Saving European Solar Manufacturing

Call for Action to support Europe's nascent solar industry in times of oversupply and low prices

SolarPower Europe

Image © Enel Green Power

Executive Summary

The global solar PV sector has been marked by steep reductions in solar module prices in Europe in recent months. While this is welcome news for accelerating a cost-effective energy transition, it is also **creating an extremely precarious situation for European solar PV manufacturers.**

While declining costs is typically welcome news for accelerating a cost-effective energy transition, it is also **creating a deeply precarious situation for European solar PV manufacturers which were building up their manufacturing capacities encouraged by the broad political support for reshoring a European PV value chain.**

Since the start of the year, prices of PV modules have dropped by over 25% down to less than 0.15 EUR/W for low-cost products, now even submerging pre-Covid levels, making it extremely difficult for European manufacturing companies to sell their products. This is creating concrete risks for companies to go into insolvency as their significant stock will need to be devalued. We have already witnessed the ingot producer Norwegian Crystals filing for bankruptcy on 21 August 2023.

If no immediate action is taken, this situation will render the European ambition to create Open Strategic Autonomy, in key sectors like solar PV, extremely hard to reach.

The EU goal of reshoring 30 GW of the solar PV supply chain, as stated in the Net Zero Industry Act and adopted by the European Solar Industry Alliance, is at serious risk.

The recent decreases in solar PV module prices can be explained by a 'perfect storm' in the global solar PV sector. The combination of strong global demand signals during the pandemic (a demand-induced bullwhip effect) has led to new, large investment in solar PV supply chains with fierce competition between Chinese suppliers to gain market shares. This has resulted in large overcapacities across the value chain – thus leading to quickly dropping prices for silicon to modules, inverters and batteries. This is exacerbated by a slight, temporary, slowing down of the European solar market in Q3, compared to the energy crisis induced strong demand in 2022. The combined impacts of faster than expected power price decline, interest rate increases, and tightening bottlenecks around grid connections and project permitting all contributed to the slowing down of demand and were underestimated by wholesalers and developers ordering high quantities of PV equipment. Attached to this letter, please find a more detailed analysis of the market dynamics.

While these market dynamics are not unknown to global commodity markets, **the situation does require urgent action if EU leaders want to materialise the European Open Strategic Autonomy agenda and the rebirth of European solar manufacturing.**

SolarPower Europe, therefore, asks the European Commission and the Member States to take the following actions:

1. **Swift emergency acquisition of European PV manufacturer's module inventories.** This could be procured through an EU level special-purpose-vehicle, and/or by elaborating the Ukraine Facility for the green reconstruction of Ukraine. Such emergency measures are essential in the immediate term as the only effective way to tackle the issue of looming depreciation of inventories and ensure the survival of many European manufacturing companies;

2. **Set up a Solar Manufacturing Bank at EU level**, similar to the Hydrogen Bank under the Innovation Fund. Based on a system of two-sided competitive auctioning, the Bank will bring

together the cheapest European solar production projects with the highest willingness to pay from solar project developers backed up with a contract for difference from the state. Such Solar Manufacturing Bank can be set up in a matter of weeks and would give the much-needed short-term financial impetus in rebuilding solar supply chains in Europe;

3. **Address the inadequacies of the Temporary Transition and Crisis Framework (TCTF) for State Aid, in particular point 86** which is presented as a clause to allow for matching aid vis-à-vis Europe's global competitors, but does not adequately allow for aid for operational expenditure in compensation for structural energy cost disadvantages.

4. **Accelerate the adoption of the Net Zero Industry Act, including strong sustainability and resilience non-price criteria in specific auctions.** Member States should be allowed to set up 'resilience auctions', rewarding solar PV systems with the highest shares of production in the EU. This will secure a stable market for European manufacturers in the years to come, which is essential in that phase of industrial scaling-up;

5. **Advance the effects of the EU Forced Labour Regulation by backing the Solar Stewardship Initiative (SSI)**. The SSI, as a value chain assurance program, with third-party audits, ensures that companies can independently demonstrate commitment to upholding sustainability best practices in their production. With the support and recognition from the European Commission and national governments, we will see expedited market adoption of the SSI, enabling project developers to focus on the import of SSI-compliant PV modules, potentially creating an upward effect on PV module import prices;

6. **Enable collaboration between Member States programs** to support the build up of PV manufacturing value chains in Europe and ensure that significant pan-national clusters of PV manufacturing emerge. Only by leveraging the full market and technological ecosystem power of the EU will European Manufacturers become competitive players in the global PV market.

