Solar surge: Meeting two-thirds of the rise in Türkiye's peak electricity demand in 2024

In the first eight months of 2024, Türkiye's solar energy generation surged by over 40% compared to the same period in 2023, contributing to meeting record-high electricity demand during summer.

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Content

About

This report examines the role of solar energy in meeting Türkiye’s growing peak electricity demand. Particularly during hot summer months, cooling needs rise and as a result, electricity demand reaches its highest levels. At the same time, solar energy also achieves peak production, providing a significant contribution to meeting this demand. The continuous increase in solar energy's share in meeting peak demand over the years proves it has become a critical and sustainable solution within Türkiye's electricity infrastructure.

Executive Summary

Türkiye’s solar surge meets rising peak demand in 2024

Since 2017, solar generation's contribution to meeting Türkiye's electricity demand peak has increased sevenfold from 2.5% to 18%.

Growth in Türkiye’s solar generation contributed to meeting electricity peak demand, which has been driven by increasing cooling needs. In 2024, Türkiye experienced a significant surge in solar energy generation, which covered two-thirds of the hourly peak demand increase. Solar energy even produced enough electricity to cover the entire electricity consumption in Western Anatolia provinces during the year's highest electricity demand.

Growing share of solar power in Türkiye’s energy mix can meet future electricity needs in a sustainable and cost-effective manner.

01 Solar met hourly peak demand for 10 million people

Solar power generated more than 10 GWh of electricity in peak hour in 2024, covering the hourly electricity demand for over 10 million people.

02 Solar met 70% of the increase in peak demand since 2019

Solar power covered 70% of the rise in hourly peak electricity demand over the last five years, proving its ability to meet rising demand driven by increasing cooling needs.

03 Peak electricity demand supplied by solar increased from 2.5% in 2017 to 18% in 2024

Solar power has been meeting bigger portions of peak electricity demand over the years. In 2024, solar energy has been meeting 18% of peak demand, up from just 2.5% in 2017 – underscoring its growing role in Türkiye's energy mix.

This upward trend is expected to continue as investments in solar energy expand and storage solutions improve, positioning solar power as a key pillar in Türkiye's energy strategy.

Solar energy's growing contribution

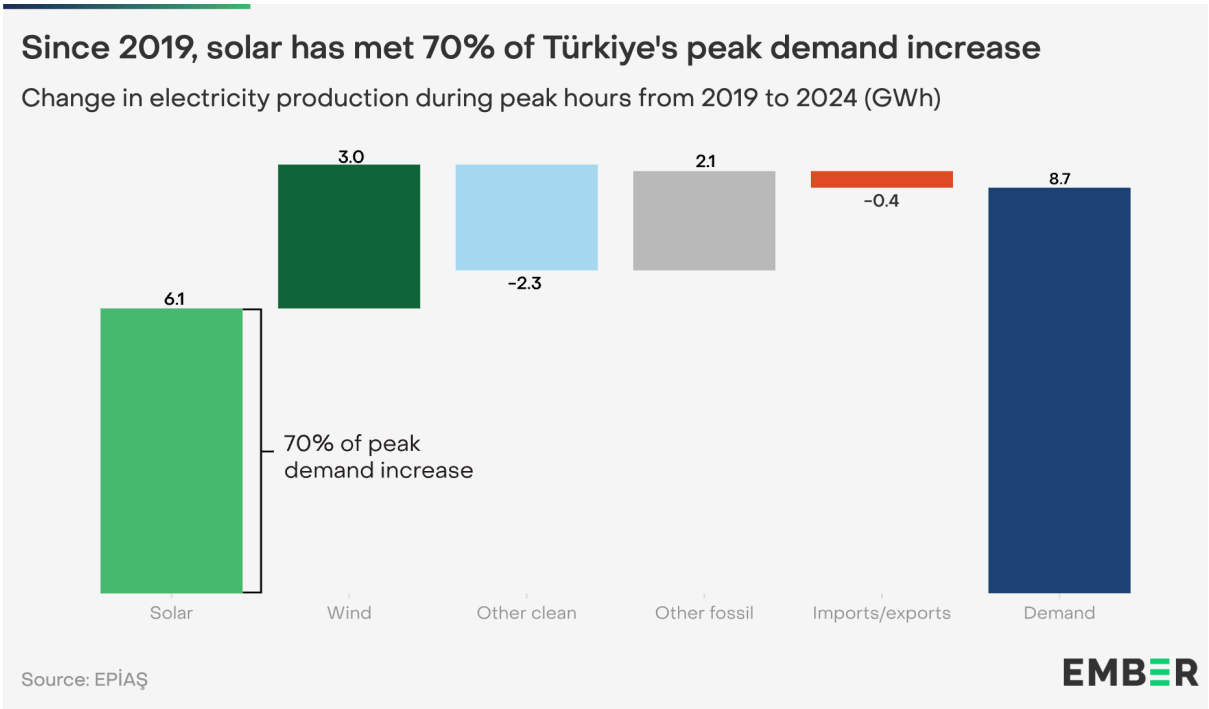
In the last five years, solar energy has met 70% of the increase in peak demand

