Domestic coal is far from providing a baseload in Türkiye

The low capacity factor and availability rate, and frequent production losses due to breakdowns of Türkiye's domestic coal power demonstrate that this source is far from capable of providing a baseload supply.

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Lead author: Bahadır Sercan Gümüş

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About

This study provides a comparative analysis of Türkiye's coal-fired power plants by examining their current stock, development and performance in electricity generation. Our data is free and easily downloadable.

Highlights

52%

The available capacity ratio of domestic coal power plants in Türkiye.

22 TWh

Annual generation loss due to malfunctions of coal power plants in Türkiye.

20%

Share of emissions from coal power in Türkiye's total emissions.

Executive Summary

Domestic coal fails to provide baseload electricity

In the last decade, electricity generation from coal has doubled, with coal-generated electricity reaching a record high of 118 TWh in 2023, marking the highest production in Türkiye's history. Additionally, a large portion of Türkiye's domestic coal reserves has low energy potential and high moisture content, which reduces the performance of the power plants. Consequently, a high amount of coal is consumed per unit of electricity generated, leading to high emissions.

In Türkiye, most of the coal power plants fall short of achieving the performance expected of baseload providers due to their low efficiency, availability, and capacity factor, coupled with frequent breakdowns and irregular production profiles. While Türkiye's continuous electricity demand is estimated to be around 20 GWh, which is referred to as baseload, domestic coal plants fail to provide the baseload supply as they show low performance in producing electricity. Reducing dependency on coal in electricity generation is crucial for lowering emissions and preventing economic losses. It is imperative for Türkiye to promptly establish a phase-out strategy from coal and accelerate investments in renewable energy to mitigate future economic and environmental burdens.

01 Emissions from coal electricity generation account for 20% of Türkiye's total emissions

Türkiye's coal-fired electricity generation doubled over the past decade, reaching a record high of 118 TWh in 2023. As a result of increased production, coal-fired power plants caused 111 million tons of carbon emissions in 2023. In simpler terms, one-fifth of Türkiye's emissions stemmed solely from coal-fired power plants. The annual growth rate of emissions from coal-fired plants was 6.2% between 2012 and 2023.

On the other hand, the majority of coal reserves in Türkiye have a low energy potential, necessitating high coal consumption per unit of electricity generation. While approximately 1,700 kg of coal is consumed per 1 MWh of electricity produced in lignite-fired plants, imported coal-fired plants, which have higher energy potential compared to domestic coal, use 350 kg of coal per 1 MWh of electricity generated. Furthermore, due to the relatively higher efficiency of coal plants in the European Union, Türkiye has had to consume 50% more coal to achieve the same amount of electricity generation.

02 Domestic coal power plants are far from providing baseload supply

The capacity factor of domestic coal reached an average of 48%, whereas, for imported coal and wind, this rate was calculated at 71% and 34% respectively. It was observed that more than 4 GW of installed capacity of domestic coal operated at a capacity factor below 50%. Some domestic coal plants even dropped to as low as 16% capacity factor, while some of the wind farms in Türkiye surpassed coal-fired plants. Approximately one-fifth of wind turbines were found to operate with a capacity factor exceeding 40%. The ten power plants with the lowest rates were all domestic coal plants.

On the other hand, it was calculated that only three domestic coal plants could maintain an availability rate of over 75%, while domestic coal-fired

plants were found to utilise approximately half of their capacity on average. In other words, out of the 10.4 GW of installed domestic coal capacity, only 5.4 GW were capable of generating electricity.

03 The production losses due to breakdowns amount to an average of 22 TWh annually

According to the average of the last three years, malfunctions in coal-fired plants led to an annual production loss of 22 TWh, amounting to more than one-fifth of total production. While domestic coal plants experienced losses equivalent to 31% of their total generation, imported coal plants saw this figure at 13%. Nine out of the top ten plants with the highest losses relative to their generation were domestic coal plants. Domestic coal plants experienced 1,500 hours of downtime per TWh of electricity generated, which was five times higher than that of imported coal plants.

"The significant portion of coal power plants held in the system with various supports with the claim of providing baseload is actually far from achieving baseload supply. The ability of solar and wind energy to generate electricity at a lower cost presents an opportunity for Türkiye's clean energy transition. Türkiye must swiftly establish a strategy to phase out low-performing and expensive coal, focusing particularly on harnessing its substantial potential in solar energy to accelerate the transition to clean energy."

Bahadır Sercan Gümüş
Energy Analyst, Ember

Türkiye moves away from net zero target

The share of coal in electricity generation continues to increase

Türkiye's electricity generation emissions do not show a downward trend due to the recent rise in coal-fired electricity generation

Electricity generation from coal has doubled in the last decade

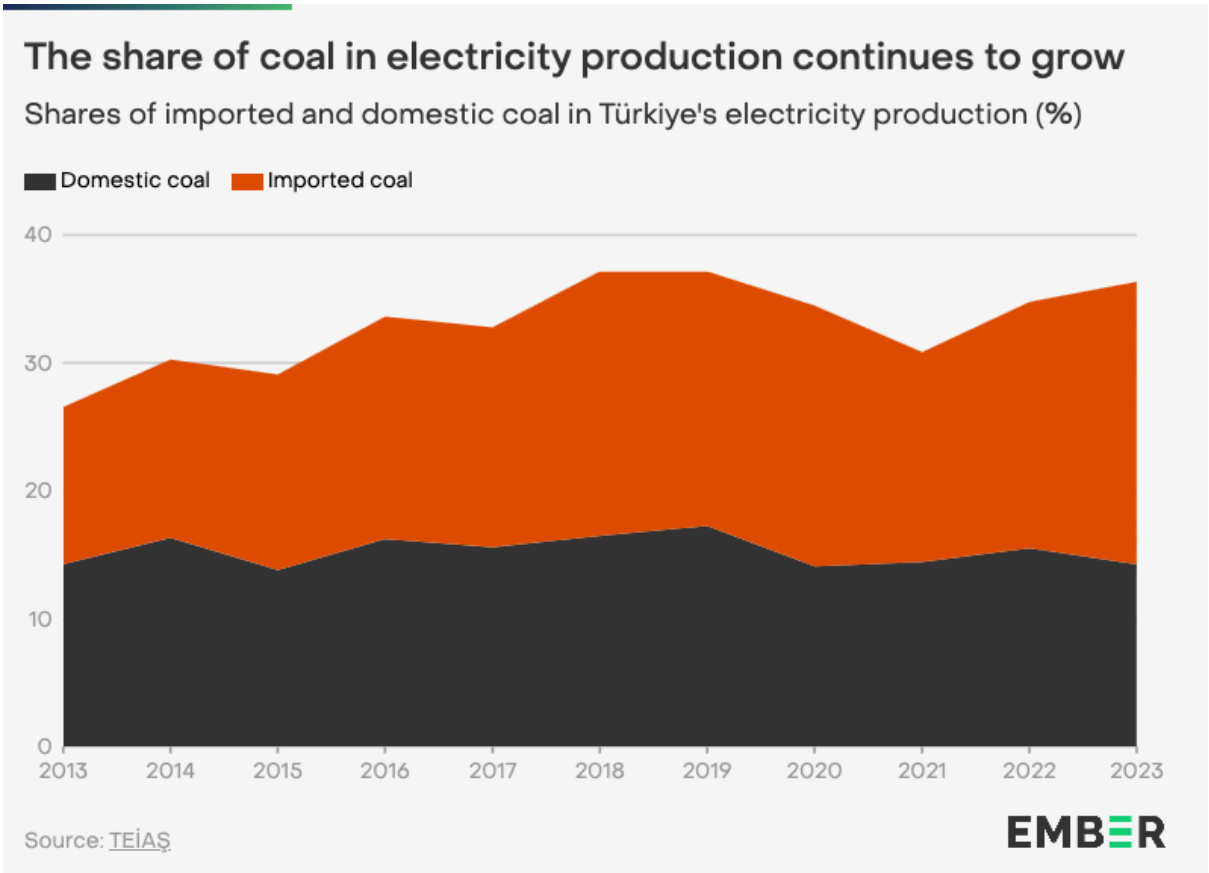
In 2023, Türkiye produced a record level of 118 TWh of electricity from coal, making the country the second-largest coal generator in Europe after Germany. This production also means that more than one-third (36%) of Türkiye's electricity generation in 2023 came from coal-fired power plants. The driving force behind this increase in coal generation came from newly built imported coal-fired power plants.

Since 2015, the share of imported coal in Türkiye's electricity generation has surpassed that of domestic coal. While the installed capacity of coal-fired power plants grew by 65% over the last decade, annual electricity generation from coal almost doubled from 64 TWh to 118 TWh. With the establishment of new imported coal power plants, the share of electricity generated from imported coal in the country's total electricity mix rose from 12% in 2013 to 22% in 2023. In contrast, the share of electricity generated from domestic coal remained constant compared to 2013.

Furthermore, the share of electricity generation from coal is expected not to decline in the foreseeable future. Currently, there are 51 operational coal-fired power plants, according to the Energy Market Regulatory Authority's (EPDK) database for electricity in Türkiye. Out of these, 13 use imported coal, 33 use lignite, four use domestic hard coal, and one uses asphaltite coal.

