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TSKB Economic Research

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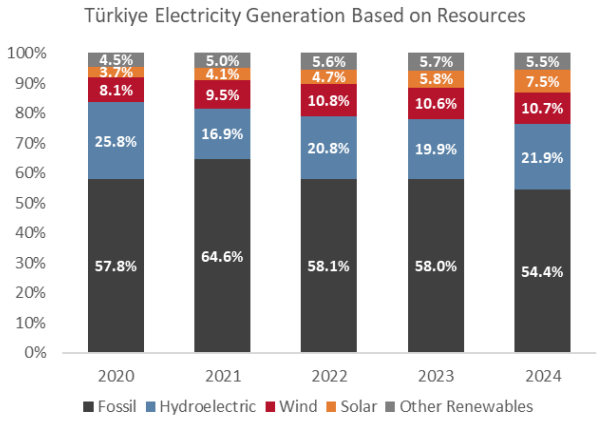
20 May 2025

Clean energy sources provide 40% of global electricity generation in 2024

According to Ember Climate's Global Electricity Outlook Report, 12,609 terawatthours (TWh) of electricity was generated from clean energy sources reached in 2024, with renewable energy playing a larger role in generation. Hydroelectric power had the highest share among renewable energy sources at 14.3%, followed by wind (8.1%) and solar (6.9%). Nuclear power accounted for 9.0% of electricity generation.

When compared to 2023, there was an increase of 858 TWh in the generation of electricity from renewable energy sources, with solar power accounting for 474 TWh of this increase. China accounted for 53% of the increase in electricity generated from solar power. There was a 1.4% YoY increase in the amount of electricity generated from fossil fuels while emissions from the global power sector increased by 1.6% to 14.6 billion tonnes of CO_2. According to Ember Climate, demand for cooling due to heatwaves played a role in this increase.

In 2024, the amount of electricity generated from solar power in Türkiye increased by 39% YoY to 341.2 TWh. According to the update of the "Türkiye Electricity Outlook 2025" report published by Ember Climate, with this increase, the amount electricity generated from the sun reached 25.7 TWh, accounting for 7.5% of the total generation. The share of electricity generated from wind was 10.7%, while total electricity generated from wind and solar reached 62 TWh, exceeding the amount of electricity generated from domestic coal. The share of electricity generated from fossil fuels fell from 58% in 2023 to 54.4% in 2024, its lowest level since 1993. Electricity generated from natural gas also fell by 4% YoY.



Source: Ember Climate, TSKB Economic Research
*Other renewables include bioenergy and other renewable energy resources.

Ember Climate emphasizes that meeting the growth in Türkiye's electricity demand and replacing fossil fuels with renewable energy sources depends on the rapid distribution of electricity generated from solar and wind energy.

26.6 TWh	2,452.7 TL/MWh
April Gross Generation	Average MCP

7.3%

Daily average licensed electricity generation decreased by 7.3% MoM and increased by 9.2% YoY in April.

Click for details.

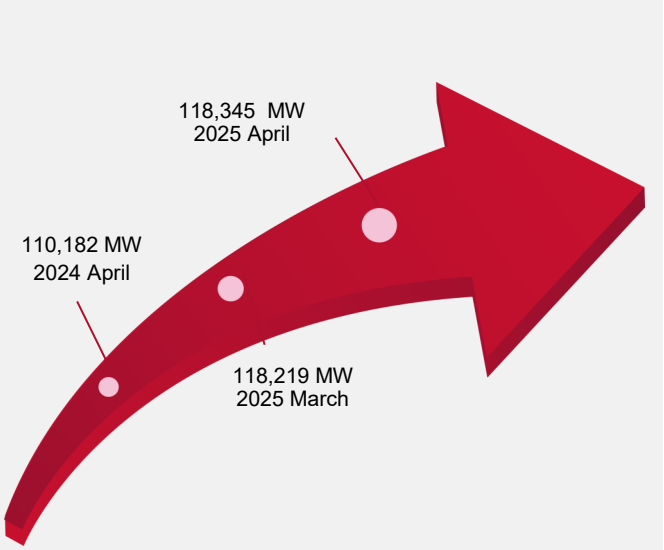
12.3%

Market Clearing Price (MCP) increased by 12.3% MoM and by 39% YoY in March.