The time period between 7 a.m. and 5 p.m. is when electricity generation from solar energy reaches its highest levels. These hours coincide with when the industry and service sector, public buildings, and households all see their highest activity and frequently need to

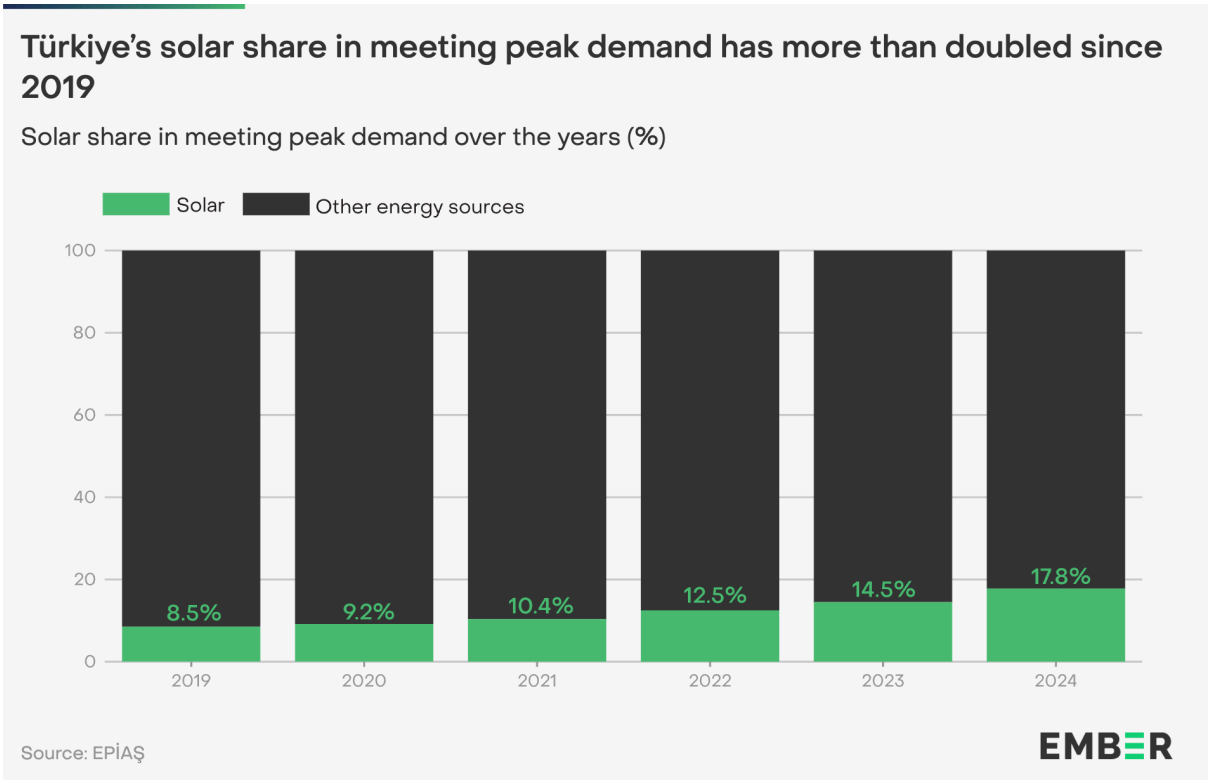
use energy-intensive devices like air conditioners. This ultimately drives electricity demand to its highest level.

