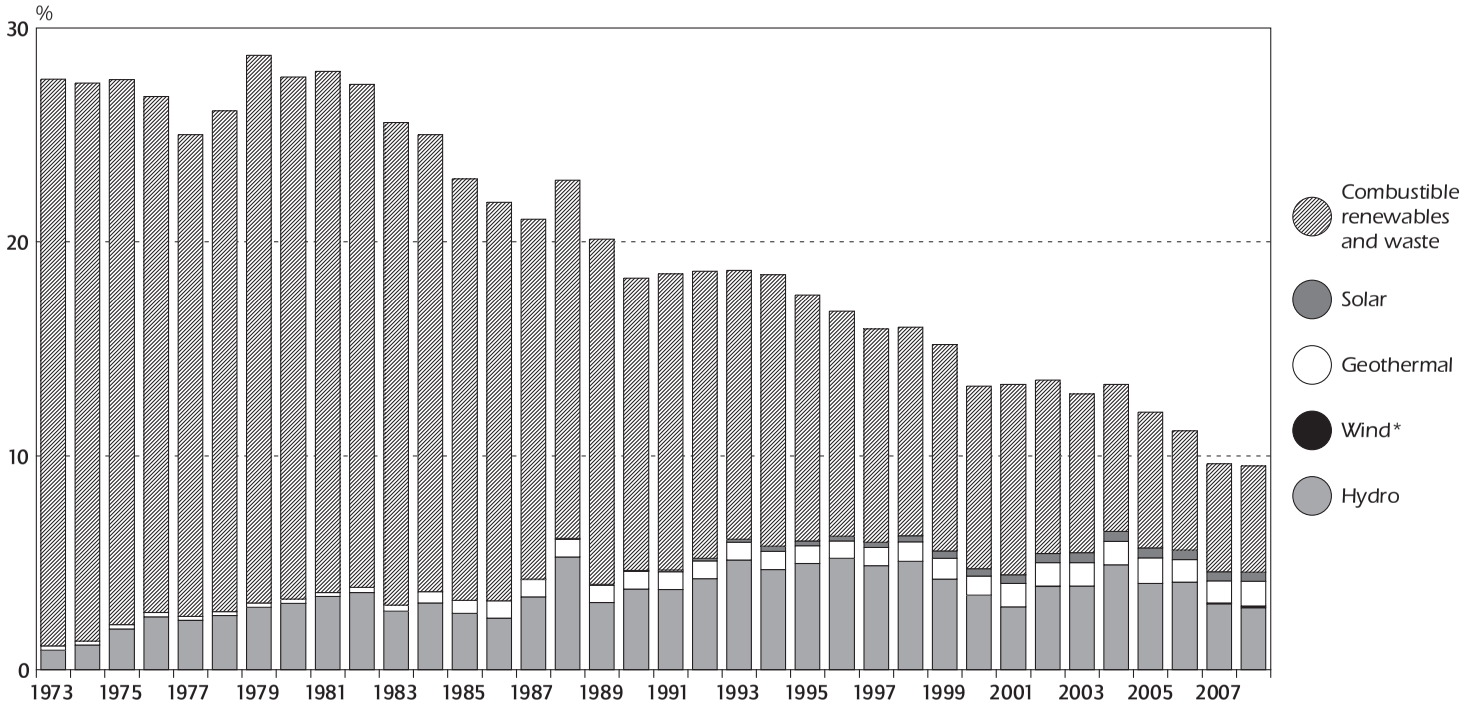
In 2009, renewable sources provided 37.8 TWh of electricity, or 19.6% of the total power generation in Turkey, which is the 12th highest share among the 28 IEA countries (see Figure 26). Hydropower accounted for 95% (35.9 TWh) of this total and wind power for 4% (1.5 TWh). The remaining 1% came from biomass (0.3 TWh) and geothermal energy (0.5 TWh). Hydropower generation varies according to rainfall and since 2000 has ranged from the low of 24 TWh in 2001 to the high of 46 TWh in 2004.

According to the TSO, renewable electricity capacity reached 15 433 MW in December 2009, a good fifth more than in 2000. Hydropower capacity amounted to 14 553 MW and wind power to 803 MW. According to EMRA, Turkey has around 14 000 MW of hydropower capacity and 2 500 MW of wind power under construction. As of December 2009, construction was still to be started on hydropower projects amounting to around 2 500 MW and wind power projects amounting to close to 2 186 MW. In contrast, Turkey has less than 200 MW of generating capacity using solid biomass, geothermal, biogas and industrial waste.

Turkey has large potential for increasing power generation from renewable sources. The government has estimated the technically viable potential for

Figure 24

Renewable Energy as a Percentage of Total Primary Energy Supply, 1973 to 2008

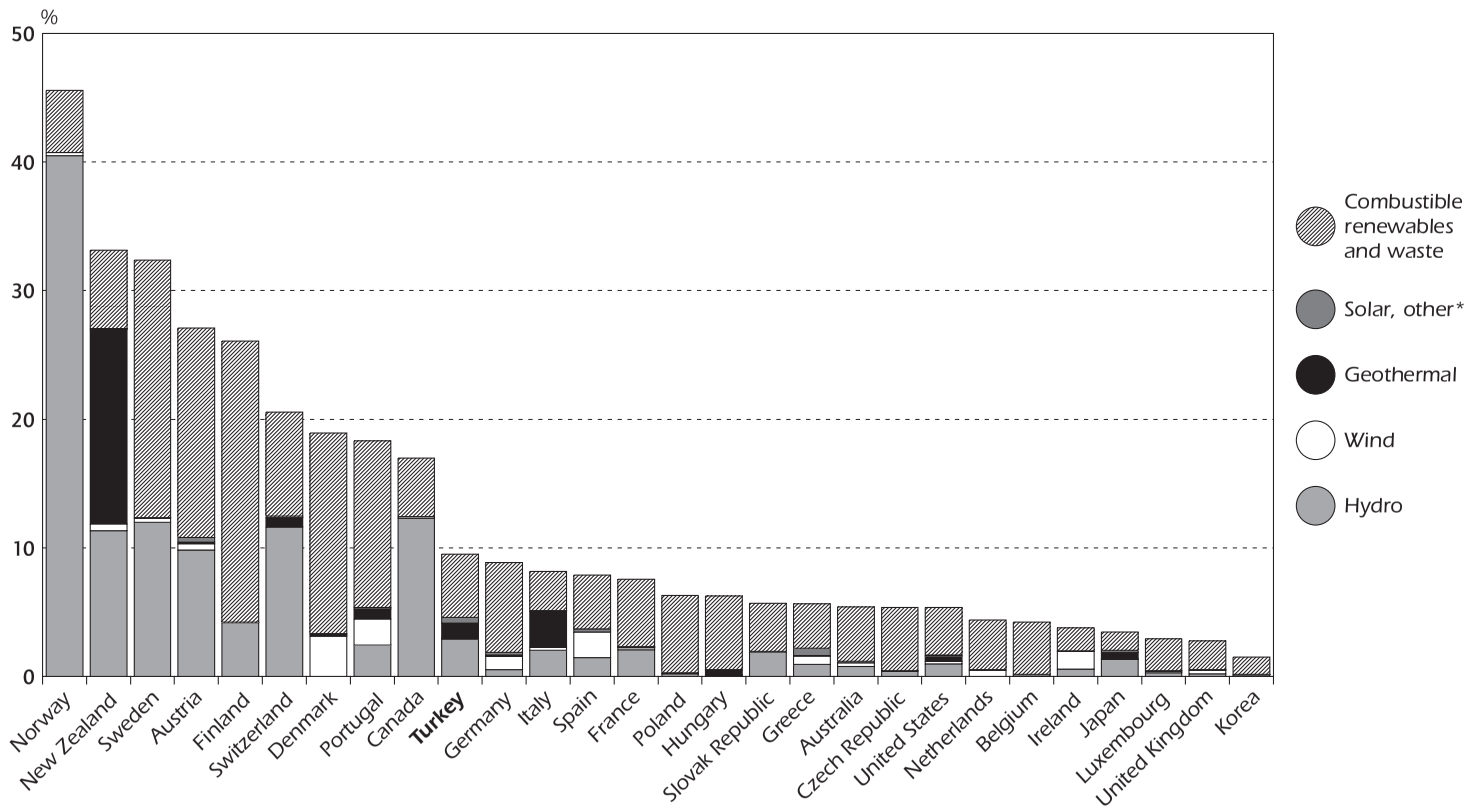


* negligible.

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2009.

Figure 25

Renewable Energy as a Percentage of Total Primary Energy Supply in IEA Member Countries, 2008

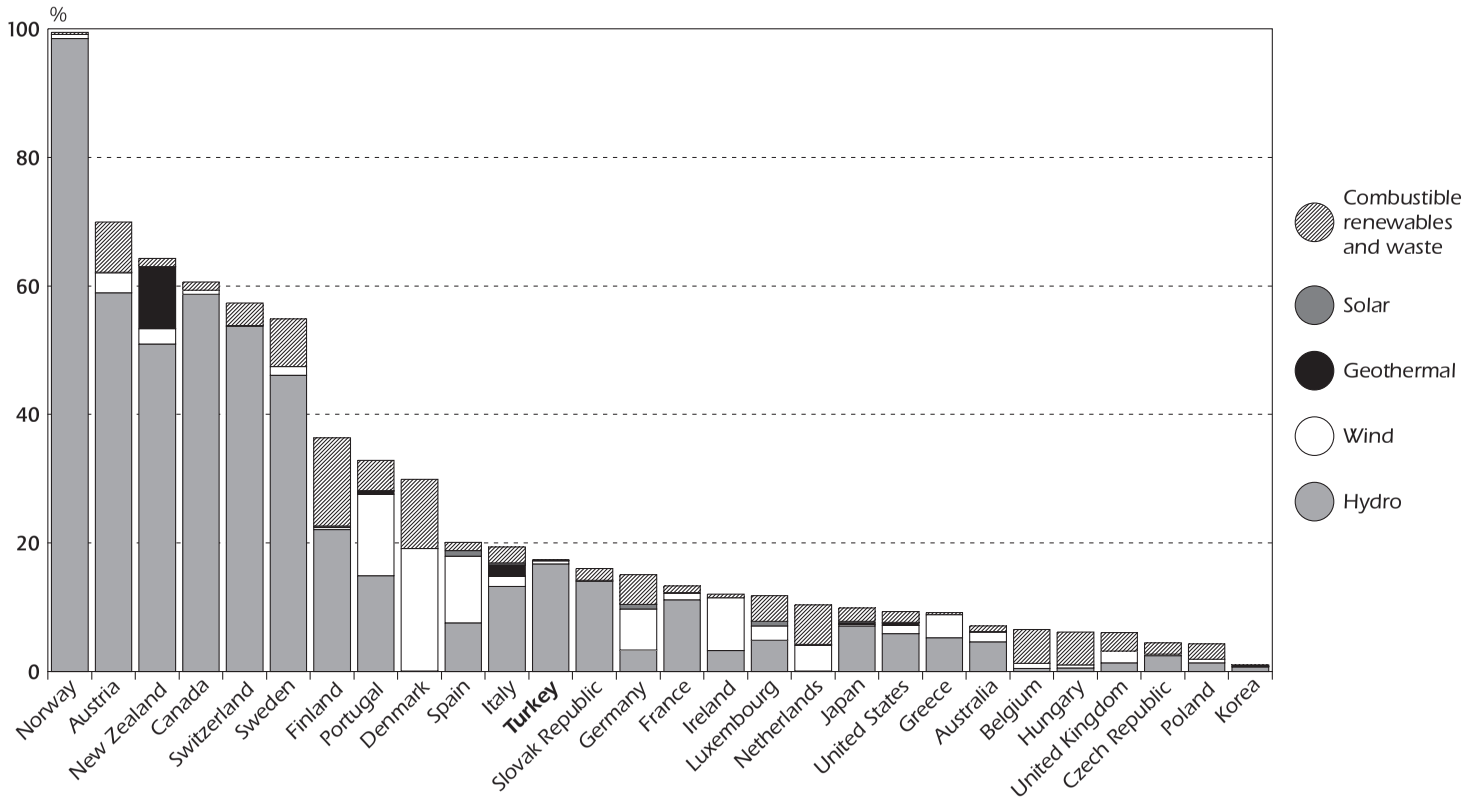


* *other* includes tide and wave.

Source:*Energy Balances of OECD Countries*, IEA/OECD Paris, 2009.

Figure 26

Electricity Generation from Renewable Energy as a Percentage of All Generation in IEA Member Countries, 2008



Source: *Energy Balances of OECD Countries,* IEA/OECD Paris, 2009.

hydropower generation to be 216 TWh, more than five times the generation in 2009. The government has prepared national atlases to map the potential for wind, solar and geothermal energy. The wind atlas indicates a technical power generating capacity of 48 GW and the geothermal atlas 600 MW. Photovoltaic applications have a total capacity of around 2 MW and are mainly used where transmission of electricity is not economically feasible. Wider use is anticipated, depending on the developments in the price and efficiency of the appliances.

In its Electricity Market and Security of Supply Strategy, approved on 18 May 2009, the government outlines an overall target for renewable sources to provide at least 30% of electricity generation by 2023. Targets by mode of generation are detailed below under Policies and Measures.

HEAT

Firewood is the largest source of heat from renewable sources. In 2008, 5.0 Mtoe of firewood was used for residential heating in rural areas. Other forms of biomass are negligible. The second-largest source of heat from renewable sources is geothermal, 0.9 Mtoe of which was used in 2008. Turkey ranks among the leaders worldwide in the direct use of geothermal heat. District heating systems in 17 municipalities, with a total capacity of 728 MW_{th}, use geothermal energy to serve around 81 060 residences. Geothermal energy is also used in 215 spas (402 MW_{th}) and greenhouses (379 MW_{th}). Turkey's total installed capacity for geothermal heat increased from 1 131 MW_{th} in 2005 to 1 509 MW_{th} in 2010. The country's untapped technical potential remains very large at 31.5 GW_{th}, according to government estimates.

The third source for heat from renewable sources is solar energy, the use of which amounted to 0.4 Mtoe in 2008. Two-thirds of this was used in the residential sector and the rest in industry. Significant potential remains, as Turkey's 12 km^2 of solar collectors (equivalent to 8 400 MW_{th}[6]) utilise only slightly more than one per cent of the country's technical potential for solar energy, which the government estimates at 380 TWh, or 32.6 Mtoe.

BIOFUELS FOR TRANSPORT

Biofuels use for transport is marginal and amounted to 15 kt in 2008, most of which was domestic biodiesel.

6. Applying the conversion factor of 0.7 $kWth/m^2$ of solar collector area, as agreed upon by the IEA Secretariat and the IEA Solar Heating & Cooling Programme.

INSTITUTIONS

The Ministry of Energy and Natural Resources (MENR) is responsible for policy making. Within MENR, the General Directorate of Energy Affairs (EIGM) conducts studies and develops policies on renewable energy. The Electrical Power Resources Survey and Development Administration (EIE) is responsible for surveys and research on renewable energy sources. The Energy Market Regulatory Authority (EMRA) regulates and supervises the electricity market and also monitors the progress in the renewable energy segment of the market.

POLICIES AND MEASURES

OVERVIEW

Turkey aims to utilise its energy potential, including from renewable sources, in a cost-effective manner. In its efforts to promote renewable energy, the government has focused on electricity, but has recently started to pay more attention to heat (geothermal and solar). Biofuels for transport, in turn, are hardly used, and remain marginal in the policy debate.

Turkey does not have legally binding targets for primary renewable energy supply. The country has, however, included several targets for electricity from renewable sources in its 2009 Electricity Market and Security of Supply Strategy.

ELECTRICITY

Targets

In the 2009 Electricity Market and Security of Supply Strategy, the government outlines large increases in renewable electricity capacity by 2023. Renewable sources should generate at least 30% of all electricity by that year. All economically available hydropower potential should be harnessed and the government has estimated this potential to be 140 TWh, four times generation in 2009. Wind power capacity should increase to 20 GW, or 42% of the estimated technical capacity of 48 GW. The 600 MW economical potential for geothermal power capacity should be exploited in full. Solar energy use for power generation should also be increased. These targets may, however, be revised, depending on developments in technology, markets and resource potential.