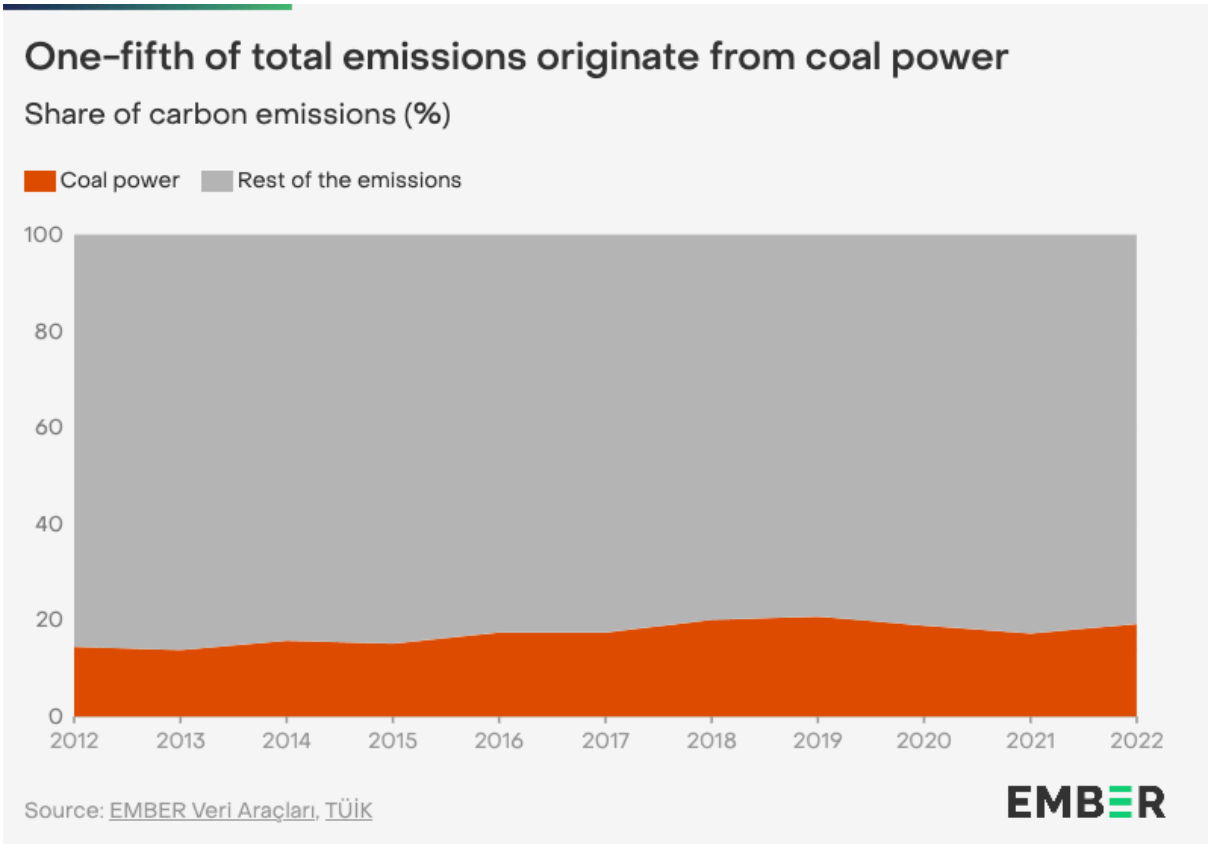
The total installed capacity of lignite-fired power plants is 10 GW, with plants owned by the state-owned company Elektrik Üretim Anonim Şirketi (EÜAŞ) having a capacity of 2.4 GW. Within EÜAŞ, there are no coal plants other than lignite-fired ones. The installed electricity generation capacity includes 11 GW for imported coal-fired plants, 841 MW for hard coal,

and 405 MW for asphaltite-fired plants. According to the National Energy Plan (UEP) prepared by the Ministry of Energy and Natural Resources (MENR), it is estimated that the installed capacity of coal-fired power plants will exceed 24 GW by 2035, while they currently constitute 22 GW in total. In other words, the plan anticipates an increase of 2.5 GW in coal installed capacity by 2035.



One-fifth of carbon emissions in Türkiye comes from coal power

In 2023, the electricity generation sector's carbon emissions amounted to 148 million tons (Mt), with three-quarters of this originating from coal-fired power plants, which corresponds to one-fifth of Türkiye's annual emissions. The annual growth rate of emissions from coal-based power plants was 6.2% between 2012 and 2023.



When examining 2023's emissions from coal-fired power plants calculated by Ember, it is seen that Zonguldak Eren Energy Thermal Power Plant (ZETES) emitted the most carbon, releasing 15 Mt of carbon dioxide due to its high electricity generation in 2023. ZETES was followed by Soma B (8.8 Mt), İsken-Sugözü (8.6 Mt), Hunutlu (8.2 Mt) and Cenal (7.2 Mt) plants. Four out of the five highest-emitting plants were imported coal plants.

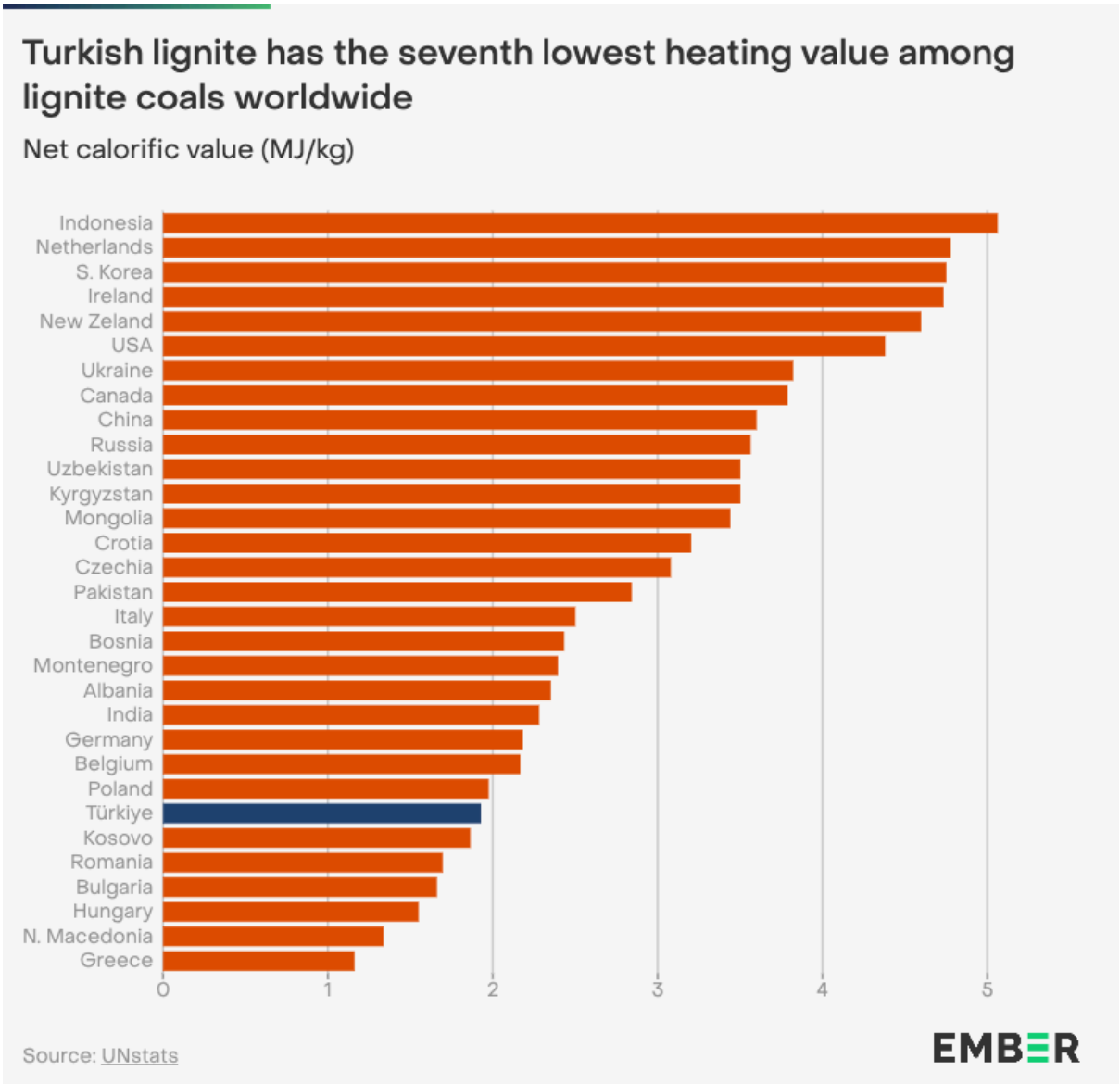
Although imported and domestic coal plants in Türkiye have similar installed capacities, the imported plants generated 50% more electricity in 2023. Despite this, emissions from imported coal are almost equal to emissions from domestic coal, which means that domestic plants produce more emissions per unit of electricity generated than imported coal plants. A similar situation is seen in the emission factors for electricity generation as calculated by the Ministry of Energy and Natural Resources (MENR).