The highest level of electricity consumption is referred to as peak demand. Solar energy reaches its maximum production capacity during midday when cooling needs and peak demand are highest. This contributes directly to the grid, reduces dependence on fossil fuels, and strengthens energy supply security.

In Türkiye, although peak demand has not increased consistently every year, the trend shows a strong rise with an increasing share of this demand being met by solar. While solar energy only met 2.5% of peak demand in 2017, this share increased to 18% by 2024. The fact that solar power plants have met 70% of the 8.7 GWh peak demand increase over the last five years highlights the growing importance of this source in Türkiye's energy infrastructure.



In 2024, solar energy covered two-thirds of the peak demand increase compared to 2023, up from 52% the previous year. This shows that solar energy offers an effective and sustainable solution to Türkiye's electricity needs during the highest demand hours.



One of the most tangible examples of solar energy's contribution to meeting hourly electricity demand occurred on July 23, 2024, at 2:00 p.m. when consumption reached its annual peak due to cooling needs. At this time, solar energy successfully met the total hourly electricity demand of the provinces of İzmir, Çanakkale, Balıkesir, Manisa, Aydın and Muğla — home to a combined population of more than 10 million — by generating over 10 GWh of electricity.

Given Türkiye's abundant solar potential and rising demand for cooling, accelerating investments in solar energy will continue to support energy supply security sustainably.

Rising cooling demand drives record peak electricity use

As Türkiye experiences hotter summers due to climate change, cooling demand has surged, pushing peak electricity demand to new annual records. In July 2024, peak electricity demand spiked by 6.9% to 58 GWh compared to 2023, with projections of 68 - 81 GWh by 2030.

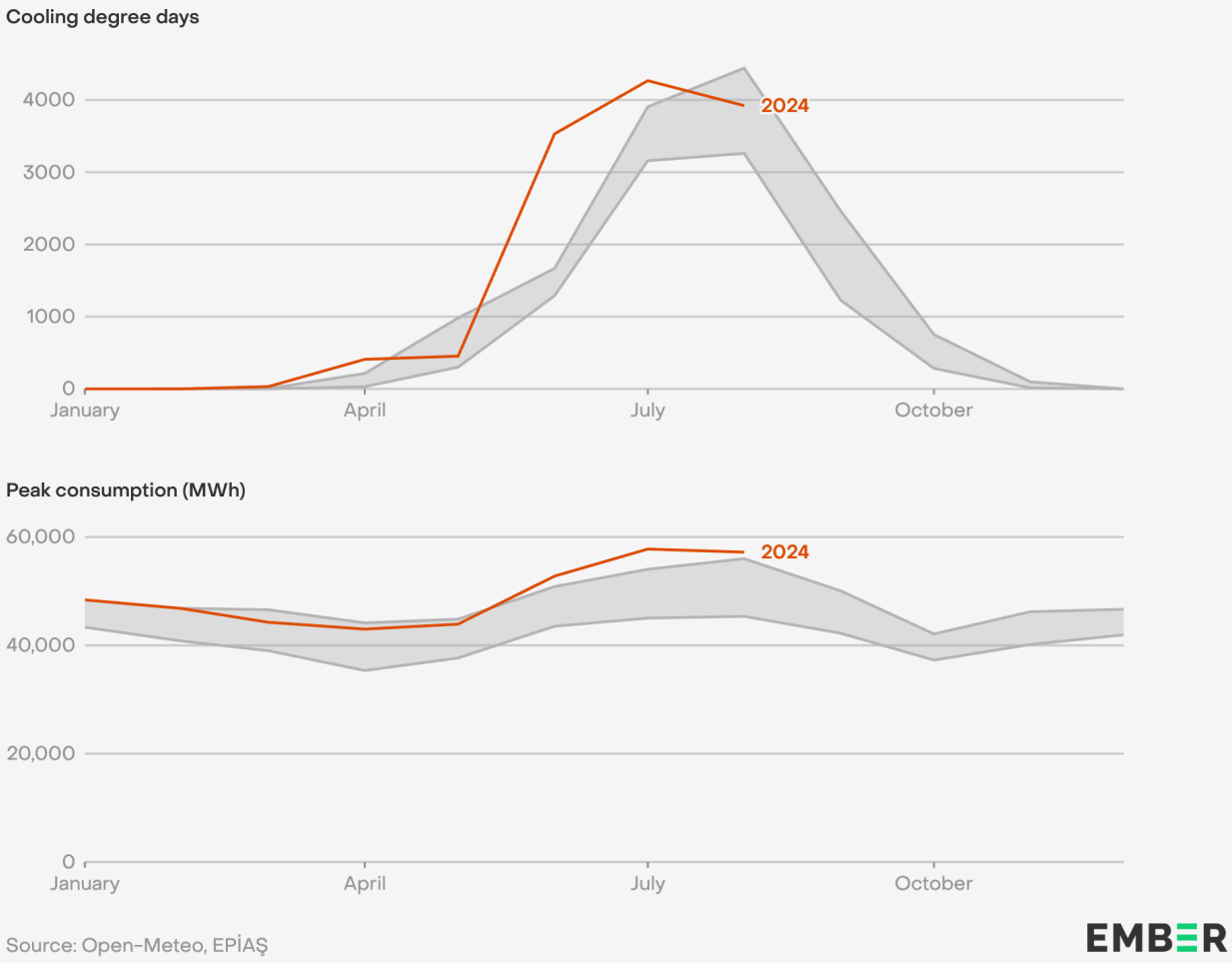
Peak demand now occurs during midday summer hours, emphasising cooling as a primary driver, with population growth and ongoing economic development further amplifying this trend.