Legislation

The cornerstone of Turkey's legislation on electricity from renewable sources is the Law on the Utilisation of Renewable Energy Resources for the Purpose of Generating Electricity, enacted in May 2005, and its subsequent amendments. Also relevant are the 2001 Electricity Market Law and the 2007 Energy Efficiency Law. Together, they set the legal framework for promoting electricity generation from renewable sources and include the following main instruments:

- Feed-in tariffs and purchase obligations;
- Connection priority;
- Reduced licence fees;
- Exemptions from licence obligation for small-scale generators;
- Reduced fees for project preparation and land acquisition.

Since 2007, all these support mechanisms are in force for ten years, compared to seven years before.

Feed-in tariffs

Since 2007, power plants that have been in operation for ten years or less are eligible for feed-in tariffs. This applies to power plants to be commissioned before 2013. The feed-in tariff applies to all forms of renewable energy, including large hydropower. The tariff equals the average wholesale price of the previous year, as defined by EMRA, and is lower bounded to the equivalent of EUR 5 cents per kWh and limited to the equivalent of EUR 5.5 cents per kWh. For 2010, EMRA has set the tariff at TRL 0.1332/kWh.

Generators may also sell their output on the spot market or via bilateral contracts with eligible customers. In practice, average wholesale prices have been close to the maximum feed-in tariff since 2007, and sometimes higher than the feed-in tariff, for example in late 2008 (see Chapter 9).

The government presented to the Parliament in November 2008 a draft amendment to the 2005 Renewable Electricity Law. The draft amendment considers different feed-in tariffs for each renewable energy source.

Purchase obligation

Electricity retailers must sell electricity from renewable sources in proportion to their share of the domestic market in the previous year. They have to meet this obligation by buying electricity from eligible generators, *i.e.* those that have been in operation for ten years or less.

Connection priority

The 2001 Electricity Market Law obliges TEIAŞ the Turkish Electricity Transmission Corporation, and the distribution companies to give priority to renewable energy plants regarding connection to the grid.

Reduced licence fees

Renewable electricity generators pay 99% less for the initial licensing fee than non-renewable electricity generators. They are also exempted from the annual licence fee during the first eight years of operation.

Exemptions from licence obligation for small-scale generators

Small generators (with a capacity of 0.5 MW or less) are exempted from licensing and company obligations.

Reduced fees for project preparation and land acquisition

New renewable energy plants commissioned before the end of 2012 are given an 85% discount on several land-use fees during the first ten years of operation. This applies to fees on permission, rent, right of access and land-use when the land is owned by the General Directorate of Forestry or the Under-Secretariat of Treasury. The 85% discount also applies to fees on investments in the transportation infrastructure and on power lines to the connection point to the grid.

Grid integration

The 2009 Electricity Market and Security of Supply Strategy foresees large increases in wind power capacity by 2023. The resulting increases in variable power generation require upgrading the electricity system, in terms of grid connections, transmission system reinforcement and grid management. TEIAŞ, the transmission system operator, has prepared an investment plan to accommodate 15 GW of wind power and is working to ensure grid reliability and stability (see Chapter 9). Technical criteria for the connection of wind turbines to the grid were included in the Grid Code in September 2008.

EMRA has developed a road-map for receiving and evaluating applications for wind power plants and issuing the related licences. Its licensing decision is preceded by a technical evaluation of the licence application by EİE. If limited transmission capacity does not allow for the construction of several wind power plants in the same grid location, TEIAŞ will tender the project licence to the highest bidder under the Electricity Market Law and the 2007 Energy Efficiency Law.

HEAT

The Law on Geothermal Resources and Natural Mineral Waters was enacted in June 2007. It sets forth the rules and principles for exploring, producing and protecting geothermal and natural mineral water resources, which are the property of the State. A special licence is required for exploration and shall be valid for three years. An operational licence is also necessary to exploit geothermal resources. Operational licences are valid for 30 years and may be extended for up to 10 years. Exploration and operational licences are transferable. Site activities are subject to annual inspections by the General Directorate of Minerals Research and Exploration. The law also regulates the integrated use of geothermal energy, the re-injection of geothermal energy after use, efficiency and environmental protection.

Turkey does not have specific legislation concerning solar energy for heat, and does not offer subsidies or tax incentives for its uptake.

TRANSPORT

Turkey does not have a broad policy on promoting biofuels for transport. To encourage the take-up of biofuels, the government lifted the excise tax on biodiesel in December 2006 (for blends up to 2%), after having introduced this tax in June 2006. Turkey relies on excise taxes on transport fuels for a large part of its budget revenue and biofuels are likely to remain uncompetitive under this fiscal regime.

CRITIQUE

Since the 2005 in-depth review, Turkey's renewable energy supply has remained largely unchanged. The use of firewood for heating, the largest source of renewable energy, is slowly declining, while electricity generation from renewable sources is rising. In relative terms, renewable sources contribute less to total primary energy supply than they did a few years ago, but, commendably, the government has introduced targets and policies that will help to change this downward trend.

Turkey has made substantial progress on the regulatory side to promote renewable energy production. The 2005 Law on the Utilisation of Renewable Energy Resources in Electricity Generation is the cornerstone of its legislation in the sector, and the IEA commends the developments on the legislative aspects. Effective from 1 July 2008, a cost-based pricing mechanism among state-owned energy companies (TKI, BOTAŞ, EÜAŞ, TETAŞ and TEDAŞ) is being applied. This mechanism ensures cost-reflective prices which generate an attractive price level for investors. Legislation on geothermal energy resources was passed in 2008; it will help the country to exploit its significant resources

for heat and power generation. Furthermore, the atlases on the country's wind, solar and geothermal resources give valuable guidance to potential investors.

Turkey's long-term plans to tap its large potential for renewable energy are included in the 2009 Electricity Market and Security of Supply Strategy. The ambitious overall target is to generate at least 30% of electricity from renewable sources by 2023. In absolute terms, this implies a considerable increase in generation, as total electricity generation is expected to at least double by the same year.

To meet the 2023 targets, large investments in grids and generating capacity are needed. Commendably, the World Bank and other international financial institutions are assisting Turkey to improve access to finance, but much work remains for attracting the needed private investment. The key to this is a credible promise of profits.

The current promotion mechanism for renewable sources of electricity relies on a feed-in tariff capped at the equivalent in Turkish liras of EUR 5.5 cents per kWh. The draft amendment to apply different tariff levels for different renewable energy sources is on the agenda of the Parliament.

Turkey should move to implement the draft incentive system in a cost-effective manner. Large hydropower is already, in most cases, competitive relative to conventional fossil fuel-based electricity, but the enhanced feed-in tariffs would undoubtedly facilitate expanding the deployment of other, less mature, renewable energy technologies. Investors would enjoy predictable remuneration over ten years, which fosters their confidence in regulatory certainty. If feedback from stakeholders suggests that the proposed ten-year time horizon is not sufficient, the government should indicate early whether the tariffs will be extended, and preferably also indicate that the tariffs will decrease over time to encourage technologies towards competitiveness. A timely decision on new feed-in tariff levels would also push companies to investing now, instead of waiting in the hope of receiving higher tariffs later.

The government should closely monitor the cost-effectiveness of the feed-in system, and revise it if necessary. In particular, there is a trade-off between diversity of supply sources and cost-effectiveness of the programme. It should closely monitor spending on both renewable energy and energy efficiency, as both are means of meeting the primary energy policy goals of securing supplies, fostering economic growth and protecting the environment.

The government should consider explicitly and transparently limiting the feed-in tariffs for individual technologies. It could do this either by limiting the absolute spending on individual technologies, or by limiting the share of individual technologies in total spending on feed-in tariffs. This would help the government avoid possible feed-in tariff budget overruns and subsequent

abrupt reductions in feed-in tariff levels, as experienced in several IEA countries.

The 2005 law initially involved a feed-in tariff level of wholesale market price plus 20% premium decided by the Council of Ministers. However, as requested by investors, the tariff level has been changed to the current scheme. The IEA encourages the government to assess options for further flexibility in the design of support mechanisms, while ensuring predictability to reduce investor risk.

One such option would be a system of gradually decreasing premium on the wholesale price – the higher the wholesale price, the smaller the premium needed. Such a premium system would provide some revenue guarantees to underpin investment, but also long-term downward pressure on prices. Alternatively, the government could also consider a quota obligation with tradable certificates, differentiated by technology, which has been recently introduced in the United Kingdom.

To succeed in its ambitious plans to increase power generation from renewable sources, Turkey needs to ensure a smooth integration of this new renewable electricity capacity into the grid. The main concern is the inherently variable wind power, as the country's plan is to increase capacity from around 1 GW today to 20 GW by 2023. Expanding hydropower and natural gas capacity will help balance the variations in wind power generation, and so will additional interconnections, but more is needed to ensure the reliability of the electricity system as the share of variable generation increases. The Turkish authorities should therefore carefully monitor the effects on the grid as the implementation of the plan proceeds.

Several other IEA countries have seen very fast growth in wind power capacity, notably Spain and Germany, and Turkey would do well to turn to their experience for guidance. The IEA also recommends that Turkey, and other IEA member countries, consider the recommendations from the wind energy roadmap (see Box 4), as appropriate under the national circumstances.

As in most countries, work remains in the area of overcoming non-economic barriers to increasing renewable energy supply, potentially including administrative hurdles, obstacles to grid access, lack of information and training, and social acceptance issues. The government should continue to remove any remaining non-economic barriers.

Electricity is the clear focus of Turkey's renewable energy policy. However, as the country has large potential for geothermal and solar heat, Turkey should also consider stronger mechanisms to promote the use of renewable energy for non-electricity purposes. Turkey could consider expanding biofuels use for transport, as long as these are produced in a sustainable and cost-effective manner and help reduce greenhouse gas emissions.

Box 4

Key Recommendations of the IEA Wind Energy Roadmap

Set long-term targets, supported by predictable market-based mechanisms to drive investment, while pursuing cost reductions; set mechanisms for appropriate carbon pricing.

Advance planning of new plants to attract investment, taking account of other power system needs and competing land/sea usage.

Appoint lead agencies to co-ordinate advance planning of transmission infrastructure to harvest resource-rich areas and interconnect power systems; set incentives to build transmission; assess power system flexibility.

Increase social acceptance by raising public awareness of the benefits of wind power (including strategic CO_2 emissions reductions, security of supply and economic growth), and of the accompanying need for additional transmission.

Exchange best practice with developing countries; target development finance at wind power deployment bottlenecks; further develop carbon finance options in developing regions.

Source: *Technology Roadmap – Wind Energy*. IEA/OECD Paris, 2009.

RECOMMENDATIONS

The government of Turkey should:

- *Continue efforts to ensure a predictable and transparent support framework to attract investments, while creating technology-specific incentives that will decrease over time.*
- *Design the feed-in tariff to be as flexible and predictable as possible and assess the options to introduce further flexibility in support mechanisms, such as a premium on wholesale price.*
- *Continue efforts to ensure smooth integration of new renewable electricity capacity into the grid.*
- *Continue efforts to remove non-economic barriers to renewable energy development.*
- *Consider stronger policy support for the wider use of solar and geothermal heat and biofuels for transport in a sustainable and cost-effective way.*

SUPPLY AND DEMAND

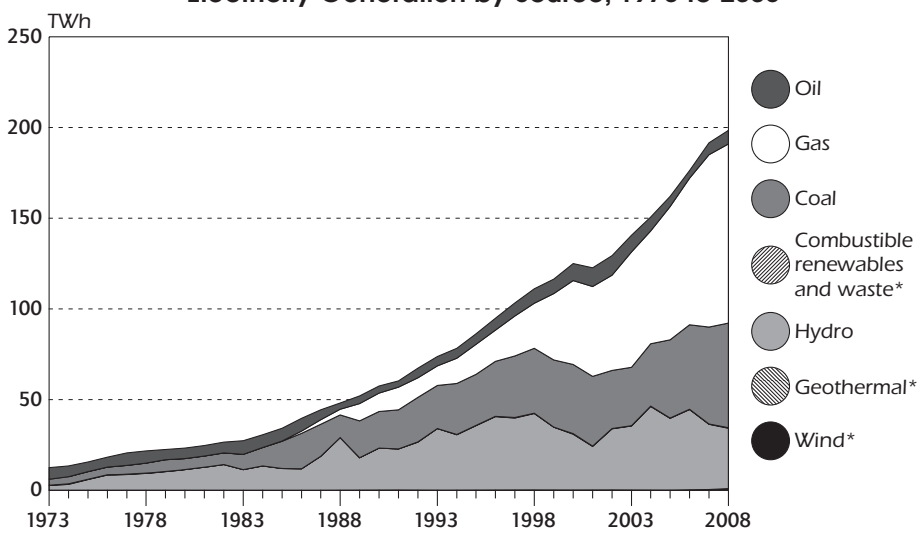
SUPPLY

In 2009, total electricity supply in Turkey reached 194 TWh, up by 51% from 2000. Natural gas fuelled 49% of power generation, while coal provided 28%, hydropower 19%, oil 3% and other sources 1% (see Table 12 below). Following the contraction of the Turkish economy in 2009, electricity supply fell 2% from 2008, but, according to the TSO, has returned to growth in 2010. Turkey is a net exporter of electricity, but on a small scale. In recent years, annual exports have averaged around 2 TWh and annual imports less than 1 TWh.

Electricity generation has more than tripled from 58 TWh in 1990, but the generation mix has remained fairly stable. Coal, gas, oil and hydropower provided all electricity in 1990 and 99% of the total in 2009. Within that group, combined-cycle gas turbines (CCGTs) have been penetrating rapidly; coal-fired generation has also increased markedly, while hydropower and oil have seen their shares decline (see Figure 27).

Figure 27

Electricity Generation by Source, 1973 to 2008



* negligible.

Source: *Energy Balances of OECD Countries,* IEA/OECD Paris, 2009.

From 2000 to 2009, gas-fired generation grew by 48 TWh, accounting for 72% of total incremental power generation. Coal-fired grew by 17 TWh, accounting for a quarter of the incremental demand. Hydropower generation varies according to annual hydrological conditions, and increased by 5 TWh from 2000. Oil-fired generation peaked in 2002 and is steadily declining.

Power generation in Turkey is set to grow strongly over the long term. Government projections that were made before the economic downturn expect total generation to increase by some 300 TWh from 2008 to 2020. These scenarios will be updated in the near future on the basis of the new targets included in the May 2009 Electricity Market and Security of Supply Strategy. The strategy foresees rapid economic growth and large increases in supply from the currently dominant sources, especially hydropower and lignite, but also from wind and nuclear power, a new entrant-to-be to the power mix.

DEMAND

In 2008, total final electricity demand reached 162 TWh (see Figure 28). Demand has grown very rapidly in the past two decades, particularly from 2001 to 2008, averaging 8.8% per year. As a result of the economic contraction, electricity use decreased by around 2% from 2008 to 2009, according to the TSO, but is increasing again in 2010.

