Solar exports from China increase by a third

Exports of solar panels from China increased by 34% in the first half of 2023 compared to the same period last year.

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About

This report analyses Chinese customs data on exports of solar modules–also called solar panels–in the first half of 2023.

It accompanies an open dataset that will be updated monthly by Ember to track the capacity of solar modules exported from China to the rest of the world.

Executive Summary

Solar boom continues

The growth in solar exports from China is helping to meet growing demand for clean, affordable power, driven by markets like Europe and South Africa that are aiming to increase energy security.

Solar power is expected to be the largest source of electricity capacity by 2027 and will be key to rapidly reducing emissions across the power sector. Pathways aligned with limiting global heating to 1.5 degrees require a tripling of renewable capacity by 2030, in which solar is expected to play the largest role.

China has at least 80% of the global market share in solar manufacturing capacity, making Chinese exports an important dataset for tracking the clean energy transition.

01 China's solar exports rise

In the first half of 2023, exports of solar panels from China grew by 34%, with 114 GW shipped worldwide, compared to 85 GW in the same period last year. This is equivalent to the total installed solar panel capacity of the United States (113 GW).

02 Exports satisfy a surge in demand from Europe

More than half of the solar modules exported from China in the first half of 2023 were destined for Europe (58%). The region has also seen the greatest absolute growth worldwide, with exports of solar panels from China to Europe up 47% year-on-year. 66 GW were shipped to Europe in the first half of 2023, up from 44 GW in the same period last year. Brazil is the next biggest importer after Europe, receiving 9.5 GW of Chinese solar panel exports in the first six months of 2023, almost unchanged from the previous year.

03 Africa sees the fastest growth

Africa was the region with the largest percentage growth (+187%), driven by large increases in South Africa, with the country importing 3.4 GW (up from 0.6 GW in H1-2022) as governments and citizens turned to rooftop solar as a way out of their energy crises. After Africa, the region with the next fastest relative growth was the Middle East, up 64% (+2.4 GW) in the first half of 2023 compared to the same period last year.

Based on Chinese export data, 2023 should see another big step up in installed solar capacity worldwide. However, the gap between module exports and installed capacity is growing, with significant stocks of modules sitting in warehouses. Concerted policy effort is needed to ensure that the installation and integration of solar PV can keep pace with module supply and match the acceleration needed for the tripling of renewable energy capacity by 2030.

"Solar growth is going through the roof. The world is racing to harness this cheap, clean and abundant source of energy to power the future economy.

It is clear that global manufacturing capacity is currently not the limiting factor to achieving the required fivefold growth in solar power by 2030.

We have enough solar panels, we just need to get busy installing them. Policies should focus on ensuring installation and grid integration can ramp up as fast as global module supply."