Cooling demand metrics and regional impacts

Cooling degree days (CDD), a key indicator of cooling demand, reflect how many days exceed comfort temperatures and by how much. In June 2024, Türkiye's cooling degree days tripled in comparison to the June average of the past five years. Likewise, in July 2024, they were 1.5 times higher than the July average for the last five years. The increasing cooling demand driven by rising CDD values caused electricity peak demand to reach record monthly levels in June and July.

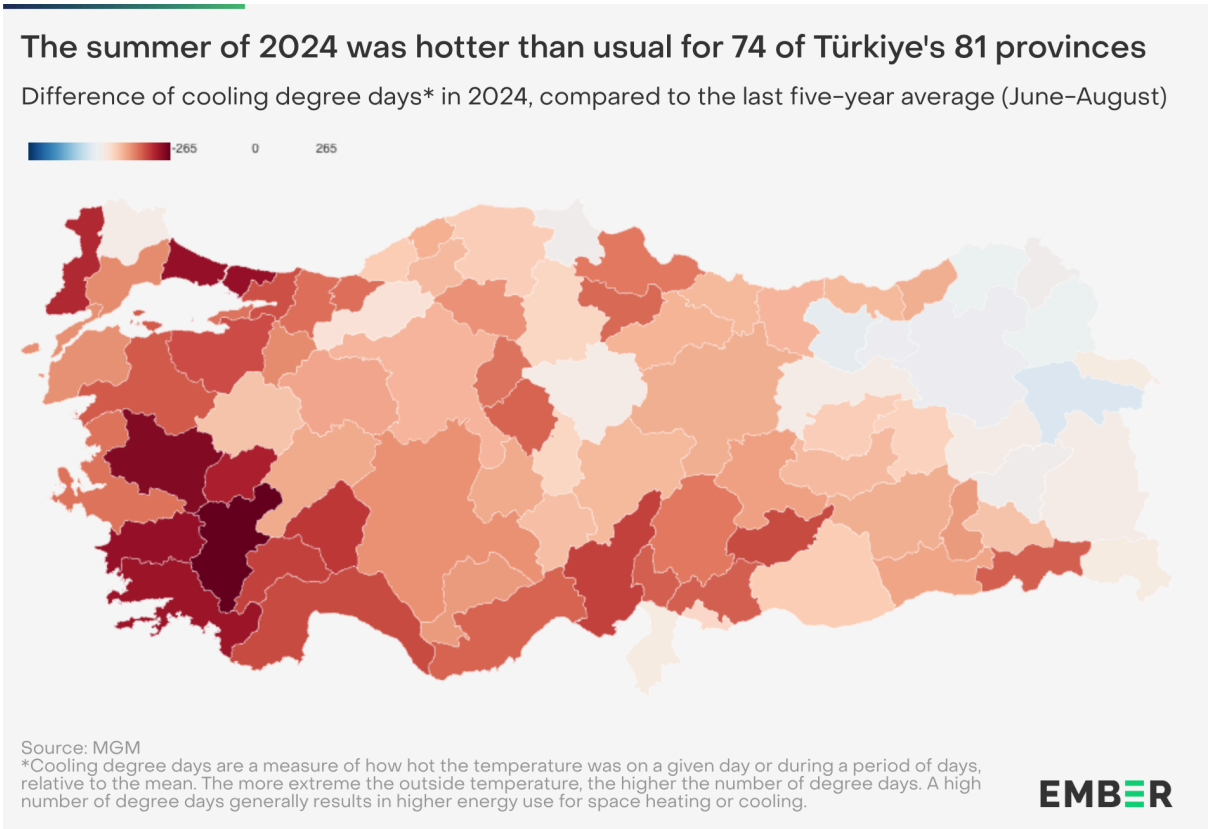
Hot weather is the main driver of peak electricity demand during Türkiye's summer