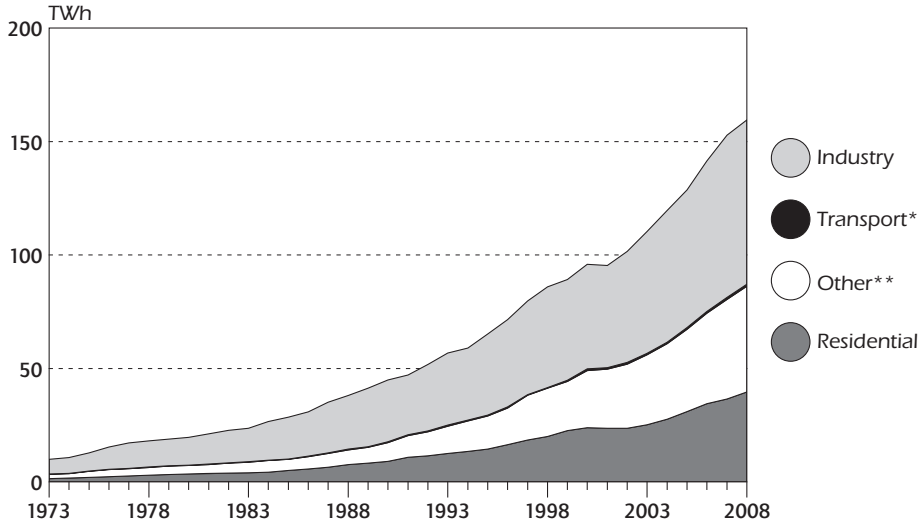
In 2008, industry consumed 46% of electricity, while services, agriculture, forestry and fishing accounted for 29%, households 24% and transport less than 1%. Electricity consumption increased by 55% from 2000 to 2008. Growth was slightly slower in industry (55%) and households (53%), but much faster in the service sector (75%). Annual use per citizen, at around 2.3 MWh, is one-quarter of the IEA average. Air-conditioners and electric heaters are, however, becoming more common and have contributed to the rise in peak demand in recent years.

According to TEIAŞ, the TSO, peak demand rose from 27 594 MW in 2006 to 29 249 MW in 2007 and 30 517 MW in 2008, but declined to 29 870 MW in 2009. Summer demand typically peaks in July-August owing to air-conditioning load, while winter demand usually peaks in December owing to residential heating. Winter peak has traditionally been higher than summer peak, but this difference has gradually decreased. From 2000 to 2008, winter peak demand increased by 56% and summer peak by 66%. In 2008, the summer peak exceeded the winter peak for the first time, by 2%.

The difference between electricity supply and consumption is explained by losses and theft. Turkey has managed to reduce their share in the distribution system from 25% in 2002 to 14% in 2009. By December 2009, some 36.7 million electricity users had been controlled to detect losses and theft and such controls are still in progress.

Figure 28

Final Consumption of Electricity by Sector, 1973 to 2008



* negligible.

** *other* includes commercial, public service, agricultural, fishing and other non-specified sectors.

Source: *Energy Balances of OECD Countries,* IEA/OECD Paris, 2009.

Generating capacity

Total installed capacity reached 44 782 MW by year-end 2009, an increase of 7.1% over 2008 (see Table 12). From 2000 to 2009, total capacity increased by 64%. This was one of the largest increases in IEA member countries, reflecting a significant build-up in CCGTs but also coal and hydro capacity. Together, natural gas, hydropower, oil and coal plants account for 98% of total installed capacity. The margin between total capacity over peak demand capacity is reduced by variations in hydrological conditions and the limited availability of ageing lignite-fired plants.

In order to respond to the strong anticipated growth in power demand, capacity of all forms of power generation will have to increase substantially. In its 2009 Electricity Market and Security of Supply Strategy, the government states its plan to harness the economical hydro and lignite reserves for power generation by 2023. It also sets an overall target for renewable energy to provide at least 30% of power supply by the same year, and sub-targets of 20 000 MW of wind and 600 MW of geothermal capacity. Finally, nuclear power should account for 5% of power supply by 2020. The government is also planning to introduce a capacity mechanism to ensure that investments are made to maintain security of supply.

Table 12

Breakdown of Generation and Capacity by Energy Source, 2009

Energy source	*Generation. TWh*	*Share, %*	*Capacity, MW*	*Share, %*
Natural gas	94.4	48.6	16 345.2	36.5
Domestic coal	42.2	21.7	8 691.3	19.4
İmported coal	12.8	6.6	1 921.0	4.3
Hydropower	35.9	18.5	14 553.4	32.5
Liquid fuels (oil)	6.6	3.4	2309.7	5.2
Wind, geothermal, biogas	2.2	1.1	961.2	2.1
Total	**194.1**	**100**	**44 782**	**100**

Source: Turkish Electricity Transmission Corporation (TEIAŞ).

MARKET REFORM

Turkey is gradually reforming its electricity sector in order to ensure an efficient and cost-effective supply of electricity through a competitive market and private-sector participation. The legal framework is based on the 2001 Electricity Market Law and its 2008 amendments, and secondary legislation on licensing; tariffs; grids; distribution; imports and exports; and balancing and settlement.

Turkey is also planning wider reforms in the electricity sector. These plans are outlined in the Electricity Market and Security of Supply Strategy of May 2009. The strategy's main focus is on security of supply, including a capacity mechanism and targets to utilise domestic sources for power generation. The strategy, however, also covers market design and includes a road-map for implementing a new wholesale market regime.

Since the enactment of the 2001 law, Turkey has unbundled the government-owned incumbents into different business activities (transmission, generation, distribution, wholesale trading and retail supply). It has created an independent energy regulator (EMRA) and implemented a licensing regime. It has also started to privatise the state-owned distribution and generation businesses; and taken steps to create competitive wholesale and retail markets.

The 2001 law created EMRA as the regulator of the electricity market. EMRA has several tasks. It issues licences, determines and approves regulated tariffs; sets the eligibility limit for market opening; drafts secondary legislation on the electricity market; resolves disputes; and applies penalties.

EMRA has the powers to issue licences for all market activities: generation; transmission; distribution; wholesale; and retail. Separate licences are required for each market activity and for each facility where the activity is carried out. Separate accounts are required for all licensed activities and facilities, and regions; for sales to eligible consumers and sales to captive consumers; and for non-market activities. Generation, distribution and transmission licences are granted for at least 10 years and not more than 49 years, which is also the maximum duration of wholesale, retail and imports and export licences.

The gradual opening of the electricity market began in March 2003, when all consumers directly connected to the transmission network and those consuming more than 9 GWh per year became free to choose their supplier. EMRA defines this eligibility threshold for a year at a time. In 2010, the threshold is set at 0.1 GWh, corresponding to a market opening level of 63%. The 2009 Electricity Market and Security of Supply Strategy envisions full eligibility for industrial users by the end of 2011 and for non-industrial users by the end of 2014.

The transmission system operator TEİAŞ and the distribution system operators are obliged to provide non-discriminatory transmission and connection services to all system users, including eligible consumers connected and/or to be connected to the transmission system. The necessary investment for constructing new lines and other facilities may be made or financed by the licence applicant. The facilities would be owned by TEİAŞ or the distribution system operator, and the investment would be paid back to the licence applicant in less than 10 years from the start of operation.

MARKET DESIGN

Turkey's electricity market model combines bilateral agreements that are expected to cover the bulk of electricity demand with day-ahead and real-time balancing mechanisms as well as a settlement system for imbalances.

Within the scope of the balancing and settlement implementations, two different prices were produced, namely, an hourly marginal price and a system imbalance price. The hourly marginal price was calculated on an hourly basis and announced daily through the website of TEİAŞ. Theoretically, this price was the market price indicating the supply-demand situation of the energy.

After August 2006, when the Transitional Balancing and Settlement Regulation came into force, suppliers selling electricity through bilateral contracts terminated their contracts with the consumers and started to sell power to the balancing market. According to EMRA, from September 2006 to May 2008, the volume of electricity trade based on bilateral contracts fell by 38%. Prices and demand volumes in the balancing market have been attractive to generators, because high growth in demand has led to supply shortages which in turn have forced the system operator to purchase electricity from the balancing market. Demand has grown fast partly also because regulated end-user tariffs have been artificially low and at times below generating costs. The introduction of cost-reflective tariffs, together with tariff increases in 2008 improved the situation, but the generating capacity remained tight during 2008 and early 2009. Slow-down in demand growth during 2009 eased the supply-demand balance.

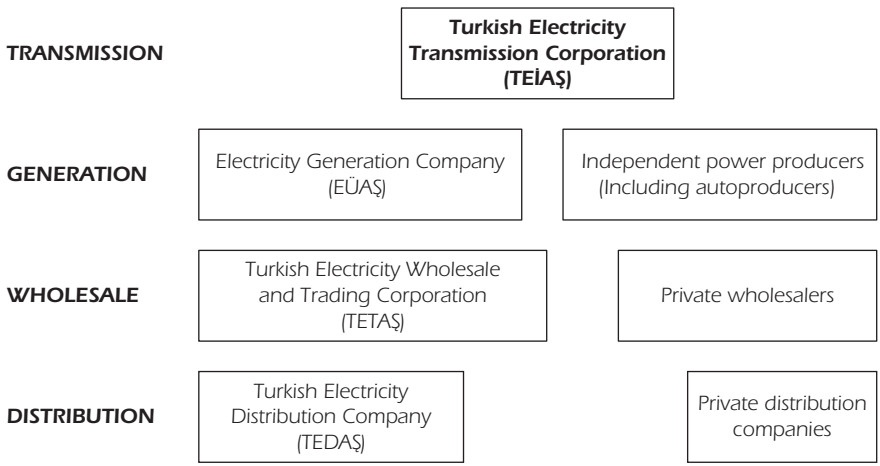
To make the wholesale market function better, the government has decided on a two-step reform. First, the existing transitional balancing and settlement

mechanism was replaced by the Final Balancing and Settlement Regulation (N-DUY). The balancing market is divided into two parts: the "day-ahead planning" for use in the day-ahead trade, with the primary aim of providing a stabilised system for the system operator TEIAŞ on the previous day; and the "balancing power market" which serves the real-time balancing of supply and demand. Two sets of hourly prices are being generated, namely the day-ahead price and the real-time system marginal price. This process, whereby imbalances are settled on an hourly basis, is effective as of 1 December 2009. As part of the reform, active participation of the demand-side in the market will be ensured.

The second phase of the transition, expected by 1 January 2011, entails switching from day-ahead planning to the "day-ahead market," which is a spot market where market participants will carry out activities towards the goal of balancing their own portfolios and providing a stabilised system for TEIAŞ on the previous day. The practice of hourly reconciling imbalances in the real-time balancing power market will continue. Following this transition, over the medium term, a futures market is also planned.

Figure 29

The Structure of the Electricity Market



Source: Ministry of Energy and Natural Resources.

In addition to a new wholesale market system, a capacity mechanism will be developed to ensure adequate supply capacity. Furthermore, if electricity investments do not meet the demand and/or if peak demand is not met by the capacity, including reserve, a centrally organised tender could be employed upon the decision of the Council of Ministers. If the result of the tender does not ensure sufficient supply, the Council of Ministers may authorise state-owned generation companies to build new power plants.

INDUSTRY STRUCTURE

The Turkish electricity industry has been dominated by large, publicly owned and vertically integrated companies but the situation is changing. Until 2001, the private sector was able to participate in generation, transmission and distribution through three different modes, namely Build-Operate-Transfer (BOT), Build-Own-Operate (BOO) and Transfer of Operating Rights (TOOR).[7] The 2001 law introduced market liberalisation and abolished these modes, but legal obligations arising from them still remain (see Tables 13 and 14).

Table 13

Breakdown of Generation and Capacity by Company, 2009*

Company	*Generation. TWh*	*Share, %*	*Capacity, MW*	*Share, %*
Electricity Generation Corporation EÜAŞ	89. 5	46.1	24 203	54.0
Independent power producers	28.7	14.8	7 510	16.8
Build-Own-Operate	43.8	22.5	6 102	13.6
Autoproducers	13.9	7.2	3 615	8.1
Build-Operate-Transfer	13.9	7.2	2 439	5.4
Transfer of operating rights	4.3	2.2	650	1.5
Mobile	–	–	263	0.6
Total	**194.1**	**100.0**	**44 782**	**100.0**

* provisional.

Source: Turkish Electricity Transmission Corporation (TEİAŞ).

The 2001 Electricity Market Law led to the unbundling of the incumbent TEAS into three companies, namely EÜAŞ (generation), TEIAŞ (transmission) and TETAS (wholesale). TEDAŞ, the distribution monopoly, had been formed in 1994. The 2001 law decreed TEIAŞ as the sole transmission and market operator, and allowed direct participation by the private sector in all other segments of the industry.

Privatisation started with the restructuration of TEDAŞ in 2005; the company was divided into 20 distribution companies. The first eleven of these companies were tendered and four of them transferred to the private sector. The government is aiming to complete the privatisation of all regional power distribution networks by the end of 2010. Distribution companies are the monopoly suppliers to ineligible consumers and they must unbundle their generation and retail activities into separate companies by the beginning of 2013.

7. In the BOT schemes, private investors build power plants and operate them for a given time. Transfer of the plants to government ownership occurs after the depreciation period, generally after 15 or 20 years of operation. In the BOO schemes, electricity generated is sold to TETAS under long-term power purchase agreements, but the investors remain the owners of the power plants. Under the TOOR mode, the private sector operates, but does not own, energy infrastructures.

Table 14

New Generating Capacity by Type of Ownership, 2003 to 2009

	2003	*2004*	*2005*	*2006*	*2007*	*2008*	*2009**	*Total*
Private	337	488	1 124	686	759	876	2 753	7 023
Public	410	-	795	1 132	301	106	212	2 956
BOO	2 994	798	-	-	-	-	-	3 792
BOT	-	-	100	-	-	-	-	100
Total	**3 741**	**1 286**	**2 019**	**1 818**	**1 060**	**982**	**2 965**	**13 871**

* provisional.

Source: Turkish Electricity Transmission Corporation (TEIAŞ).

The largest generation company is the state-owned EÜAŞ which controlled around half of all installed capacity in 2009. Independent power producers had 17% of total capacity in 2009. Together with autoproducers, they accounted for 52% of the incremental capacity from 2003, opening the electricity market to 2009 (see Tables 13 and 14). BOO, BOT and TOOR power plants (with long-term purchase agreements with TETAŞ) had 20.5% of capacity.

The government plans to privatise a significant share of state-owned generation assets. The Privatisation Administration (OIB) is working with the Ministry of Energy and Natural Resources on a plan to launch the privatisation of state-owned power plants in 2010. By the time of writing, the structure of these privatisations remained to be determined. Generation privatisation would include around 16 GW of state-owned capacity. By law, the market share of any privately owned company is limited to 20% of the total generating capacity in the previous year. The generation company ADÜAŞ, a former affiliate of EÜAŞ with an installed capacity of 141.4 MW was privatised and licensed already in 2008.