Sam Hawkins
Data Lead, Ember

Analysis

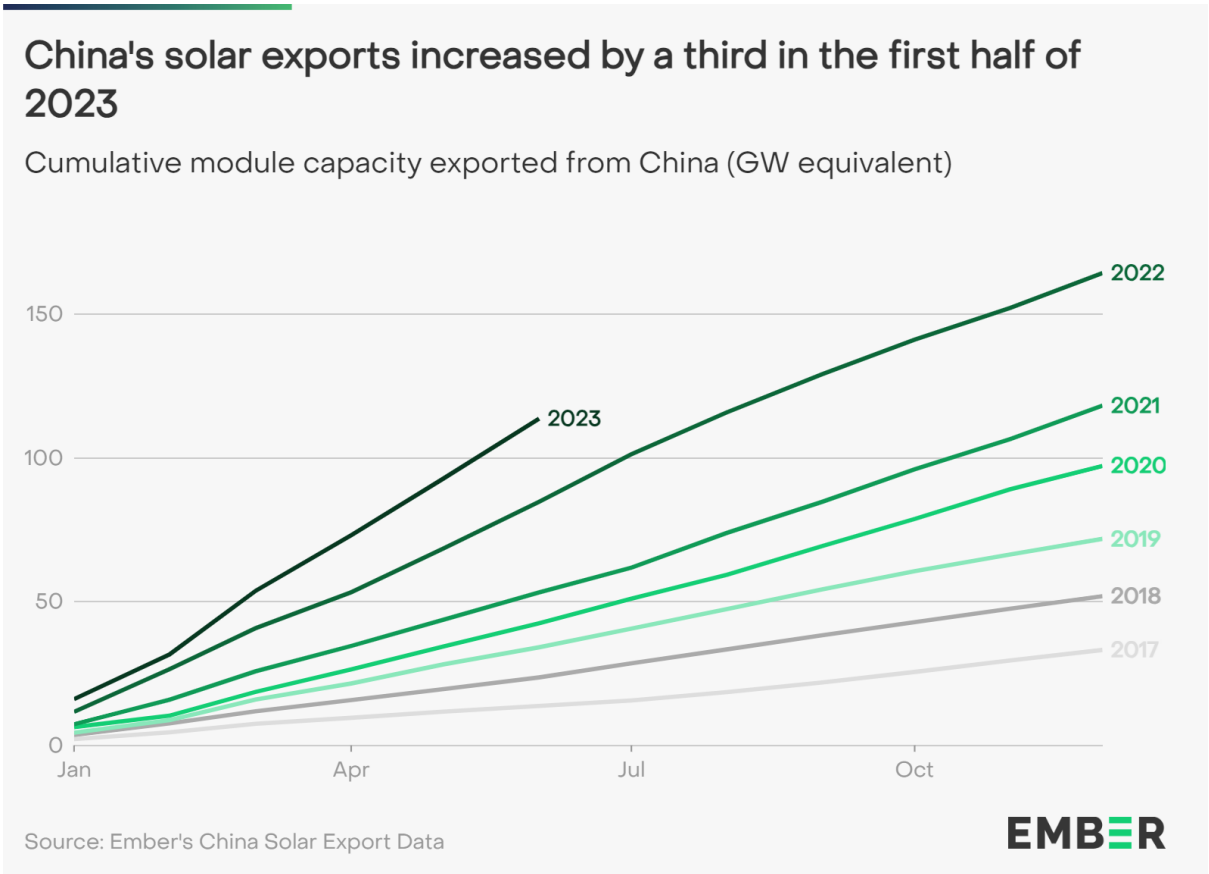
A 34% increase in China’s solar panel exports meets growing global demand

Exports of solar panels from China grew by 34% in the first half of 2023, with the fastest growth in Europe and Africa.

China’s module exports increase by a third

Exports of solar modules from China to the rest of the world have increased 34% year-on-year, growing from 85 GW in the first half of 2022 to 114 GW in the same period this year, which is almost as much as the total exported over the whole of 2021. This amount of solar panels would generate enough electricity to power Sweden and is equivalent to the total installed solar panel capacity of the United States (113 GW).

China currently produces around eight out of every ten solar panels, and the growth in Chinese exports has global implications for the scale-up of clean power.