Grey areas represent the range of values between 2019 and 2023



Source: Open-Meteo, EPİAŞ

Cooling needs create regional differences in electricity demand. For example, in the summer of 2024, CDD values increased in 74 out of 81 provinces compared to the last five years, with the highest rise being observed in the Aegean region. In the Western Mediterranean region, where cooling needs are high, peak electricity demand in July was 68% higher than in April. In contrast, Eastern Anatolia, which has the lowest cooling needs, saw only a 3% rise.

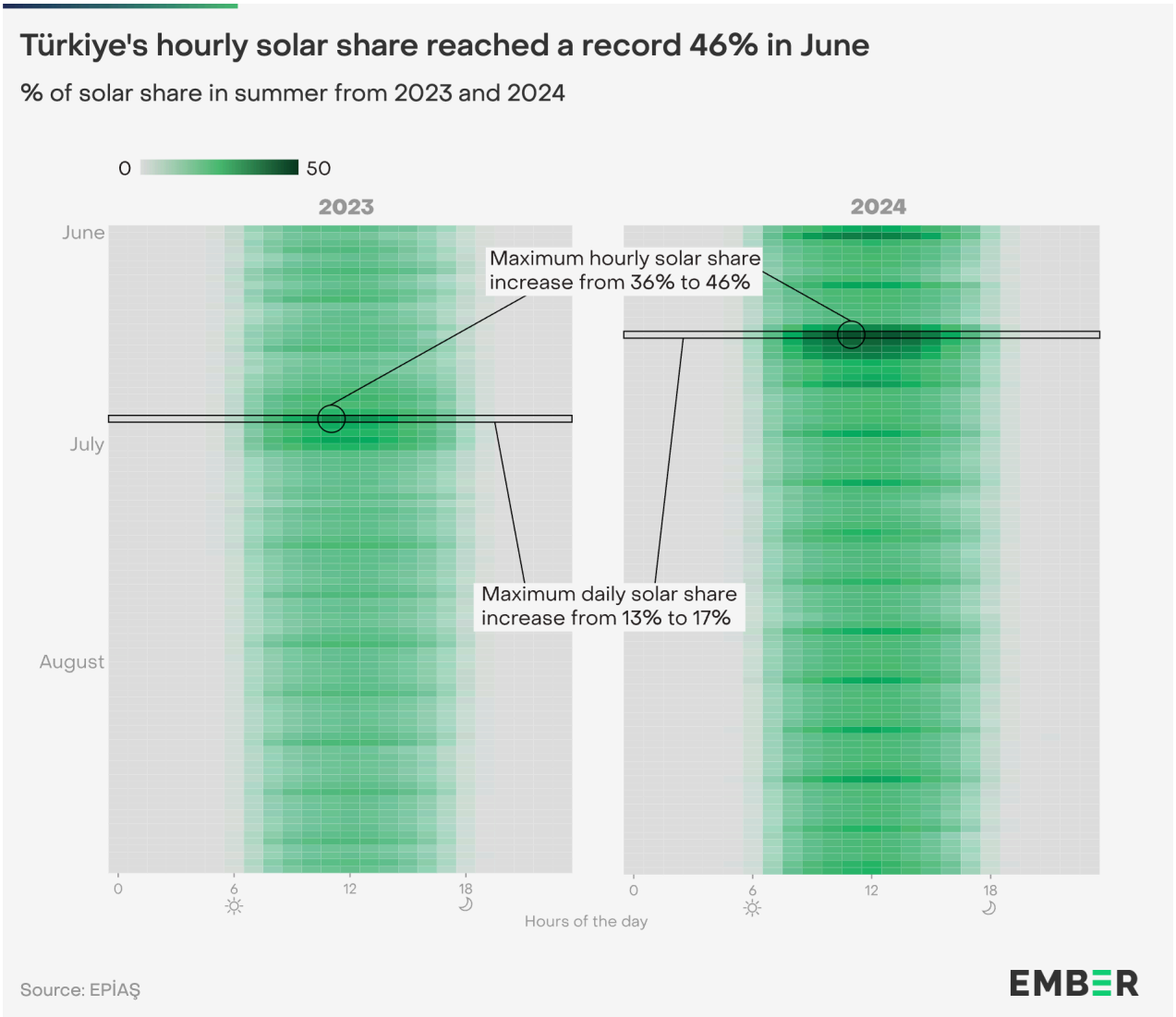


Solar energy meets growing demand with record production

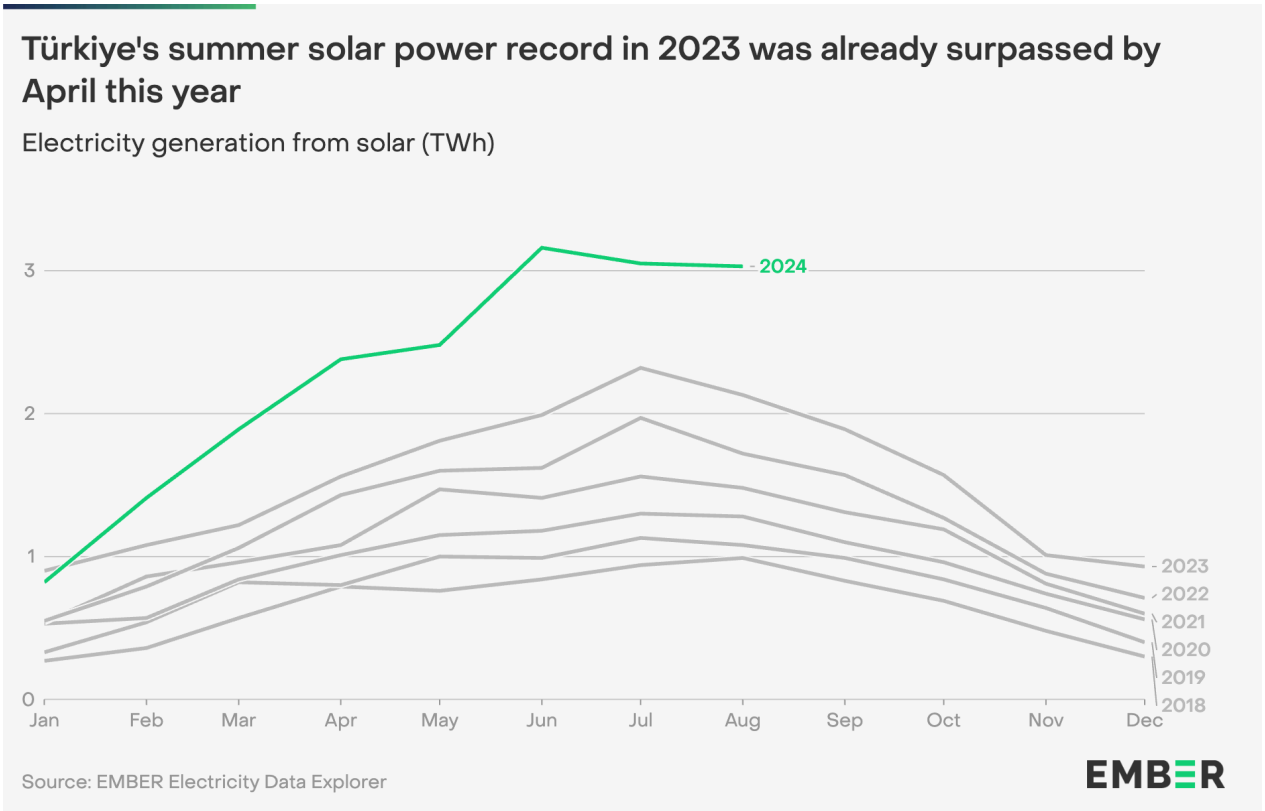
By 2024, the growth in solar energy accelerated, setting new records in both production volumes and its share in overall electricity generation.