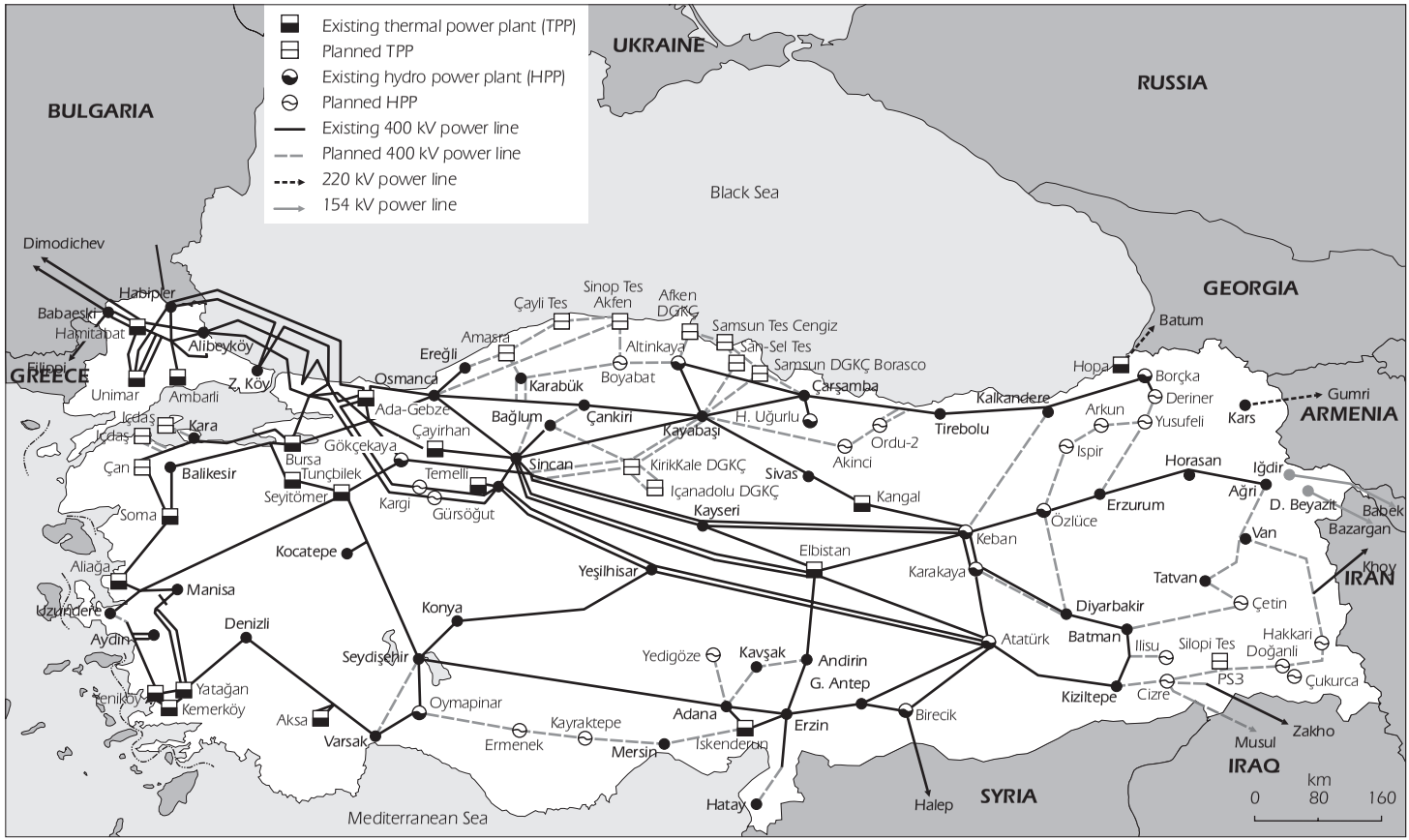
The only state-owned wholesale company is TETAŞ, with a market share of around 43% in 2009. By March 2010, there were 45 wholesale licence-holders. By law, the market share of any privately owned company is limited to 15% of the total wholesale volume in the previous year.

TRANSMISSION

TEİAŞ is the publicly owned enterprise that owns and operates the transmission system. It also operates the electricity market and is legally unbundled. By the end of 2009, the 400-kV high-voltage grid had reached 14 623 km with 34 720 MVA transformer capacity (see Figure 30).

Figure 30

Map of the Electricity Transmission Network



The boundaries and names shown and the designations used on maps included in this publication do not imply official endorsement or acceptance by the IEA.

Source: Ministry of Energy and Natural Resources.

CROSS-BORDER INTERCONNECTIONS

Turkey has been actively pursuing synchronisation of its network with ENTSO-E, the European Network of Transmission System Operators for Electricity and, prior to that, with UCTE, the Union for the Co-ordination of Transmission of Electricity which is now part of ENTSO-E; synchronisation is anticipated in September 2010. The connection will be by three lines, two with Bulgaria and one with Greece. Net transfer capacity for imports to Turkey will range from 800 to 1 300 MW and for exports from Turkey from 1 000 to 1 100 MW. This will ensure physical integration of the Turkish electricity system with the EU internal electricity market.

In order to reach the technical requirements for synchronisation, Turkey has improved frequency control, and operation and maintenance performance of its system. Given ENTSO-E's technical requirements, near-term possibilities for synchronising the Turkish system with its eastern and south-eastern neighbours are rather limited.

Power imports and exports with these unsynchronised neighbouring systems are carried out under two types of contracts, which are "island" and "directed unit" modes of operation. In both cases, requirements and instructions of ENTSO-E are followed. Under contracts that were signed before the introduction of the 2001 Electricity Market Law, "island" operations are used: Turkey's importing regional areas are run synchronously with the network of the neighbouring country, but isolated from the remainder of the Turkish grid. For contracts signed after the enactment of the 2001 law, the method of unit direction is also used, *i.e.* ability to operate a power generating facility or a unit of a generating facility in the electricity system of another country in parallel with the national electricity system.

The May 2009 Electricity Market and Security of Supply Strategy states that direct current (DC) lines would be the main option for interconnections with non-ENTSO-E countries. Therefore, agreements to be executed for existing and new connections between TEIAŞ and transmission network operators of neighbouring countries will contain a condition for building the required AC-DC (alternating-direct current)/DC-AC convertor facilities. Until the installation of the DC connections, importing and/or exporting will be possible through routing of units; exporting will be possible to isolated regions created outside Turkey.

According to TEIAŞ, transfer capacities in 2008 were as follows:

- Bulgaria: two interconnectors, each 400 kV (net transfer capacity NTC: 700 MW);
- Azerbaijan (Nahcievan): one interconnector at 154 kV (NTC: 100 MW);
- Iran: two interconnectors, one at 400 kV currently energised at 154 kV, and the other at 154 kV (NTC: 150 MW);

- Georgia: one interconnector at 220 kV and project of a 400 kV interconnection line and a DC back-to-back station in Georgia is under way (NTC: 150 MW);
- Armenia: one interconnector at 220 kV (not in use);
- Syria: one interconnector at 400 kV (NTC: 230 MW);
- Iraq: one interconnector at 400 kV (currently energised at 154 kV) and a second 400 kV interconnector is planned (NTC: 200 MW);
- Greece: one interconnector at 400 kV. The line has been completed and currently is operational at 400 kV (NTC: 250 MW).

PRICES AND TARIFFS

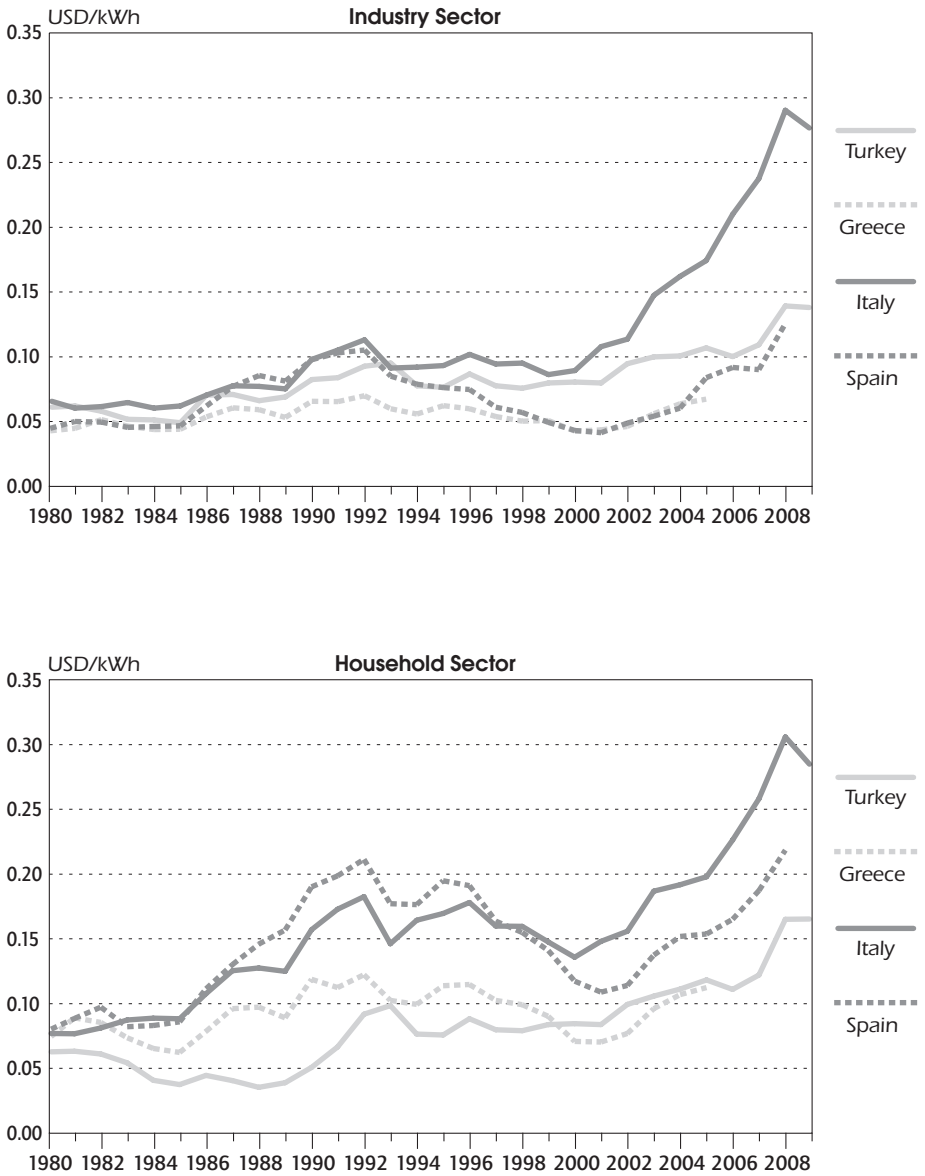
Turkey has traditionally regulated end-user tariffs but, as part of its market reform policy, is gradually moving to a fully cost-reflective tariff system by the end of 2012. The wholesale tariffs are already cost-based. Until the end of 2012, a uniform national retail tariff, which is approved by the regulatory authority EMRA, is applied for all distribution companies. The purpose of these tariffs is to protect the consumers partially or wholly from the existing price differences that result from cost differences among the distribution regions. This price equalisation is based on a cross-subsidy between distribution companies. From the beginning of 2013, the price cap would be set by individual distribution companies and subjected to EMRA's approval.

A major step towards fully cost-reflective retail tariffs was the introduction of a cost-based pricing mechanism in July 2008. Retail tariffs had been kept largely constant from 2002 to 2007 (see Figure 31), despite a significant increase in gas prices and in generation costs, and limited improvements in reducing network losses and increasing collection. At times, tariffs were below generating costs. These tariff levels were the main cause of TEDAŞ's total operating losses of TRL 4.5 billion from 2006 to 2008. Low retail tariffs further led to arrears to the transmission, generation and trading companies, and the generation company in turn passed on arrears to its state-owned gas and coal providers, BOTAŞ and TKI (*Türkiye Kömür Isletmeleri*). According to the World Bank, since 2002, these two companies have taken on an estimated TRL 3.2 billion in loans to cover losses from such non-payments.

In the automatic pricing mechanism, tariffs are adjusted quarterly, on the basis of changes in input prices (coal and natural gas), inflation, and exchange rates. The transition to this system in 2008 was complemented by three large tariff increases (January 2008, July 2008 and October 2008) which raised the average retail tariff by about 50%, thereby reaching fully cost-recovery levels. From 2013 on, the distribution tariffs will include a "loss-theft adjustment component", which will allow distribution companies to increase revenue by going below their target loss-theft ratio.

Figure 31

Electricity Prices in Turkey and in Other Selected IEA Member Countries, 1980 to 2009

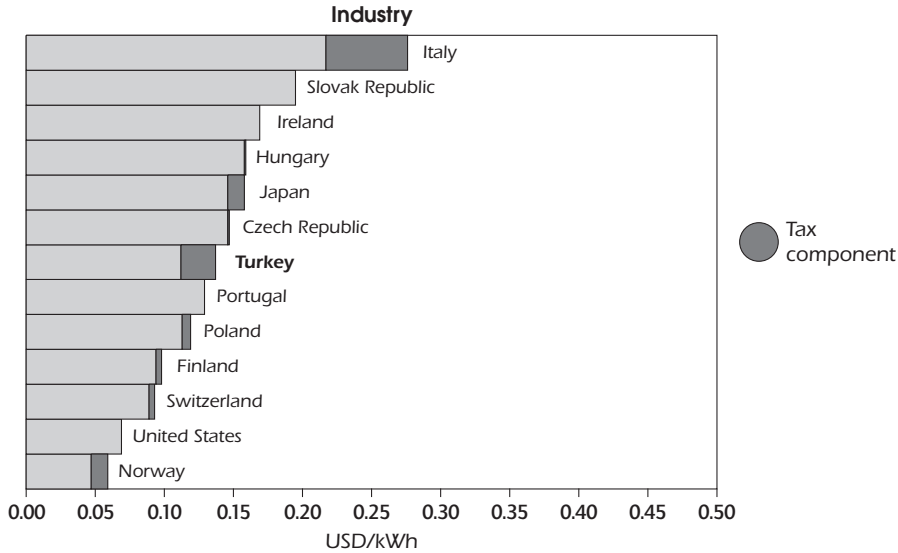


Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2010.

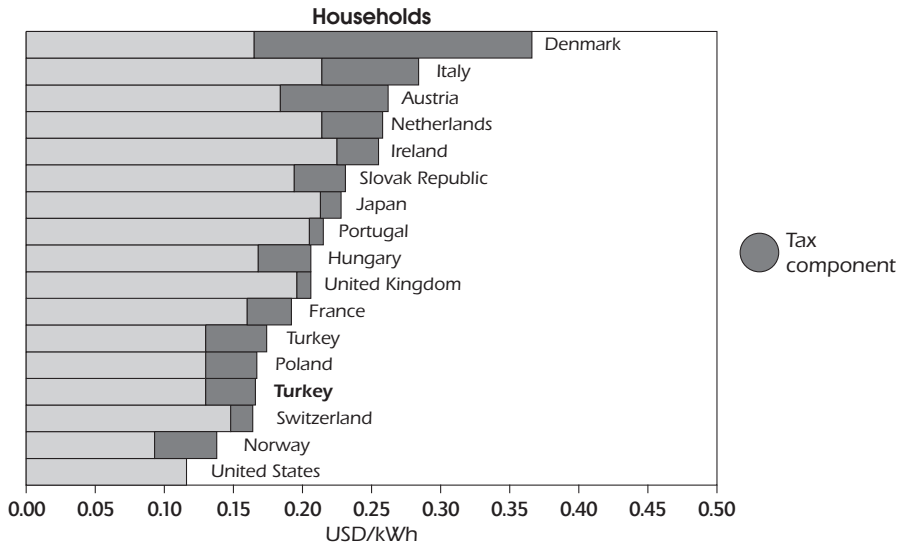
By international comparison, electricity prices to end-users in Turkey are close to the IEA median for industry and slightly below the IEA median for households (see Figure 32).

Figure 32

Electricity Prices in IEA Member Countries, 2009



Note: Tax information not available for the United States. Data not available for Australia, Austria, Belgium, Canada, Denmark, France, Germany, Greece, Korea, Luxembourg, Netherlands, New Zealand, Spain, Sweden and the United Kingdom.



Note: Tax information not available for the United States. Data not available for Australia, Belgium, Canada, France, Germany, Greece, Korea, Luxembourg, New Zealand, Spain and Sweden.

Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2010.

NUCLEAR ENERGY

OVERVIEW

Turkey does not currently have any nuclear power plants in operation or under construction, but has a long-standing nuclear research programme and has been considering nuclear power for many years. The 2009 Electricity Market and Security of Supply Strategy envisages a contribution from nuclear power by 2020. A number of steps have been taken over recent years to prepare the legal and institutional framework needed for a nuclear programme. A competitive tendering process for the construction of up to 5 000 MW_e of nuclear capacity was launched in early 2008. However, only one bid was received. Following legal challenges to the process, in November 2009 it was announced that the tender had been cancelled. Direct negotiations have been continuing with potential suppliers, and in May 2010 an agreement was signed with the Russian Federation to build the country's first nuclear power plant.

ACTIVITIES IN PREPARATION FOR A NUCLEAR PROGRAMME

The Turkish Atomic Energy Authority (*Türkiye Atom Enerjisi Kurumu,* TAEK) was established in 1956. It operates the Çekmece Nuclear Research and Training Institute near Istanbul, where a research reactor has been in operation since 1962. In addition to its research activities, TAEK is responsible for promoting nuclear power and regulating nuclear activities in the country. The separation of TAEK's research and regulatory activities by establishing two separate organisations is envisaged, and a law to this effect has been drafted.

