

Solar installs erupt as Polysilicon price peaks US falters on anti-dumping, IRA adjustments 222 GW solar installed this year, but 330 GW was made

Quarterly Solar Capacity Statistics





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Energy

ReTHINK



Introduction

In Q3 the world installed 54 GW of new solar capacity, which is a 37.8% year-

on-year increase. 142.5 GW was installed in the first nine months of the year, almost at par with full-year 2021. We predict that 222 GW will be installed in the entire year, with a year-on-year growth rate of 35%.

So far this year China is by far the most rapidly growing region, partly because its installations are becoming less skewed into Q4. European growth is very strong at 46%, a growth rate it will double and triple down on through 2023 and 2024, while the US declined thanks to self-inflicted trade disruptions.



Year-on-year solar installations growth rate, first nine months of 2022, by region







Since 2019, Poland has dramatically risen by nine slots in the rankings of the twenty national markets which we track, from sixteenth place just ahead of the

UK, to seventh place ahead of the Netherlands, Spain, and Australia. The other big winner is Brazil, up six slots from 10th place to become the 4th biggest market in the world ahead of Germany and Japan. Meanwhile Mexico fell from 11th place to 20th, while Turkey and South Korea fell four spots with stagnant deployments.



	MW installed first 9	year-thus-far
	months of 2022	growth rate
CHINA	52,079	94.90%
US	15,409	-1.50%
INDIA	11,468	30.20%
BRAZIL	6,542	108.20%
GERMANY	5,340	45.50%
JAPAN	5,000	-10.70%
POLAND	3,391	44.70%
NETHERLANDS	2,951	25.60%
SPAIN	2,872	36.90%
AUSTRALIA	2,303	-11.50%
SOUTH KOREA	2,195	-20.80%
FRANCE	1,697	-16.20%
ITALY	1,640	116.60%
TAIWAN	1,457	23.00%
PORTUGAL	1,413	437.30%
CHILE	1,400	-38.70%
VIETNAM	1,230	-40.00%
TURKEY	1,146	32.20%
UNITED KING- DOM	970	132.60%
MEXICO	628	-44.20%





China

China's 'whole county promotion' policy of building several hundred MW apiece across hundreds of municipalities has seen its installations spread more evenly across the year, with more than twice the Q2 and Q3 figures for 2022 than in 2021. The 52 GW installed in nine months is almost equal to the full-year figure of 54.88 GW for 2021.

Having said that, China is also seeing the first of its 'desert base project' utility complexes commissioned this year, many of them in Q4, and so we expect China to build an unprecedented 42 GW in the last quarter, taking its annual total to 94 GW – that's 42% of new global installations in the year.









At this point it's rather pointless to speak of the official national target of 1,200 GW new wind and solar which Chairman Xi Jinping announced for the decade from 2020 to 2030. China will soon be installing 200 GW combined wind and solar each year and will install more like 2,000 new GW, not 1,200 GW. There's a great many new targets being estab-



lished across China's thirty-three province-level administrative units, but they are too numerous to address here. The leading province for solar development is Shandong and it is pushing for 57 GW by 2025, serving a population of 100 million, including several GW of tidal-flat and offshore installations.





US

The shifting economics of domestic energy storage, electricity prices, and modules have seen US installs shift moderately towards rooftop so far this year, with 43.2% of the total, up considerably from 37.2% in 2020 and 31.7% in the first nine months of 2021.

Considering that domestic manufacturing is mostly used in utility-scale projects, the module import disruptions caused by the Department of Commerce anti-dumping and countervailing duties investigation will have prevented an even bigger shift towards the rooftop and residential sector. Even First Solar itself is working towards a Si-CdTe tandem module with Sunpower, for use in residential installations.









Thanks to the Department of Commerce and other interference such as the Withhold Release Order (WRO), US installations are down 1.5% compared to 2021 in the first nine months. But the full-year figure will likely be a slight in-

crease, and the IRA subsidies will see a major upswing next year.

The Department of Commerce recently published a draft decision in which four out of eight south-east Asian manufacturers were found to be circumventing, and thus placed under punitive tariffs, while the other four were found to be in the clear. Both groups had at least one major



manufacturer among them, and even losing half of this source of module imports is a serious problem for US solar demand, which could easily double or triple towards 80 GW a year. Both imports and the reshoring efforts for domestic manufacturing will be an ongoing drama for at least five years.





