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Despite being among the countries with the least sunshine hours, Germany is one of the largest solar power producers in the world. After leading the field for several years, the country ranked 5th globally in installed capacity in the International Renewable Energy Agency"s (IRENA) global ranking in 2021. At the end of 2023, the country boasted a capacity of about 61 gigawatts (GW), according to figures by solar PV industry group BSW Solar.

In contrast to conventional energy systems focused on big and centralised producers, tens of thousands of small solar panel operators have become an important part of the German energy system. In 2023, all solar PV operators together produced about 12 percent of the country"s net power consumption, contributing to a total renewable power share of 52 percent. Solar power"s global share in power generation stood at about 4.5 percent in 2022, according to the International Energy Agency (IEA).

Solar arrays can contribute a much greater share to the German power mix during particularly sunny times. On 7 July 2023, solar power reached its highest output ever in Germany so far, providing 68 percent of the entire electricity mix at about noon, when both sun intensity and usually also power consumption are at peak levels. Throughout June 2023, solar PV had an output of 9 terawatt hours (TWh), according to research institute Fraunhofer ISE. The total output in that year was 61 TWh.

The high output, both in the short-term around midday and in the long-term during summer, is offset by a reciprocally lower or non-existent output during the winter and at night, respectively, highlighting the need for reliable storage technology to complement renewables expansion. However, sunny weather and hot temperatures are not automatically leading to higher solar power output, as solar modules lose electric tension when they become hot, which brings down their capacity despite the stronger radiation.

Fraunhofer ISE says solar panels achieve up to 980 full load hours per year in Germany, meaing about ten percent of the year - or less than half of the amount that wind power can deliver. The researchers estimate that 1,030 full load hours are possible in the country. However, this is still far below the nearly 6,600 full load hours that lignite plants ran in 2016.

Adding more capacity also acts as a check against oscillating solar power production levels due to weather effects. Despite experiencing a comparatively cloudy summer but thanks to capacity expansion, solar PV installations between January and August 2021 generated roughly the same amount as in the much sunnier previous year.

The large-scale roll-out of solar power installations began around the year 2000 and peaked for a first time in 2012, with annual additions reaching more than 7 gigawatts (GW). Expansion then fell of a cliff, reaching less than 2 GW between 2015 and 2017, but since has steadily increased again. In 2023, the buildout exceeded

government plans significantly, with added capacity reaching more than 14 GW instead of the scheduled 9 GW, almost twice as much as in the year before, according to Fraunhofer ISE data.

As a key component of the country"s push for greater energy independence following Russia"s invasion of Ukraine, interest in the technology grew rapidly. In April 2022, the government released its "Easter Package" of renewable energy policy reforms. It aims for a share of renewables in electricity production of 80 percent in 2030 and 100 percent in 2035, which means average annual expansion volumes must exceed 20 GW to reach the target of 215 GW installed capacity by the end of the decade.

Industry groups generally have lauded the efforts that the government of chancellor Olaf Scholz has taken to accelerate solar PV expansion since taking office in late 2021. A sustained high investor interest in the technology backs this assessment: In the last ground-mounted solar PV auction of 2023, the volume of bids (5.5 GW) by far exceeded auctioned capacity (1.6 GW), the Federal Network Agency (BNetzA) said

However, business confidence in the sector has steadily increased in the past years and was further bolstered by the government"s 2022 announcement to aim for 100 percent renewables in the power system by 2035. As of 2021, the solar power industry employed about 58,500 people in the country, according to data by Germany"s Federal Environment Agency (UBA). In 2023, lobby group BSW Solar said it expects a "lasting solar boom" in the country. However, a shortage of skilled labour for installing panels and several other factors could still hamper a quick growth of solar power.