Turkey has been considering building a nuclear plant since the 1970s, but plans have repeatedly been deferred. However, two suitable sites have been identified, one at Akkuyu on the Mediterranean coast, the other at Sinop on the Black Sea. The Akkuyu site was licensed in 1976 as part of a previous effort to launch a nuclear programme, while site evaluation activities for the Sinop site are under way.

A new law on the construction and operation of nuclear power plants was passed in 2007. This aims to facilitate private-sector investment in building nuclear power plants, and their subsequent operation by private-sector organisations, supported by power purchase agreements. Furthermore, the law also allows the State to take part in nuclear power projects directly or indirectly by means of public-private partnership. The law also defines responsibilities for radioactive waste management and decommissioning, including mechanisms for funding these activities.

There is an interim storage facility at Çekmece for the limited amounts of low-level radioactive waste currently produced. The on-site management of wastes from future nuclear power plants will be the responsibility of the site operator. Detailed plans for the longer-term management and disposal of such wastes will be developed at a later stage, but the 2007 law ensures funding will be available.

Uranium exploration in Turkey began in the 1950s, but uranium has not been extracted on a significant scale. Some exploration activities are currently being conducted by the government, and just over 9 000 tonnes of uranium resources amenable to open-pit mining have been identified. ETI-MADEN (General Directorate responsible for Mining, Metallurgy and Chemistry activities) has recently surveyed the feasibility of uranium production from some sites.

RECENT EFFORTS TO LAUNCH NUCLEAR PLANT CONSTRUCTION

In February 2008, the Ministry of Energy and Natural Resources (MENR) formally invited bids to build and operate a nuclear power plant. The tender, managed by state-owned electricity wholesaler TETAŞ, was to supply and operate a nuclear station of between 3 000 and 5 000 MW_e, to be built at Akkuyu. The tender was based on a set of technical criteria established by TAEK in 2007. Financing for the project was to be arranged by the bidders, supported by a 15-year power purchase agreement with TETAŞ. Neither the government nor any state-owned entity would be directly involved in the financing, ownership or operation of the plant. The first unit was scheduled to be in operation by 2014.

Although several consortia initially showed interest in submitting bids, only one bid was submitted by the September 2008 deadline. The sole bidder was a consortium led by the Russian state-owned nuclear vendor Atomstroyexport. Its proposal was to build four 1 200 MW_e reactors of the VVER type (pressurised water reactor), known as AES2006. TAEK considered the technical merits of the bid received, and found that it met its requirements. TETAŞ was responsible for commercial evaluation of the project, and discussions on the commercial terms (including on the price to be paid for electricity under the power purchase agreement) continued during 2009.

However, following a legal challenge to the 2008 regulation on nuclear energy governing the tender process, in November 2009 the State Council (Turkey's supreme administrative court) suspended the award of any contract under the existing tender. Subsequently, TETAŞ announced that the tender had been cancelled. Despite this, direct government-to-government discussions with Russia continued on the Akkuyu project, as part of broader discussions on

energy and trade co-operation. An agreement for a Russian-led consortium to start the project was signed in May 2010.

Meanwhile, in March 2010 a preliminary agreement was announced between state-owned utility EÜAŞ and the Korea Electric Power Corporation (Kepco) to jointly study the feasibility of a four-unit nuclear plant of around 5 400 MW_e at Sinop. This would involve the APR-1400 reactor design, the first two of which are under construction in Korea and four of which were recently ordered by the United Arab Emirates. In June 2010, Turkey and South Korea signed a MoU on co-operation regarding nuclear power plant projects. The aim is to reach an initial agreement on the proposed project by September 2010.

CRITIQUE

ELECTRICITY

With the fast growth of the Turkish economy, increasing population and rising living standards, electricity demand is growing at a high rate: from 2000 to 2007 electricity consumption increased by 50%. It is expected that the temporary decrease in consumption during the economic downturn in 2008/09 will not change the long-term trend and that – according to conservative projections – electricity consumption will double by 2020. This will require at least doubling installed generating capacity, which represents a unique challenge among IEA member countries.

This very specific situation offers great policy opportunities with regard to market reforms, the electricity mix, and the improvement of efficiency and environmental standards. It also requires careful attention to system integrity and security of supply. Concerning the electricity mix, the 2009 Electricity Market and Security of Supply Strategy foresees the following key developments:

- Significant development of new coal- and lignite-fired power plants (8 GW licensed, new projects), while undoubtedly necessary to ensure security of supply but raising major concerns in terms of CO_2 emissions.
- More than doubling the production of electricity from renewable sources to provide at least 30% power supply by 2023, mainly by means of an ambitious development of the hydro potential (14. GW licensed, new projects) and up to 20 GW of wind power (2.5 GW licensed, new projects).

Such major investments require a robust regulatory framework and effective price signals, notably CO_2 cost and fine-tuned incentives for renewable energy to ensure timely and adequate investments. In addition, while the introduction of nuclear electricity generation may add only marginally to supply by 2020, it may offer new possibilities in the longer term.

Since the last in-depth review, Turkey has successfully engaged in a comprehensive reform of its electricity market and in its gradual opening to competition. With the introduction of a cost-based pricing mechanism for the state-owned energy companies by mid-2008, Turkey took a major step to create a sound economic and financial basis for the electricity sector. Transitional measures have been defined in order to move towards a fully competitive electricity market. In this context, the role of public wholesale operator exerted by TETAŞ should be limited to the necessary phasing-out of the existing purchasing agreements and, if necessary, to limited and well-justified new purchase agreements (*e.g.* nuclear). As regards nuclear, it will be possible to provide a reasoned assessment only once the economics of the project become clear.

Since the last in-depth review in 2005, the new 400-kV interconnection to Greece was completed and additional links with Georgia and Romania are in preparation (further to the two existing high-voltage lines to Bulgaria). Major progress was achieved by TEIAŞ in view of the synchronous interconnection with ENTSO-E (of which UCTE is now part), which should become effective in 2010. These developments will allow for very significant new electricity flows and new synergies with neighbouring countries, in particular as regards renewable electricity, which will reinforce Turkey's security of supply and benefit the whole region.

The ambitious targets for renewable electricity will require significantly upgrading and expansion of the transmission system. The experience of many IEA member countries reveals that a large integration of electricity from variable renewable sources, such as wind, depends on the degree of flexibility of the power system. This flexibility can be achieved in three fundamental ways: by diversified and flexible supply, by demand-side initiatives and by expanding cross-border interconnections. The government should increase efforts in these directions. In a rapidly growing economy, measures on the demand side, such as energy saving, peak shifting and smart metering, merit particular focus so as to limit the need for new generating capacity.

Nuclear power

Since the last in-depth review, Turkey has made significant progress in its efforts to become a nuclear energy country. The new law adopted in 2007 established a legal framework for construction and operation of nuclear power plants; a competitive tendering process for the construction and operation of a multi-unit plant was launched in early 2008. However, the invitation for bids only produced a single bidder, and the process was subsequently cancelled following a legal challenge.

Several factors may explain the limited interest in the tender. Although the financing model adopted has been used in Turkey and elsewhere for non-nuclear electricity plants, it has not previously been used for nuclear projects.

The very large investment involved in building several nuclear units, and the requirement to operate them for at least 15 years to recoup that investment, presented a significant challenge to potential bidders (even without the credit crisis that became apparent before the bid deadline). Since nuclear plant vendors are themselves not in the business of operating plants and selling electricity, they would need to bid jointly with another party able and willing to operate the plants on the basis of the power purchase agreement offered. Even where a consortium was prepared to take on the financial risks of both construction and operation, to provide an adequate return would require a high guaranteed electricity price under the power purchase agreement.

Following the tender cancellation, the government decided not to pursue the competitive tendering process, at least for the first one or two nuclear plants. Rather, direct negotiations were entered into with Russian and Korean suppliers, at government as well as at industry level. After protracted commercial and political discussions, a deal for Russian companies to take part in building and operating a four-unit nuclear station at Akkuyu was agreed at government-to-government level in May 2010.

Nevertheless, the government may need to consider additional options for the ownership structure of any further nuclear plants and for the sale of their output. One option would be for EÜAŞ or another domestic utility to invest in the nuclear plants, probably jointly with foreign and other domestic investors. The direct involvement of a major domestic utility, especially one backed by the State, could reduce overall financial risks and hence the cost of electricity produced. In such a case, however, necessary measures should be taken in order to monitor and manage contingent liabilities that might arise from state guarantees.

Over the coming years Turkey will need to continue to take steps to establish the required institutions and facilities for its nuclear programme. This includes developing and implementing plans for radioactive waste management, proceeding with separation of TAEK's regulatory functions from its other activities, and continuing to develop the skills base in industry and government. In particular, if the government aims to develop the participation of domestic industry in nuclear construction and in the nuclear fuel cycle, continued support for nuclear research and training will be required.

RECOMMENDATIONS

The government of Turkey should:

- ***Electricity***
  - *Monitor electricity consumption growth, with a focus on demand-side initiatives, and facilitate sufficient expansion in generation and the grid,*

while ensuring increased system flexibility to integrate a larger share of renewable electricity.

- *Further implement the cost-based pricing mechanism in the years to come and examine the possibilities to take into account CO_2 cost.*
- *Ensure the effective opening of the electricity wholesale market notably by limiting and scrutinising TETAŞ's role in a medium- to long-term perspective.*
- *Define a clear framework for the privatisation of the generation assets, ensuring effective gains in efficiency and environmental performance for existing plants, and for new investments in generation, and set high efficiency standards for new plants.*

◗ ***Nuclear power***

- *Review the reasons for the limited interest in the recent tender for a nuclear power plant, and consider alternative models for the ownership and operation of further nuclear plants.*
- *Continue to take steps to establish the required institutions and facilities to support the nuclear programme, including developing detailed plans for radioactive waste management and ensuring sufficient skilled human resources.*
- *Separate the regulatory functions of TAEK from its nuclear research, development and promotional activities, and ensure regulatory independence.*

PART III

ENERGY TECHNOLOGY

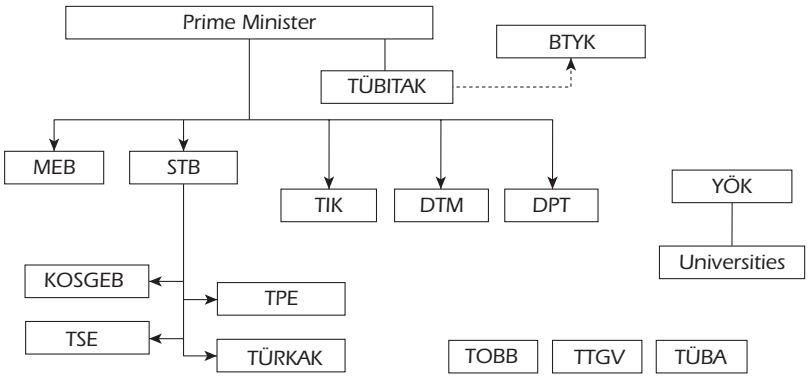
ENERGY RESEARCH AND DEVELOPMENT

OVERVIEW

The highest-level decisions on science and research policy are made by the Grand National Assembly of Turkey, the Council of Ministers, the State Planning Organisation (DPT), the Supreme Council of Science and Technology (BTYK) and the Scientific and Technological Research Council of Turkey (TÜBİTAK). DPT and TÜBİTAK are the two main responsible institutions regarding the science and research policy development process.

Figure 33

Turkish National Science and Research Structure



RTD Institutions

BTYK- Supreme Council of Science and Technology
DPT- State Planning Organisation
DTM- Under-Secretariat for Foreign Trade
KOSGEB- Small and Medium Sized Enterprises Development Organisation
MEB- Ministry of National Education
STB- Ministry of Industry and Trade
TIK – Turkish Statistical Institute
TPE- Turkish Patent Institute
TOBB- Union of Chambers and Commodity Exchange of Turkey
TSE- Turkish Standards Institution
TTGV-Technology Development Foundation of Turkey
TÜBA- Turkish Academy of Sciences
TÜBİTAK- The Scientific and Technological Research Council of Turkey
TÜRKAK- Turkish Accreditation Board
YÖK- Higher Education Council

Source: Technology Development Foundation of Turkey.

DPT is responsible for providing consultation for the government in the determination of the economic, social and cultural policies and targets including science and research, co-ordinating and guiding the implementations of the ministries' and remaining public institutions' activities regarding those policies, providing perspective for the private sector by eliminating the

uncertainties regarding the medium to long term by defining the framework of macro-economic and sectoral policies and targets.

TÜBİTAK is responsible for supporting, co-ordinating, promoting, monitoring and carrying out R&D activities in the science and technology area and for developing programmes and projects for this purpose. It acts as the secretariat for the BTYK and consults the government on determination of science and technology policies. It also establishes research centres and institutes, develops support programmes for the public sector and incentive programmes for the private sector.

Furthermore, TÜBİTAK develops programmes to improve the university-public-private sector co-operation, provides support to increase the number of researchers. and takes responsibility for the international co-operation on science and technology.

On a macro level, Turkey's national R&D policy and priorities are determined in the seven-year National Development Plans. Furthermore, medium-term R&D policy is laid out in the National Science and Technology Strategy for the years 2005-2010. The strategy was developed by TÜBİTAK, in collaboration with the relevant public agencies, academia, private sector and non-governmental organisations. The strategy and an accompanying implementation plan were approved by the BTYK in 2005. The implementation plan does not mention specific research areas, but includes general support for science and technology in several areas. The BTYK has agreed on seven primary objectives:

- increase science and technology awareness and culture;
- educate, train and develop more scientists;
- provide support for high-quality and goal-oriented research;
- increase effectiveness of national science and technology management;
- strengthen the science and technology performance of the private sector;
- improve the research potential and infrastructure;
- establish and strengthen national and international connections.

Turkey's long-term R&D policy is guided by the National Research and Technology Foresight Programme (the Vision 2023 Programme). The programme is co-ordinated by TÜBİTAK and covers the period 2003-2023. It has the following objectives:

- building long-term science and technology objectives for Turkey;
- establishing a dynamic mechanism to adopt R&D policies based on the previous R&D outcomes;

- determining priority technologies and areas for R&D;
- formulating science and technology policies, while being supported by a whole spectrum of stakeholders and creating public awareness of the importance of science and technology for socioeconomic development.

Energy and natural resources are among the areas included in the Vision 2023 Programme whose priority areas for energy technology R&D are:

- wind energy
- solar energy
- energy storage
- clean coal
- energy efficiency and renewable energy in buildings
- energy efficiency in industry
- control technologies for power systems
- hydropower plants (mini and micro)
- hydrogen and fuel cells and their applications
- nuclear energy

The current energy policy implies demand for energy technology advancements that will have to be achieved, in part, through R&D. For example, the 2009 Electricity Market and Security of Supply Strategy outlines large increases in renewable electricity capacity by 2023 and R&D efforts are needed to facilitate reaching these targets in a cost-effective manner. The 2007 Energy Efficiency Law also obliges TÜBİTAK to give priority to funding R&D projects on energy efficiency and new and renewable energy.

To provide incentives for private-sector energy R&D, the Turkish Parliament approved a law in 2008 to support R&D activities, including a partial tax break as well as up to 90% tax break for R&D personnel and 50% social security payments for five years. Additionally, the draft R&D funding mechanism of the Ministry of Energy and Natural Resources encourages private-public partnerships on energy R&D in priority areas of energy policy. Independent research companies employing at least 25 R&D personnel may apply for support of up to 25% (up to a limit of TRL 250 000) of their R&D investment expenses. The mechanism also allows for multi-company co-operation, with tax breaks for all collaborators. This mechanism will help achieve the goal of raising the R&D expenditure to 2% of GDP by 2023.

TÜBİTAK (THE SCIENTIFIC AND TECHNOLOGICAL RESEARCH COUNCIL OF TURKEY)

Most public R&D investment is undertaken by TÜBİTAK and the universities, supplemented by state-owned companies with separate R&D programmes. Established in 1963, TÜBİTAK is an autonomous institution governed by a Scientific Board whose members represent universities, industry and research institutions. TÜBİTAK funds research projects carried out in universities and other public and private organisations. It has a broad portfolio, including:

- conducting research on strategic areas;
- developing support programmes for public and private sectors;
- publishing scientific journals, popular science magazines and books;
- organising science and society activities; and
- supporting undergraduate and graduate students through scholarships.