India

India has installed 11.5 GW so far this year, which like China is almost as

much as full-year 2021. And rather like the US, it has questions hanging over both its source of imported modules and its domestic production efforts.

As far as domestic manufacturing is concerned India appears to be doing very well, with multiple conglomerates taking an interest in polysilicon and wafer production capacity for the latter part of the decade, and an immediate ongoing



buildout of module and cell production capacity right now backed by billions of government spending.

For module imports however, the story may be different – India is now working through a stockpile of Chinese modules imported prior to the imposition of the Basic Customs Duty on cells and modules. It will be interesting to see how bumpy the transition is once that stockpile runs out.

India's nascent residential sector may reach over 3 GW in the next two quarters, at which point it may merit some dedicated coverage.

The other question mark over India's solar industry has been court challenges over payments from distribution companies to renewable generators, as well as the shoddy finances of those distributors. In India's federal system this has to be fought with state-by-state court cas-



es as well as significant attention from the Modi administration – on both sides the renewable side of things is gaining ground.



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Europe

Europe will install around 40 GW this year, up from around 26 GW last year. Some parts of its grids are now too congested to accelerate further – namely the Netherlands. But other European markets are still in the process of waking up, and high power prices look set to stay. One UK commercial-segment in-

stallation company we spoke to recently told us that their workforce, and the difficulty of finding new hires, had become their sole limiting factor. A massive hike in conventional power prices completely changes the financial viability of projects. We're also seeing the first utility-scale projects spring up in Finland and Sweden now.

After 40 GW this year, expect around 80 GW next year. That could be justified



on a case-by-case national basis or by looking at the below graph – the other reason is that Europe imported 74 GW of solar modules from China in the first 10 months of the year, and will probably finish the year with 85 GW imported.

It will be very unsurprising to see around 80 GW installed in 2023, and then 110 GW in 2024.





Latin America

For now we only track Brazil, Mexico and Chile specifically in Latin America – Colombia will be included in future but is a distant fourth. The story this year is that Mexico has stagnated with only a few hundred MW per quarter, Chile underperformed its 2021 showing, but both have been more than counterbal-anced by Brazil's continued growth, which looks exponential on a graph.

The country went from a little over 10 GW to a little over 20 GW in the past

four quarters, and is the fourth-biggest solar market behind only the US, China and India. Its market and regulatory framework is welcoming to foreign capital, supported also by the **Brazilian** National Development Bank. Projects below 5 MW will be eligible for Net Metering through to 2045. The explosion has been



fueled by subsidy and grid-connection-fee exemption deadlines, but as these come and go, the result won't be to reduce development, merely to decelerate its expansion.

Having said that, both Chile and Mexico have very considerable pipelines, with several utility-scale projects to be commissioned in Q4, so the commentary for the next quarterly update will have something different to say on these two. As a foretaste, government statistics show 6.4 GW of utility-scale operational in Mexico, with 2.25 GW under construction and 10 GW under development, all to be commissioned by Q1 2025. So Mexico's policies have certainly strangled solar development, but have not killed it off completely. There's 1.1 GW to be installed next year utility-scale, and you can add a similar number for rooftop.



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East Asian Periphery

Unfortunately there's little to say about Taiwan, Japan and South Korea – they are still constricted in terms of land availability, they have no big new policies in play, and they are less affected than Europe by the increased cost of fuels and energy. Japan has the highest electricity price of the three by far, but even so is only expected to stagnate at 6 GW per year through 2023 –



the new movement for renewables there right now is domestic energy storage to go with the country's many existing solar installations.



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Manufacturing and Trade

The polysilicon shortage is as tight as it's ever been, which makes it a useful angle from which to track global solar module manufacturing output. We still expect the polysilicon bottleneck to loosen from the start of 2023, with the first few percentage points of price decline in evidence right now in December 2022.

For now, a useful idea of total global solar manufacturing can be derived simply by tracking China's polysilicon production, adding 7,000 tons of monthly imports from the West, dividing by 2,650 to go from tons of polysilicon to GW of wafers (and cells/modules). Then add 10 GW for non-silicon (i.e. First Solar) product.