Click for details.

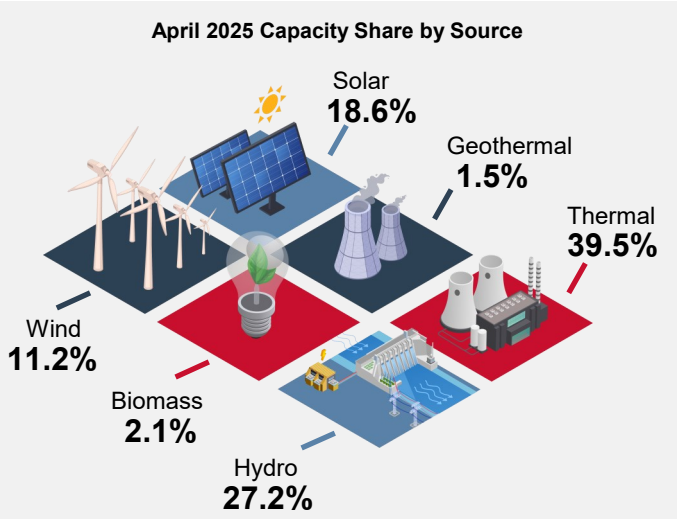
Installed Capacity Analysis

Türkiye's total installed capacity, which was 118,219 megawatts (MW) at the end of March 2025, reached 118,345 MW in April 2025. A total of 125.5 MW of net installed capacity was commissioned in April compared to March, with 99.9 MW of this installed capacity provided by solar power plants. While the installed capacity of wind power increased by 27.6 MW, the installed capacity of domestic coal power plants decreased by 2 MW. There was no change in the installed capacity of other power plants.



Source: TEİAŞ, TSKB Economic Research

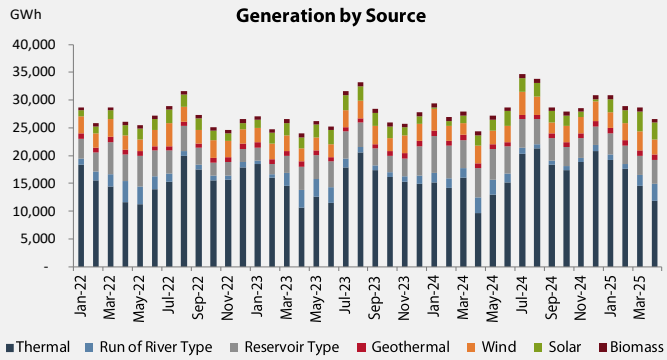
In April, 60.5% of the capacity in operation consisted of power plants generating electricity from renewable sources. Hydroelectric power plants accounted for 27.2% of Türkiye's total installed electricity generation capacity, while the share of wind and solar power plants in total installed capacity exceeded the share of hydroelectric power plants, at 29.7%

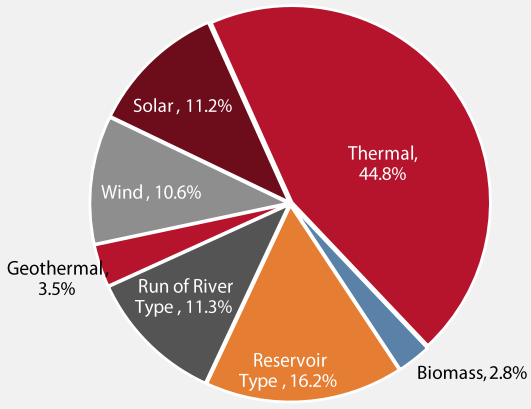


Source: TEİAŞ, TSKB Economic Research

Generation-Consumption Analysis

Total electricity generation stood at 26.6 TWh in April 2025, down from approximately 28.6 TWh in March 2025. Average daily electricity generation in April decreased by 7.3% compared to the previous month, while being up by 9.2% compared to the same month of the previous year.