7. **Boost demand for solar PV in Europe.** This can be done in the short-term, for example, by landing a rooftop solar mandate as part of the ongoing European Building Performance Directive, or by pushing Member States to implement the December 2022 EU emergency regulation to accelerate renewable energy. EU leaders should also deal with inflationary effects that are currently delaying solar projects, for example by collaborating with the European Central Bank (ECB). Ultimately, the only structural way to deal with supply overcapacity is to boost demand. That is a win for all players in the solar industry, as well as for Europe's economic, security and climate goals.

Inaction will jeopardise the implementation of the Green Deal Industry Plan. Right now, we risk losing a key strategic industry in Europe, precisely at the moment when energy transition geo-politics require supply chain diversification, and a revival of the European solar manufacturing sector.

Introduction: European Solar Market Developments

The European solar sector is facing a dramatic situation in a year that will likely break another installation record.

Today, a trend of oversupply is felt all over the world, and while resulting price decreases are a key driver for solar deployment and the energy transition, European solar supply chain resilience is negatively impacted. Structural disadvantages such as higher energy prices, investment, and labor costs for European manufacturing leads to an uneven playing field. Since the start of the year, prices of PV modules have dropped by over 25% down to less than 0.15 EUR/W for low-cost products, now even submerging pre-Covid levels, making it extremely difficult for European manufacturing companies to sell their products. This is creating concrete risks for companies to go into insolvency as their significant stock will need to be devalued. We have already witnessed the ingot producer Norwegian Crystals filing for bankruptcy on 21 August 2023. Through this, the commission's aim to create a more resilient solar supply chain with 30 GW re-shored capacity by 2030 is jeopardized and a need for strong manufacturing support is revealed. In this report the reasons that led to the current situation are discussed, as well as the necessary policy measures to still meet the goal of 30 GW re-shored solar PV capacity by 2030.

Although European manufacturers are facing unprecedented challenges, solar development is rising significantly. 2023, global demand is expected to reach new heights, and is tending more towards the High Scenario of 402 GW of SolarPower Europe' Global Market Outlook 2023, but module manufacturing capacity is still set to strongly outweigh this mark growth. In 2023, the EU alone will see around 54 GW being installed according to the medium scenario of SolarPower Europe's Global Market Outlook, a 35% growth compared to last year[1]. The first months of the year have shown strong growth in a number of markets, in particular Germany, which installed nearly 8 GW between January and July, that's already more than added in 2022 in total. Other major European solar markets are facing difficulties, like Poland, after policy framework conditions worsened. In general, the European solar sector is facing a market environment governed by high interest rates, with economic sentiment and employment expectations on a downward trend[2]. It remains to be seen how much low-price modules will drive demand after installers have mostly deployed the large order backlog for solar systems stemming from the energy crises.

Over the past two years, the European solar market looked very different. Supply chain disruptions such as COVID-19 restrictions impacting Shanghai port accessibility, the Suez Canal blocking and the global computer chip shortage had resulted in severe product shortages, negatively impacting European solar (and other) companies' business. Not much later, Russia's illegal invasion of Ukraine triggered a global energy price crisis in 2022. The EU's response was to go bullish on solar as a fast, sustainable, and affordable means to lower energy prices, help in getting independent from Russian gas, and phase out fossil fuels in the long run. With Repower EU the European Commission created a first solar strategy acknowledging the huge potential of solar technology, setting more ambitious targets of 750 GWdc (600 GWac) by 2030, and defining the measures to reach that goal.

Consequentially, in 2022, in the EU around 40 GW was installed, up 45% from the 28 GW deployed in 2021. It could have been much more if a severe installer shortage had not limited deployment. The supply chain disruptions from China and the learnings from major EU member states' gas dependency on Russia changed the atmosphere of international trade. Previous just-in-time supply chain strategies

[1] SolarPower Europe: Global Market Outlook for Solar Power 2023 - 2027
[2] European Commission: Business and consumer survey results for August 2023

made room for strategic reserves. In solar, that meant distributors and large installers filled up their warehouses to be prepared for further growth.

In the meantime, the solar boom in China – the market doubled from a volume of around 48 GW in 2020, to 95 GW in 2022, and is estimated by Bloomberg NEF to grow to 209 GW in 2023 –, and bullish projections for long-term solar growth to a global annual TW-level market before 2030, has been triggering leading Chinese companies to expand dramatically while many new manufacturers entered the solar segment. Leading to unprecedented competition for European manufacturing.

