COAL: A REALISTIC HOPE FOR TURKEY'S FUTURE ENERGY SECURITY?

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INTRODUCTION

As it is well known, energy is the basic element of the social and economic development for any country. Energy consumed in today's world is produced mainly from fossil fuels such as oil, natural gas, largely from coal (87 %), from nuclear and as a smaller proportion from renewable (13 %) resources. European countries have been the biggest energy importers but lately, China seems to carry the flagship as it is going to be the major importer by 2030. Russia is expected to keep its position as the biggest energy exporter country in the world, as it is now.

Turkey's priority on its energy policies is to achieve supplying cheap and quality energy sources continuously and reliably. However, Turkey's energy security has become controversial since some of the analysts recently addressed the issue that Turkey covers its energy demand largely from imported sources. This study analyzes the status of domestic coal reserves and production facilities in Turkey as if it can be an alternative to the imported energy sources.

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ENERGY PRODUCTION IN TURKEY AND THE WORLD

Growing population and industrialization in developing countries cause a rapid increase in energy demand in such countries. Energy that indicates a country's social and economic potential is a mandatory element as a factor of production. There is a linear relation between energy consumption and social development in a country, whereas the more the country develops by economic gains and draws cultural relief, the more the energy consumption increases (Koç and Kaplan, 2008; Koç and Şenel, 2013). Energy finds its place in every stage of everyday life for people who use it and it can be supplied by various chemical, nuclear, mechanical (potential and kinetic), thermal, geothermal, hydraulic, solar, and electrical ways and converted to each other with suitable unique methods. A comprehensive case analysis needs to be implemented both in the world and in Turkey to make a reliable plan to stop the rapid declination of energy resources and to arrange the utilization of renewable energy sources.

The pioneer energy sources are non-renewables like oil, natural gas and coal in the world's energy production. The share of natural gas in energy production increases day by day in the world because of being a cleaner source for the environment. Oil is the most used energy source in the world, which is followed by mined coal with a decreasing consumption rate and natural gas with an increasing production and consumption rate. In all periods to the day, a particular energy source (Coal) was superior to other sources. Oil replaced coal with time, later in the following years, natural gas gained an importance and at last, alternative energy sources are expected to replace them in the forthcoming years.

Figure 1 presents the share of primary energy sources in the world's electricity production in 2012. In the following year (2013), electricity production from primary energy sources was 23,322 TWh. Coal had the biggest share (41.3 %) that was followed by natural gas (21.7 %) and hydraulics (16.3 %) respectively. The share of renewables (geothermal, solar, wind, bio, etc.) was 5.7 %, bigger than the previous year's (5 %).

For Turkey, primary energy production was 252.00 TWh in 2014. The distribution of sources in primary energy production was 47.9 % for natural gas, 29.9 % for coal, and 16.1 % for hydraulics (See Figure 2). The energy production from lignite, geothermal, wind and solar sources was more than the last year's, whereas it was lesser from wood, animal and plant sources.

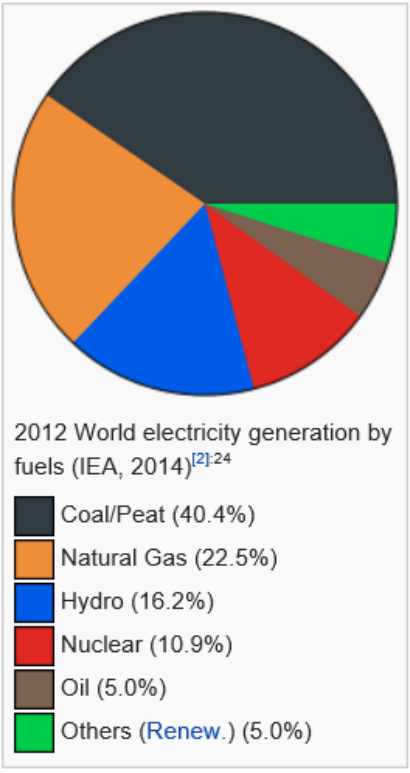

Figure 1: World energy production in 2012 (IEA, 2015).

Figure 3 displays Turkey's energy production and consumption from domestic sources. The ratio of energy consumption to energy production from domestic resources decreased rapidly between the years 1990 and 2011. This ratio was 48.1 % in 1990, and 28.2 % in 2011 (Koç and Şenel, 2013).

COAL RESERVES AND COAL TRADE IN THE WORLD AND IN TURKEY

Coal has become an important asset in the energy world due to some recent developments on clean coal technologies, coal gasification and coal liquefaction processes. According to the International Energy Outlook 2014 Report, coal's share in world electricity generation in 1990 increased from 37.4 % to 40.3 % in 2012 and stood steady since then (Energy Report, 2014).

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Due to continuous energy demand globally, fossil fuels are decreasing day-by-day and proven and prediction of the probable reserves are to be depleted in the next millennium. As of 2013, the calculated proven reserve of coal was 891 billion tons and determined to have run out in 142 years' time. Table 1 presents coal reserves in continents.