Most of the coal reserves in Türkiye have low energy potential

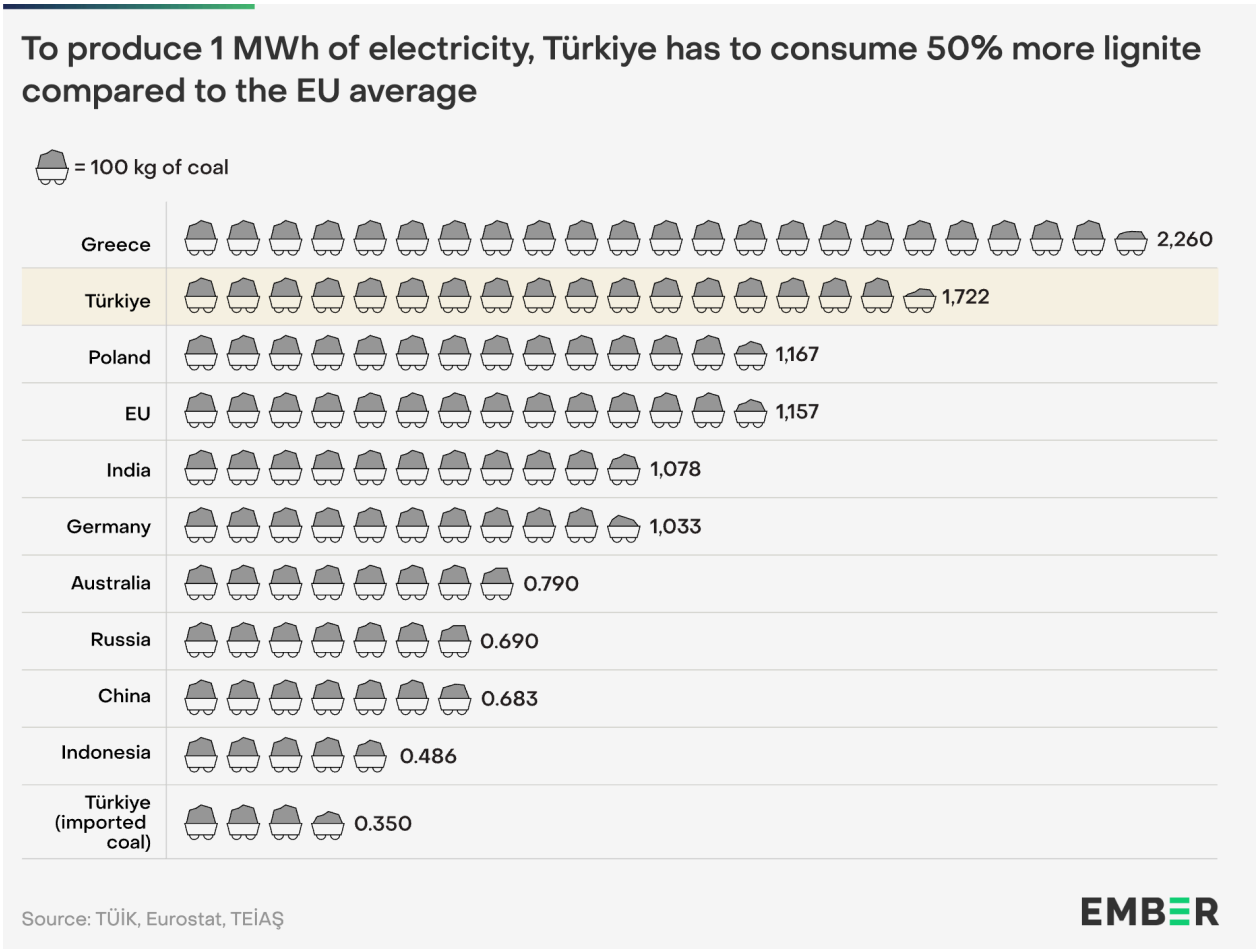
Türkiye has a total of 21 billion tonnes of coal reserves, of which 93% is lignite, which has lower energy output than other coal types. Like all other fuels, the energy content per unit

mass of coal is defined as a calorific value. According to internationally accepted standards, coal with a calorific value below 3,800 kcal/kg is defined as low calorific value coal. In Türkiye, only 10% of the lignite has a calorific value above 3,000 kcal/kg. Additionally, Türkiye has reserves of 1.5 billion tons of hard coal, with the calorific value delivered to power plants being 3,300 kcal/kg.

Lignite in Türkiye has the seventh lowest calorific value on a global scale. Mining and processing low heating value coal as ore, subjecting it to preliminary treatment in power plants, burning it to generate electricity, and subsequently disposing of the resulting waste is a more challenging task compared to high heating value coal.



In 2023, approximately 57 million tonnes of domestic coal was produced in Türkiye, while more than 80% of this production was consumed by power plants. In lignite-fired power plants, an average of 1,722 kg of coal is consumed per 1 MWh of electricity generated, whereas in imported coal plants with higher calorific value compared to domestic coal, 350 kg of coal is burned per 1 MWh of electricity. The EU average is 1,157 kg, while countries like India, Russia, China, and Indonesia require less coal per 1 MWh of electricity generation compared to Türkiye.



The low calorific value of coal and the high content of non-combustible inorganic materials lead to a high amount of waste produced when coal is burned for electricity. In Türkiye, coal plants produce 23 million tons of ash and slag annually. In other words, for every 1 MWh of electricity produced from coal, 210 kilograms of ash is created.

The efficiency of Türkiye's lignite plants is 15% below the EU average

One of the key performance indicators, energy efficiency in power plants, indicates the proportion of fuel consumed that is converted into electrical energy. Over the last five years,

lignite power plants owned by the state-owned company EÜAŞ had an average energy efficiency of 33.9%. Privately operated lignite power plants had an even lower efficiency, calculated at 31.5%. In comparison, the EU average efficiency was 38%. In countries such as Germany and Poland, the average efficiency rates were 39.4% and 40.6% respectively.

Another factor that may affect the performance of the power plants is their age. In Türkiye, the installed capacity of coal-fired power plants aged 30 years and above is 6 GW with a share of 27% of total coal capacity, while there is 8.8 GW installed capacity between 30 and 10 years old and 6 GW installed capacity under 10 years old. The average age of coal-fired power plants in Türkiye is 21 years old.

In Türkiye, the low calorific value of coal, combined with its high ash, sulphur, and moisture content, contributes to the low efficiency of power plants. Additionally, some plants have completed their economic life, which affects the reliability of electricity generation, particularly as expected from a baseload power plant. In fact, a considerable number of coal-fired power plants cannot operate at full capacity. Their available capacity falls far behind the installed capacity. The plants frequently report malfunctions and their hourly production shows high variability. These factors lead to unreliable electricity generation and frequent operational issues, making it difficult for Türkiye to balance demand and supply.

Is coal base load?

Domestic coal plants are the furthest from providing baseload

Domestic coal power plants older than ten years are the farthest from providing baseload power, whereas some wind farms achieved higher capacity factors than domestic coal

Baseload power plants meet the minimum electricity demand of the system

In Türkiye, the lowest hourly consumption in 2023 occurred in April at 19.6 GWh, while the highest consumption of 54 GWh was recorded in July. Over the past five years, electricity demand in May has consistently remained above 25 GWh, while in August, the minimum demand during peak consumption periods was 32 GWh. In short, minimum electricity consumption varies depending on seasons, weather conditions, and human behaviours, but Türkiye's continuous electricity demand is estimated to be around 20 GWh. This consistent demand is referred to as baseload.

Baseload power plants are facilities that consistently produce a fixed amount of electricity, meeting the minimum demand of the grid. These plants contribute to reducing fluctuations and outages in the electricity system. Due to their high capacity factors, baseload power plants operate efficiently. They have lower operating costs because they operate continuously over long periods, which also helps to reduce national electricity production costs. However, since baseload power plants operate at a fixed capacity, they cannot provide flexibility in power generation and may experience efficiency losses when operating outside of their designed capacities.

Due to the mentioned characteristics, a baseload power plant should operate with a high capacity factor. Capacity utilisation rate or capacity factor indicates the extent to which the actual production of an electricity generation facility approaches its maximum capacity during a specific period, and it is a fundamental indicator for baseload power plants. The higher this rate is for a plant, the closer it operates to being a baseload power plant.