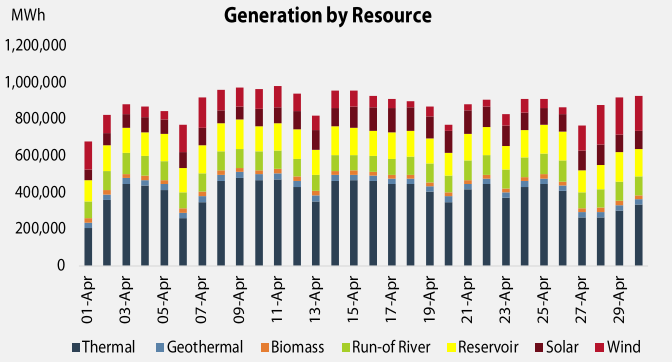




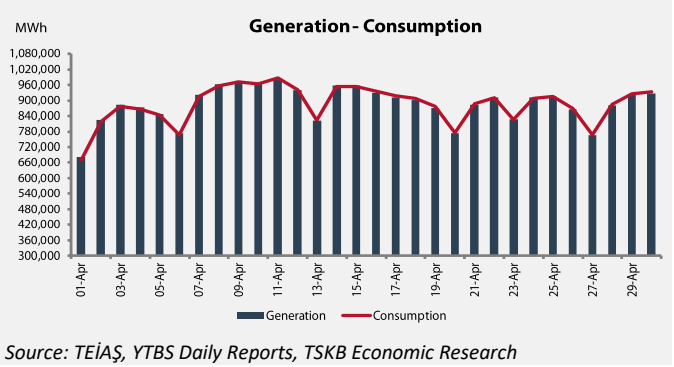
Source: TEİAŞ, YTBS Daily Reports, TSKB Economic Research

Thermal power plants, which provided 50.9% of the electricity generated in March, provided 44.8% of the total electricity generated in April. Looking at a source-based breakdown of electricity generation, hydroelectric power plants, which had a share of 18.8% of total generation in the previous month, generated 27.5% of the electricity in April. In the same period, the share of electricity generated from solar power plants stood at 11.2%, with geothermal power plants providing 3.5% of total electricity generation.

The share of renewable energy in electricity generation increased from 46.5% in March to 52.7% in April. In the same period, dam-type hydroelectric power plants contributed 16.2% to total generation, with run-of-river type hydroelectric power plants meeting 11.3% of total generation and being the renewable resource to generate the most electricity after dam-type hydroelectric power plants. In total, wind and solar power provided 21.7% of total electricity generation.



Source: TEİAŞ, YTBS Daily Reports, TSKB Economic Research



Source: TEİAŞ, YTBS Daily Reports, TSKB Economic Research

On average, daily electricity generation stood at 885,912 megawatt hours (MWh) in April, with the daily highest generation in the month recorded on Friday, April 11, at 984,252 MWh and the lowest on Sunday, April 27, at 766,464 MWh.

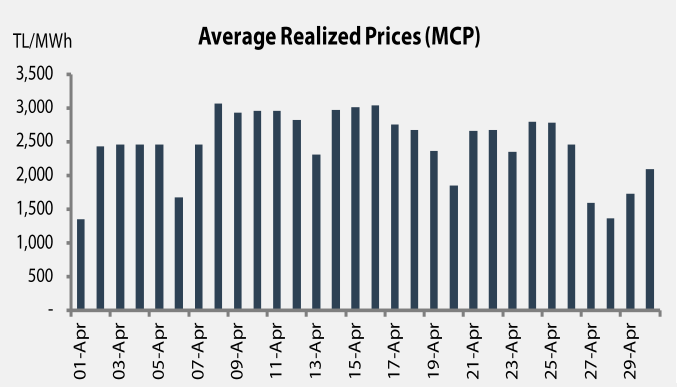
In the same period, daily electricity consumption averaged 885,379 MWh in April, with the highest level of consumption recorded on Friday, April 11 at 986,627 MWh and the lowest on Sunday, April 27, at 767,031 MWh.

