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Securing Türkiye's energy supply – The importance of coal and coal mining[1]

Abstract: Given its historical importance and relatively high level of reliability in terms of availability compared to alternative energy sources, coal has become increasingly important as a key component of energy supply security. This study aims to analyze the role of coal mining and coal, one of the local energy resources, in Türkiye's energy security with the aim of formulating relevant policy recommendations. Through a comprehensive examination, Türkiye's coal energy profile and its external energy dependence are discussed, and the critical importance of coal and coal mining in strengthening the country's energy security is revealed. The findings underscore the enduring importance of coal and coal mining in diversifying the energy portfolio over time and reaffirm its indispensable role in ensuring the resilience and stability of Türkiye's energy supply.
Keywords: Energy, Energy Supply Security, Coal, Coal Mining, Türkiye.

Összefoglalás: Tekintettel történelmi jelentőségére és az alternatív energiaforrásokhoz képest viszonylag magas szintű megbízhatóságára, valamint a rendelkezésre állás szempontjából, a szén az energiaellátás biztonságának kulcsfontosságú elemeként egyre fontosabbá vált. E tanulmány célja, hogy elemezze a szénbányászat és a szén, mint az egyik helyben megtalálható energiaforrás szerepét Törökország energiabiztonságában, azzal a szándékkal, hogy megfelelő szakpolitikai ajánlásokat fogalmazzon meg. Egy átfogó vizsgálat alapján Törökország szénenergia-profilját és külső energiafüggőségét tárgyalja, valamint feltárja a szén és a szénbányászat kritikus fontosságát az ország energiabiztonságának erősítésében. Az eredmények alátámasztják a szén és a szénbányászat tartós jelentőségét az energiaportfólió időbeli diverzifikálásában, és megerősítik nélkülözhetetlen szerepét Törökország energiaellátása rugalmasságának és stabilitásának biztosításában.
Kulcsszavak: Energia, energiaellátás biztonsága, szén, szénbányászat, Törökország.

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[7] Balat, M. (2010): Security of energy supply in Turkey: Challenges and solutions. *Energy Conversion and Management,* 51., (10.), pp. 1998–2011.

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Introduction

Despite lacking a universally agreed-upon definition of energy security, it is a construct whose scope continues to expand. It encompasses a wide range of factors that influence a nation's energy prosperity. Notably, the notion of uninterrupted energy supply permeates prevailing conceptualizations of energy security [1], often coupled with the imperatives of ensuring adequate supply levels and reasonable pricing [2]. Furthermore, Marin-Quemada et al. [3] assert that energy security involves a complex interplay of factors spanning external relations, domestic energy structure, and geographic considerations. The International Energy Agency [4] articulates energy security as the provision of consistent energy supply at affordable prices, a definition reinforced by Kalicki and Goldwyn [5]. This conceptualization recognizes the physical, economic, social, and environmental dimensions of energy security [6] and requires both short- and long-term perspectives for a comprehensive analysis [7, 8]

The fact that Turkey meets a large part of its energy needs from imported energy sources brings external energy dependence to the agenda as an important and critical issue [9]. This situation emerges as a priority issue that needs to be resolved to ensure energy security and support sustainable growth in the country. In this context, the provision of energy necessary for stable and sustainable growth under the most reasonable conditions and the reduction of energy dependence on foreign energy are possible primarily through the diversification of energy resources and investment in domestic and relatively more reliable resources. In addition to the fact that oil and natural gas reserves are concentrated in certain geographical regions of the world and that these regions are often economically, politically, and geopolitically unstable, fluctuations in the prices of such energy resources cause major problems [10].

Geopolitical conflicts can disrupt energy supplies and negatively affect economic stability. In addition, factors such as the waste problems of nuclear energy sources and societal concerns about this issue, as well as the high cost of renewable energy sources, make coal more advantageous than its alternatives in ensuring energy security and reducing energy costs. Coal, which is widely available throughout the world, easier to produce and transport than other energy resources, stable in price, advantageous in terms of storage facilities, and safe to use, plays a key role in energy security because it is a more economically viable option.

Coal resources, especially lignite, are Türkiye's most important domestic energy source and are of strategic importance for its growing population and growing economy. In parallel with the rapid growth in Türkiye's population growth, the expansion of the economy, the increase in the rate of urbanization, industrialization processes and the rise in living standards, and the increase in energy demand, coal, and coal mining continue to be seen as an important energy source in terms of meeting the energy needs of the country and this situation is expected to continue in the future. Coal and coal mining are of strategic importance to ensure Türkiye's energy supply security and to diversify energy sources in this direction. However, in this process, factors such as environmental sustainability, technological developments, effective energy policies, and international cooperation should not be ignored. A review of the literature reveals that while coal is recognized as an essential element of a reliable energy system, there are debates that a reduction in coal use could jeopardize the security of the energy supply [11]. From this point of view, it is of great importance to examine Türkiye's current overall energy balance and the level of energy dependence and to analyze the role of coal and coal mining in the establishment of energy supply security in this direction.