The current state of European manufacturing

The current conditions undermine the rebirth of European solar manufacturing. The European solar boom, further encouraged by the broad political support for rebuilding a European PV value chain, has triggered several European PV manufacturers expand production capacities or newcomers to invest or looking for funding to build manufacturing capacities. The European Commission has created financing tools to support these efforts, such as the EU Innovation fund that has awarded several manufacturers. However, that was too little, too late. A first promising start-up manufacturer, Norwegian Crystals, filed for insolvency in August 2023. Only little later, in early September, Norsun announced to temporary suspend production until the end of the year as "the enormous number of low-priced Chinese modules has caused a large inventory build-up in Europe, and more than one year's uninstalled capacity is in stock, affecting the entire value chain." Both Norwegian companies were active in ingot/wafer manufacturing, a part of the solar module supply chain in which Europe has no other producers today. Norsun's managing director said, "We can only register that the price drop and the build-up of modules in stock are creating major challenges for European players in solar energy. The market is flooded with low-cost modules that no one in Europe can compete *with*."[3]

In December 2022, McKinsey reported Chinese produced modules hit a cost of 18.1 $c/W while European-produced modules rose above 24 $c/W[4]. Estimates showed that, with shipping costs, this would rise by 2.2 $c/W. The same data showed that, without any incentives, Chinese solar would still be only 3.6 $c/W more expensive. Nine months later, this data is long outdated as the price of polysilicon has plummeted, and additional capacity and production efficiency was reached. Today, low-cost modules hit the European spot market at around 15 $c/W (see Figure 5). It is unlikely that a scaled European solar manufacturing industry would even reach this low price point. More than ever markets show there are structural disadvantages European manufacturers must face. Shipping cost alone cannot make up for the price difference they cause.

Amongst others, the large cost difference is rooted in energy prices. Particularly early in the supply chain, production is energy intensive. Polysilicon and wafers account for over two-thirds of the energy consumption and mostly electricity is used in both processes. The more downstream in the supply chain, the less energy intensive and therefore, the lower the cost difference. Besides this, labor and material costs are significantly higher in Europe, whereas automation can be used to counter the labor cost disadvantage.

Also, investment costs are generally higher in Europe. A lack of policy support and provided stability, leads to high required returns on capital. The more capital intensive the segment of the supply chain, the truer this becomes. While module assembly lines can be as 'small' as 100MW, polysilicon factories

[3] Norsun press release 6 Sept. 2023
[4] McKinsey: Building a competitive solar-PV supply chain in Europe

undergo large economies of scale at higher capacity levels. Currently, economies of scale are hardly comparable to those reached in China.

Additionally, setting up polysilicon, ingot, wafer, or module capacity takes significantly more time in Europe than in China. Longer timelines lead to more uncertainties for investors and slower reactiveness. Not only permitting procedures and construction laws but also the expertise of manufacturing at large scale is not comparable in Europe. Today, several Chinese manufacturers have over a decade of experience in the industry.

Because of structural disadvantages and a lack of stability for investors, the revamping of a European solar manufacturing supply chain is not possible without industrial policy evening the playing field.

Analysis and outlook: Overcapacity and oversupply

While annual global installed capacity is set to reach unprecedented levels of up to around 400 GW in 2023, analysts expect Chinese module manufacturing capacity to reach much higher levels of 955 GW by the end of this year[5].

• Booming solar leads to overcapacity

Through a combination of strong demand signals and fierce Chinese competition, solar PV manufacturing capacity has grown at a record rate over the past years. Enabled by booming demand and triggered by ambitious forecasts, successful IPOs and local funding, large expansion plans were made, ensuring a continuous expansion throughout the next years. The IEA estimates that global polysilicon capacity increased over 70% to 450 GW in 2022, while module manufacturing reached around 640 GW[6]; a number that analysts from Rystad Energy believe was even 720 GW that year. Chinese expansions are estimated to count for more than 95% of these expansions.