Half of China’s solar exports shipped to Europe

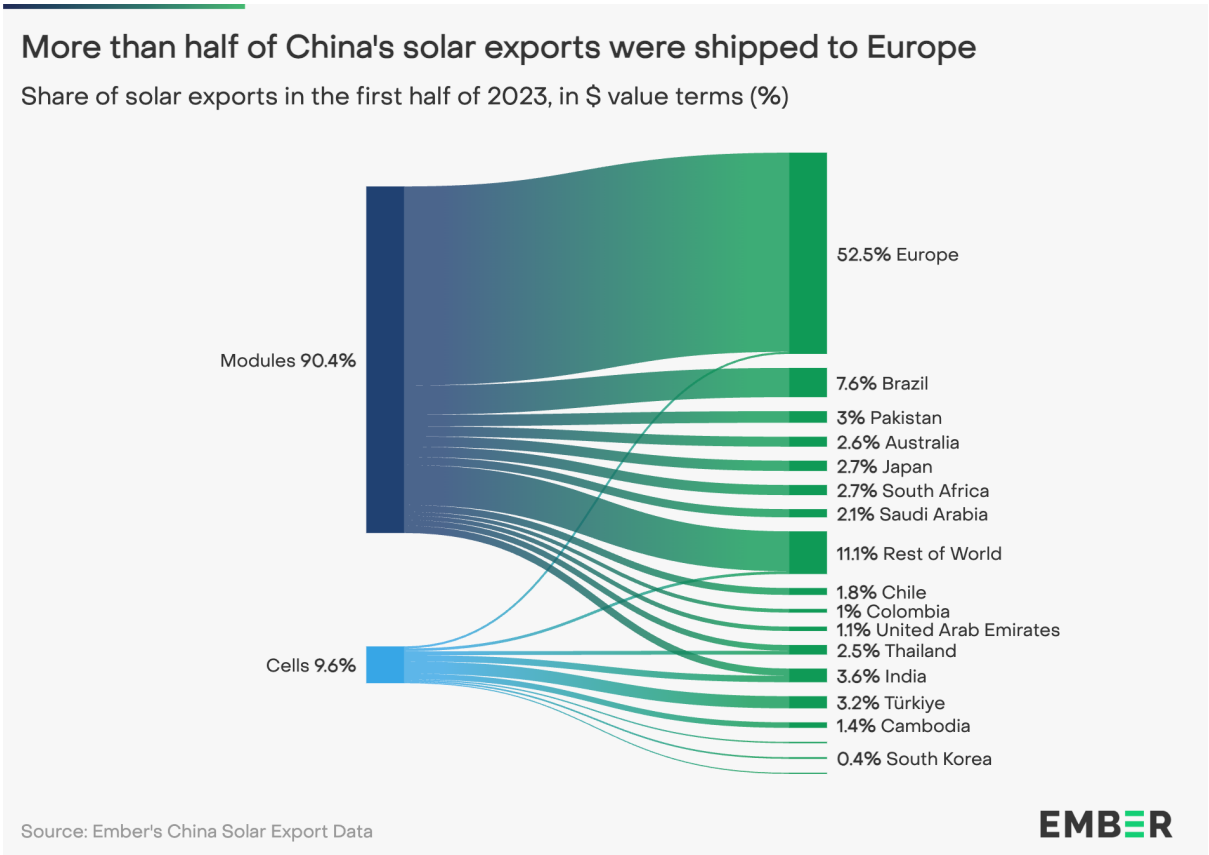
The data reveals that Europe accounted for 52.5% of the value of China’s solar exports in the first half of 2023.

Solar modules, which are fully assembled solar panels, accounted for 90% ($23.8 bn) of China’s total solar exports by value in the first half of 2023. Over the last 12 months, China exported 111 GW of solar modules to Europe, the same amount as the total installed PV