The Role of Coal and Coal Mining in Turkey

Today, energy resources stand out as a strategic resource that affects not only production costs but also the global economy and underpins international relations [12, 13].

[11] Mayer, A.–Smith, E. K.–Rodriguez, J. (2020): Concerned about coal: security, dependence, and vulnerability among coal-dependent communities in western Colorado. *Energy Research & Social Science,* 70.

[12] Aydin, C.–Esen, O. (2016): Threshold effects of energy consumption on economic growth in Turkey. Journal of Environmental *Management and Tourism,* 7., (3.), pp. 370–382.

[13] Aydin, C.–Esen, O. (2018): Does the level of energy intensity matter in the effect of energy consumption on the growth of transition economies? Evidence from dynamic panel threshold analysis. *Energy Economics,* 69., pp. 185–195.

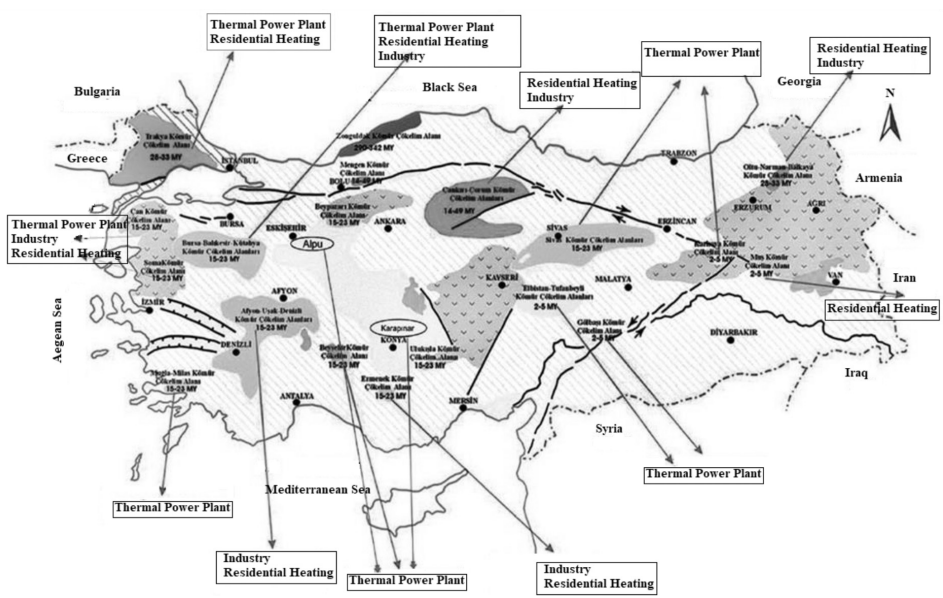
[14] Aydin, C.–Esen, O. (2017): Does too much energy consumption harm the economic growth of the Turkish Republic in the transition process? New evidence on threshold effects. *International Journal of Energy Economics and Policy,* 7., (2.), pp. 34–43.

Yet, Turkey is facing problems of energy supply security due to its dependence on fossil-based energy resources and increasing energy demand [14].

In this context, coal and coal mining have a strategic importance in ensuring Türkiye's energy supply security and diversifying its energy portfolio. Coal plays an important role in this strategy as it has large reserves and can be supplied from domestic resources. In the context of Türkiye's energy supply security, coal is considered a potential solution to contribute to energy production based on domestic resources. In this context, examining the current status of coal and coal mining in Turkey and their potential role in the establishment of energy supply security is of great importance for Türkiye's stable and sustainable growth.

Türkiye's hard coal reserves are mainly concentrated in the Zonguldak basin, but there are also lignite deposits in different geographies of the country. The most productive lignite reserves are located in Eastern and Southeastern Anatolia [15].

Türkiye's major coal fields and potential utilization areas as of 2022 are shown in *Figure 1.*



[15] ILO (2015): *Türkiye Kömür Madenciliği Sektöründe Sözleşmesel Düzenlemeler: Gerçekleşme Biçimleri–Boyutları, Nedenleri–Yasal Nedenleri ve İSG Üzerindeki Etkisi.* Ankara: ILO Türkiye Ofisi.