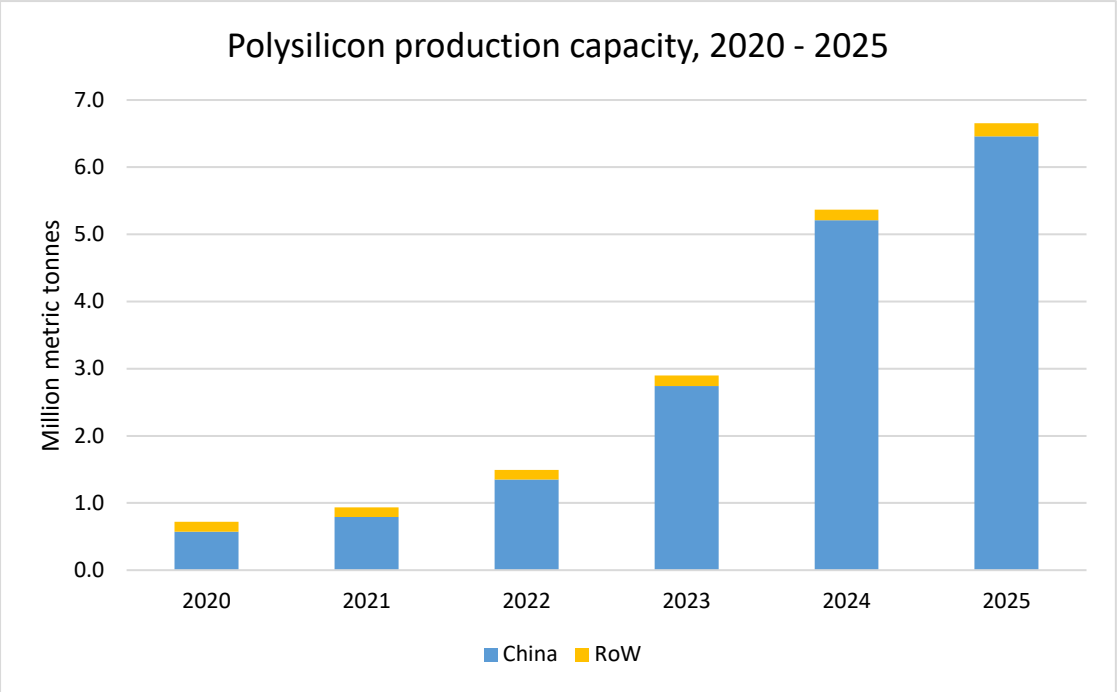
a. Overcapacity might stay for some time

Manufacturing capacity has been rising rapidly, with planned capacity significantly exceeding current demand forecasts. Unlike other industries, solar PV manufacturing is relatively easy to scale, leading to increased reactiveness on the manufacturers side. Well-experienced Chinese industry giants can rely on government support and relaxing policies to shorten factory set-up times significantly. While elsewhere around the world, the set-up of upstream PV production plants takes nearly half a decade, greenfield Chinese module plants can be built in 1 to 2 years. Additionally, a strong influx of private capital facilitated deep investments as well as high valuations for solar companies on Chinese stock markets. Besides international efforts to diversify the global supply chain, this faster reaction and positive investment environment in China has led to further industry concentration.

As such, Chinese polysilicon manufacturing capacity is set to more than double by the end of 2023, reaching around 2.7 million metric tons globally, which equals over 1 TW production capacity. (Figure 1).