Turkey's proven coal reserves are owned and operated by public and private sector were calculated as 15.8 billion tons in 2013. Hard coal is extracted only from Zonguldak Re-

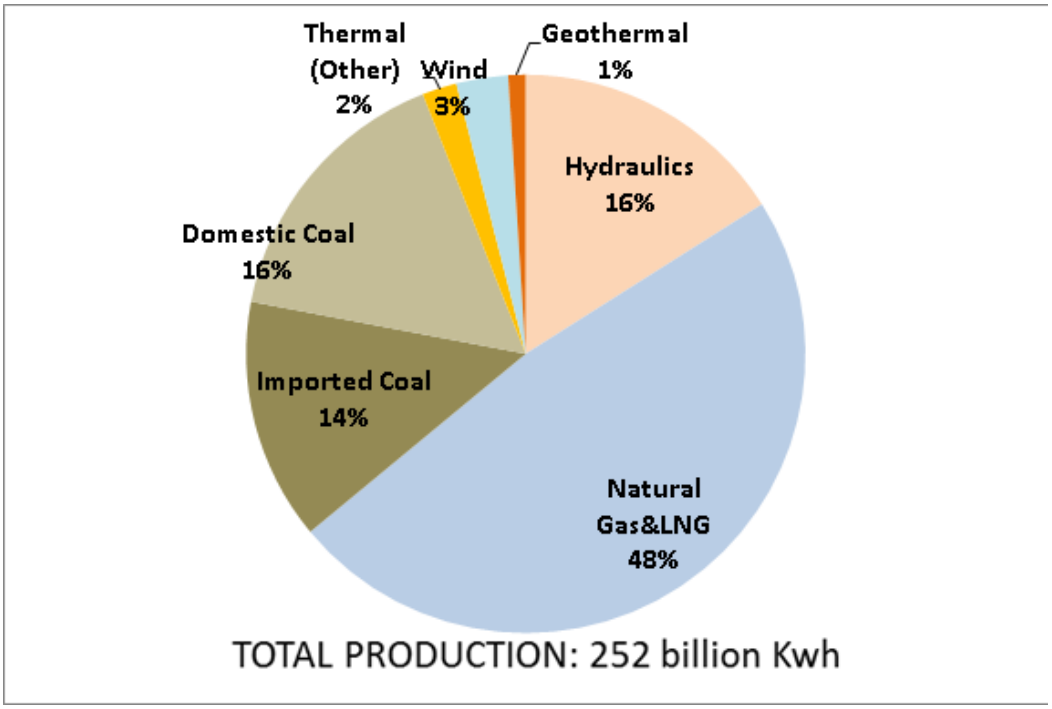

Figure 2: Turkey's electricity generation in 2014 (TEIAS, 2015).

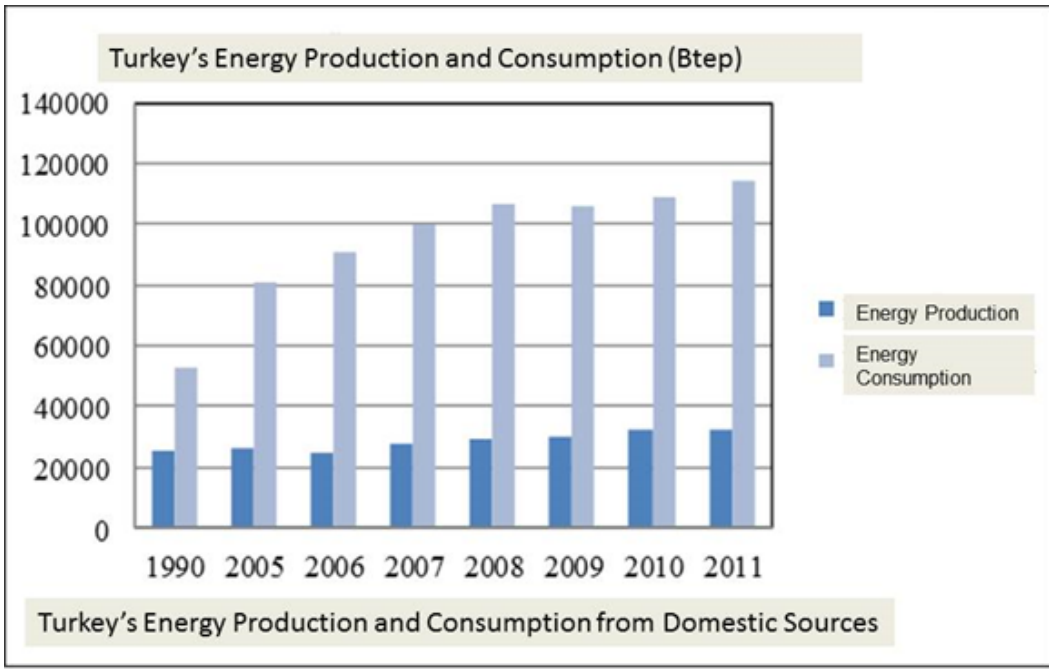

Figure 3: Turkey's energy production and consumption from domestic sources.

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gion, and lignite basins are spread over the Middle Anatolia and Aegean Regions. Turkey's mineral reserves, prepared by Mineral Research and Exploration Institute (MTA), are presented in Table 2.