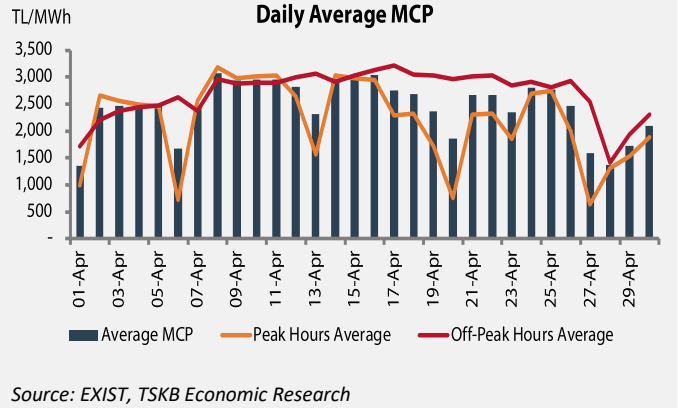
Electricity Price Analysis

In April, the daily average market clearing price (MCP) ranged between TL 1,353.5 and TL 3,073.6 /MWh. The daily average MCP in April was TL 2,452.7 /MWh while the highest daily average MCP was recorded on Tuesday, April 8, at TL 3,073.6 /MWh with the lowest being TL 1,353.5 /MWh on Tuesday, April 1.

Looking at the hourly data, the MCP was at its maximum limit of TL 3,400 /MWh for a total of 69 hours in April. The hourly minimum price in April, at TL 56 /MWh, was recorded between 12-1PM on Sunday, April 6.

During April, the average peak rate (between 8AM-8PM) was 10.1% below the average value for all hours, to be recorded at TL 2,204.9 /MWh. The maximum limit price of TL 3,400 /MWh was recorded on 25 occasions during peak hours, while the lowest price of TL 256 /MWh was realized for one hour during peak hours.

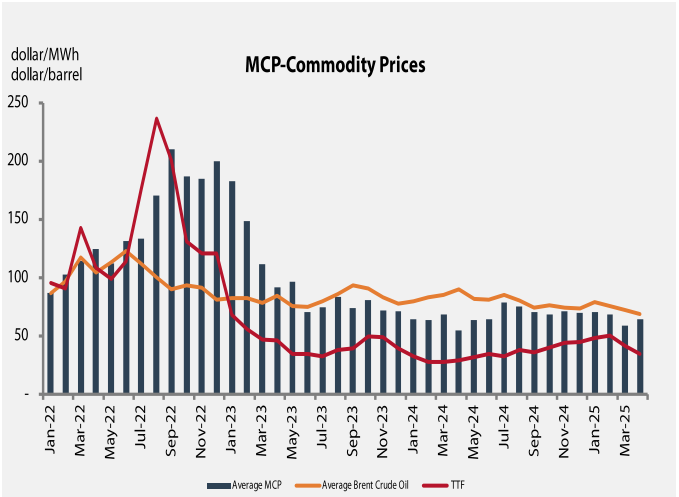




Source: EXIST, TSKB Economic Research

In the same period, the average off-peak rate (between 8PM-8AM) was TL 2,700.4 TL/MWh. While the maximum limit price of TL 3,400 /MWh was realized for 44 hours during off-peak hours, the lowest price during off-peak hours, at TL 250 /MWh, was only recorded between 7-8AM on Monday, April 28.

The average MCP increased from USD 59 /MWh in March to USD 64.4 /MWh in April. Compared to the same period of the previous year, the MCP was 18% higher in dollar terms.



Source: EPİAŞ, TCMB, EIA, TSKB Economic Research

Average Commodity Prices

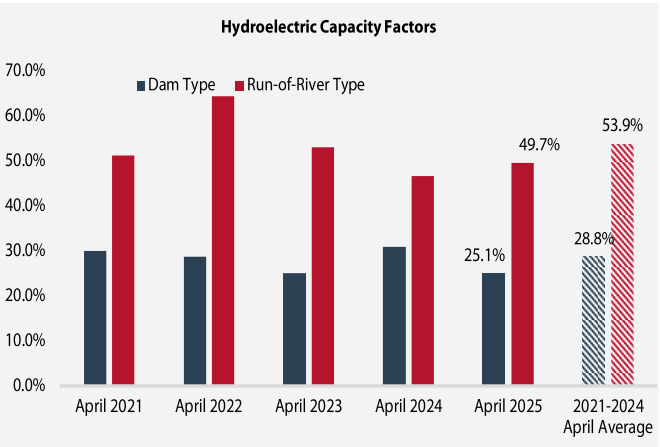
The price of Brent crude oil, which averaged of USD 72/ bbl in March, decreased by 4.7% on a monthly basis to USD 68.60/ bbl in April. This average price was 23.7% lower than in the same period of the previous year.