capacity of the United States. With a total over the last 12 months of 19 GW, Brazil is the largest single destination for China's solar module exports outside of Europe.

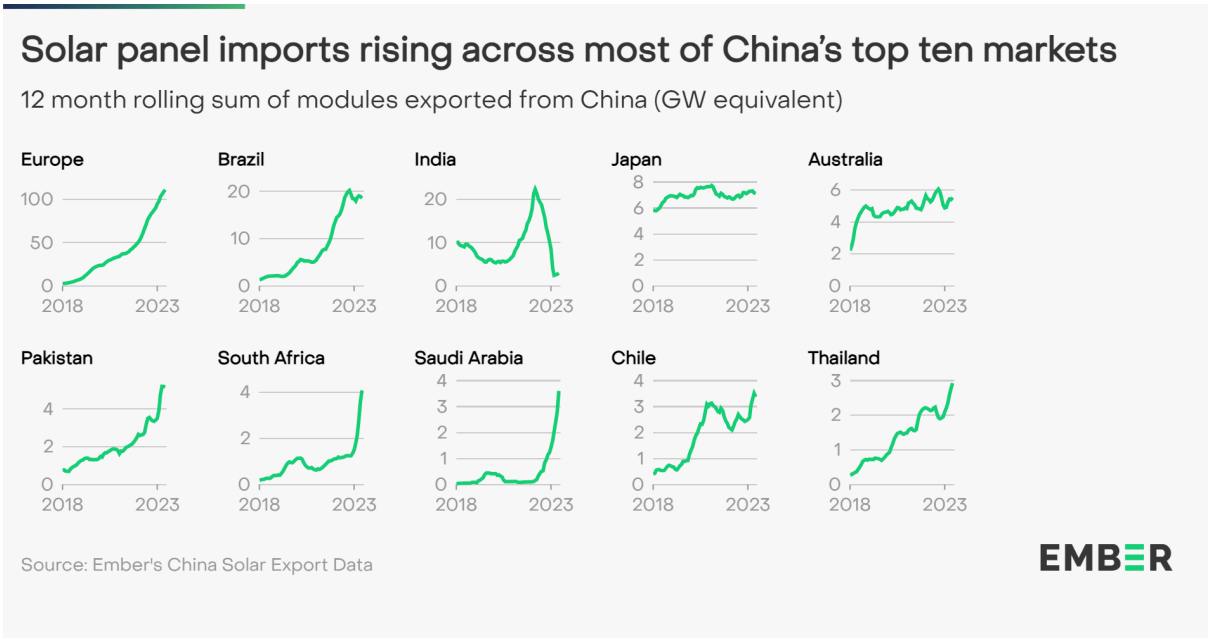
Solar cells, which are unassembled parts that make up solar panels, made up the remaining 10% of China's solar exports by value ($2.5 bn). The main export destinations for solar cells were Türkiye (33%), India (17%), Cambodia (15%), Thailand (10%) and South Korea (4%).