TÜBİTAK's energy R&D activities are carried out at its Marmara Research Centre (TÜBİTAK-MAM), where the Energy Institute has more than 100 full-time staff. The Energy Institute has four strategic business units: Advanced Energy Technologies; Fuel Technologies; Vehicle Technologies; and Power Electronic Technologies. The Institute's applied research projects focus on fuel cells, hydrogen, combustion, gasification and gas cleaning, energy storage, electric vehicle technologies, power electronics and fuel technologies, including second-generation biofuels.

Examples of current energy R&D projects include coal gasification, CO_2 storage and transport, and fuel production from biomass and coal blends. On coal gasification, TÜBİTAK has entered into a public-private partnership with Zorlu Energy on a project to study electricity generation from gasified coal. The aim is to reduce the environmental impact of coal use. TÜBİTAK expects to lend Zorlu Energy TRL 9 million for constructing an R&D centre to reduce the environmental burden of coal burning and improve energy efficiency in electricity generation. The centre is expected to begin operation by the end of 2011.

A pre-feasibility study on underground carbon storage supported by the Ministry of Energy and Natural Resources is expected to be completed in 2010. This study investigates the possible storage locations in deep geological formations, such as saline formations and exhausted oilfields in Turkey. The project was started in 2007 and it has a budget of TRL 500 000. The Middle East Technical University and Turkish Petroleum Company are the primary

partners in the project. Apart from this project, Karadeniz Technical University and a number of other public and private entities have issued reports on the same subject in 2009.

TÜBİTAK has also initiated an R&D project on preparing liquid fuels from coal and biomass blends. The country has abundant coal and forest resources, and the project aims to develop a pilot facility for producing more economical, efficient and clean liquid fuels from these resources. It will focus on developing integrated technologies on fuel feeding, gasification, gas cleaning, gas conditioning and separation, liquid fuel production systems, and heat and electricity generation systems. The project has started in June 2009 and is expected to end in 2013. Its main goals are the following:

- liquid fuel production from coal and biomass syngas;
- application of coal and biomass syngas to power generation;
- heat production and recovery during liquid fuel production to enhance efficiency;
- CO_2 capture in order to increase liquid fuel production efficiency.

TECHNOLOGY DEVELOPMENT FOUNDATION OF TURKEY (TTGV)

TTGV was founded in 1991 to support the development of technological innovation capacity in Turkish industry in order to improve its international competitiveness. TTGV has at its disposal different support mechanisms and it also participates in several national and international projects. Energy efficiency and renewable energy are among its priorities. Together with the Ministry of Energy and Natural Resources, EÜAŞ and OSTIM Organised Industrial Zone, TTGV established in 2010 the "Local Energy Technologies R&D Platform". The Platform aims to create inventories of existing capacity (equipment and technology) in the energy sector, to evaluate the status in the world, identify the needs, gaps and opportunities (competitive advantage) for local companies and devise policies and programmes for the development of relevant technologies in Turkey.

UNIVERSITIES

Basic and applied research on energy is undertaken by several universities. Research projects are mostly funded via the Turkish Research Area Programme, which is implemented under the co-ordination of TUBİTAK, and universities' Scientific Research Programmes, which are funded by the individual universities.

In addition to these projects, the State Planning Organisation (DPT) is funding large-scale research infrastructures on energy in universities. The largest such infrastructures are the Solar Energy Research Centre (USD 7.5 million) at the Middle East Technical University and research laboratories at the Solar Energy Institute of the Ege University. The institute owns laboratories for photo-electronic technologies, biogas technologies and fuel cells, with total investment exceeding USD 5 million. Others include the Lignite R&D Laboratory at the Gazi University (USD 1.5 million), the Solar Energy Laboratory at the Harran University (USD 500 000), the Hydro Electric Power Station Research Laboratory at the Istanbul Technical University (USD 500 000), and the Hydrogen Production Technologies Laboratory at the Bogazici University (USD 1 million).

GENERAL DIRECTORATE OF TURKISH COAL ENTERPRISES (TKİ)

TKİ has initiated a "Clean Coal Technologies" programme in 2009. The main objective of this programme is funding research institutions, universities and private-sector research companies to develop more efficient and cleaner coal technologies. The programme budget for 2010 is USD 3.5 million.

MINISTRY OF ENERGY AND NATURAL RESOURCES (MENR)

The Ministry of Energy and Natural Resources initiated the "Energy Research-ENAR" programme in 2008. The main objective of this programme is funding research institutions, universities and private-sector research firms to develop new technologies and innovative equipment, especially in the fields of renewable energy and energy efficiency. The programme priorities include research on energy conversion, transmission and distribution. Its budget for 2010 is USD 1.5 million. The institutional strategic plan 2010-2014 of the ministry indicates that the budget of the ENAR programme will increase gradually to TRL 50 million by 2014. This plan also includes a vision to double the spending on R&D by the related and affiliated institutions of MENR from 2009 to 2015. The plan highlights the importance of technology development centres and their role in bridging universities and policy makers. The ENAR programme is expected to create technology-oriented synergies in fostering energy policy goals, in particular those relevant to the sustainability of the national energy sector.

FUNDING

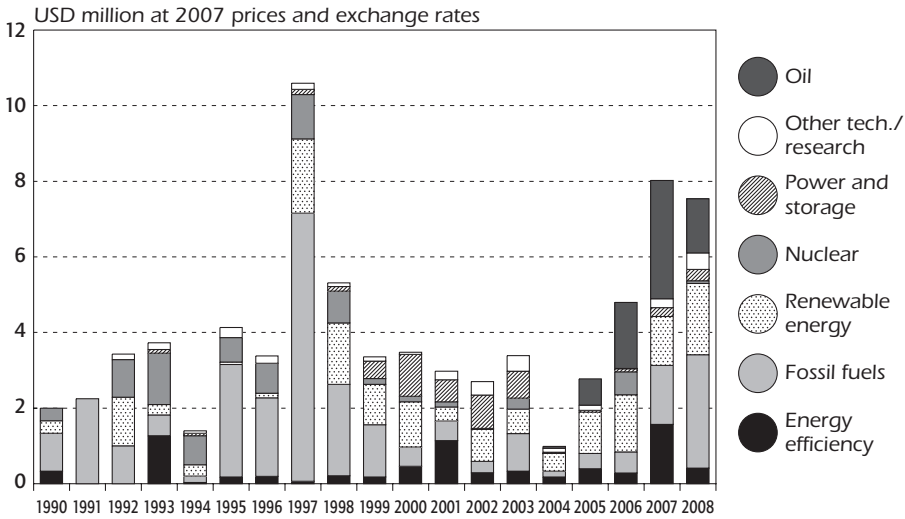
Since 2004, public spending on energy RD&D has increased to reach USD 7.5 million in 2008 (see Figure 34). Out of that total, USD 3 million

was spent on fossil fuels projects, USD 1.9 million on renewable energy and USD 1.4 million on hydrogen and fuel cells. There are no comprehensive data on private-sector spending on energy R&D.

Public spending on energy R&D is expected to continue to grow, as the Vision 2023 Programme, which contains several energy R&D priorities, is supported by an increase in financing. The government plans to increase total funding (public and private) for all R&D to 2% of GDP by 2023 from 0.7% in 2007.

Figure 34

Government RD&D Spending on Energy, 1990 to 2008



Sources: *OECD Economic Outlook,* OECD Paris, 2009 and country submission.

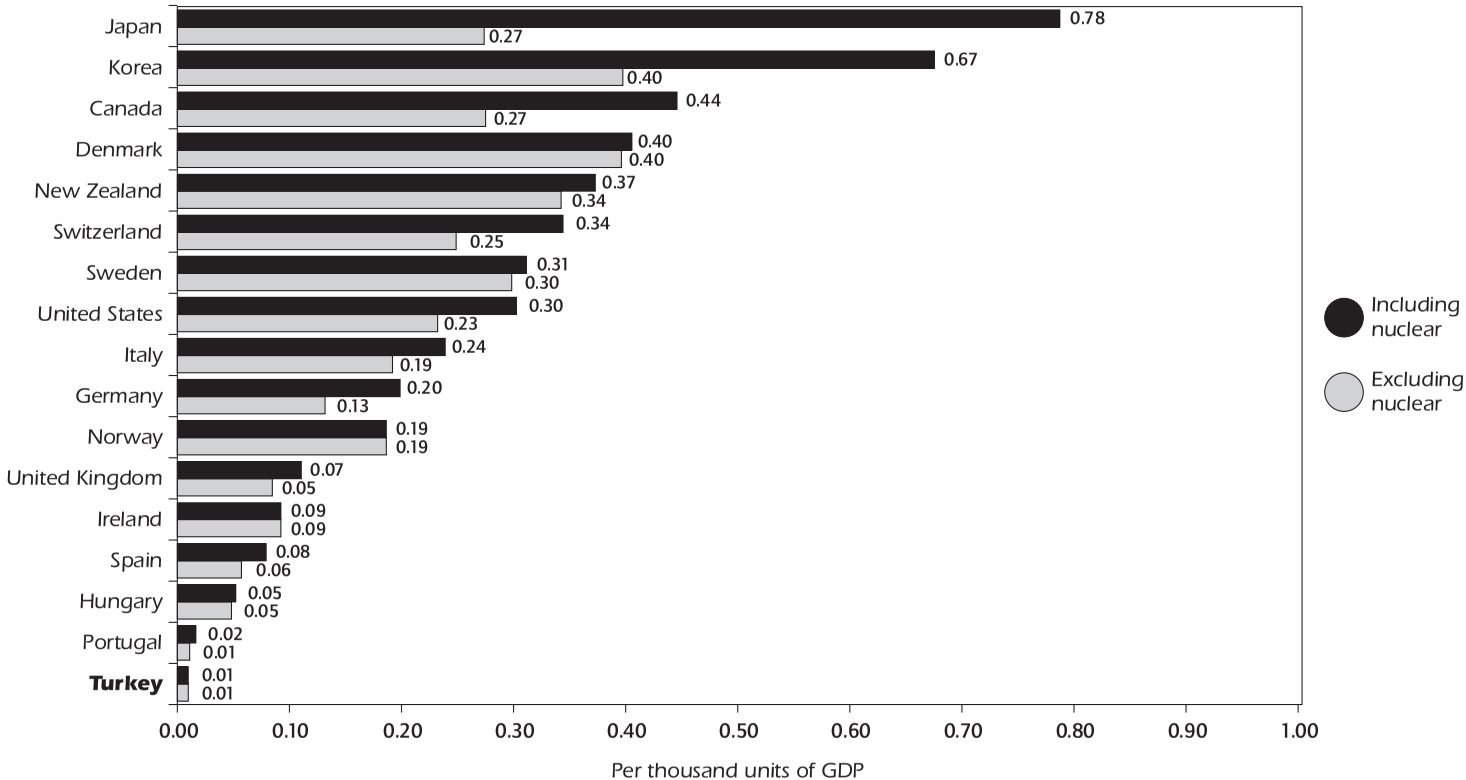
Compared to other developed countries, public funding for energy R&D remains low in Turkey (see Figure 35). In 2008, it was at 0.001% of GDP, while most IEA member countries spent more than ten times that share.

The following government bodies provide funding or financial incentives for R&D:

- The Ministry of Finance provides tax reduction for the R&D expenditures of private firms by a ratio of 40%.
- TÜBİTAK provides grant funds for the private sector with the Under-Secretariat of Foreign Trade.
- The Technology Development Foundation of Turkey (TTGV) provides soft loans for technology development (R&D) projects in the private sector. It also provides support for commercialisation projects and for technological

Figure 35

Government R&D Budgets in IEA Member Countries, 2008



Data not available for Australia, Austria, Belgium, the Czech Republic, Finland, France, Greece, Luxembourg, the Netherlands, Poland and the Slovak Republic.
Sources: *OECD Economic Outlook,* OECD Paris, 2009 and country submissions.

entrepreneurship, such as pre-incubation, risk-sharing facility and start-up supports.Through its Environmental Support Programme, TTGV provides soft loans to companies with implementation projects in the fields of renewable energy, energy efficiency and cleaner energy production. TTGV has also started to develop a new programme for commercialisation of advanced technologies, including energy-related ones.

- The Under-Secretariat of Foreign Trade (DTM) provides grant funds for the private sector. The support is on project base and DTM takes consultation from TTGV and TÜBİTAK on the selection of projects.
- The Ministry of Industry and Trade, through its bounded institution KOSGEB, provides funds for small and medium-sized enterprises (SMEs).
- The Ministry of Energy and Natural Resources provides funding for energy related R&D projects within its ENAR programme.
- The Credit Guarantee Fund (KGF) provides guarantees on loans to SMEs for facilitating risk-sharing and lending among Turkish banks. In accordance with a recent agreement with TTGV, KGF will support companies for the collaterals while applying for soft loans from TTGV.

INTERNATIONAL COLLABORATION

To augment its national R&D framework, Turkey participates in several international collaborative efforts, including the following IEA Implementing Agreements:

Buildings sector

Buildings and Community Systems

Transport sector

Hybrid and Electric Vehicles

Renewables

Bioenergy
Photovoltaic Power Systems

Energy storage

Advanced Fuel Cells
Energy Storage
Hydrogen

Modelling

Energy Technology Systems Analysis Programme

Turkey is represented in these Implementing Agreements through the TÜBİTAK Marmara Research Centre, the municipality of Ankara and several universities. Turkey has also entered into bilateral agreements with 19 countries to co-operate in the field of science and technology.

Turkey is the host of the International Centre for Hydrogen Energy Technologies (ICHET), a joint initiative of the United Nations Industrial Development Organization (UNIDO) and the MENR. Located in Istanbul, ICHET focuses on advancing applied R&D on hydrogen energy and stimulating hydrogen energy technology application in industrial development globally, in particular in developing countries. The areas of work include hydrogen production, storage and utilisation, as well as hydrogen economics. The centre has its own ongoing national R&D projects as well as international R&D projects.

Turkey has also participated in R&D projects under the sixth and seventh EU Framework Programmes for Research and Technological Development (FP6 and FP7). TÜBİTAK is Turkey's official contact organisation for the FP participation. TÜBİTAK Marmara Research Centre's Energy Institute has participated in the following energy-related projects under the EU FP6 and FP7:

Ongoing projects

- MC-WAP (FP6) Molten-Carbonate Fuel Cells for Water Borne Applications.
- MCFC-CONTEX (FP6) Effects of CONTaminants in biogenous fuels on MCFC catalyst and stack component degradation and lifetime and EXtraction strategies.
- TYGRE (FP7) High Added Value Materıals from Waste TYre Gasificatıon REsidues.
- EPHESTUS (FP7) Enhanced Energy Production of Heat and Electricity by a Combined Solar Thermionic-Thermoelectric Unit System.

Completed projects (FP6)

- EU-DEEP: The Birth of a European Distributed Energy Partnership that Will Help the Large-Scale Implementation of Distributed Energy Resources in Europe.
- NATURAL-HY: Preparing for the hydrogen economy by using the existing natural gas system as a catalyst.
- TERMISOL: New Low Emissivity and Long-Lasting Paints for Cost-Effective Solar Collectors.
- HYPROSTORE: Improving the S&T Research Capacity of TÜBİTAK MRC Energy Institute in the Fields of Hydrogen Technologies.

- BIGPOWER: Improving of the S&T Research Capacity of TÜBİTAK MRC Energy Institute in the Fields of Integrated Biomass Gasification with Power Technologies.
- CASES: Cost Assessment Sustainable Energy.
- NETBIOCOF: Integrated European Network for Biomass Co-Firing.

CRITIQUE

Turkey is facing significant energy and environment policy challenges, including on energy security and emissions to air, and the government needs to explore all possible means to respond to them. One such means is effective energy R&D policy. In this context, the Vision 2023 Programme can help the government to have a coherent energy R&D strategy or programme to contribute to the energy policy challenges.