In 2024, solar energy hit new highs in meeting electricity consumption on an hourly, daily, and monthly basis. On June 16, 2024, the share of solar in electricity generation reached 46% on an hourly basis and surpassed 17% on a daily basis – both record highs. Additionally, with reduced consumption in June due to a nationwide holiday, the monthly share of solar surpassed 11%, achieving its highest level ever.

Alongside these records, solar's share in hourly production continues to rise with more installed capacity. In the first eight months of 2019, solar made up 15% or more of hourly electricity production for only about 1.2% of the time. By 2024, this happened 25% of the time – a twentyfold increase.



On the other hand, the previous record for the monthly generation level reached in July 2023 was surpassed again in April 2024; and by June, it had reached the highest level ever. In the first eight months of 2024, total solar-powered electricity generation increased by more than 40% compared to 2023, exceeding 18 TWh. This growth in production during the first eight months raised the share of solar in electricity generation from 6% to 8% compared to the same period in 2023.



Data transparency and solar capacity challenges

The Turkish Electricity Transmission Corporation (TEİAŞ) reports on electricity statistics. In addition to its central units in Ankara, TEİAŞ operates through 22 regional directorates and nine regional load dispatch centres, one of which is national.

These statistics, which include data on installed capacity, are prepared based on information obtained from TEİAŞ's structure and authorised electricity distribution companies. However, the installed capacity data sometimes shows abnormal increases within a single day. A similar change was observed between June 30 and July 1, when solar energy capacity saw a one-day increase of approximately 17% (2.6 GW). As a result, the daily capacity factor of solar energy dropped from 30% on June 30, 2024, to 23% the next day, and remained at this level throughout the month.

These sudden changes in the statistics significantly affect the results of analyses, weakening market participants' ability to make accurate forecasts, altering the feasibility of investments, and misleading outcomes in the assessment of national system indicators. Transparent, accurate data is essential to bolster confidence, improve forecasting, and support energy sector growth and investment.

Conclusion

Solar power is Türkiye’s most cost-effective solution for peak demand

Solar energy is becoming a central pillar of Türkiye's energy strategy, especially for meeting peak demand efficiently. While the global solar market is projected to add 593 GW of new installed capacity in 2024 (a 29% increase from 2023), new solar investments in Türkiye have played a significant role in meeting the 2024 peak demand.

Despite rising cooling needs and electricity demand, the steady increase in the share of peak demand met by solar energy highlights its growing importance as a critical solution in Türkiye’s electricity system. Solar energy not only reaches its maximum production capacity during the hours when cooling demand is at its highest, but it also offers additional benefits.

Solar’s stable costs, unaffected by volatile fossil fuel prices, ensure predictable electricity bills for consumers. Moreover, solar energy directly reduces Türkiye’s dependence on energy imports, helping to lower its current account deficit.

In 2024, Türkiye avoided investing in approximately 16 GW of fossil fuel capacity thanks to its solar installations (see Methodology). As solar energy technologies continue getting cheaper, electricity generation at lower costs relative to fossil fuels is becoming increasingly possible. This not only reduces carbon emissions, but also brings substantial savings to the Turkish economy by lowering electricity production costs.