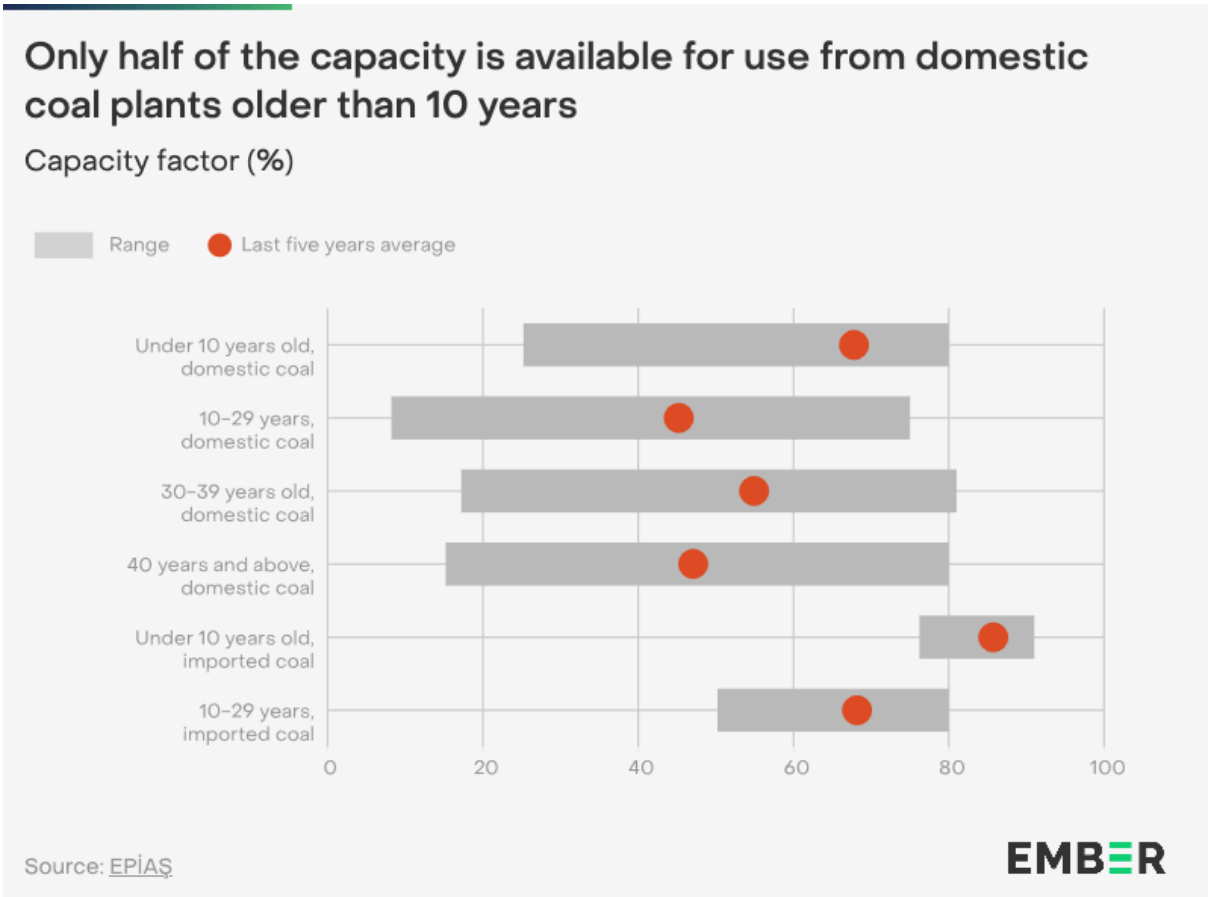
The electricity generation performance of coal-fired power plants in Türkiye with installed capacities exceeding 200 MW has been evaluated within the scope of the report, in terms of

how closely they approach baseload power plant levels (See: Methodology). These plants, representing 96% of the total installed coal capacity, consist of eight imported coal, sixteen lignite, one domestic hard coal and one domestic asphaltite coal.

Old domestic coal plants' capacity factors are far from baseload supply

The average capacity factor of coal power plants over the last five years varied between 16% and 77%. The capacity factor of domestic coal plants was 49% in 2023, with an average of 48% over the last five years.

In the lignite-fired power plants owned by EÜAŞ (such as Afşin-Elbistan B, Çayırhan, 18 March Çan), this rate was 28% in 2023 and 29% between 2018 and 2023. These rates show that EÜAŞ power plants ran well below their capacity and lagged behind the average of Türkiye. In lignite plants operated by private companies, the five-year average rate was 49%, while this was calculated as 58% in 2023 only.



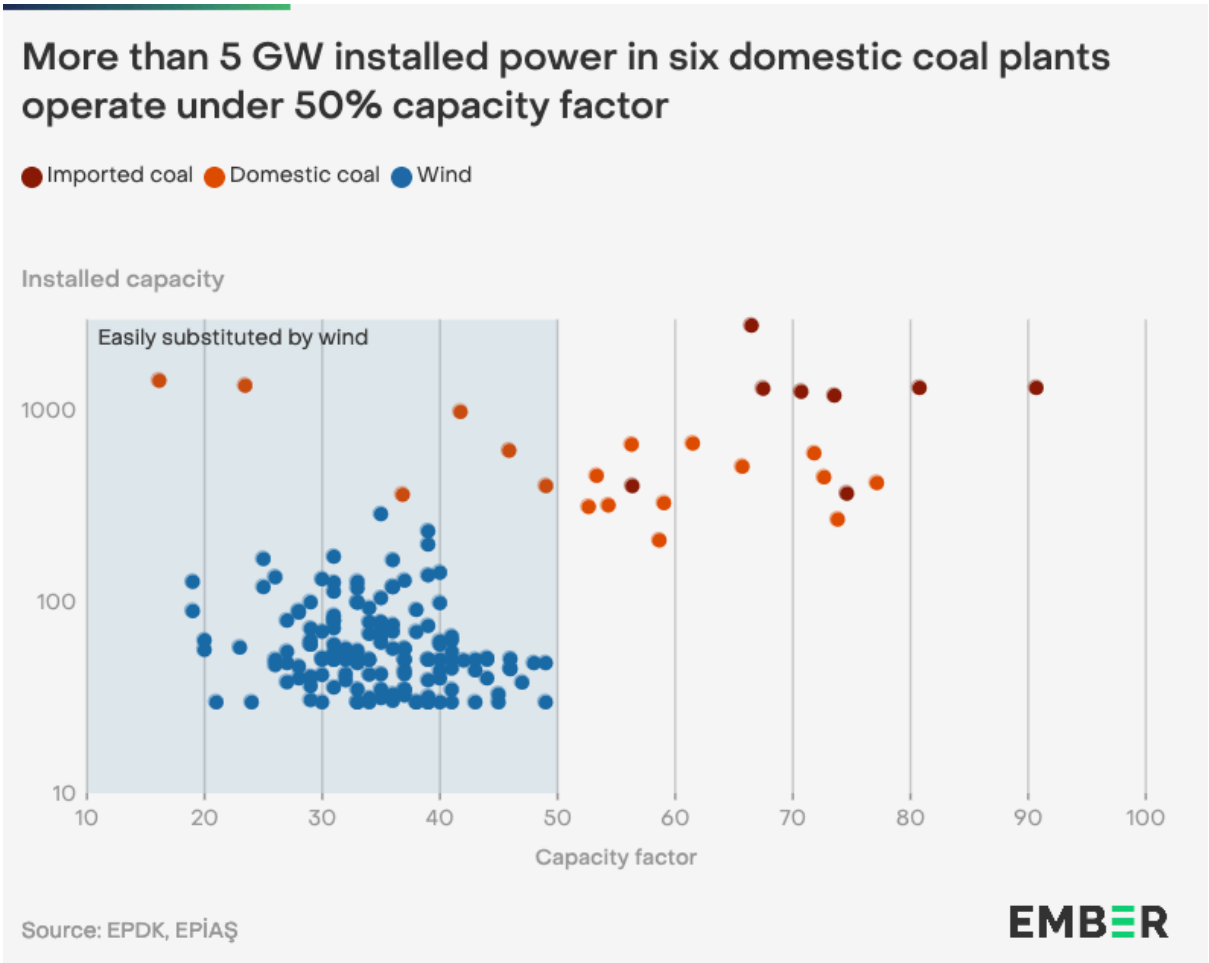
According to the total electricity generation for the last five years, the Afşin-Elbistan B power plant had the lowest capacity utilisation rate at 16%. Whereas the average capacity utilisation rate of domestic coal power plants under 10 years old was calculated to be 68%. For plants aged between 10-29, 30-39, and 40 years and above, the average capacity utilisation rates were 45%, 55%, and 47%, respectively. In other words, plants older than 10 years are operating at only about half of their capacity on average. This indicates that these plants have operated well below their installed capacity, making it difficult to count them as baseload power plants.

It is seen that all of the top ten power plants with the lowest capacity factor use domestic coal. On the other hand, for imported coal power plants, the capacity factor was 75% in 2023, with an average of 71% over the past five years. The average capacity factor for imported coal plants over the last five years ranges between 56% and 90%. In the last five years, the average capacity utilisation rate of imported coal power plants under 10 years old was 86%, while for plants 10 years and older, this rate was calculated to be 68%.

Some wind power plants have higher capacity factors than coal power plants

When evaluating the capacity factor of wind turbines, it is observed that especially wind power plants commissioned in the last five years have capacity factors equivalent to or even higher than domestic coal power plants. In other words, some wind power plants in Türkiye have higher capacity factors than some coal power plants.