The TTF natural gas contract price, which averaged USD 41.8 /MWh in March, fell by 16.2% month-on-month to USD 34.9 /MWh in April. The TTF increased by 20.8% compared to the same period of the previous year.

Hydroelectric Capacity Factors

The capacity factors of dam- and river-type hydroelectric power plants in April 2025 were 25.1% and 49.7%, respectively. When compared to April 2024, the capacity factors for dam-type hydroelectric power plants was down by 6 percentage points while there was an increase of 2.9 percentage points for run-of-river type hydroelectric power plants in April 2025. Looking at the months of April over the last 5 years, April 2024 saw the highest capacity factors for dam-type power plants, at 31%, while the highest capacity factor for run-of-river type plants was recorded in April 2022, at 64.6%.

The capacity factors for dam-type power plants was 3.7 percentage points below the average for the month of April between 2021-2024, and the capacity factors for run-of-river type power plants was 4.3 percentage points below the average.



Source: TEIAS, EPIAS, TSKB Economic Research

Blackout in the Iberian Peninsula

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April 28, 2025 is a date that not be forgotten for a long time. We are talking about the blackout which affected the Iberian Peninsula and the south of France, affecting millions of people. The power outage caused disruption to flights and train services, queues at ATMs and supermarkets, and even came with a directive not to use electric vehicles. It would be no exaggeration to say that the power outage that started in Spain on April 28 was one of the biggest electricity infrastructure failures Europe has ever seen.

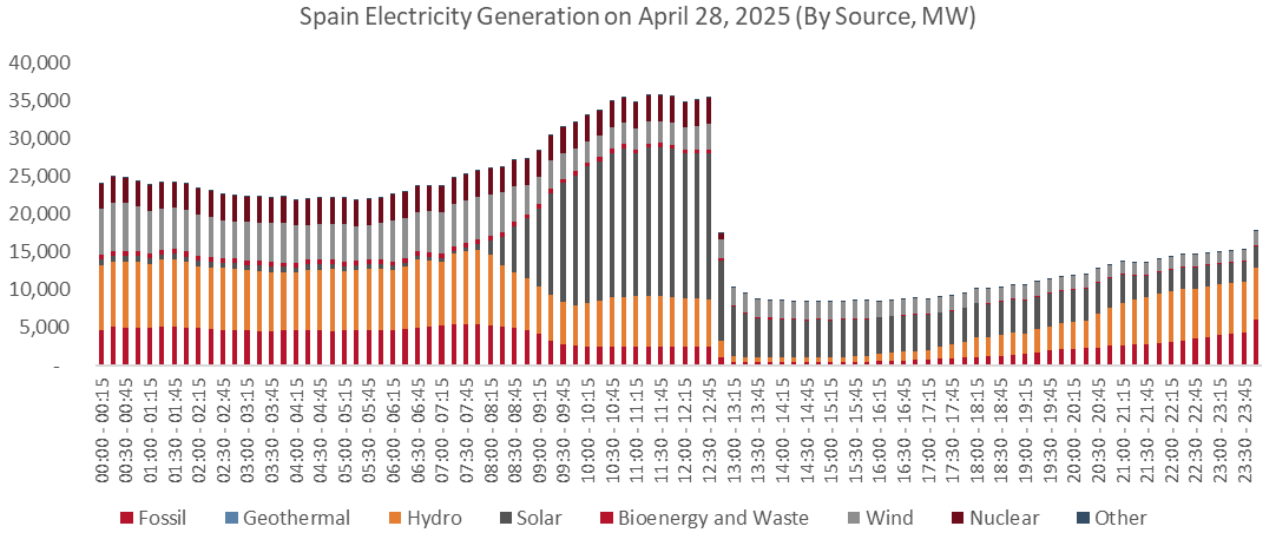
According to data provided by the European Network of Electricity Transmission System Operators (ENTSO-E), the amount of electricity generated in Spain between 12.30 and 12.45 PM was 35,416 megawatts (MW), while this decreased to 17,588 MW between 12.45 and 1.00 PM, and to 8,400 MW in the following hours. So what happened? According to statements in the Spanish press, at around 12.32 PM, there was wide fluctuation in the network frequency. This surge was stated to be caused by a loss of 15,000 MW in electricity generation within five seconds, causing Spain's ENTSO-E to be disconnected. The disconnection also caused the system in Spain to crash, according to Eduardo Prieto, Chief Operating Officer of Spanish grid operator Red Electrica Espanola (REE)[1]. Millions of people were left without electricity, while the normal functioning of train stations, airports and shopping malls was affected. As a state of emergency was declared in six regions of Spain, the Spanish Government deployed nearly 30,000 soldiers and police[2]. In the morning of the next day, with the support of France to the north and Morocco to the south, the generation capacity in the electricity system reached 80%, turning the page on an incident which witnessed the most serious power outage in Spain's history.