[5] Rystad Energy
[6] IEA

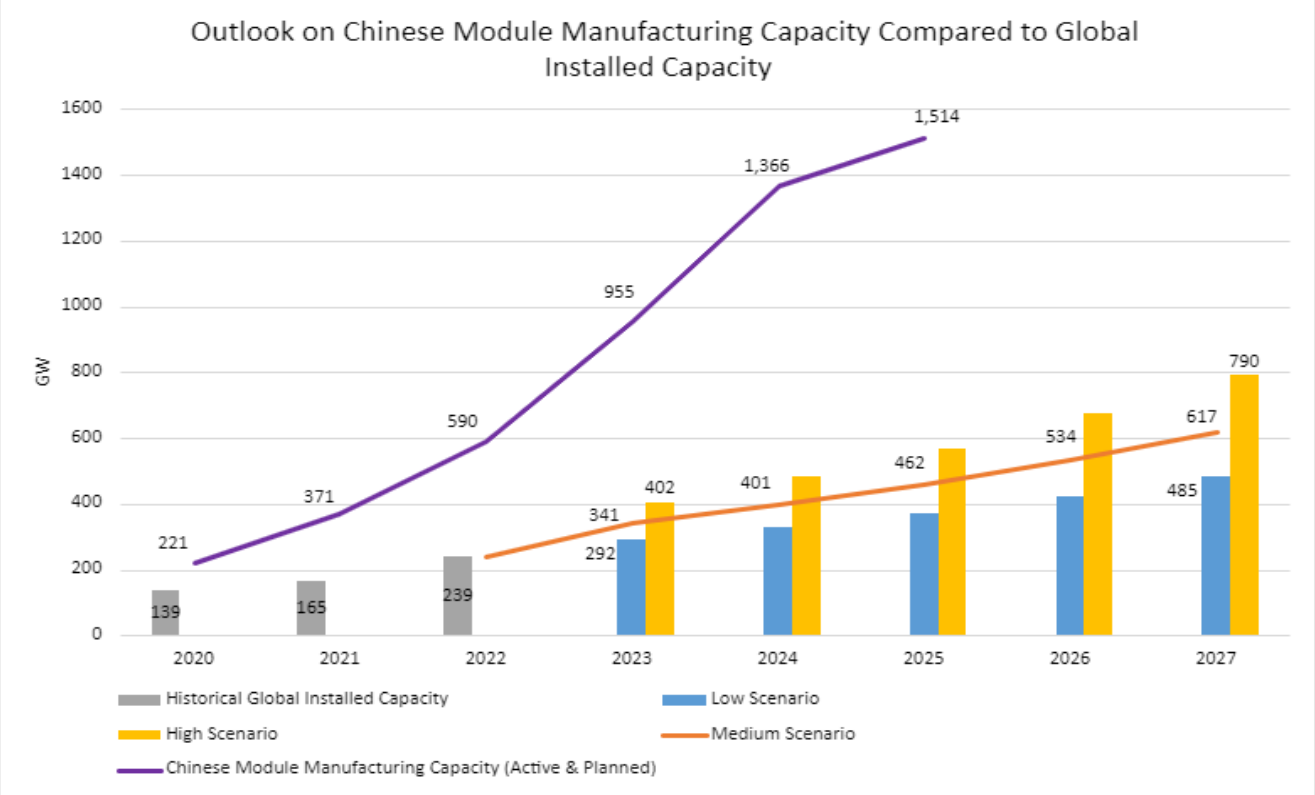
Figure 1



Source: Rystad Energy

Module plants require little time to set up, and the investment needed is the lowest among all production steps of the silicon module value chain - and therefore module production is more sensitive to demand signals than polysilicon capacity. The massive ramping up of upstream capacity has enabled further module production. While module manufacturing overcapacity is not new, recent growth forecasts showcase an increased degree of overcapacity. In 2022, Chinese module manufacturing capacity rose to 590 GW, more than twice as high as the global demand of that year (239 GW), according to Rystad. By end of 2023, this will rise to 955 GW, 2.8 times higher than the forecasted global demand. By end of 2025, Chinese module manufacturing is estimated to be more than triple that of the forecasted deployment of 462 GW, under SolarPower Europe's Medium Scenario (Figure 2).

Figure 2



Source: Rystad Energy & SolarPower Europe Global Market Outlook 2023-2027

b. Cause 1: Growing demand and ambition

The growth of the solar market has historically been underestimated. SolarPower Europe revised its forecast for 2023 upwards by 22% in 2021, only to revise it again with 14% in 2022, still 26% below the latest medium forecast (341 GW). Developers see booming demand and ambition has reached unprecedented levels as global forecasts were adjusted, making the solar very attractive for investors who want to be a part of the global energy transition. The IEA estimates investments in low-emission power will count for 90% of total global investments in electricity generation. Solar takes the lion's share with close to one billion euro per day in 2023 (USD 380 billion), reaching a level above upstream oil investments for the first time[7]. Accordingly, record manufacturing expansions were made.

c. Cause 2: Fierce Chinese competition

While the European solar market rose 45% to a level of 40 GW in 2022, China installed around 95 GW, a 72% annual growth. Bloomberg NEF forecasts estimate the Chinese annual solar market reaching over 200 GW already in 2023[8]. As a result of these (inter)national forecasts, the national industries' sentiment is bullish with new players entering the market. Consequently, Chinese competition has been fierce, forecasts are rounded up rather than down out of fear to lose market share. While this boosts both cost-effectiveness and technology advancement to new heights and leading to the faster devaluation of existing stock, creating pressure to sell, this pressure is met with increased trade barriers, in particular in the two other larger markets US and India. This includes import tariffs, anti-dumping and anti-circumvention measures, taxes, local content requirements, and a ban on forced labor products (UFLPA), leaving the European market as the main export area (56% of 2022 exports[9]).

[7] IEA: World Energy Investments 2023
[8] Bloomberg NEF
[9] Wood Mackenzie: China's solar exports booming, up 64% in 2022 despite global trade tensions

With insufficient demand to meet this growing supply, price levels have been plummeting and decreasing margins are taken.

d. Cause 3: Post lockdown market dynamics and a demand-induced bullwhip effect.

The post-lockdown market sentiment is different. Supply chain disruptions such as lockdown restrictions, the Suez Canal blocking and a global computer chip shortage have exposed vulnerabilities in globalized, just-in-time supply chain strategies. Additionally, Russian's illegal invasion of Ukraine changed revealed the crucial role of energy at the base of the economy. When analyzing manufacturing capacity created under these new market dynamics, a critical factor to consider is the bullwhip effect. This phenomenon occurs when sudden fluctuations in customer demand are amplified as they move up the supply chain. For solar PV manufacturing, this is especially true since manufacturing concentration typically amplifies volatility[10].