The five-year average capacity factor of each wind power plant - with an installed capacity of 30 MW and above, corresponding to a total of 9.8 GW capacity - varies between 19% and 49%. It has been calculated that approximately one-fifth of these wind turbines operate with a capacity factor exceeding 40%.



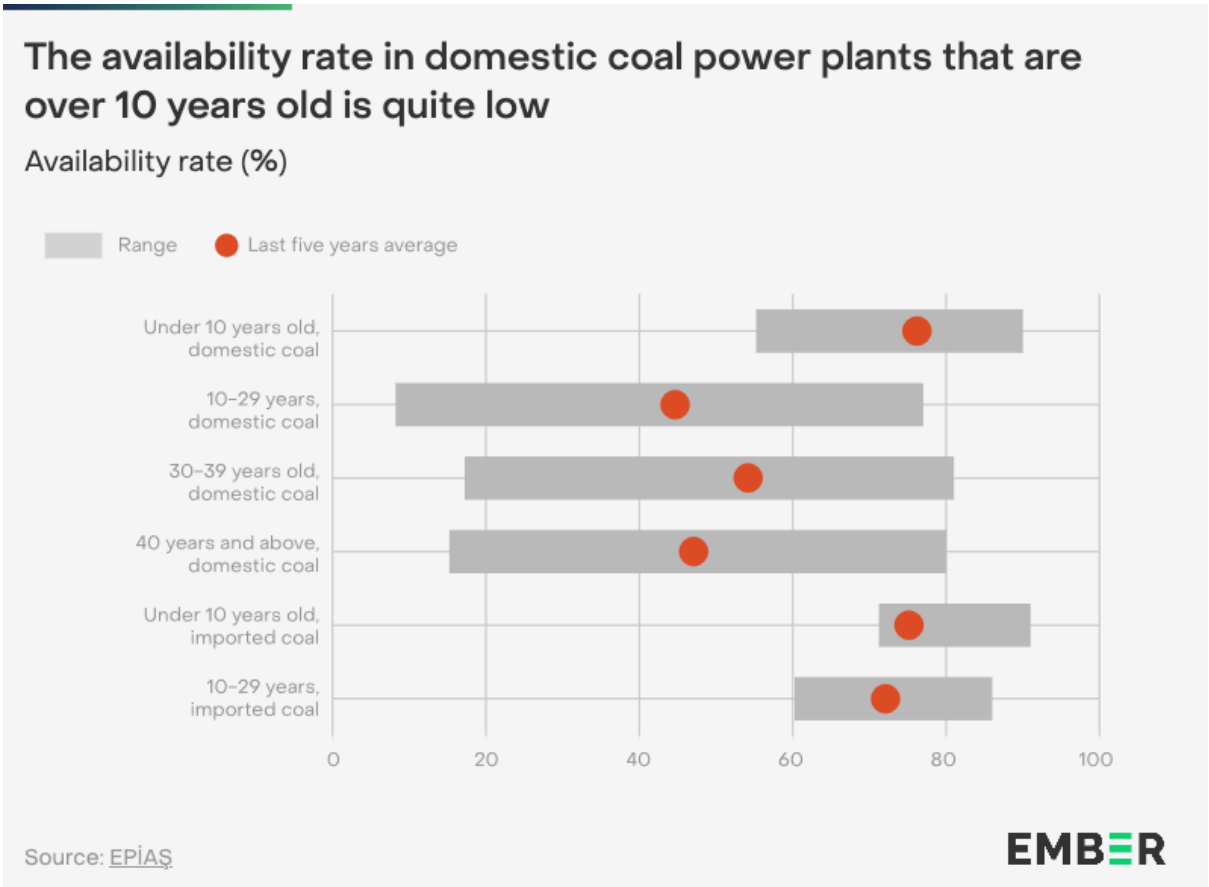
Among these plants, the Yeniköy Wind Plant in Çanakkale has achieved the highest capacity factor at 49%, surpassing Afşin-Elbistan B and Çayırhan coal power plants. Similarly, 96% of the examined wind turbines have higher capacity factors than those at the Afşin-Elbistan B Plant, while the top six wind farms have rates higher than Çayırhan. The existence of wind turbines with higher capacity factors than coal plants indicates that some domestic coal plants provide electricity to the grid well below their capacities, highlighting their low baseload effects.

Only half of the installed capacity in old domestic coal plants can be utilised

Availability, another key performance indicator of power plants, refers to the readiness and capability to generate electricity when required by the grid. Availability capacity reveals the capacity ready for generation even if the power plant does not produce (see: Methodology). Base load power plants need to have high available capacity to consistently and reliably meet electricity demand.

In the last five-year period, the average availability rate of coal power plants was calculated as 62%, while this rate was calculated as 52% for domestic coal and 74% for imported coal power plants. In other words, the average availability of domestic coal power plants with an installed capacity of 10.4 GW was only 5.4 GW. The low availability rate in domestic coal power plants reveals the capacity that is thought to be in operation but cannot be utilised.

The significantly lower available capacity rates of domestic coal power plants older than ten years (48%) compared to imported plants (74%) unreliability and limited production capacity. As a result, these plants are unable to function effectively as baseload power plants. On the other hand, since a quarter of the installed capacity of imported coal plants also remains unavailable, the total coal installed capacity of 22 GW actually has an effective electricity generation capacity of 13 GW.



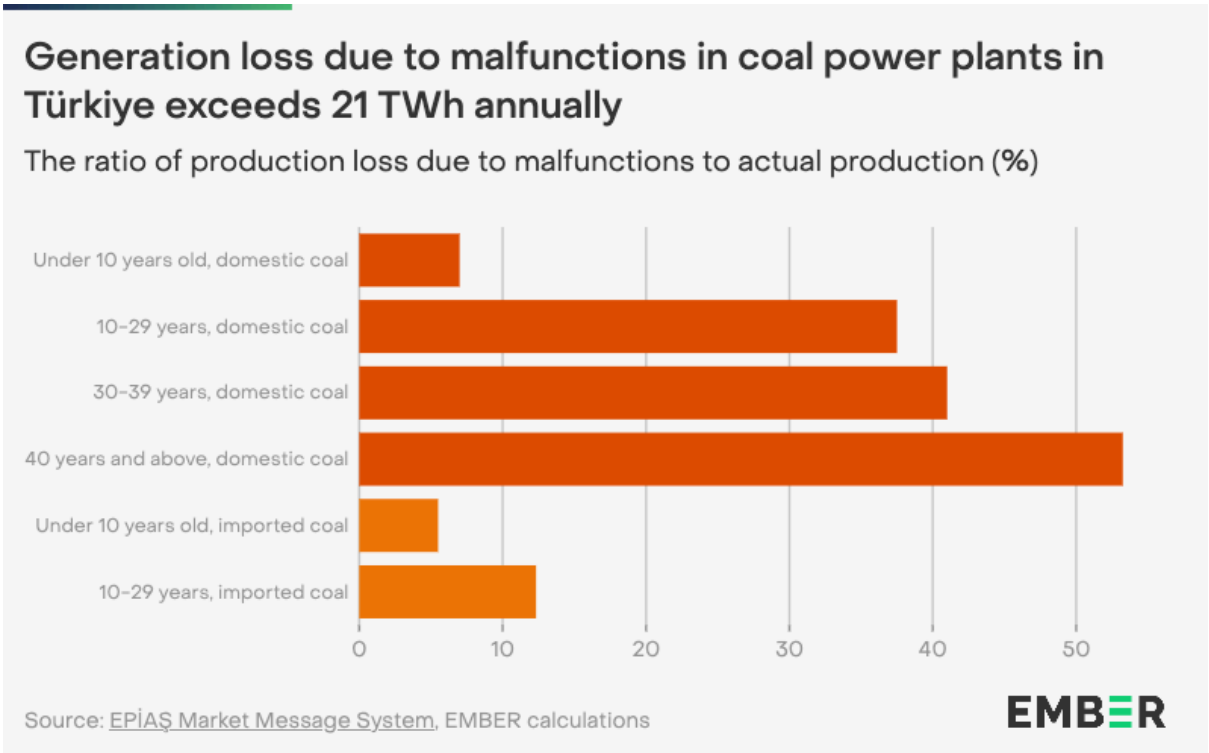
When considering individual coal power plants over the past five years, the power plant with the lowest available capacity rate was Afşin-Elbistan B Power Plant at 17%. The average availability rates for power plants are as follows: 76% for those under 10 years old, 45% for those between 10 and 29 years old, 54% for those between 30 and 39 years old, and 47% for

those 40 years and older. On the other hand, only three domestic coal-fired power plants can maintain 75% of their electricity production capacity on average. These three plants constitute only one-tenth of the total domestic coal installed capacity. In imported coal power plants, the availability rate is 75% for those under 10 years old and 72% for those 10 years and older.

Generation losses due to failures exceed one-fifth of total production

In addition to the capacity factor and availability, another factor that indicates the baseload electricity generation performance of a power plant is the generation losses due to malfunctions. Baseload power plants are defined as facilities that provide a portion of electricity demand uninterrupted and with high reliability. Therefore, these plants are expected to have a very low frequency of failures.