So what caused this interruption?

At the time of writing, no official announcement has been forthcoming regarding the reason of the outage, or rather statements issued state that the cause of the outage has not yet been determined, and it seems that the reason will not be determined for some time. The possibility that it was a "cyber attack", which was among the possibilities, was ruled out a day after the outage. Spanish Prime Minister Pedro Sánchez stated that a detailed investigation was being carried out to confirm the cause, but also pointed out that this may take some time.

The inability of the network to synchronize stands out among the most likely reasons for the outage. While all power plants that supply electricity to the grid must be synchronized at 50 Hertz, this synchronization can be provided by nuclear power plants, large natural gas plants and hydroelectric power plants, called baseload power plants, which are in the Spanish electricity mix. Looking at the Ember Climate data, wind had the highest share among Spain's electricity generation resources in 2024, with a share of 22.4%, followed by solar, at 20.9%[3]. The total share of power plants able to provide synchronization among all power plants is approximately 50%. However, while the nuclear power plants were among the plants which closed themselves due to the fluctuation in the system, hydroelectric power plants and natural gas plants failed to keep the frequency constant.

In this context, this power outage in Spain, where nearly 60% of the electricity demand is met by solar power plants at some times, indicates that the availability of electricity storage facilities could play an important role in the security of the system. It also points out that countries should take grid security and modernization into account while aiming to ensure diversity in the supply in electricity.



Source: ENTSO-E, TSKB Economic Reserach

[1] El Pais, https://english.elpais.com/spain/2025-04-28/what-is-known-and-what-remains-unknown-about-the-massive-blackout-in-spain.html.
[2] El Pais, https://english.elpais.com/international/2025-04-28/massive-power-outages-cause-blackouts-in-spain-and-portugal.html
[3] EMBER-Climate, https://ember-energy.org/countries-and-regions/spain/#:~:text=It%20was%20the%2021st%20largest,of%20its%20electricity%20in%202024.

Sector News

Local News

- Energy cooperation between Türkiye and Azerbaijan "of great importance for Europe's natural gas supply security". The Minister of Energy and Natural Resources Alparslan Bayraktar stated that the Trans-Anatolian Natural Gas Pipeline (TANAP) and the Trans Adriatic Pipeline (TAP) were being built with a capacity of 32 billion cubic meters, emphasizing that the infrastructure is ready to meet Azerbaijan's goal of doubling the amount of natural gas it exports to Europe by 2027. In addition, Mr. Bayraktar added that with the agreement to be signed between Türkiye, Bulgaria, Georgia and Azerbaijan in the coming days, a project that will contribute to energy supply security in Türkiye and Europe in the field of electricity as well as natural gas and oil will be implemented.

- Spot electricity ceiling price raised from TL 3,000 /MWh to TL 3,400 /MWh. Energy Exchange İstanbul (EPİAŞ) raised the ceiling price of the Day-Ahead Market and the Balancing Power Market, while leaving the minimum price limit unchanged at 0 TL. The effective date of the change in the ceiling price was determined as April 5, 2025.

- Final electricity retail prices raised by 25% for residential subscriber group. The Energy Market Regulatory Authority (EMRA) increased tariffs for residential subscribers by 15%, for industrial subscribers by 10% and for agricultural users by 12.4% for the public and private services sector subscriber group, together with the residential subscriber group, due to the increase in electricity and distribution costs. In addition, EMRA revised the Renewable Energy Resources Support Mechanism (YEKDEM) cost per unit of energy supplied for April and beyond. Accordingly, it is predicted that YEKDEM costs will vary between TL 204.35 and TL 488.64 per megawatt hour between April and December. In addition, according to the statement issued by Petroleum Pipeline Company (BOTAŞ), final natural gas sales prices were raised by an average of 20% for industrial consumers and by an average of 24.2% for electricity generation plants.