[16] MTA [Mineral Research and Exploration] (2023). Kömür Arama Araştırmaları. (accessed 5.12.2023), https://www.mta.gov.tr/v3.0/arastirmalar/komur-arama-arastirmalari

Source: [16]

The main elements shaping the international dimension of Türkiye's energy strategy can be expressed as follows [16]: (i). Ensuring route and resource diversity in the supply of oil and natural gas, taking into account the increasing demand and external dependency level, (ii). Contributing to regional and global energy supply security, (iii). Efforts to become a regional trade center in the field of energy, (iv). Considering social and environmental impacts at every stage of the energy supply chain within the framework of sustainable development, (v). Increasing the share of domestic and renewable energy in electricity generation, (vi). Inclusion of nuclear energy sources in the energy portfolio.

Given today's technological and industrial landscape, coal remains a major player, especially as a major contributor to global energy production. Its economic affordability and the worldwide spread of its resources relative to alternatives make it a reliable source of baseload power while offering a solid supply to meet the energy demands of a growing population and ever-growing industrial sectors. Coal's role as a reliable source of baseload power provides significant stability and balance to the energy supply, acting as a complement to intermittent renewable energy sources. This balance is crucial for meeting the energy demands of various sectors and ensuring resilience against interruptions. Coal mining, which is of strategic importance, faces several challenges in terms of environmental impacts and concerns over greenhouse gas (GHG) emissions. However, the development and deployment of less polluting and more efficient technologies, particularly carbon capture, utilization, and storage (CCUS) in the context of carbon management through ongoing R&D and innovative activities in coal technologies with the goal of cleaner energy sources, aims to reduce environmental concerns while maintaining coal's contribution to energy security [17]. In this regard, tackling pollutant emissions from the coal industry presents important opportunities for climate action that can strengthen energy security [18].

Turkey, which is a net energy importer, is pursuing a policy of diversifying its energy portfolio by turning to alternative energy sources to meet its energy needs and ensure energy supply security. Coal is at the forefront of these resources. Turkey has a wide range of coal reserves, especially lignite, asphaltite, and hard coal. The two main types of coal mined in Turkey are lignite and hard coal. In addition, Turkey produces coke as a result of hard coal processing and also produces asphaltite in limited quantities. Lignite is a type of coal spread across various regions of Turkey

[16] MTA [Mineral Research and Exploration] (2023). Kömür Arama Araştırmaları. (accessed 5. 12. 2023), https://www.mta.gov.tr/v3.0/arastirmalar/komur-arama-arastirmalari

[17] EIA (2022a): *Natural gas and the environment.* (accessed 08. 11. 2023), https://www.eia.gov/energyexplained/natural-gas/natural-gas-and-the-environment.php

[18] EIA (2022b): *U.S. Energy Information Administration: Coal explained.* (accessed 29. 11. 2023), https://www.eia.gov/energyexplained/coal/

and, unlike hard coal, it generally has a young geological structure.

Lignite, which has high moisture content and low calorific value, is widely used in electricity generation in Turkey in parallel with the rest of the world. Türkiye's coal reserves are approximately 20.84 billion tons in total, including 19.32 billion tons of lignite and asphaltite (92.7%) and 1.52 billion tons of hard coal (7.3%) [19]. The total coal supply in Turkey consists of 89,844 thousand tons of lignite, 38,039 thousand tons of hard coal, 1,550 thousand tons of asphaltite, and 991 thousand tons of coke. Lignite occupies an important place in Türkiye's coal resources with a high share of 69% of the total coal supply. This source is followed by hard coal with a share of 29%, followed by alfastite and coke with a share of 1.2% and 0.8%, respectively. Considering the level of coverage of resources by domestic production, lignite has the highest share with 70%. The others are hard coal with 1.1% and asphaltite with 1.2%, respectively. These rich resources are of strategic importance to meet the country's energy demand and ensure energy supply security [20].

Table 1. Outlook for Türkiye's Coal Balance in 2022 (Thousand Tons)

	Bituminous Coal	**Lignite**	**Asphaltite**	**Coke Coal**
Domestic Production	1.416	92.296	1.600	–
Net Import Input	36.938	-14	0	1.129
Total Energy Supply	38.039	89.844	1.550	991

Source: [20]

According to *Table 1*, Türkiye's hard coal reserves have an energy potential ranging between 6,200–7,250 kcal/kg in terms of lower heating value. This allows hard coal to be used effectively in various industrial applications and energy production. While the lignite resource is lower in terms of calorific value (ranging from 1,000 kcal/kg to 4,200 kcal/kg), a large amount of it has a lower calorific value below 2,500 kcal/kg. Lignite plays an important role in electricity generation, mainly used in thermal power plants [20]. Coal and its derivatives form part of Türkiye's efforts to diversify its energy portfolio, while also contributing to energy supply security. Lig-

[19] MENR [Republic of Turkey Ministry of Energy and Natural Resources] (2023a): *Tabii Kaynaklar: Kömür.* (accessed 15. 11. 2023), https://enerji.gov.tr/bilgimerkezi-tabiikaynaklar-komur

[20] MENR [Republic of Turkey Ministry of Energy and Natural Resources] (2023b): *EİGM Raporları: Ulusal Enerji Denge Tabloları.* (accessed 28. 11. 2023), https://enerji.gov.tr//Media/Dizin/EIGM/tr/Raporlar/Ulusal_Enerji_Denge_Tablolari/2022.xlsx

nite can reduce dependence on energy imports and increase the country's energy security, especially when used based on domestic energy resources.