An analogy can be drawn with the biking industry under COVID-19 lockdown. During the global pandemic, bicycle popularity spiked due to restrictions on other sports and activities. Just like a solar PV system, a bicycle is a complex good, consisting of many parts that cannot easily be replaced, of which supply chains are highly concentrated in China, leading to a vulnerability that was exposed under COVID-19 lockdown restrictions. Retailers faced demands they could no longer meet. As a reaction, forecasts adapted and strategic reserves were ordered, leading to further backlogs on the distributor's side. The distributor, who saw strong demand increases, reacted similarly and increased forecasts with an additional strategic margin. Finally, manufacturers received orders that no longer matched realistic demand predictions. When the supply chain restriction was resolved, the backlog was cleared, leading to sudden oversupply and devaluation of stock.[11]

Similarly, in 2022, solar PV deployment rose by 45% while facing several bottlenecks throughout the value chain. Besides a lack of skilled labor and political rigidity on permitting, grid and land use; inverter, module and other material shortages led to pressure from the buyer's side. This pressure accumulated further under ambitious forecasts. When several bottlenecks were resolved, modules were shipped faster than they could be installed, lowering demand side pressure significantly. As upstream prices dropped simultaneously with module demand, the pressure to sell existing stocks led to the rapid decline of prices throughout 2023.

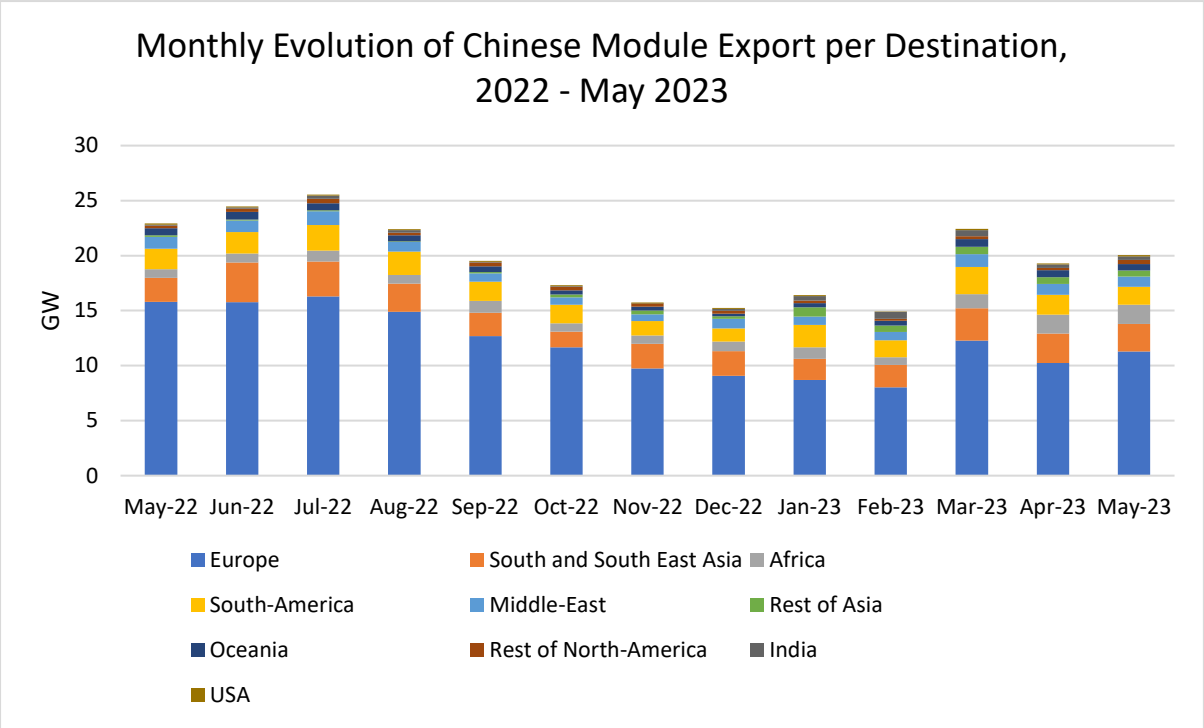
- Oversupply leads to rapid price drops

Exports to the European harbors far outweighed the installed capacity over 2022. As mentioned, the EU has installed 40 GW in 2022, while imports from China reached around 80 GW. Europe received more modules from abroad than any other region (Figure 3). In the first half of 2023, oversupply continued, leading to further stockpiling.

[10] OECD: Global value chains: Efficiency and risks in the context of COVID-19

[11] Bloomberg: Can E-Bikes Rescue the Covid Bicycle Boom?