The remainder of the report analyses exports of assembled modules only.



Europe and Africa see the greatest growth

Europe saw the largest absolute growth in solar panels imported from China in the first half of 2023 compared to the previous year, while Africa saw the largest percentage growth, driven by large increases in South Africa. Many parts of Asia, Latin America and the Middle East also saw significant growth.

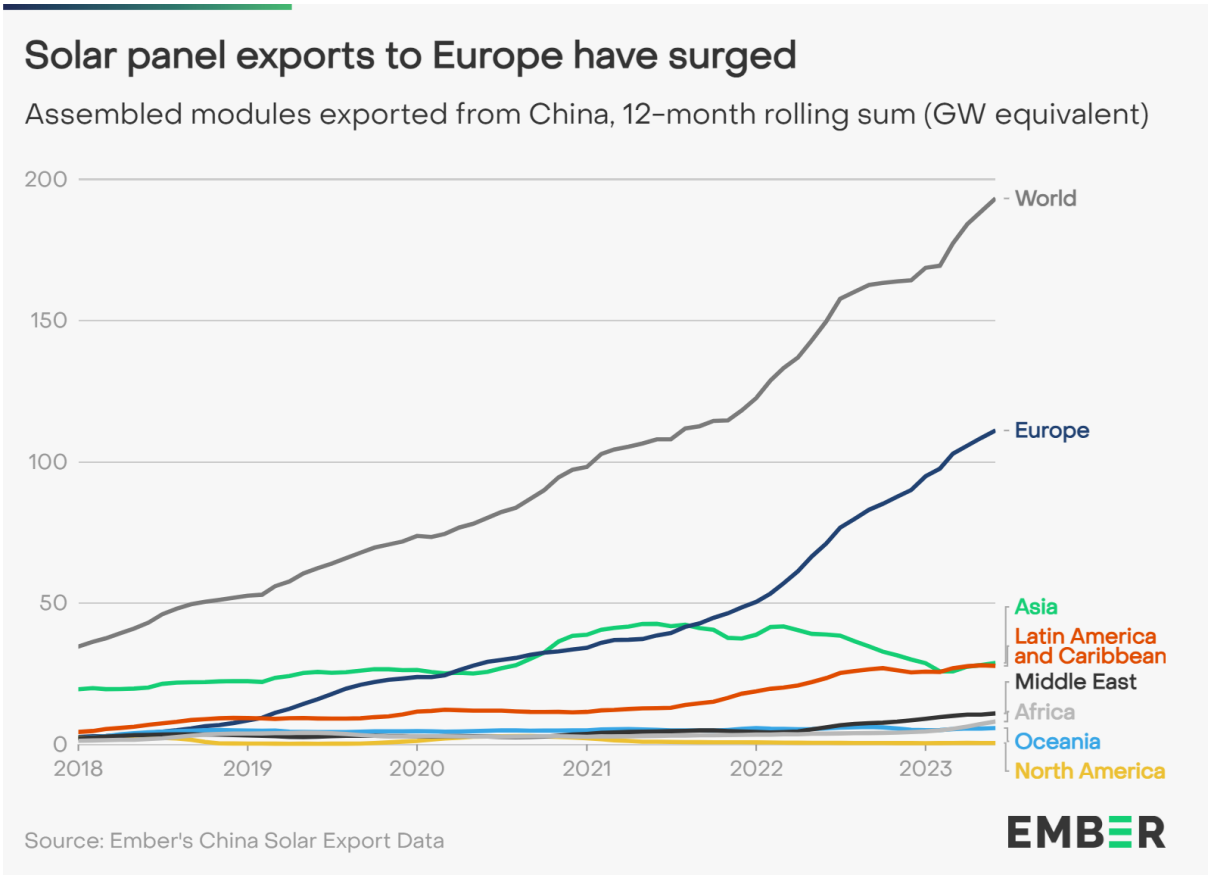


Europe

Growth is concentrated in Europe, where imports of solar panels from China are up 47% (+21 GW), from 44 GW in the first half of 2022 to 66 GW in the same period this year. Once installed, this new capacity could provide around 2% of Europe's annual electricity demand, similar to the annual demand of Belgium, supporting the region's goals to increase energy independence.

However, stockpiles grew, with an estimated 40 GW of solar panels currently in warehouses within Europe, underlining the bottlenecks in installing and connecting solar panels.

Note: It is not possible to confirm from the export data which countries within Europe are receiving these panels since the majority are shipped to the Netherlands, which is a major import hub rather than the final destination for large volumes of solar panels. A number of countries within Europe have seen record additions of solar capacity in the first half of 2023.



Africa

Outside of Europe, South Africa was the country with the largest absolute increase in imported solar panels from China. Module exports to South Africa saw rapid growth in 2023, with 3.4 GW exported to the country in the first six months of 2023, an increase of 438% (+2.7 GW) compared to the same period last year (0.6 GW).

Frequent load-shedding has led citizens in South Africa to turn to rooftop solar, accelerated by the introduction of short-term tax incentives. In the last 12 months, South Africa imported

4 GW of solar panels from China, which would generate electricity equivalent to around 3% of its annual demand.

Mostly due to South Africa's growth, Africa's solar imports from China were up 187% (+3.7 GW) year-on-year. As a result, it was the region with the fastest percentage growth in 2023 so far and the second-largest absolute growth after Europe.

Middle East

After Africa, the Middle East was the region with the next fastest relative growth, with solar panel exports from China up 64% (+2.4 GW) in the first half of 2023 compared to the same period last year.

Solar panel exports from China to Saudi Arabia grew more than sixfold from a low base in 2022 (0.4 GW) to reach 2.8 GW in the first half of 2023, driven by large-scale projects. Module exports from China over the last 12 months now stand at 3.6 GW, and would generate 2% of Saudi Arabia's annual electricity demand. Rapid growth in capacity must be maintained if solar PV is to do the heavy lifting for the country's target 50% share of renewables by 2030.

The growth in solar panels exported from China to the United Arab Emirates is also notable. Exports increased by 33% to 1.4 GW in the first half of 2023 compared to 1.1 GW in the same period last year, and the total over the past 12 months was 4.1 GW, equivalent to around 4% of annual electricity demand. This is broadly in line with solar PV meeting most of the country's target of 30% clean power by 2030, but there is still room to increase ambition, given the growth rates achieved in other countries.