- First phase of Sakarya Gas Field completed by reaching daily production of 9.5 million cubic meters. According to the statements issued by the Minister of Energy and Natural Resources, Alparslan Bayraktar, this natural gas produced from this field was distributed to more than 4 million households, while work on the second phase to double production has got underway. Mr. Bayraktar added that in 2028, the production from the Sakarya Gas Field would increase to 40 million cubic meters per day, with the aim that the the Sakarya Gas Field would meet the natural gas needs of all households.

Foreign News

- International Energy Agency (IEA) releases its report on "The State of Energy Innovation". According to the report, energy R&D expenditures has increased by 6% annually in real terms in recent years. In 2024, direct government spending on energy R&D globally exceeded USD 50 billion, but with a slowing in the pace of the rise. The IEA highlights that member countries spend about 0.04% of their GDP on energy R&D, and 60% of this expenditure is allocated to energy efficiency, renewable energy and nuclear energy. It also emphasizes that energy innovation has implications for trade balances. Accordingly, the USA, which imported 46% of its oil and natural gas needs in 2000, is today able to export the equivalent of 10% of its demand through the use of horizontal drilling and hydraulic fracturing. In China, innovations in EV and battery technology have resulted in the country's oil imports being 8% lower than in a scenario where there are no electric vehicles. While the IEA emphasizes that energy innovation can also create benefits for other sectors, it also highlights that addressing climate change in the sector can bring significant advances in innovation.

- Renewable energy capacity in Mediterranean countries exceeds fossil fuel capacity. Ember Climate includes 18 countries, including four Southern European Unions, five North African countries, Türkiye and other Mediterranean countries, in its study which examines the "TeraMed" initiative, which aims to reach 1 terawatt (TW) of renewable energy capacity in the Mediterranean Region. The TeraMed initiative aims to shape the energy dynamics in the region and contribute to energy security by developing cooperation with the European Union in countries in the Mediterranean Region. Accordingly, as of 2023, the renewable energy capacity of the countries included in the analysis will reach 315 GW, surpassing fossil

fuels with a capacity of 293 GW. Southern European countries accounted for 73% of the renewable energy capacity in the region in 2023, with Türkiye having a 19% share and North African countries comprising 4% of this capacity. The remaining Mediterranean countries had a total renewable energy capacity of 14 GW. Although renewable energy capacity in the region is projected to double by 2030, this would still fall short of the TeraMed initiative's target of 1 TW. Ember Climate underlines the need to accelerate wind and solar capacities in order to achieve the target, drawing attention to the importance of increased political support and financial incentives.

- Global Energy Monitor (GEM) publishes its report "Rise and Fall 2025", which examines coal capacity. Although additions to global coal capacity in 2024 fell to a 20-year low according to the report, total capacity continued to increase, reaching 2,175 gigawatts (GW). The report highlights China's role in the increase in global coal capacity, emphasizing that 70% of the 44.1 GW of coal capacity commissioned in 2024 was in from China, while the growth elsewhere in the world is slowing. GEM also notes that the expansion in coal capacity has slowed in Türkiye, with only one new 0.7 GW project under proposal.

- The President of the U.S. Donald Trump, signs executive order to increase domestic coal production. The executive order aims to remove regulatory barriers to coal production in the U.S., encouraging the use of coal to meet growing energy demand in the country and increasing coal exports.

- IEA publishes its report titled "Energy and Artificial Intelligence (AI)". While the report draws attention to the energy needs of AI, especially by emphasizing the electricity demand of data centers, it highlights that AI applications could change the way the energy sector operates. Examples of this are more accurate weather forecasting with AI, predicting the production of wind and solar power plants and real-time monitoring and optimization of transmission lines. According to the report, data centers will account for approximately 1.5% (415 TWh) of global electricity consumption in 2024, and affordable, reliable and sustainable electricity supply is gaining importance in this direction. The report states that data centers provide half of the growing electricity demand from renewable energy sources. However, the report emphasizes that various resources such as natural gas, nuclear and geothermal power, as well as smarter grids will be needed to meet the demand for data centers, which are expected to consume 1,200 TWh of electricity by 2035. The IEA claims that the deeper dialogue and collaboration between the technology and energy sector is needed to drive AI and harness its energy benefits.