In the near term, the government should revisit the 2005-2010 National Science and Technology Strategy to ensure that energy technology research, development and demonstration (RD&D) is aligned with energy and environmental policy priorities. It should assess the best energy technologies for prioritisation, based on Turkey's resource mix, policy goals, previous R&D activities and international collaboration efforts. In particular, Turkey should ensure that its energy efficiency, low-carbon and renewable energy policy goals will be successful through adequate funding and strategic design of energy R&D.

It is commendable that the government has been increasing the energy R&D budget significantly since the last in-depth review. However, Turkey's public spending on energy R&D as a percentage of GDP remains well below IEA average. The IEA encourages Turkey to continue to significantly increase public spending on energy R&D.

Regular and systematic R&D evaluation provides an opportunity for improved efficiency in energy R&D expenditure. Several IEA member countries have found benefits from regularly evaluating outputs of R&D efforts and reallocating funding from programmes that are not delivering on their goals. The IEA urges Turkey to allocate the funding efficiently by instituting regular evaluations of the outcomes of energy R&D and by updating energy R&D strategies according to results. The government should enhance efforts to improve R&D data collection and cost-effectiveness analysis.

TÜBİTAK is a unique organisation in Turkey, conducting research and financing R&D activities as well as planning R&D policy. It has been increasing the R&D budget and the number of projects and made a good effort to identify activities that support the government's energy policy. Given the limited

public resources for energy R&D, effective co-ordination between TÜBİTAK and energy policy planning offices needs to be ensured.

Turkey would also benefit from improving the overall levels of private-sector energy R&D. It is positive that co-operation between TÜBİTAK and industry is becoming more intensive, supported in part by government policies. However, these efforts should be intensified to encourage greater private-sector participation in partnership with public-sector research institutes and universities. Goals should include greater sharing of information, policy mechanisms and financing for R&D activities and assistance in commercialising R&D outcomes. Expanding public-private partnerships would help increase the resources available for energy R&D, but also for the commercialisation of new technology.

Commercialisation of the outcomes of supported R&D projects is a critical issue. In this regard, the outcomes of joint R&D projects implemented by private-sector research institutes and universities should be transmitted to the economical value creation process through appropriate commercialisation mechanisms. This is also critical for technologies whose R&D process has recently been completed. Hence, comprehensive support models which provide specific approaches and solutions for each step throughout the whole process from R&D to commercialisation is necessary.

Evidence from other countries clearly indicates a fall-off in R&D in the various components of the electricity and gas sectors following privatisations. In the rush to competitiveness and productivity improvements, R&D expenditures are often an early victim. The government will need to actively facilitate and encourage R&D investment by privatised and corporative entities to avoid this potential pitfall.

It is essential to continue to focus public spending on energy R&D in areas where Turkey has a competitive advantage or specific needs. For example, considering its natural and social conditions as well as the current interest among IEA member countries, R&D on cleaner fossil fuels, in particular clean coal technologies and CO_2 capture and storage, should be a priority consideration.

Turkey is actively participating in international research programmes, such as those of the EU and the IEA. Such participation has clear benefits, as Turkey will continue to be a technology-taker for the foreseeable future. R&D efforts need to promote the acquisition and adaptation of the best available technologies to suit the particular Turkish circumstances through international collaboration. Turkey's participation in multilateral initiatives is consistent with the country's Vision 2023 Programme, and the IEA recommends Turkey to continue to integrate, as much as possible, the national energy R&D activities into international programmes.

Given that the goals of the Vision 2023 Programme also include energy efficiency and control technologies for power systems, the IEA encourages Turkey to expand national research capabilities in these areas by joining energy efficiency and electricity network-related IEA Implementing Agreements.

RECOMMENDATIONS

The government of Turkey should:

- *Revisit its medium-term R&D plan in the context of its long-term policy to ensure that energy technology research, development and demonstration (RD&D) is aligned with energy and environmental policy priorities; assess the best energy technologies for prioritisation on the basis of Turkey's resource mix, policy goals, previous R&D activities and international collaboration efforts.*
- *Continue to significantly increase public spending on energy R&D to align it more closely with that of other IEA member countries; allocate the funding efficiently by instituting regular evaluations of the outcomes of energy R&D; and update energy R&D strategies according to results.*
- *Expand partnerships with the private sector through increased use of public-private partnerships for energy R&D.*
- *Consider developing comprehensive support models that cover the whole innovation spectrum from R&D to commercialisation.*
- *Focus on the development of energy technologies and their early and cost-effective deployment in areas where there is a clear competitive advantage or need, such as cleaner fossil fuel, clean coal and CCS-related technologies.*
- *Continue to integrate, as much as possible, the national energy R&D activities into international programmes; in particular, expand national research capabilities in energy efficiency and electricity network-related international collaborative efforts such as the IEA Implementing Agreements.*

PART IV
ANNEXES

ORGANISATION OF THE REVIEW

REVIEW CRITERIA

The *Shared Goals* of the IEA, which were adopted by the IEA ministers at their 4 June 1993 meeting held in Paris, provide the evaluation criteria for the in-depth reviews conducted by the IEA. The *Shared Goals* are set out in Annex C.

REVIEW TEAM

The in-depth review team visited Ankara from 6 to 10 April 2009. The team met with government officials, energy suppliers, interest groups and various other organisations. The team members are grateful for the openness, co-operation and hospitality of the many people they met who greatly contributed to a successful and productive review. The team members wish to express their gratitude to Under-Secretary Selahattin Çimen and Deputy Under-Secretary Yusuf Yazar for their personal engagement and support during the visit. They also wish to express their gratitude to Director-General Budak Dilli in briefing them on current Turkish energy policy issues. The team wishes to thank Deputy Director-General Nilgun Acikalin and other staff of the Ministry of Energy and Natural Resources, in particular Ms. Sinem Çaynak and Mr. Celal Yesilyurt, for their help in preparing and guiding the visit. The team also wishes to thank Mr. Zafer Ateş from the Permanent Delegation of Turkey to the OECD for his kind assistance throughout the review process. Finally, the team is particularly grateful to Mr. Bora Şekip Güray of MENR for his professionalism and unfailing helpfulness displayed as the contact person for the whole review process.

The members of the team were:

Mr. Stephen J. Gallogly
(team leader)
Department of State, United States

Mr. Erik Just Olsen
Ministry of Petroleum and Energy, Norway

Mr. Max-André Delannoy
Ministry for Ecology, Sustainable Development and Sustainable Town and Country Planning, France

Mr. Antonio Moreno-Torres Gálvez
Ministry of Industry, Tourism and Trade, Spain

Mr. Antonio Moreno-Torres Gálvez
Ministry of Industry, Tourism and Trade, Spain

Mr. Masatoshi Shinagawa
Ministry of Economy, Trade and Industry, Japan

Mr. Ian Cronshaw
International Energy Agency

Mr. Tim Gould
International Energy Agency

Mr. Masatoshi Shinagawa
Ministry of Economy, Trade and Industry, Japan

Mr. Olivier Silla
European Commission

Mr. Shinji Fujino
International Energy Agency

Mr. Miika Tommila
International Energy Agency

Miika Tommila managed the review and drafted the report, with the exception of Chapter 7 on coal and the section on oil pipelines in Chapter 5, which were prepared by Tim Gould, and the section on nuclear energy, which was prepared by Martin Taylor from the OECD Nuclear Energy Agency. Many other IEA colleagues have provided important contributions, including Barbara Buchner, Anne-Sophie Corbeau, Ian Cronshaw, Tom Kerr, Carrie Pottinger, Brian Ricketts and Akihiro Tonai. Helpful comments were also contributed by Ulrich Benterbusch, Shinji Fujino, Richard Baron, Rebecca Gaghen, Francois Nguyen, Jungwook Park and Samantha Ölz.

Monica Petit, Georg Bussmann and Bertrand Sadin prepared the figures. Karen Treanton and Alex Blackburn provided support on statistics. Muriel Custodio, Jane Barbière and Madeleine Barry managed the production process. Viviane Consoli provided editorial assistance. Marilyn Ferris helped in the final stages of preparation.

ORGANISATIONS VISITED

Competition Authority

- The Electrical Power Resources Survey and Development Administration (EİE)
- Electricity Generation Corporation (EÜAŞ)
- Energy Market Regulatory Authority (EMRA, Turkish abbreviation: EPDK)
- General Directorate for Mineral Research and Exploration (MTA)
- Hydroelectricity Power Plant Industries and Businessmen Association (HESIAD)
- Ministry of Energy and Natural Resources (MENR, Turkish abbreviation: ETKB)
- Ministry of Environment and Forestry

- Ministry of Foreign Affairs (MFA)
- Ministry of Transport and Communication
- Natural Gas Distribution Companies Association (GAZBİR)
- Petroleum Industry Association (PETDER)
- Petroleum Pipeline Corporation (BOTAŞ)
- Petroleum Platform Association (PETFORM)
- Privatisation Administration
- The Scientific and Technical Research Council of Turkey (TÜBİTAK)
- State Planning Organisation (DPT)
- Turkish Atomic Energy Authority (TAEK)
- Turkish Coal Enterprises (TKI)
- Turkish Electricity Distribution Company (TEDAŞ)
- Turkish Electricity Transmission Corporation (TEİAŞ)
- Turkish Electricity Wholesale and Trading Company (TETAŞ)
- Turkish Hard Coal Enterprises (TTK)
- Turkish Petroleum Corporation (TPAO)
- Under-Secretariat of Treasury
- The Union of Chambers and Commodity Exchanges of Turkey (TOBB)
- Wind Power Plant Industries and Businessmen Association (RESIAD)
- World Bank Ankara Office
- World Energy Council-Turkish National Committee (DEK-TMK)

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	2000	2005	2007	2008	2020
TOTAL PRODUCTION		**15.53**	**25.82**	**25.86**	**23.93**	**27.27**	**29.03**	**65.99**
Coal		5.21	12.37	12.49	10.81	14.79	16.68	37.10
Peat		–	–	–	–	–	–	–
Oil		3.59	3.61	2.73	2.23	2.11	2.13	0.69
Gas		–	0.17	0.53	0.74	0.74	0.84	0.23
Comb. Renewables & Waste[1]		6.45	7.21	6.51	5.36	5.06	4.88	3.93
Nuclear		–	–	–	–	–	–	8.23
Hydro		0.22	1.99	2.66	3.40	3.08	2.86	9.42
Wind		–	–	0.00	0.01	0.03	0.07	0.72
Geothermal		0.05	0.43	0.68	1.01	1.05	1.15	4.81
Solar		–	0.03	0.26	0.39	0.42	0.42	0.86
TOTAL NET IMPORTS		**8.72**	**27.77**	**49.98**	**59.67**	**73.81**	**70.57**	**151.76**
Coal	Exports	–	–	–	–	–	–	–
	Imports	0.01	4.21	9.31	11.72	14.64	12.86	43.50
	Net Imports	0.01	4.21	9.31	11.72	14.64	12.86	43.50
Oil	Exports	0.84	1.88	1.29	5.41	6.09	6.53	–
	Imports	9.68	23.13	30.54	33.48	37.62	35.98	60.23
	Int'l Marine and Aviation Bunkers	-0.13	-0.30	-0.92	-2.14	-1.98	-1.96	-4.67
	Net Imports	8.71	20.94	28.33	25.93	29.54	27.49	55.56
Gas	Exports	–	–	–	–	0.03	0.36	0.67
	Imports	–	2.68	12.05	22.13	29.78	30.60	51.98
	Net Imports	–	2.68	12.05	22.13	29.76	30.24	51.31
Electricity	Exports	–	0.08	0.04	0.16	0.21	0.10	..
	Imports	–	0.02	0.33	0.06	0.07	0.07	1.40
	Net Imports	–	-0.06	0.29	-0.10	-0.13	-0.03	1.40
TOTAL STOCK CHANGES		**0.11**	**-0.83**	**0.51**	**0.77**	**-1.08**	**-1.04**	**-**
TOTAL SUPPLY (TPES)[2]		**24.36**	**52.76**	**76.35**	**84.38**	**100.01**	**98.55**	**217.75**
Coal		5.15	16.91	22.91	22.79	29.39	29.46	80.60
Peat		–	–	–	–	–	–	–
Oil		12.48	23.40	30.40	28.75	30.70	29.55	56.25
Gas		–	2.86	12.63	22.79	30.42	30.18	51.54
Comb. Renewables & Waste[1]		6.45	7.21	6.51	5.36	5.06	4.88	3.93
Nuclear		–	–	–	–	–	–	8.23
Hydro		0.22	1.99	2.66	3.40	3.08	2.86	9.42
Wind		–	–	0.00	0.01	0.03	0.07	0.72
Geothermal		0.05	0.43	0.68	1.01	1.05	1.15	4.81
Solar		–	0.03	0.26	0.39	0.42	0.42	0.86
Electricity Trade[3]		–	-0.06	0.29	-0.10	-0.13	-0.03	1.40
Shares (%)								
Coal		*21.1*	*32.0*	*30.0*	*27.0*	*29.4*	*29.9*	*37.0*
Peat		–	–	–	–	–	–	–
Oil		*51.3*	*44.4*	*39.8*	*34.1*	*30.7*	*30.0*	*25.8*
Gas		–	*5.4*	*16.5*	*27.0*	*30.4*	*30.6*	*23.7*
Comb. Renewables & Waste		*26.5*	*13.7*	*8.5*	*6.3*	*5.1*	*4.9*	*1.8*
Nuclear		–	–	–	–	–	–	*3.8*
Hydro		*0.9*	*3.8*	*3.5*	*4.0*	*3.1*	*2.9*	*4.3*
Wind		–	–	–	–	–	*0.1*	*0.3*
Geothermal		*0.2*	*0.8*	*0.9*	*1.2*	*1.0*	*1.2*	*2.2*
Solar		–	*0.1*	*0.3*	*0.5*	*0.4*	*0.4*	*0.4*
Electricity Trade		–	*-0.1*	*0.4*	*-0.1*	*-0.1*	–	*0.6*