Asia Pacific

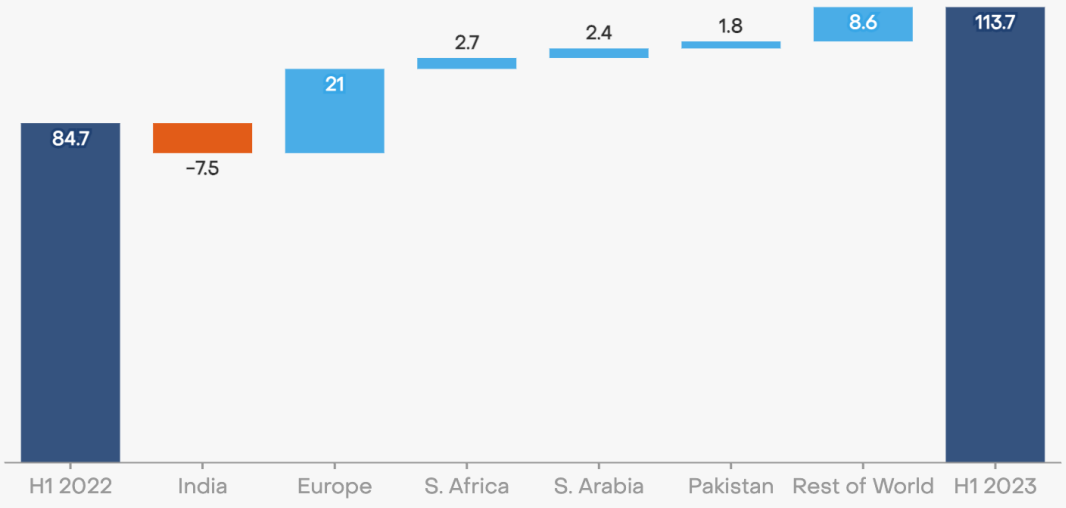
The only region to see fewer imports from China over the first half of 2023 compared to the previous year was Asia, as India turned to focus on growing domestic manufacturing capacity. However, Pakistan is a notable exception, with rapid growth in imports in 2023 so far. Many other importers remained steady, such as Australia and Japan.

Pakistan saw a rapid rise in 2023, with 3.8 GW exported to the country in the first six months of 2023, an increase of 86% (+1.8 GW) compared to the same period last year. Power prices remain very high with frequent load shedding, and sales taxes on solar modules were removed in 2022 to encourage uptake. It is not yet clear whether these imports will translate into installations within the country: if they do, it will have a significant effect on the generation mix. The total capacity of panels exported to Pakistan over the last 12 months is 5.2 GW, which would generate the equivalent of 5% of Pakistan's annual electricity demand.

India was the only country to see a large fall in imports from China. Module exports to India declined by 76% (-7.5 GW) year-on-year, down from 9.8 GW in the first half of 2022 to 2.3 GW in the same period this year. This followed the imposition of tariffs as India shifts away from imports to focus on building and utilising domestic manufacturing capacity. India's domestic solar module manufacturing capacity has stepped up. There has also been a rise in the number of Chinese cells, which are then assembled locally into solar panels, with India now the second largest destination for exported solar cells after Türkiye.

India bucks the trend as it prioritises domestic solar manufacturing

Solar PV modules shipped from China, Jan–Jun and the five destinations which contributed most to the change (GW equivalent)



Source: Ember's China Solar Export Data

Latin America

Latin America is just behind Asia as the third-largest export market for Chinese solar panels. It has a growing appetite for solar panels from China, with imports up 18% (+2.3 GW) in the first half of 2023 compared to the same period last year.

Exports to Brazil–the second largest market after Europe–were steady, with 9.5 GW imported in the first half of 2023 compared to 9.4 GW in the same period last year. Over the last 12 months, Brazil has imported 18.6 GW of panels, which would generate electricity equivalent to 4% of the country's annual demand.

In the region, Chile and Colombia are seeing the most rapid growth. Exports to Chile increased by 70% (+0.9 GW) from 1.3 GW in the first six months of 2022 to 2.2 GW in the same period this year. Over the past 12 months, exports to Chile totalled 3.4 GW, which would generate electricity equivalent to 6% of the country's electricity demand. Exports to Colombia also saw rapid growth, from 0.5 GW in the first half of 2022, to 1.2 GW in the same period this year, an increase of 135% (+0.7 GW). Over the last 12 months, exports to Colombia totalled 2 GW, which would generate electricity equivalent to around 3.5% of the country's electricity demand.