However, the use of coal also brings environmental impacts. Pollutant emissions released during the combustion process can affect air quality and contribute to climate change. Therefore, it is important for Türkiye's energy strategies to manage coal utilization in line with sustainability principles and reduce environmental impacts by investing in clean technologies. In conclusion, Türkiye's coal resources have significant potential in terms of energy supply security. However, sustainably managing these resources and reducing environmental impacts play a critical role in the country's energy transformation process. While one-third of lignite production in Turkey is realized in underground mines, two-thirds of the extracted ore is obtained from open pit operations. In this context, the speed and scale that open pit operations can achieve through extensive mechanization have the potential to offset the low-quality heat content of Türkiye's lignite reserves [15].

Coal, which plays an important role in Türkiye's energy portfolio, is used in electricity generation through local resources and imported coal types.

As of 2022, the amount of electricity generated from domestic coal-fired power plants was 49,556.15 GWh, while the amount of electricity generated from imported coal-fired power plants was 63,259.66 GWh. Thus, total coal-based electricity generation amounted to 112,815.81 GWh. This production accounted for 36.18% of the total electricity generation in 2022, which represents a very important share in terms of ensuring energy supply security. At this point, the share of domestic coal (lignite + hard coal + asphaltite) in electricity generation was 15.89% [19]. This situation emphasizes the efficiency and importance of local coal resources in energy generation. While Turkey strengthens its energy independence with electricity generated from domestic coal resources, it also utilizes local resources in terms of energy security.

Conclusion

Coal and coal mining plays a key role in the context of global energy security. Coal and coal mining have historically played a role in balancing energy portfolios, and their current contribution and strategic role are critical to ensuring a stable and secure energy supply. With the evolution of energy production and utilization, it is

[15] ILO (2015): *Türkiye Kömür Madenciliği Sektöründe Sözleşmesel Düzenlemeler: Gerçekleşme Biçimleri–Boyutları, Nedenleri–Yasal Nedenleri ve İSG Üzerindeki Etkisi.* Ankara: ILO Türkiye Ofisi.

[19] MENR [Republic of Turkey Ministry of Energy and Natural Resources] (2023a): *Tabii Kaynaklar: Kömür.* (accessed 15. 11. 2023), https://enerji.gov.tr/bilgimerkezi-tabiikaynaklar-komur

crucial to adopt sustainable practices and technological innovations to adapt to environmental and social issues so that coal can be used sustainably.

Coal plays a critical role in energy access due to its wide availability, reliability, security, and cost-effectiveness compared to alternatives. Today, the world still faces the serious problem that billions of people lack access to modern energy services. Access to energy is a basic necessity of modern life. With this in mind, coal is still under-appreciated, even though it serves as an important tool for reducing extreme poverty at the global level.

In this context, coal plays a decisive role in meeting energy needs, especially in economies with high electricity demand. Coal-fired power plants can provide energy to national energy grids, enabling communities to access energy and thus contribute to economic growth and improved living standards in many regions, particularly in developing countries.

In this context, coal, as an ancient energy source, is directly related to mining activities as well as being intensively used in energy production today.

At this point, coal mining should be evaluated together with its environmental impacts. It should be kept in mind that environmental impacts that occur during mining activities can affect local ecosystems and especially water resources. Therefore, today, sustainable coal mining practices and the establishment of effective policies to minimize environmental impacts should be a necessity rather than a preference. The sustainability of coal utilization within the framework of energy supply security needs to be supported by technological developments. Clean coal technologies include important steps towards a more efficient and environmentally friendly use of coal. In this context, Turkey should aim to utilize coal efficiently by investing in these technologies. From this point of view, to reduce Türkiye's dependence on foreign energy and to ensure the security of the energy supply, it is essential to give coal and coal mining an important place at the center of national energy policies. A balanced consideration of environmental sustainability, economic factors, and technological developments in the formulation of energy policies plays a critical role in this respect.

Note: This study is derived from the Master's Project titled "The Role of Coal Mining in Türkiye's Energy Supply Security" accepted by the Institute of Social Sciences of Tekirdağ Namık Kemal University in 2023.