In addition, self-consumption applications enable electricity to be used directly where it is produced, avoiding potential energy losses in transmission and distribution lines. Consumers meeting their own electricity needs through self-consumption rather than relying on the grid also help prevent regional peak demand increases. This improves overall grid efficiency, reduces the need for additional infrastructure investments, and lowers grid operating costs. In this context, Türkiye’s rooftop solar potential of at least 120 GW offers a significant opportunity to enhance energy security.

While solar energy plays a crucial role in meeting midday peak demand, Türkiye could further optimise its solar potential by integrating it with storage systems, making the consumption

curve more balanced and manageable. Storage would extend the effectiveness and usage time of solar energy, simplifying grid management and enabling surplus renewable energy to be stored and used during high demand hours in the future.

Türkiye already has over 14 GW of solar energy capacity with storage in pre-licensing stages, far exceeding the 2030 target of 2.1 GW outlined in the National Energy Plan. The realisation of this capacity will enhance the flexibility of Türkiye's energy grid and facilitate the integration of even more solar capacity into the system by storing future excess generation for use when needed.

Supporting Materials

Methodology

Electricity Generation and Consumption

Electricity generation and consumption calculations were obtained using the EPİAŞ Transparency Platform web API.

Installed Capacity Values

The changes in installed capacity on a daily basis were obtained from the TEİAŞ Load Dispatch Information System page. On July 23, 2024, at 2:00 p.m., when solar energy met 10.2 GW of peak demand, the capacity factors of natural gas, imported coal, and domestic coal power plants were calculated as 56%, 97%, and 55%, respectively. In a scenario where solar energy did not exist, and the peak demand met by solar had to be shared equally between natural gas and coal power plants, it was calculated that an additional 9.1 GW of natural gas capacity and 6.8 GW of coal capacity would be required using the relevant capacity factors.

Regional Peak Demand

Regional peak demand data was obtained from the TEİAŞ Load Dispatch Information System page. The regions consist of the following provinces, which fall under the responsibility of the nine regional directorates of the TEİAŞ Load Dispatch General Directorate.

- **Trakya:** Edirne, Istanbul (European side), Kırklareli, Tekirdağ
- **Northwest Anatolia:** Bartın, Bilecik, Bolu, Bursa, Düzce, Eskişehir, Istanbul (Asian side), Kocaeli, Kütahya, Sakarya, Yalova, Zonguldak
- **Western Anatolia:** Aydın, Balıkesir, Çanakkale, İzmir, Manisa, Muğla
- **Central Anatolia:** Aksaray, Ankara, Karaman, Kayseri, Kırıkkale, Kırşehir, Konya, Nevşehir, Niğde, Yozgat
- **Central Black Sea:** Amasya, Çankırı, Çorum, Giresun, Karabük, Kastamonu, Ordu, Samsun, Sinop, Sivas, Tokat, Trabzon

- **Eastern Anatolia:** Ağrı, Ardahan, Artvin, Bayburt, Bitlis, Erzincan, Erzurum, Gümüşhane, Hakkari, Iğdır, Kars, Muş, Rize, Van
- **Southeastern Anatolia:** Adıyaman, Batman, Bingöl, Diyarbakır, Elazığ, Gaziantep, Kahramanmaraş, Kilis, Malatya, Mardin, Siirt, Şanlıurfa, Şırnak, Tunceli
- **Eastern Mediterranean:** Adana, Hatay, Mersin, Osmaniye
- **Western Mediterranean:** Afyonkarahisar, Antalya, Burdur, Denizli, Isparta, Uşak

Cooling demand

The occurrence of peak demand at 2 p.m. during the summer months in recent years highlights the strong correlation between peak demand and temperature levels. To explore this relationship, the "Cooling Degree Days (CDD)" metric, widely accepted in international studies, was used to indicate the extent of cooling demand. Monthly CDD values were obtained from the General Directorate of Meteorology's "Heating and Cooling Degree Days" webpage. Hourly values were gathered at the provincial level using the open-meteo "Historical Weather API."

When calculating CDD values at regional and national levels, rather than the provincial level, population-weighted averages were used. Provincial populations were sourced from the "Address-Based Population Registration System" data.

Acknowledgements

Links

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