

The role of coal in energy production—Consumption and sustainable development of Turkey

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Abstract

Energy is one of the indispensable factors regarding the assurance of social prosperity and economic development of a country. The developing countries struggle to obtain energy sources reliable in the long term to complete their economic development, and the developed countries struggle to get them to keep their present prosperity levels. Coal seems to continue its indispensable position among the other energy sources for many years because of its production in more than 50 countries, the least effect it has from the price fluctuation and its usage lifespan of more than 200 years. The countries that are aware of it have investments in mining fields in the countries rich in coal reserves, and they continue investing considerable amount of money.

In the projections of Turkey in 2020, the primary energy consumption is estimated to be 298 Mtoe, the production is estimated to be 70 Mtoe, the ratio of production to consumption will reduce to the level of 23.5%, and this situation will cause serious risks for sustainable development. In other words, Turkey will have to import 76.5% of the energy that it consumes in the 2020s. However, Turkey can reduce the rate of the external dependency to the level of 50% by using the hard coal reserve of 1.3 billion tons, the lignite reserve of 8.058 billion tons and renewable source of great potential.

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1. Introduction

It is certain that energy is the most important necessity of human life and there is an increasing relation between the level of development and amount of energy consumed in the country. Coal, which has the greatest importance among the energy sources, is the primary factor for the industrial revolution in the world. Countries that found their coal reserves and used them in the 19th century are now developed countries of the world. Coal keeps its favor even today. Steel consumption, which is the primary indicator of the degree of development of a country, still uses coal. Coal is also commonly used in electrical power plants. Because of the inevitable decline in world reserves of petroleum and natural gas and rising demand for energy, coal is a major alternative along with nuclear power to meet these needs (Uslu, 2002).

Coal is often the only alternative when low-cost cleaner energy sources are inadequate to meet the growing energy demand. Developing countries use about 55% of the world's coal today; this share is expected to grow to 65% over the next 15 years. The world coal consumption is projected to increase by 2.2 billion tons, from 5.3 billion tons in 2001 to 7.5 billion tons in 2025 (Balat and Ayar, 2004).

Coal is a major fuel source for Turkey, used primarily for power generation, steel manufacturing, and cement production. Total lignite and hard coal reserves are estimated as 8075 and 1130 Mtoe, respectively. Rich lignite deposits are spread all over the country. Afşin-Elbistan, Muğla, Soma, Tuñbilek, Seyitömer, Beypazarı and Sivas basins constitute the most important lignite reserves (Balat and Ayar, 2004). The hard coal reserves are only in Zonguldak, situated in the northwest of the country, and in its surroundings (TTK, 2004).

Turkey predominantly used hard coal and lignite in electricity production by the middle of 1940–1960. From

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the middle of the 1960s to the beginning of the 1980s, crude petroleum took the first order in energy production because of its attractive price and its usage rate of 30–40%. The serious rise in the price of petroleum after the crisis of 1973 led Turkey to the use of indigenous sources in energy production (Arioğlu, 1994; Arioğlu and Yılmaz, 1997a, b). Turkey produced the electricity energy of 23.275 GWh totally in 1980. The distribution of the produced electricity energy according to primary energy sources was as follows: hard coal 3.9%, lignite 21.7%, petroleum 25.1%, hydraulic 48% (SIS, 2003; MENR (Ministry of Energy and Natural Resources), 2004; TEDAS, 2004). From the beginning of the 1980s, explosions took place in lignite production after the use of indigenous sources gained importance, and the share of lignite in energy production rose to the levels of 40%. The development based on lignite in energy production continued until 2000. It is very noticeable that imported natural gas, which joined the primary energy sources in 1985, and the share of natural gas in the energy production began to increase rapidly. While the electricity production based on lignite, which had a serious potential among the indigenous sources, was diminishing, natural gas began to replace it. Turkey began to provide 45.2% of its electricity production from natural gas from 2003 (Arioğlu, 1994; Arioğlu and Yılmaz, 1997a, b). The share of lignite in electricity production reduced to 16% in 2003 (SIS, 2003; MENR, 2004; TEIAS, 2004).

2. Coal usage in the energy production of the world

The world coal reserves are in considerable amounts, and these reserves show a large distribution in contrast to petroleum. Although 64% of petroleum is in the Middle Eastern Countries and 72% of natural gas is in the Middle Eastern Countries and the former Soviet Union, coal is distributed much more fairly in the world because of its production in more than 50 countries. The total coal reserve in the world is 984 billion tons; 52% of it consists of anthracite–bituminous coal, and 48% of sub-bituminous coal and lignite. The total reserve distribution is 36% for Europe–Eurasia, 26% for North America, 30% for Asia

Pacific, 6% for Africa–Middle East and 2% for Central America. When the average coal production for 1981–2003 is taken into consideration, the known coal reserves of the world are approximately at the level of 220 years (BP, 2003, 2004). Total recoverable coal reserve in the world is 908 billion tons as seen in Table 1 (IEA, 2003). In 2003, coal production and consumption in the world is 2519 and 2578 Mtoe, respectively (BP, 2003, 2004).

The distribution of the primary energy consumption of the world according to the energy sources is given in Fig. 1 for 1973 and 2002. The total consumption, which was 5555 Mtoe in 1973, rose to the level of 9131 Mtoe by increasing 64% in 2002. The share of coal in this consumption was 1579 Mtoe in 1973, and this value became 2398 Mtoe by increasing 52% in 2002. Although there was an increase in the use of coal, its rate in the total remained constant. In other words, approximately one-third of the total primary energy consumption is met by coal. The important change within the 30 years' period was the reduction of the share of petroleum from 50% to the level of 40%. In contrast to the reduction in the use of petroleum, the rate of natural gas usage increased 6% and the share of nuclear energy increased 7% (RWE, 2004; BP, 2003, 2004).

Coal is also in an indispensable position in the electricity generation of the world. From 2001, 5992 billion kWh (~40%) of the total 15,477 billion kWh electricity generation of the world was provided by coal. In 2001, coal was in the first order in electricity generation with 38%, it was followed by natural gas with 18%, hydroenergy with 17% and nuclear energy with 17% (RWE, 2004; BP, 2003, 2004; OECD/IEA, 2003) (Fig. 2).

In World Energy Report 2003, it was estimated that coal, which had a share of 39% in the electricity generation of the world in 2000, would also continue this usage level in 2030. While a 14% increase was predicted in the rate of natural gas usage in 2030, a decrease of 8% was predicted in nuclear energy (Fig. 3) (RWE, 2004).

It is clear that the importance of coal in the world for electricity production will continue. Lifespan and fair distribution of coal reserves in the world provide resource availability and supply safety. Nevertheless, prospecting

Table 1
World coal reserves (IEA, 2003)

Region/country	Recoverable coal reserves (million tons)		
	Anthracite and bituminous	Lignite and sub-bituminous	Total
North America	118,102	135,460	253,562
Central & South America	7701	12,192	19,893
Western Europe	1425	31,677	33,102
Eastern Europe & Former USSR	110,830	142,978	253,809
Middle East	419		419
Africa	50,162	174	50,336
Asia & Oceania	192,563	104,324	296,887
World total	481,202	426,805	908,008

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