Before going further into the data, let's state the conclusion - around 320 GW of silicon PV modules will be manufactured this year. Add 10 GW of CdTe and CIGS, and you have 330 GW.

In 2021, 227 GW of wafers were manufactured, and it's looking like 2022's installations will come to 222 GW. We can therefore expect that 2023 will see the better part of 330 GW of new solar capacity installed worldwide.

If you find the 330 GW figure too much to believe, as this author almost does, then you may write off 15% if the supply chain performs poorly in last few months of 2022 (for example, with cell production technology updates interfering with the expansion of their demand for wafers on a short-term basis), and on the project end in 2023 there will also be some hurdles such as limited workforce for installations in some Western countries and some grids becoming congested. But that would still leave



us with 280 GW installed in 2023, a 27% year-on-year increase.





From January to November China manufactured 715,400 tons of polysilicon, and will likely produce 100,000 in December for a total of 815,000 tons, up from 505,000 tons last year and exceeding expectations of how fast the industry would be able to commission new facilities. Both years are supplemented by around 85,000 tons of imports from the west, so total polysilicon supply has gone from 600,000 to 900,000 tons.

In other words the solar manufacturing industry has increased output by over 50% year-on-year in its bottleneck, with the increase coming from a neardoubling of production capacity to 1.2 million tons by the end of the year.

Wafer thickness is gradually declining from the prior multi-year norm of $175\mu m$, with the current norm being $150\mu m$. The relationship between wafer thickness and polysilicon usage is non-linear, but the decline in grams per Watt is also aided by the latest incremental efficiency improvements. In 2021 the figure was already around 2.8 g/W, and this year it is around 2.65 g/W, with 2023 likely to be at 2.5 g/W.

July and August were a weak period for polysilicon production and for downstream supplies, but even these months were up almost 50% from January.

There's some delay in processing from polysilicon to wafer to cell to module, so we didn't use the 2022 supply figure of 900,000 to determine how many GW could be made – instead we took the period from December 2021 to November 2022 inclusive, so only 850,000 tons.







In the first eight months of the year China produced 206.5 GW of wafers, 183 GW of cells, and 167 GW of modules. The disparity is owed to the fact that almost all global wafer production capacity is in China, but there's some cell and considerable module capacity outside of the country, served by Chinese wafer and cell exports. So if 206.5 GW of wafers have already been manufactured in eight months – it's inevitable that the tally will come to over 300 GW for the year as a whole.



China's module exports, especial-

ly those to the EU, describe a parabola each year, as more product is used at home in China's own Q4 installations. China's export profits on solar modules more than doubled year-on-year to \$47.5 billion in the first ten months of the year, and its exports to Europe increased by 130% in the first months, to 74.7 GW. It's not hard to predict these figures increasing by another 50% in 2023.

Cost of polysilicon and 210mm solar modules Our previous predictions 350 about the polysilicon 300 210mm price (and therefore mod-250 Module Price ule price) falling in 2023 200 \$ per kW remain essentially un-150 100 changed. Polysilicon 50 Price - \$ per 5 0 kg (i.e. per 1.8 Jan-24 Apr-22 Jul-22 Jan-23 Apr-23 Jul-23 Oct-23 Oct-21 Jan-22 Oct-22 an-21 Apr-21 Jul-21 kW)





Every quarter Rethink counts up additions in all the major solar regions, and creates a new rolling summary document which shows us all "Where we are right now" in solar.

Most of the information comes from public government sources, solar interest groups and our own collection of publicized "Orders."

It's not rocket science, just hard work, but presenting this information quarterly gives us a chance to take stock and interpret how the world has reached this particular stage of solar penetration, and to see which countries are dominating.

This data is used to refresh Rethink Energy's core electricity model it's Annual Primary Electricity (APE) report, which models global electricity markets as they inflate through electrification.





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About Rethink Technology Research

Rethink is a thought leader in quadruple play, renewable energy, and 5G wireless. It offers consulting, advisory services, research papers, webinars, plus three weekly research services; Wireless Watch, a major influence among wireless operators and equipment makers; Faultline, which tracks disruption in the video ecosystem, and OTT video, Rethink Energy, which monitors investment opportunities in the changing energy landscape.



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