It is widely known that calorific values of Turkey's lignites are quite low and studies performed have shown lower heating values of lignites being between 1,000-4,200 kCal/kg, 90 % of which are lower than 3,000 kCal/kg.

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When the global coal trade is examined, almost all of the trade is set up on hard coal. This is because it is not feasible to transport lignite overseas except from short distances between neighboring countries. World coal export reached to 1.255 billion tons in 2012 and only 2.5 million tons of the whole amount consisted of lignite (IEA, 2013). In Turkey, including private sector production, 79 million tons of coal (asphaltite, oil shale, lignite, and hard coal) was produced in 2012. The coal demand has increased in recent years but coal production in Turkey has been decreasing that has resulted in a rise of coal imports. In 2013, the produced hard coal was 2.3 million tons but the imported coal that includes hard coal and lignite was approximately 25 million tons. No export process of coal is realized in Turkey because of the limited reserves and production of hard coal and low calorific values of lignite.

REGION	Hard Coal (Million Tons)	Lignite (Million Tons)	Total (Million Tons)	Ratio (%)
Eurasia	92,557	217,981	310,538	35.8
Asia Pacific	157,803	130,525	288,328	32.3
North USA	112,835	132,253	245,088	27.6
Middle East and Africa	32,722	214	32,936	3.7
South and Middle USA	7,282	7,359	14,641	1.6
Total	403,199	488,332	891,531	100

Table 1: Coal reserves in continents (Energy Report, 2014).

REGION	Total (Million Tons)
Soma	205
Pınarhisar	140
Çerkezköy	495
Eskişehir	1200
Afyon-Dinar	941,5
Ilgın	30,5
Çumra	15
Karapınar	1832
Amasya	9,2
Afşin-Elbistan	1815
Malatya	17

Table 2: Mineral reserves of Turkey (Dagistan, 2012).

ASSESSMENT

Coal keeps its position as one of the main sources of energy in the world. However, Turkey's energy policy in terms of producing energy from imported resources seems to be a bad example. Turkey produces nearly half of its electricity (47.9 %) from imported natural gas, 16.5 % from domestic coal, 16.1 % from hydraulics, 13.4 % from imported hard coal, and the remaining 6.1 % from other sources like wind, solar, geothermal and others. It should be discussed whether all of the energy demand in Turkey could be met by domestic resources although there is a big energy dependency to other countries' resources.

The energy consumption in Turkey was 78 TWh in 1994. It rised up to 150 TWh during 2001 by nearly a 100 % increase and to 255 TWh by a 70 % increase in the year 2014. However, increase in coal production could be succeeded only by 20.8 % in two decades and 34.3% in a decade time (compared with tons of oil equivalent). As a result, it would be wise to say that increase rate in Turkey's energy production by its domestic sources is much far behind the energy consumption rate. In account of these calculations, the production to consumption rate was 43.9 % two decades ago, 28.4% a decade earlier and it was 26.6 % in 2013.

After addressing the decrease in energy production to consumption rates in years, the distribution of the 31.9 mtep of domestic energy production in 2013 should be taken under consideration. It is clear that the 15.5 mtep was from coal as first, 5.1 mtep from hydraulics as second, 4.3 mtep was from wood, animal and plant wastes as third. These were followed by 4.1 mtep of renewable energy sources like geothermal, wind and solar, 2.5 mtep from oil and 0.4 mtep from natural gas. The coal distribution was 14 mtep lignite, 1 mtep hard coal and 0.5 mtep asphaltite.

In 2013, 57.5 million tons of lignite was produced with a decrease of 15.5 % when compared with previous year. Hard coal production was 2 million tons and asphaltite production was 0.9 million tons. Lignite was largely used in power plants for the electricity production (85.4 %), 6.8 % for industrial purposes and 7.7 % for heating households and work places.

As stated earlier in this study, there is a quite notable decrease among energy production to consumption ratios in Turkey. This ratio was 19.2 % in 1993, 12.9 % in 2003, and 12.8% in 2013. The energy consumed was 260 TWh in 2013 and 252 TWh of it was produced in Turkey. This production was mainly from natural gas (43.8 %) and imported coal (13.4 %). Clearly, only 107.8 TWh of energy was produced from domestic sources and the energy produced was 41.5 TWh from domestic lignite sources.

There is a 152.15 TWh energy gap due to outer dependency directly or indirectly. Even though Turkey had the opportunity to meet this gap from domestic coals, it should have produced 200 million tons of lignite instead of currently produced 50 million tons. Installed capacities of power plants using domestic coals should have been four times higher the current ones. Additionally, if the production rate is assumed to be steadfast, it can be deduced that the coal in Turkey will be depleted in 77 years even the reserves are operated by 100 % efficiency.

Consequently, it can be referenced that it would be a dream to fill Turkey's energy dependency gap by domestic coal. Even if it is succeeded, depletion of all the coal reserves

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in the near future would create a big problem. Instead, we have to accelerate renewable energy investments and especially in nuclear as soon as possible so that the energy dependency on foreign resources could be lowered substantially.

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