0 is negligible. - is nil. .. is not available

Forecasts are based on the 2006/07 submission. As of May 2010, Turkey plans to revise its forecasts in the near future.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2000	2005	2007	2008	2020
TFC	**19.86**	**40.07**	**57.85**	**65.43**	**76.48**	**74.38**	**163.26**
Coal	2.93	7.52	10.85	10.74	13.98	12.78	41.73
Peat	–	–	–	–	–	–	–
Oil	9.54	20.37	26.13	26.10	27.95	27.39	50.10
Gas	0.04	0.72	4.91	10.05	14.05	13.23	24.79
Comb. Renewables & Waste[1]	6.45	7.21	6.46	5.32	5.00	4.82	3.93
Geothermal	0.05	0.36	0.62	0.93	0.91	1.01	4.48
Solar	–	0.03	0.26	0.39	0.42	0.42	0.86
Electricity	0.85	3.87	8.25	11.06	13.14	13.71	37.37
Heat	–	–	0.39	0.85	1.03	1.02	..
Shares (%)							
Coal	*14.7*	*18.8*	*18.7*	*16.4*	*18.3*	*17.2*	*25.6*
Peat	–	–	–	–	–	–	–
Oil	*48.0*	*50.8*	*45.2*	*39.9*	*36.5*	*36.8*	*30.7*
Gas	*0.2*	*1.8*	*8.5*	*15.4*	*18.4*	*17.8*	*15.2*
Comb. Renewables & Waste	*32.5*	*18.0*	*11.2*	*8.1*	*6.5*	*6.5*	*2.4*
Geothermal	*0.2*	*0.9*	*1.1*	*1.4*	*1.2*	*1.4*	*2.7*
Solar	–	*0.1*	*0.5*	*0.6*	*0.5*	*0.6*	*0.5*
Electricity	*4.3*	*9.6*	*14.3*	*16.9*	*17.2*	*18.4*	*22.9*
Heat	–	–	*0.7*	*1.3*	*1.3*	*1.4*	..
TOTAL INDUSTRY[4]	**4.28**	**13.71**	**23.26**	**25.65**	**29.50**	**23.38**	**79.59**
Coal	1.14	4.50	8.83	8.27	11.23	6.12	33.93
Peat	–	–	–	–	–	–	–
Oil	2.59	6.18	8.23	8.01	7.05	6.44	12.17
Gas	0.00	0.67	1.76	3.19	3.92	3.46	13.65
Comb. Renewables & Waste[1]	–	–	–	–	–	–	–
Geothermal	–	–	–	–	–	–	–
Solar	–	0.01	0.10	0.12	0.13	0.13	0.26
Electricity	0.55	2.35	3.96	5.22	6.15	6.22	19.59
Heat	–	–	0.39	0.85	1.03	1.02	..
Shares (%)							
Coal	*26.6*	*32.8*	*38.0*	*32.2*	*38.1*	*26.2*	*42.6*
Peat	–	–	–	–	–	–	–
Oil	*60.4*	*45.1*	*35.4*	*31.2*	*23.9*	*27.5*	*15.3*
Gas	*0.1*	*4.9*	*7.6*	*12.5*	*13.3*	*14.8*	*17.2*
Comb. Renewables & Waste	–	–	–	–	–	–	–
Geothermal	–	–	–	–	–	–	–
Solar	–	*0.1*	*0.4*	*0.5*	*0.4*	*0.5*	*0.3*
Electricity	*12.9*	*17.2*	*17.0*	*20.3*	*20.8*	*26.6*	*24.6*
Heat	–	–	*1.7*	*3.3*	*3.5*	*4.3*	..
TRANSPORT[2]	**4.38**	**9.22**	**11.76**	**12.43**	**15.95**	**15.06**	**29.37**
TOTAL OTHER SECTORS[5]	**11.20**	**17.14**	**22.83**	**27.35**	**31.03**	**35.93**	**54.30**
Coal	1.27	3.00	2.02	2.47	2.75	6.66	7.81
Peat	–	–	–	–	–	–	–
Oil	3.11	5.02	6.25	5.84	5.20	6.22	8.92
Gas	0.04	0.05	3.11	6.75	9.97	9.59	11.12
Comb. Renewables & Waste[1]	6.45	7.21	6.46	5.32	4.98	4.76	3.93
Geothermal	0.05	0.36	0.62	0.93	0.91	1.01	4.48
Solar	–	0.02	0.17	0.26	0.29	0.29	0.61
Electricity	0.29	1.49	4.22	5.78	6.92	7.41	17.44
Heat	–	–	–	–	–	–	–
Shares (%)							
Coal	*11.3*	*17.5*	*8.8*	*9.0*	*8.9*	*18.5*	*14.4*
Peat	–	–	–	–	–	–	–
Oil	*27.7*	*29.3*	*27.4*	*21.3*	*16.8*	*17.3*	*16.4*
Gas	*0.3*	*0.3*	*13.6*	*24.7*	*32.1*	*26.7*	*20.5*
Comb. Renewables & Waste	*57.6*	*42.0*	*28.3*	*19.5*	*16.1*	*13.2*	*7.2*
Geothermal	*0.4*	*2.1*	*2.7*	*3.4*	*2.9*	*2.8*	*8.3*
Solar	–	*0.1*	*0.7*	*1.0*	*0.9*	*0.8*	*1.1*
Electricity	*2.6*	*8.7*	*18.5*	*21.1*	*22.3*	*20.6*	*32.1*
Heat	–	–	–	–	–	–	–

Forecasts are based on the 2006/07 submission. As of May 2010, Turkey plans to revise its forecasts in the near future.

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	2000	2005	2007	2008	2020
ELECTRICITY GENERATION[6]							
INPUT (Mtoe)	**2.77**	**10.78**	**22.66**	**26.77**	**33.83**	**35.63**	**84.79**
OUTPUT (Mtoe)	**1.07**	**4.95**	**10.74**	**13.93**	**16.47**	**17.06**	**41.56**
(TWh gross)	12.43	57.54	124.92	161.96	191.56	198.42	483.24
Output Shares (%)							
Coal	*26.1*	*35.1*	*30.6*	*26.7*	*27.9*	*29.1*	*33.2*
Peat	–	–	–	–	–	–	–
Oil	*51.4*	*6.9*	*7.5*	*3.4*	*3.4*	*3.8*	*1.3*
Gas	–	*17.7*	*37.0*	*45.3*	*49.6*	*49.7*	*34.5*
Comb. Renewables & Waste	*1.6*	–	*0.2*	*0.1*	*0.1*	*0.1*	–
Nuclear	–	–	–	–	–	–	*6.5*
Hydro	*20.9*	*40.2*	*24.7*	*24.4*	*18.7*	*16.8*	*22.7*
Wind	–	–	–	–	*0.2*	*0.4*	*1.7*
Geothermal	–	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
Solar	–	–	–	–	–	–	–
TOTAL LOSSES	**4.19**	**11.57**	**18.05**	**18.55**	**23.63**	**25.00**	**54.49**
of which:							
Electricity and Heat Generation[7]	1.70	5.83	11.53	11.99	16.32	17.55	43.23
Other Transformation	1.50	3.17	1.78	1.75	1.74	1.72	2.83
Own Use and Losses[8]	1.00	2.57	4.74	4.81	5.57	5.74	8.43
Statistical Differences	**0.30**	**1.12**	**0.45**	**0.40**	**–0.11**	**–0.83**	–

INDICATORS

	1973	1990	2000	2005	2007	2008	2020
GDP (billion 2000 USD)	87.98	185.95	266.56	333.03	372.61	375.96	714.77
Population (millions)	38.07	55.12	64.26	68.58	70.26	71.08	83.70
TPES/GDP[9]	0.28	0.28	0.29	0.25	0.27	0.26	0.31
Energy Production/TPES	0.64	0.49	0.34	0.28	0.27	0.30	0.30
Per Capita TPES[10]	0.64	0.96	1.19	1.23	1.42	1.39	2.60
Oil Supply/GDP[9]	0.14	0.13	0.11	0.09	0.08	0.08	0.08
TFC/GDP[9]	0.23	0.22	0.22	0.20	0.21	0.20	0.23
Per Capita TFC10	0.52	0.73	0.90	0.95	1.09	1.05	1.95
Energy-related CO_2 Emissions (Mt CO_2)[11]	52.4	126.9	200.6	216.4	265.0	263.4	567.5
CO_2 Emissions from Bunkers (Mt CO_2)	0.4	0.9	2.8	6.5	6.1	5.9	14.0

GROWTH RATES (% per year)

	73–79	79–90	90–00	00–05	05–07	07–08	08–20
TPES	3.7	5.2	3.8	2.0	8.9	–1.5	6.8
Coal	4.1	9.0	3.1	–0.1	13.5	0.3	8.7
Peat	–	–	–	–	–	–	–
Oil	3.0	4.2	2.7	–1.1	3.4	–3.7	5.5
Gas	–	–	16.0	12.5	15.5	–0.8	4.6
Comb. Renewables & Waste	3.1	–0.7	–1.0	–3.8	–2.9	–3.5	–1.8
Nuclear	–	–	–	–	–	–	–
Hydro	25.7	7.6	2.9	5.1	–4.8	–7.2	10.4
Wind	–	–	–	10.8	149.0	135.5	21.0
Geothermal	3.8	19.7	4.7	8.0	2.0	9.7	12.7
Solar	–	–	25.1	8.0	4.4	–	6.2
TFC	4.1	4.3	3.7	2.5	8.1	–2.8	6.8
Electricity Consumption	11.3	8.2	7.9	6.1	9.0	4.3	8.7
Energy Production	1.9	3.6	0.0	–1.5	6.8	6.4	7.1
Net Oil Imports	5.0	5.5	3.1	–1.8	6.7	–6.9	6.0
GDP	4.5	4.5	3.7	4.6	5.8	0.9	5.5
Growth in the TPES/GDP Ratio	–0.8	0.7	0.1	–2.4	2.9	–2.2	1.3
Growth in the TFC/GDP Ratio	–0.4	–0.3	0.1	–2.0	2.3	–3.4	1.2

Forecasts are based on the 2006/07 submission. As of May 2010, Turkey plans to revise its forecasts in the near future.
Please note: Rounding may cause totals to differ from the sum of the elements.

FOOTNOTES TO ENERGY BALANCES AND KEY STATISTICAL DATA

1. Combustible renewables and waste comprises solid biomass, liquid biomass, biogas and industrial waste. Data are often based on partial surveys and may not be comparable between countries.

2. Excludes international marine bunkers and international aviation bunkers.

3. Total supply of electricity represents net trade. A negative number in the share of TPES indicates that exports are greater than imports.

4. Industry includes non-energy use.

5. Other Sectors includes residential, commercial, public services, agriculture, forestry, fishing and other non-specified sectors.

6. Inputs to electricity generation include inputs to electricity and CHP plants. Output refers only to electricity generation.

7. Losses arising in the production of electricity and heat at main activity producer utilities and autoproducers. For non-fossil-fuel electricity generation, theoretical losses are shown based on plant efficiencies of approximately 33% for nuclear, 10% for geothermal, and 100% for hydro and wind.

8. 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.

9. Toe per thousand US dollars at 2000 prices and exchange rates.

10. Toe per person.

11. "Energy-related CO_2 emissions" have been estimated using the IPCC Tier I Sectoral Approach from the *Revised 1996 IPCC Guidelines*. In accordance with the IPCC methodology, emissions from international marine and aviation bunkers are not included in national totals. Projected emissions for oil and gas are derived by calculating the ratio of emissions to energy use for 2008 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.

INTERNATIONAL ENERGY AGENCY "SHARED GOALS"

The member countries* of the International Energy Agency (IEA) seek to create conditions in which the energy sectors of their economies can make the fullest possible contribution to sustainable economic development and to the well-being of their people and of the environment. In formulating energy policies, the establishment of free and open markets is a fundamental point of departure, though energy security and environmental protection need to be given particular emphasis by governments. IEA countries recognise the significance of increasing global interdependence in energy. They therefore seek to promote the effective operation of international energy markets and encourage dialogue with all participants. In order to secure their objectives, member countries therefore aim to create a policy framework consistent with the following goals:

1. **Diversity, efficiency and flexibility within the energy sector** are basic conditions for longer-term energy security: the fuels used within and across sectors and the sources of those fuels should be as diverse as practicable. Non-fossil fuels, particularly nuclear and hydro power, make a substantial contribution to the energy supply diversity of IEA countries as a group.

2. Energy systems should have **the ability to respond promptly and flexibly to energy emergencies.** In some cases this requires collective mechanisms and action: IEA countries co-operate through the Agency in responding jointly to oil supply emergencies.

3. **The environmentally sustainable provision and use of energy** are central to the achievement of these shared goals. Decision-makers should seek to minimise the adverse environmental impacts of energy activities, just as environmental decisions should take account of the energy consequences. Government interventions should respect the Polluter Pays Principle where practicable.

4. **More environmentally acceptable energy sources** need to be encouraged and developed. Clean and efficient use of fossil fuels is essential. The development of economic non-fossil sources is also a priority. A number of IEA member countries wish to retain

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

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. I**mproved energy efficiency** can promote both environmental protection and energy security in a cost-effective manner. There are significant opportunities for greater energy efficiency at all stages of the energy cycle from production to consumption. Strong efforts by governments and all energy users are needed to realise these opportunities.

6. **Continued research, development and market deployment of new and improved energy technologies** make a critical contribution to achieving the objectives outlined above. Energy technology policies should complement broader energy policies. International co-operation in the development and dissemination of energy technologies, including industry participation and co-operation with non-member countries, should be encouraged.

7. **Undistorted energy prices** enable markets to work efficiently. Energy prices should not be held artificially below the costs of supply to promote social or industrial goals. To the extent necessary and practicable, the environmental costs of energy production and use should be reflected in prices.

8. **Free and open trade** and a secure framework for investment contribute to efficient energy markets and energy security. Distortions to energy trade and investment should be avoided.

9. **Co-operation among all energy market participants** helps to improve information and understanding, and encourages the development of efficient, environmentally acceptable and flexible energy systems and markets worldwide. These are needed to help promote the investment, trade and confidence necessary to achieve global energy security and environmental objectives.

(The Shared Goals were adopted by IEA Ministers at their 4 June 1993 meeting in Paris.)

GLOSSARY AND LIST OF ABBREVIATIONS

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

b/d	barrels per day
bcm	billion cubic metres
BOO	build-own-operate
BOT	build-operate-transfer
BOTAŞ	Petroleum Pipeline Corporation
BTC	Baku-Tbilisi-Ceyhan crude oil pipeline
BTYK	Supreme Council of Science and Technology
CCGT	combined-cycle gas turbine
CCS	carbon capture and storage
CO_2	carbon dioxide
CO_2-eq	carbon dioxide equivalent
DPT	State Planning Organisation
EIE	Electrical Power Resources Survey and Development Administration
EMRA	Energy Market Regulatory Authority
ENTSO-E	European Network of Transmission System Operators for Electricity
ESCO	energy services company
EU	European Union
EÜAŞ	a state-owned electricity generation company
F-gases	HFCs (hydrofluorocarbons); PFCs (perfluorocarbons); SF_6 (sulphur hexafluoride)

GDP	gross domestic product
GHGs	greenhouse gases (CO_2, carbon dioxide; CH_4, methane; N_2O,nitrous oxide; see F-gases)
GW	gigawatt, or 1 watt $\times$ 10^9
IPCC	Intergovernmental Panel on Climate Change
JI	joint implementation (under the Kyoto Protocol)
ktoe	kilotonne of oil equivalent
kV	kilovolt, or 1 volt x 10^3
kWh	kilowatt-hour = 1 kilowatt $\times$ 1 hour, or 1 watt $\times$ 1 hour $\times$ 10^3
L	litre
LNG	liquefied natural gas
mcm	million cubic metres
MENR	Ministry of Energy and Natural Resources
MoU	Memorandum of Understanding
Mt	million tonnes
Mtoe	million tonnes of oil equivalent; see toe
MW	megawatt of electricity, or 1 watt x 10^6
MWh	megawatt-hour = 1 megawatt $\times$ 1 hour, or 1 watt $\times$ 1 hour $\times$ 10^6
OECD	Organisation for Economic Co-operation and Development
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
SO_2	sulphur dioxide
t	tonne
TAEK	Turkish Atomic Energy Authority
TEAŞ	Turkish Electricity Generation-Transmission Corporation.

TEDAŞ	Turkish Electricity Distribution Company.
TEIAŞ	Turkish Electricity Transmission Corporation.
TETAŞ	Turkish Electricity Wholesale and Trading Company (a state-owned electricity wholesale company)
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
TKI	Turkish Coal Enterprises
toe	tonne of oil equivalent, defined as 10^7 kcal
TOOR	transfer of operating rights
TPA	third-party access
TPAO	Turkish Petroleum Corporation
TPES	total primary energy supply
TRL	Turkish lira
TSO	transmission system operator
TTGV	Technology Development Foundation of Turkey
TTK	Turkish Hard Coal Enterprises
TÜBITAK	The Scientific and Technical Research Council of Turkey
TÜPRAS	Turkish Petroleum Refinery Corporation
TW	terawatt, or 1 watt $\times$ 10^{12}
TWh	terawatt-hour = 1 terawatt $\times$ 1 hour, or 1 watt $\times$ 1 hour $\times$ 10^{12}
UNFCCC	United Nations Framework Convention on Climate Change

International Energy Agency

Online bookshop

Buy IEA publications online:

www.iea.org/books

PDF versions available at 20% discount

Books published before January 2008 - except statistics publications - are freely available in pdf

International Energy Agency • 9 rue de la Fédération • 75739 Paris Cedex 15, France

iea

Tel: +33 (0)1 40 57 66 90

E-mail:
books@iea.org

IEA PUBLICATIONS, 9, rue de la Fédération, 75739 PARIS CEDEX 15
PRINTED IN FRANCE BY SOREGRAPH, July 2010
(61 2009 06 1P1) ISBN : 978-92-64-06041-8