Manufacturing capacity steps up

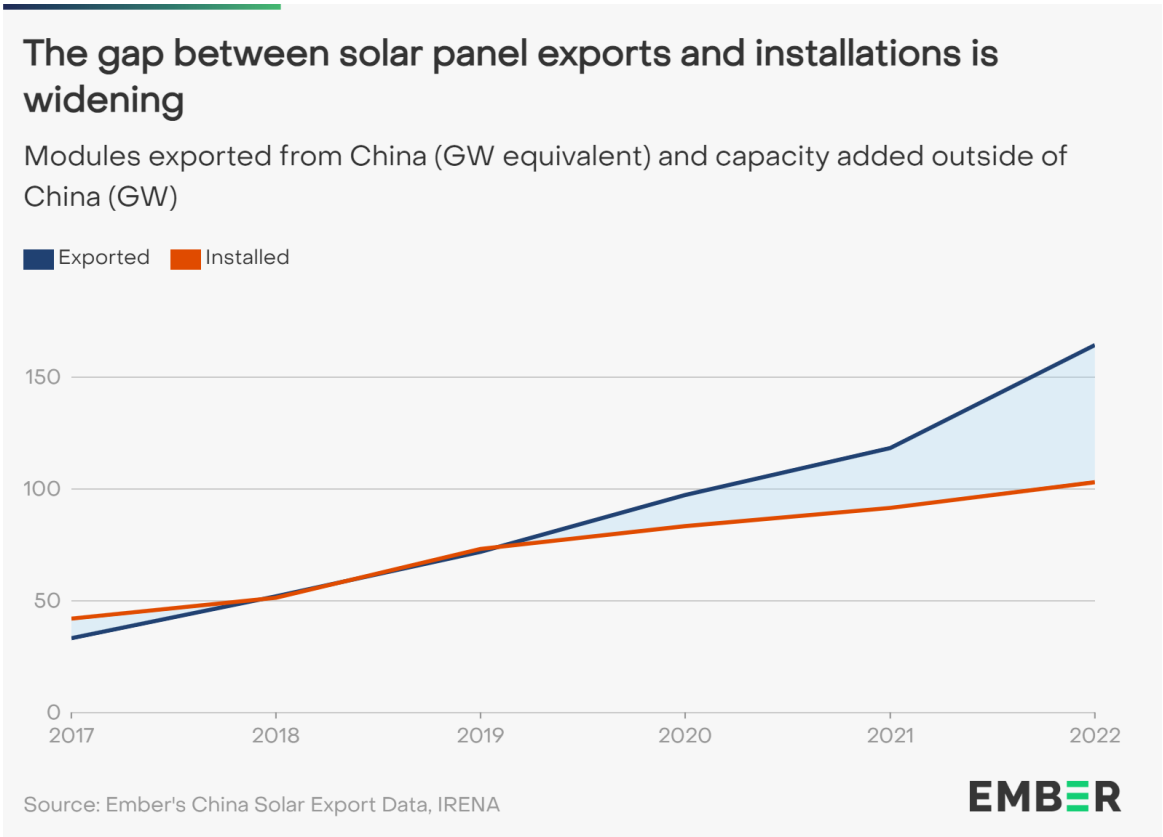
In 2022, global solar PV manufacturing capacity increased by over 70% to reach almost 450 GW, according to the IEA. Global solar PV manufacturing capacity is expected to double again and reach almost 1000 GW capacity per year in 2024. Most of the growth is still in China, although 70 GW/year of capacity will come online spread across the United States, Europe, India and other countries in Asia.

China's solar manufacturing capacity is expected to almost double in the next year, from 504 GW/year at the end of 2022 to 931 GW/year at the end of 2023. Europe is aiming for 30 GW/year of manufacturing capacity by 2025. In the United States, the Inflation Reduction Act has spurred investments of 85 GW/year of solar panel manufacturing capacity. India aims to increase manufacturing capacity to 110 GW/year by 2026.

A 1.5 degree aligned pathway requires a tripling of renewable capacity by 2030, which is already possible to achieve with 1000 GW/year of supply expected by 2024. It is clear that global manufacturing capacity is currently not the limiting factor.

However, the gap between solar module exports and installed PV capacity is widening.

In part, this gap may reflect an underestimation of installed rooftop capacity, or lags in collecting accurate numbers for total installed capacity. Yet it also clearly reflects a build-up of module stocks in warehouses as a result of the challenges of accelerating solar installation and grid integration.