Figure 3

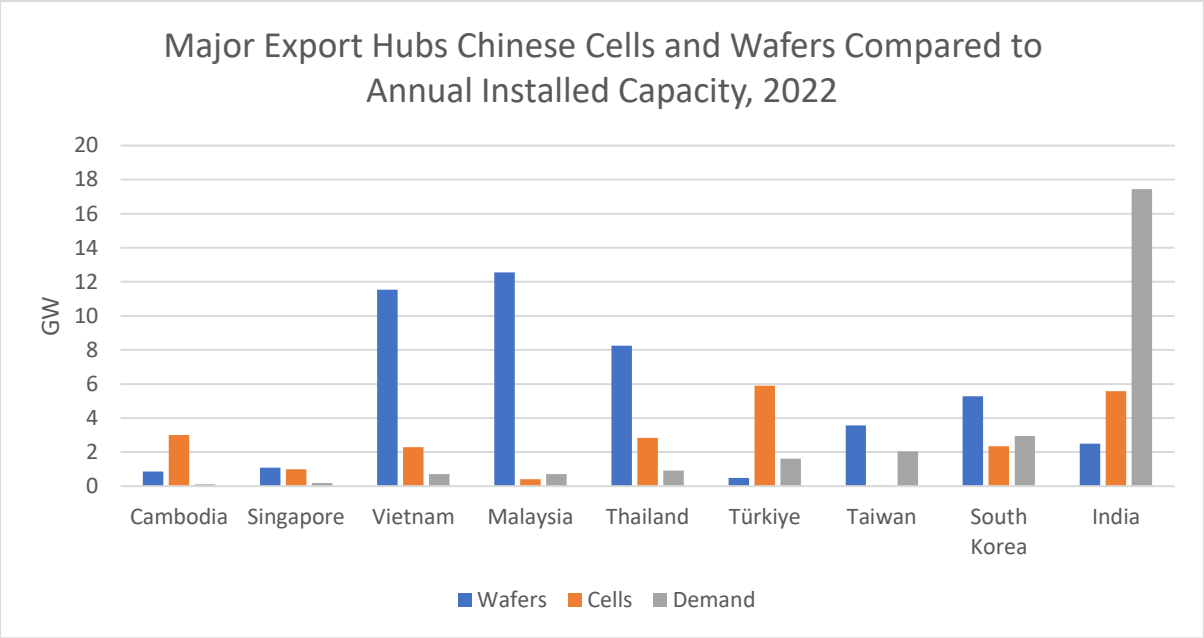


Source: Rystad Energy

However, China also exported PV product to other countries, where Chinese manufacturers make products for the US. Noticeably, Vietnam and Malaysia imported more than 16 times as much wafers than necessary to satisfy national demand in 2022 (Figure 4). Together with Thailand, these three countries imported more than 32 GW compared to less than 2.5 GW in installed capacity. Additonally, cell imports significantly outweigh demand for five out of nine countries shown. It is estimated that Malaysia, Vietnam, Thailand and Cambodia alone accounted for around three quarters of US imported modules[12].