- Global natural gas demand expected to slow down in 2025 due to macroeconomic uncertainties. According to the natural gas report published by the IEA for the second quarter of 2025, growth in global demand for natural gas is expected to be around 1.5% in 2025. While the IEA highlights regional differences in demand for natural gas, it highlights the decline in demand, especially in Asia. In the region, which saw demand increase by 5.5% in 2024, demand for natural gas is only expected to grow by 2%.

- The age of electricity has begun in the world, according to IEA director Fatih Birol, with the increasing number of power plants, electric vehicles and battery installations using renewable energy. According to IEA Executive Director Fatih Birol, Artificial Intelligence and air conditioners also trigger electricity demand, while the transition to nuclear energy has attracted attention. Drawing attention to the importance of small modular reactors for electricity supply security, Mr. Birol stated that the amount of electricity generated from nuclear energy would increase in 2025. In addition, emphasizing the importance of critical minerals and supply chains, Mr. Birol emphasized that there is a need for investment in critical minerals for electric vehicles, networks and batteries.

- Organization for Petroleum Exporting Countries (OPEC) lowers its global oil demand growth forecast for 2025 to 1.3 million barrels per day. According to the Monthly Oil Market Report for April published by OPEC, the announced tariffs on trade will reduce the growth in oil demand. The growth forecast had been left unchanged at 1.4 million barrels per day in the previous report.

- Global natural gas consumption up by 2.5% YoY to 4,170 billion cubic meters in 2024. According to the Annual Natural Gas Market Report 2025, published by the Gas Exporting Countries Forum (GECF), the Asia Pacific Region has played a key role in the increase in consumption. While the GECF expects global natural gas demand to increase by 2% in 2025 and 2026, it states that the announced tariffs pose a downside risk to the growth outlook.

- IEA publishes its April Oil Market Report. According to the report, global oil demand is expected to grow by 730,000 barrels per day in 2025. The IEA lowered its global oil demand forecast by 300,000 barrels per day compared to the previous month, emphasizing tensions over trade as being behind this reduction. In 2026, it expects growth in demand for oil to decline to 690,000 barrels per day.

- BloombergNEF publishes its "New Energy Outlook 2025" report. According to the report's scenario that energy transition investments progress in parallel with cost-competitive technologies, global electricity demand is projected to increase by 75% by 2050. Electric vehicles, cooling needs and data centers were highlighted as the driving forces of this growth. Attention was drawn to Asia, the Middle East and Africa, in terms of demand, emphasizing the infrastructure investment opportunities in these regions. According to the same scenario, renewable electricity generation is projected to increase by 84% by 2030. In addition, 6.9 TW of solar energy and 2.6 TW of wind energy are expected to come on stream 2035. According to the same scenario, BloombergNEF predicts that a cumulative investment of USD 185 trillion will be carried out between 2025 and 2050 for the energy transition. In the scenario where the world achieves its goal of net zero by 2050, it expects investments to be 15% higher with a greater focus on clean technologies such as renewable energy, electric vehicles, heat pumps, carbon

capture and grid infrastructure.

- Global Wind Energy Council (GWEC) publishes its 2025 Global Wind Report. According to the report, a total of 117 GW of capacity was added in 2024, including 109 GW of onshore wind energy and 8 GW of offshore wind energy. With this increase, global wind energy capacity reached 1,136 GW. The GWEC states that China stands out in terms of the new capacity in 2024, followed by the USA, Germany, India and Brazil. The report predicts that by 2030, the compound annual growth rate of wind power capacity growth will average 8.8%, with 981 GW of new wind capacity being added. While drawing attention to the importance of capacity increases, GWEC emphasizes that institutions could accelerate this growth even more with the right policy framework and by reducing investor risks.

- Large-scale blackouts in Spain, Portugal and France. According to media reports, the cause of the outages is not yet clear, while the power outages have led to disruptions in transportation, health and communication networks. While the outages have focused attention on Europe's energy and grid security, Spanish Prime Minister Pedro Sánchez said that the country had lost 15 GW of electricity generation in a short period of time, corresponding to 60% of the national demand.

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