Conclusion

Solar is booming

Global solar manufacturing capacity is not a barrier to the fivefold increase in solar deployment needed for 1.5C pathways, and policies must now focus on removing bottlenecks to installation.

Solar demand in 2023 is booming: the latest data shows there may be 50% more installed in 2023 than there was in 2022. And there is enough global manufacturing capacity coming online to make sure that it can continue to do so.

Nowhere is this more true than in China. There were 154% more solar panels installed in the first half of 2023, compared to the same period in 2022. By comparison, China's solar panel exports rose 34% in the same period. China's solar manufacturing capacity is expected to almost double in the next year. This has resulted in a large reduction in the price of solar panels, which have fallen by 25% since the start of the year.

Imports of Chinese solar panels will continue to be important to the global electricity transition in the short term. Much of Europe's demand for solar power is being met by China, but this reliance will be reduced as the region increases manufacturing capacity. The US has already cut Chinese imports to near-zero, and the Inflation Reduction Act has spurred investments in solar panel manufacturing capacity. India has relaxed its import duty to partly resume Chinese solar imports, whilst increasing manufacturing capacity to become self-sufficient.

But there are signs that deployment is not keeping pace with supply of solar panels, with an increase in imported solar panels left in warehouses, which is especially visible in Europe. This is caused by installation delays arising from skills shortages, permitting and grid integration. This is holding back the transition, and creating 'pent-up' demand.

In order to put the world on track for 1.5 degrees, global renewable capacity will need to triple by 2030. There will be enough supply of solar panels to make sure this happens. Government policies need to focus on how to maximise deployment, to make sure the pent-up demand for solar is unleashed.

Supporting Materials

Methodology

Summary

We have taken Chinese customs data of solar module exports by country by month, and converted the value in dollars into a megawatt capacity, using a monthly solar module spot price.

Export Data

Ember's China solar export dataset provides the following information:

- Export amount in weight (kg)
- Export amount in US dollars (USD)
- Export amount in quantity (number of items)
- Average photovoltaic module price (USD)
- Calculated capacity (MW)

Data is sourced from the General Administration of Customs of the People's Republic of China (GACC):

- Data is available from 2017 to present.
- Prior to 2022, assembled and non-assembled cells were not disaggregated into separate commodity codes.
- Prior to 2022, the commodity code used is 85414020 (Solar cells).
- From 2022 and onwards, the commodity code used is 85414300 (Photovoltaic cells assembled in modules or made up into panels).
- From 2022 and onwards the code 85414200 (Photovoltaic cells **not** assembled in modules or made up into panels) is excluded from this dataset. In 2022, unassembled modules accounted for 8.7% of total photovoltaic cell exports by value.

Module Price

Average monthly PV module prices are sourced from InfoLink Consulting Group. For this dataset, only the overseas market price for assembled modules is used. All prices published for a given month are averaged, and prices are interpolated for missing months. The monthly PV module price is included in the data download.

Capacity Calculation

The capacity (MW) of the solar exports in this dataset is not reported by GACC. We calculate capacity from the export value in US dollars (from the raw GACC customs data) and the average monthly PV module prices described above.

This capacity value is indicative - in reality modules will be traded at different prices depending on the destination, the module technology etc. It is a useful metric to compare trends over time and between countries but it should not be taken as exact.

Release Schedule

GACC releases the monthly solar export data with a one month lag (except for January and February data, which are released together in March).

The GACC release is usually available on the 20th of the month, and this dataset is updated shortly afterwards.

Caveats

GACC data records the first country solar cells and modules are exported to, which may not be the final destination. This is particularly evident for exports to the Netherlands which is a major import hub for European countries. For example, in 2022, 44 GW of solar modules were exported to the Netherlands compared to an estimated 4GW of new solar capacity installed within the Netherlands. The same may be true for other countries acting as import hubs for neighbouring countries, and country data should be used with caution.

Acknowledgements

Cover photo

Workers produce solar photovoltaic modules for export on the production line of a new energy workshop in Haian, Jiangsu province, China.

Credit: Sipa US / Alamy Stock Photo