[12] BCSE: Sustainable Energy in America 2023 Factbook

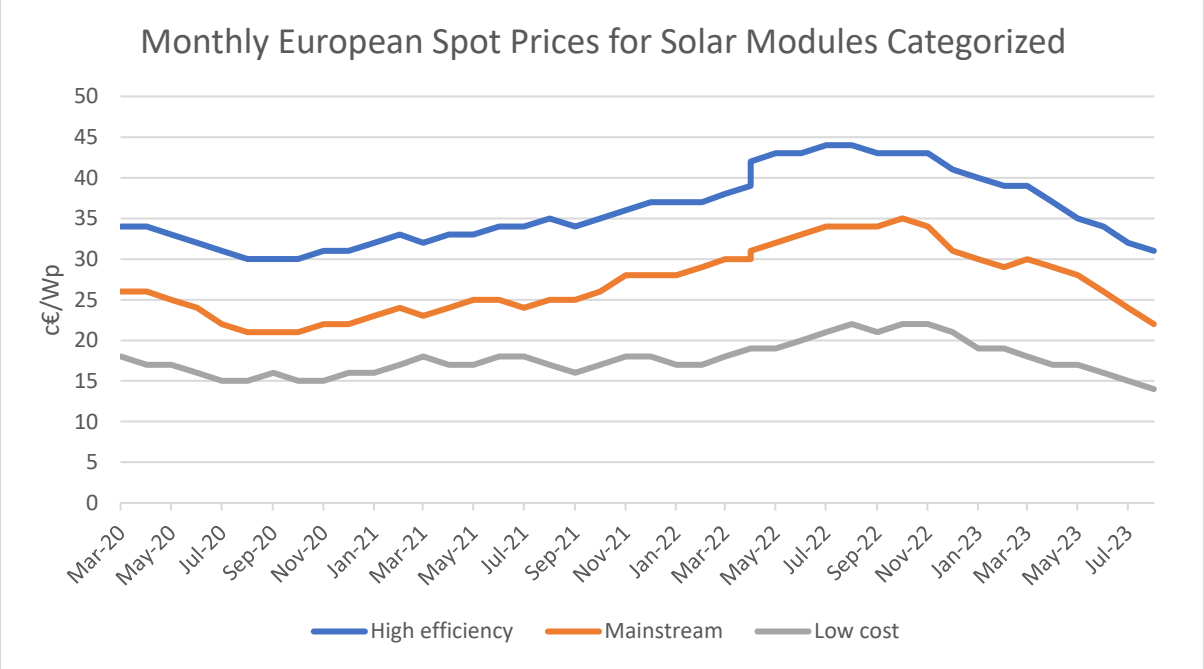
Figure 4



Source: Rystad Energy

As China's main export market, the results of the increased module supply are visible on European spot markets where, over the first three quarters, module spot prices decreased roughly 25% across the board and finally dropped below pre-pandemic levels (Figure 5) On the module market, price cycles increasingly occur much like in other commodity markets.

Figure 5



Note: From April 2022, the calculation was adjusted to account for, amongst others, TOPCon. For more information on the current calculation, visit pvxchange.com.

Source: PVxchange

Polysilicon price decrease played a significant role in the lowering of module prices. Polysilicon manufacturing proved highly profitable over 2021-2022, with high margins taken. This attracted increased capacity, which shrank margins in 2023. This spike in polysilicon capacity is lowering the price significantly. Over the first 8 months of 2022, solar grade polysilicon prices have decreased by nearly 70%. Although they have risen slightly over the past few weeks, a further decline is expected.

Manufacturers such as Daqo, 2022's third largest global polysilicon manufacturer, recently published Q2-2023 revenues halved compared to Q2-2022, while gross profits decreased to 41% from 76%, and net income lowered by 83% to 134 million USD[13]. The company blames oversupply and aggressive pricing combined with delayed and cancelled orders. While inventory levels are said by Daqo to be at a healthier level, the solar sector's silicon capacity expansions are continuing.

On the downstream manufacturing side, leading integrated Chinese module manufacturers, like JinkoSolar, have still shown two-digit gross profit margins in Q2-2023, hinting to silicon price reductions countering the effect of module sales price drops. [14]

These price shocks can be permanent in kind[15], depending on market dynamics, of which cost reduction is a significant factor. According to the learning curve, solar PV will continue a steep trajectory (Figure 6).

Figure 6

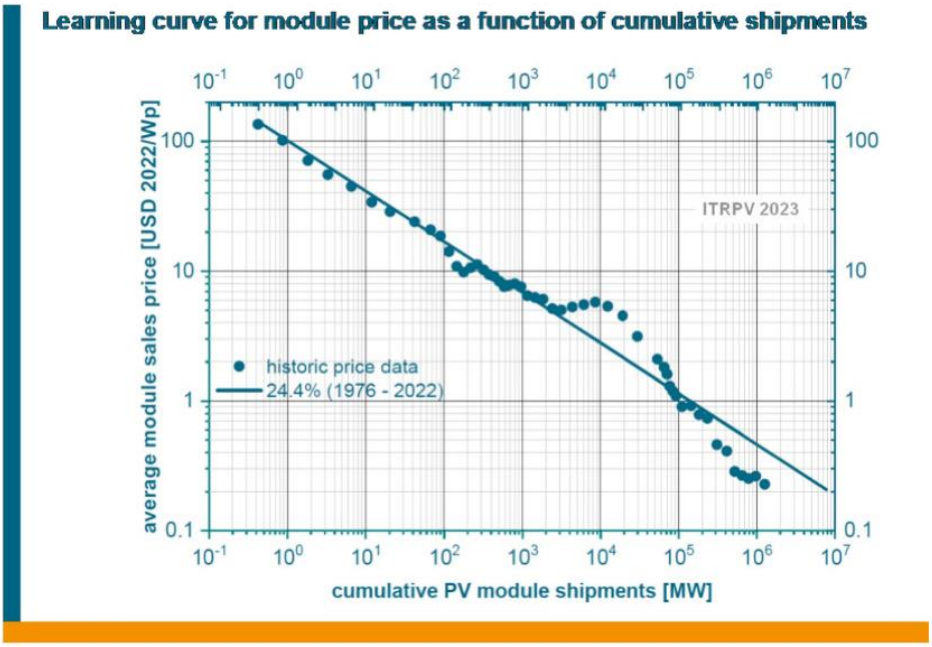


Fig. 1: Learning curve for module spot market price as a function of cumulative PV module shipments.

Source: ITRPV

[13] Daqo New Energy Quarterly Report Q2
[14] JinkoSolar Quarterly Report Q2
[15] Worldbank: The Nature and Drivers of Commodity Price Cycles