The average production losses due to failures over the past three years in coal power plants exceed one-fifth of the total generation. In other words, over 21 TWh of electricity annually is not delivered to the national grid due to failures. This loss amount is equivalent to the total production of the seven domestic coal power plants with the highest capacity utilisation rate in 2023.



In domestic coal plants, production losses due to malfunctions amount to 35% of the actual production, compared to 11% in imported coal plants.- In other words, for every unit of electricity produced in domestic coal plants, breakdowns occur about three times more often than in imported coal plants. For domestic coal power plants under 10 years old, this rate is 7%, while for those in the 10-29 year and 30-39 year age ranges, the rates are 37% and 41%, respectively.

As expected, as the age of the power plants increases, the loss rate relative to generation rises. For plants 40 years and older, production losses due to failures exceed half of the actual production. In contrast, this rate is an average of 5.5% for imported coal plants under 10 years old and 12% for imported coal plants 10 years and older.

Furthermore, it is noteworthy that nine out of the ten power plants experiencing the highest production losses due to malfunctions relative to their production are domestic coal plants. This situation can be attributed to several factors: the older age of domestic coal-fired plants compared to imported plants, challenges in consistently meeting the desired chemical properties of domestic coal, the lower calorific value of domestic coal, and operating at capacities that may not align with their design specifications.

When considering the duration of breakdowns over the last three years, it is observed that domestically coal-fired power plants average 1500 hours of downtime per terawatt-hour (TWh) of electricity generated. This downtime is five times longer than the average downtime of imported coal plants. All of the top ten power plants with the highest failure rates per unit of electricity production are domestic coal power plants.

When examining the fault messages reported to TEİAŞ (Turkish Electricity Transmission Corporation), it is observed that one-third of the reported fault hours in 2023 were attributed to lignite-fired power plants. These plants, which constitute 12% of the total electricity consumption in the same year, occupying 33% of the fault notifications, also indicate their poor performance as baseload power providers.

High variability in production in domestic coal power plants

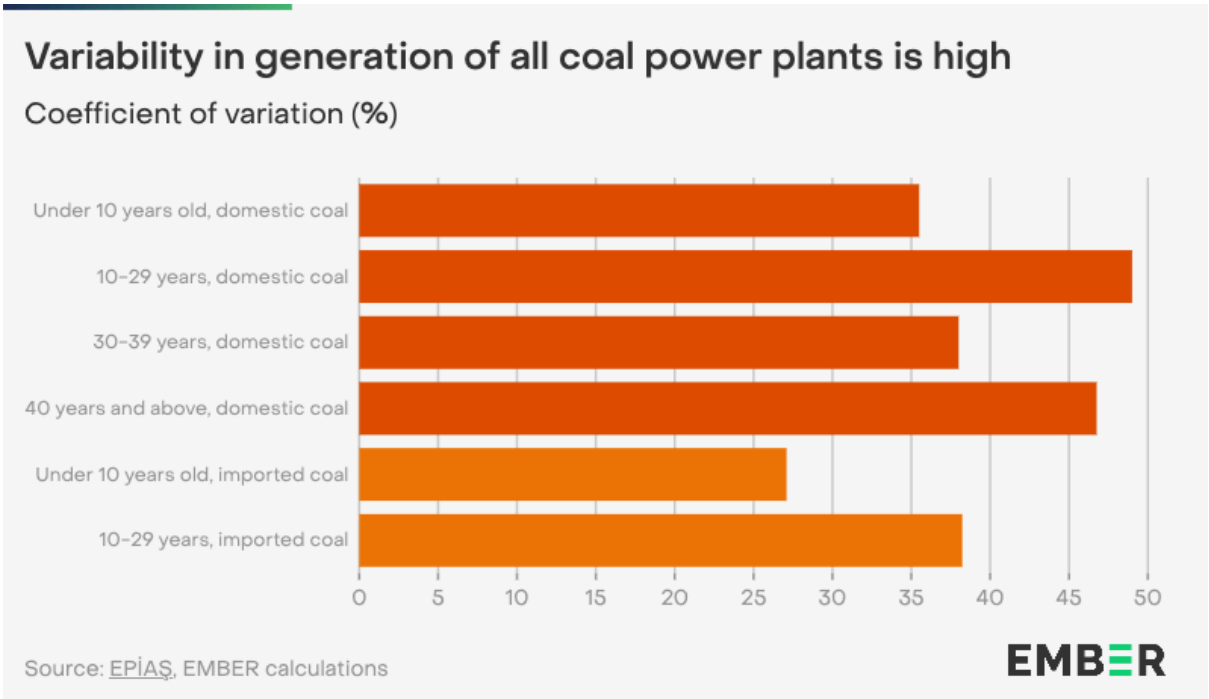
Another criterion that determines whether the power plants have baseload generation or not is the continuity of generation at a constant value. The lower the hourly variability of generation, the higher the baseload effect of the power plant.

In this study, a coefficient of variation was used to compare the production variability of power plants with different installed capacities. The coefficient of variation expresses the ratio of the standard deviation to the mean value in a data series, presented as a percentage. This method is used to compare and interpret the level of variability in data series, simply

indicating how far and dispersed hourly production is from the average production value. As this ratio decreases, production becomes more consistent, implying greater suitability for baseload operations due to its alignment with base load demand.

In internationally recognised studies, variability rates above 30% are considered relatively high. When examining domestic coal-fired power plants in Türkiye, it has been found that only four of the plants exhibit variability below 30%, with variability ranging from 22% to 70%. Lignite power plants under the management of EÜAŞ have an average variability rate of 56%, while other lignite plants managed by the private sector have a variability rate of 39%. Imported coal power plants under 10 years old operate with the lowest variability rate of 27% among coal power plants.

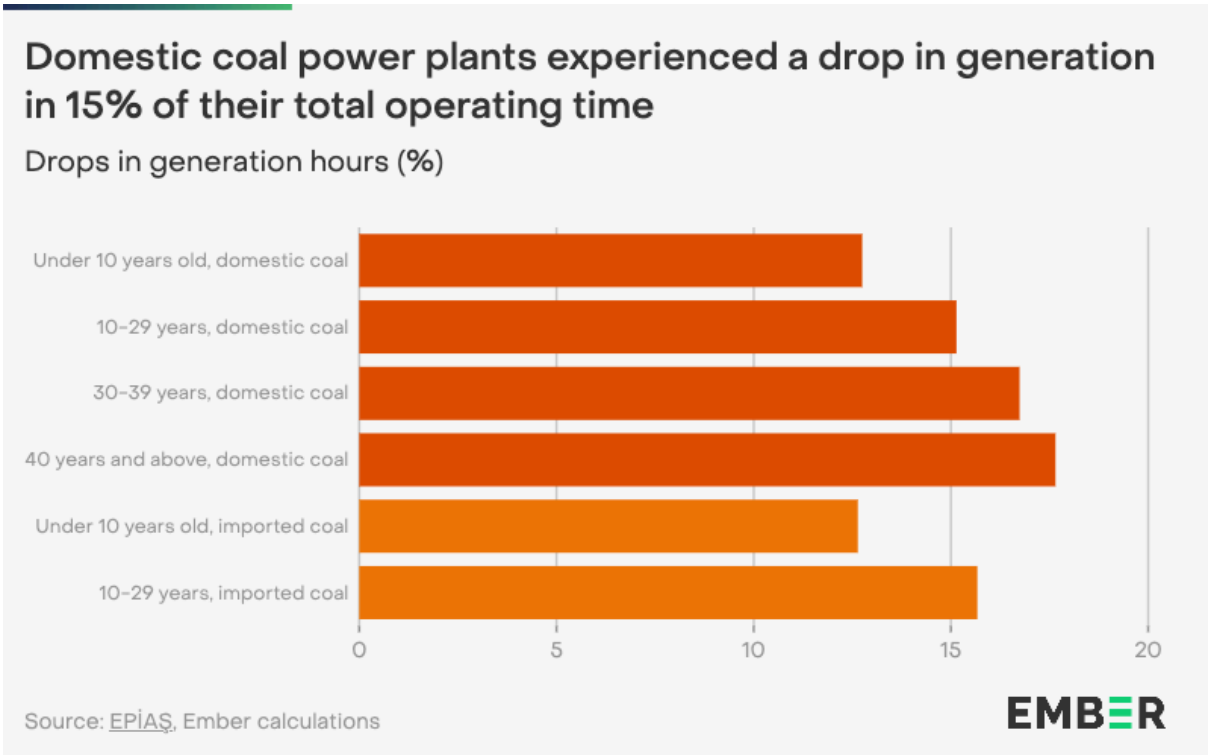
Highly variable electricity production is less predictable, complicating grid operations and making it difficult to maintain a balance between electricity demand and supply. This situation particularly disrupts energy supply security and increases grid operation costs during peak electricity demand periods.



Additionally, continuous and consistent production from baseload power plants enhances system reliability and ensures stability in electricity supply. To assess the extent to which coal-fired power plants in Türkiye meet this expectation, sudden drops in generation were analysed on an hourly basis. First, the moving average of production over a daily time

interval was calculated. Then, each hourly production was compared to this moving average to identify hours where production was 5% or lower than the average.

When examining production drops at power plants, the highest proportional drop, occurring in 29% of total operating hours, is observed at Afşin-Elbistan B Power Plant. In other words, this plant experiences a sudden drop in production for one hour after every two hours of regular production. The ratio of hours with sudden drops to total operating hours averages around 15%, with values ranging from 7% to 29%. Only one-tenth of the plants experience less than one hour of sudden drop for every ten hours of operation. The drop rates in domestic coal power plants were calculated as 13% for those under 10 years old, 15% for those aged 10-29 years, 16% for those aged 30-39 years, and 18% for those over 40 years old. There is a clear correlation between the sudden decline rates and the age of the plants.



Overall performance evaluation

Considering all indicators affecting baseload performance together, it is evident that the power plants with the lowest baseload effect are especially the older domestic coal plants. Additionally, the average performance of EÜAŞ plants is significantly below the Turkish lignite average, particularly due to the low calorific value of the coal in the Afşin-Elbistan region. In contrast, the calorific value of coal imported consistently meets commercial agreements, enabling these plants to experience fewer production drops and maintain continuous production.

It has been observed that power plants which are 10 years old or older, frequently experience malfunctions, have low availability rates, operate at low capacities throughout the year, and consequently have a low baseload effect. The age of the plants is considered to play a significant role in their baseload performance. On the other hand, the significantly higher failure-related losses in domestic coal power plants over 10 years old compared to other coal plants indicate that these plants are far from providing continuous electricity supply.

As a result of the investigations, it has been observed that especially domestic coal-fired power plants are far from being suitable for base load supply. These plants also have the highest emission factors in Türkiye due to their use of low calorific value coal and operate at low efficiencies in electricity generation. As for imported coal power plants, they produce high emission levels due to their high electricity generation capacities and also account for an annual payment for imported coal of 3.7 billion USD. In short, these plants increase dependency on imported energy sources for electricity generation and hinder Türkiye's efforts to reduce emissions. Therefore, it is recommended to replace these inefficient, costly and environmentally damaging coal plants with new renewable energy sources.

Conclusion

Electricity generation policies need to be reviewed

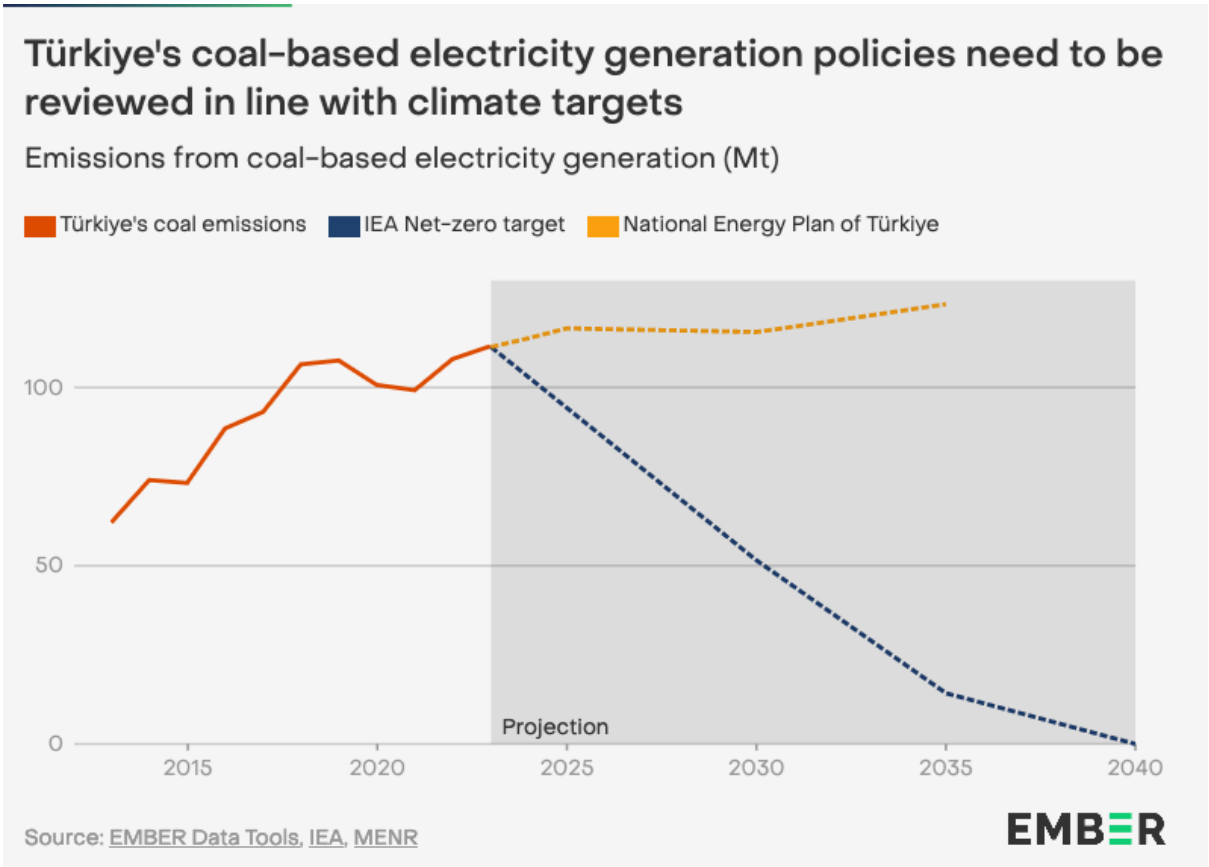
Türkiye has ratified the Paris Climate Agreement and set a net zero target for 2053, yet it lacks a strategy for phasing out coal.

Türkiye's emission reduction target actually foresaw an increase in emissions

Türkiye, by ratifying the Paris Agreement in 2021, declared that it would reduce carbon emissions by 41% by 2030 compared to the baseline scenario created in 2012. The baseline scenario forecasts that total emissions, which were 558 Mt in 2022, will more than double to reach 1,175 Mt by 2030. In short, the emission target of 695 Mt set for 2030 is approximately 25% higher than Türkiye's total emissions in 2022.

Türkiye's emission growth rate over the past decade has been 2.1% annually. If this trend continues, total emissions are expected to reach 660 Mt by 2030. Considering the current growth rate, it becomes evident that Türkiye's emission target essentially aims to maintain this rate rather than achieve reduction, which is far from an ambitious target. Following the ratification of the Paris Agreement, Türkiye has set a net zero emission target for 2053. Within this framework, Türkiye's emissions are expected to peak in 2038, followed by a 15-year period to achieve the net zero target by 2053.

One of the biggest challenges Türkiye faces in achieving its 2053 target is coal-based electricity generation, which accounts for one-fifth of the country's total emissions. The share of emissions from coal-based electricity production increased from 14% in 2012 to nearly 20% by 2022. The primary reason for this rise is the growing presence of imported coal power plants in Türkiye's energy portfolio.



To achieve net zero targets globally, coal should be phased out by 2040

According to the Net Zero Roadmap prepared by the International Energy Agency (IEA), the electricity generation sector aims to reduce carbon emissions by 35% by 2030 and 65% by 2035 compared to 2022 levels, with the goal of reaching net zero by 2050. OECD countries are expected to achieve this goal by 2035, while the remaining countries are targeted for 2045.

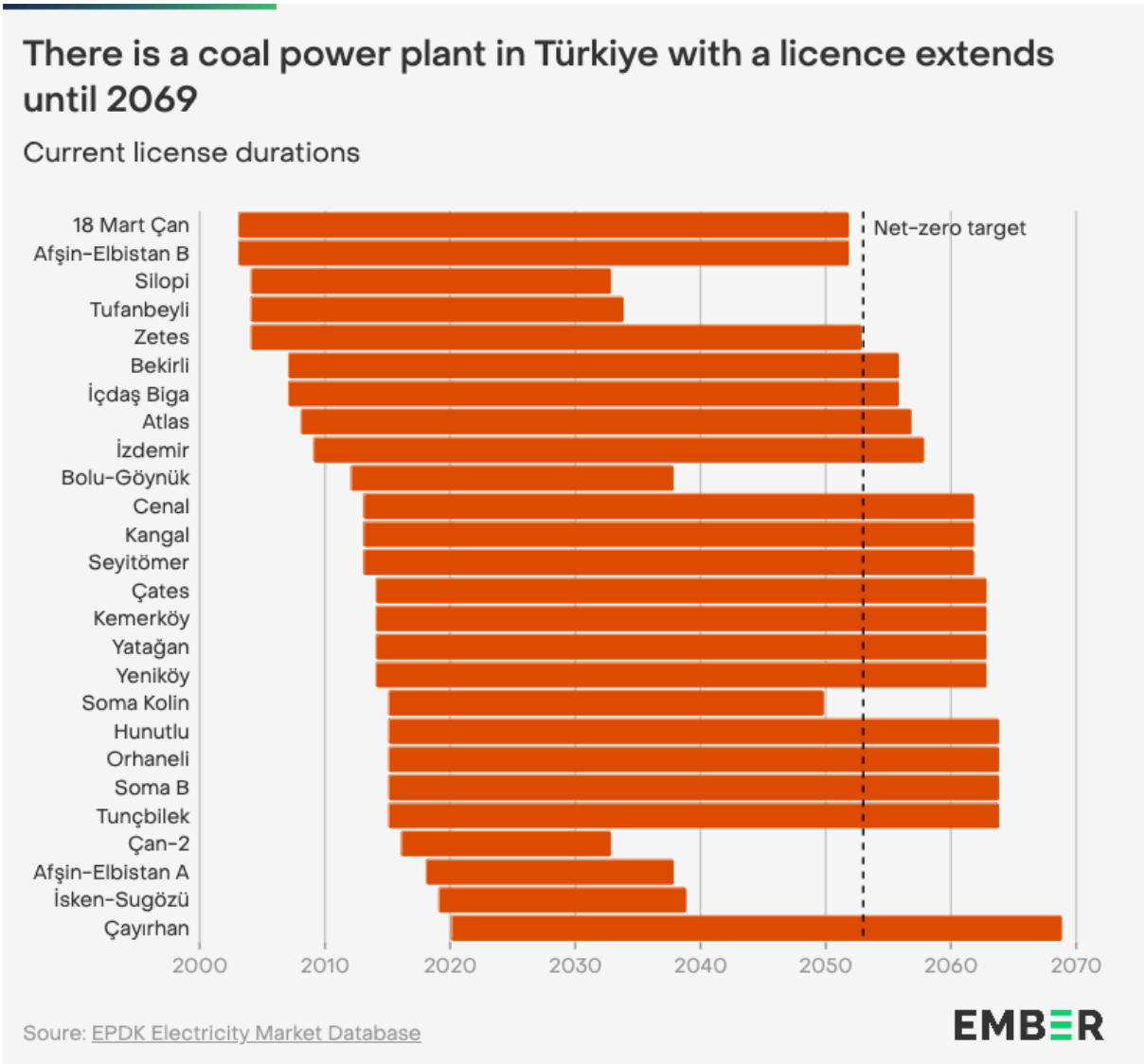
According to the same roadmap, OECD countries are expected to phase out coal by 2030, while other countries should do so by 2040. However, Türkiye, as an OECD member, has not yet committed to reducing coal-based electricity generation.

IEA suggests that 2026 could be the peak year for global coal demand for electricity generation, but it cannot be said that Türkiye will reach its highest consumption point by that year based on current strategies. Despite the increase in coal power plant capacity mentioned in the UEP, Türkiye's Nationally Determined Contribution under the Paris Agreement also states that Türkiye's total emissions will peak in 2038 and decline thereafter.

There is a coal power plant whose licence extends until 2069

According to the National Energy Plan, coal-fired power plants will contribute to electricity generation until their technical lifespans expire. Considering the current licence durations of these plants and assuming they will be decommissioned at the end of their licence's dates, the installed electricity generation capacity based on coal is projected to fall below 1 GW only by the year 2065.

In Türkiye, emissions from coal power plants appear to be deviating from the emission reduction targets set by the IEA, considering the UEP and licence durations. The projection of an additional 2.5 GW of coal power plant installations by 2035 in the UEP, coupled with the absence of a plan for phasing out coal, contradicts Türkiye's climate goals.



Electricity generation from renewable sources is cheaper than from coal

According to the IEA, 96% of solar and onshore wind installations commissioned in 2023 are cheaper than the construction of new coal and natural gas power plants. Furthermore, three-quarters of these installations can generate electricity more cost-effectively than existing fossil fuel power plants. Moreover, electricity generation based on fossil fuels is vulnerable to global energy crises and can negatively impact the economies of energy-dependent countries like Türkiye due to sudden price instabilities.

The replacement of old and expensive fossil fuel power plants with cost-effective clean technologies is inevitable. Türkiye needs to prioritise supporting this transformation, primarily by investing in electricity grid infrastructure and enabling solar and wind energy to achieve significant shares in total electricity production. Subsequently, reducing and ultimately ending support such as capacity mechanisms given to domestic coal power plants with low baseload impact and frequent breakdowns will be a crucial milestone.

Türkiye's support for these power plants, which have very low availability rates and frequently malfunction due to supply security concerns, ensures their continued operation. Redirecting support towards renewable energy plants instead of these coal plants, which require constant financial backing to stay operational, will mean delivering clean electricity to the grid at lower costs for many years. This approach would not only help reduce Türkiye's largest economic issue, the national deficit but also provide cheaper electricity to citizens and businesses while contributing to national emission reductions.

Emissions trading can accelerate clean transformation

The European Union, which accounts for 40% of Türkiye's total exports, will start implementing a Carbon Border Adjustment Mechanism (CBAM) from 2026 onwards, imposing carbon taxes on certain goods. With this regulation, the EU aims to safeguard the competitive environment for its own producers and promote broader efforts in global climate change mitigation.

According to calculations by the Directorate of Climate Change, Türkiye could face an annual cost of 2.5 billion Euros if no action is taken against climate change. Considering that one-fifth of all carbon emissions originate from coal-based electricity generation, transitioning away from coal to clean sources will not only help Türkiye mitigate potential CBAM costs but also support green growth.

Furthermore, Türkiye aims to establish an emissions trading system by preparing the Climate Law and financially protecting industries exporting to the EU. Under the emission trading

system, emission quotas for coal power plants must be set based on the “polluter pays principle”, and unlimited free allowances should not be granted. Providing unlimited and free allowances would create an unfair privilege not extended to other covered commercial enterprises, contradicting the polluter pays principle by financially supporting polluting fossil energy sources.

If coal power plants remain in operation, Türkiye’s electricity grid will maintain a high carbon emission factor. This high emission factor will impose additional costs on each business subject to reporting under CBAM and using electricity in their production, negatively affecting their competitive conditions. It is estimated that local carbon pricing, set at 50 euros per ton, will contribute a 1 percentage point increase to Türkiye’s Gross Domestic Product and generate resources worth 1.5 billion Euros.

Allocating a portion of the revenue gathered from carbon markets to support solar and wind energy will benefit Türkiye in achieving its climate goals and ensuring energy security. Investment in renewable energies will generate clean electricity for many years without requiring additional support, remain independent of fuel prices, contribute to tackling climate change, and be unaffected by carbon prices.

It is time to accelerate the transition towards clean energy for Türkiye

Coal power plants, in particular those burning domestic coal, generate electricity with low efficiency, low availability rate, and low capacity factors. Moreover, these plants frequently experience production drops and losses due to failures, diminishing their reliability. This situation not only jeopardises energy security but also leads to economic losses.

It is evident that renewable energy sources, especially solar and wind energy, are more cost-effective and environmentally friendly compared to coal. Therefore, to achieve Türkiye’s climate targets without delay, it is imperative to prioritise phasing out coal by focusing on plants with the lowest baseload performance first.

In conclusion, defining a coal phase-out strategy and integrating it into energy policies are essential for Türkiye to reach its climate and energy goals while fostering a more competitive energy market economically. This strategy will represent a significant step in the long term towards improving energy security and addressing climate change.

Supporting Materials

Methodology

For Türkiye's licensed electricity generation data "/production/real-time-generation" and for unlicensed generation "/production/renewable-unlicenced-generation-amount" EPİAŞ Transparency API web services were used. Capacity utilization rates of power plants were calculated using their Injection Quantity (UEVM) and installed capacities from the EPDK License Database (MWe).

During analysis, years where some plants had zero or very low capacity factors were excluded assuming these plants were not operational during those periods. Additionally, data for the year 2020 was excluded for five plants (Afşin-Elbistan A, Seyitömer, Tunçbilek, Kangal, and Çatalağzı) which were completely shut down and Soma, which was partially closed, due to not meeting air pollution limit values set by the Ministry of Environment, Urbanization and Climate Change. Similarly, production values for plants affected by events such as the earthquake in February 2023, like Afşin-Elbistan A in Kahramanmaraş, were also not considered.

Availability rates were calculated based on hourly data reported to TEİAŞ by power plants regarding their Available Installed Capacity (AIC). This data was obtained using the EPİAŞ Transparency Platform API web service "/production/aic". Production losses due to malfunctions and their durations were captured using the EPİAŞ Transparency Platform API web service "/v1/markets/data/market-message-system" for the period 2020-2023, on a plant-by-plant basis. Production losses were calculated by multiplying the difference between the plant's installed capacity and its capacity during the malfunction by the duration of the malfunction notification.

National greenhouse gas statistics were derived from the Turkish Statistical Institute's (TÜİK) Greenhouse Gas Emission Statistics. Emissions from coal-fired power plants were based on EMBER calculations. The global heating value of coal was compiled from the United Nations Statistics Division's 2024 Energy Statistics Yearbook. Efficiency rates of coal power plants in EU countries were calculated using Eurostat's Electricity and Heat Statistics. The amount of coal required to generate 1 MWh of electricity was calculated using heating values from the United Nations database and efficiency data from Eurostat.

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Links
Access to government data via the hyperlinks may be restricted outside Türkiye.