



PRICE TREND

Current Level, Chart,
Forecast & History of the
Polysilicon Price

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POLYSILICON PRICE TREND

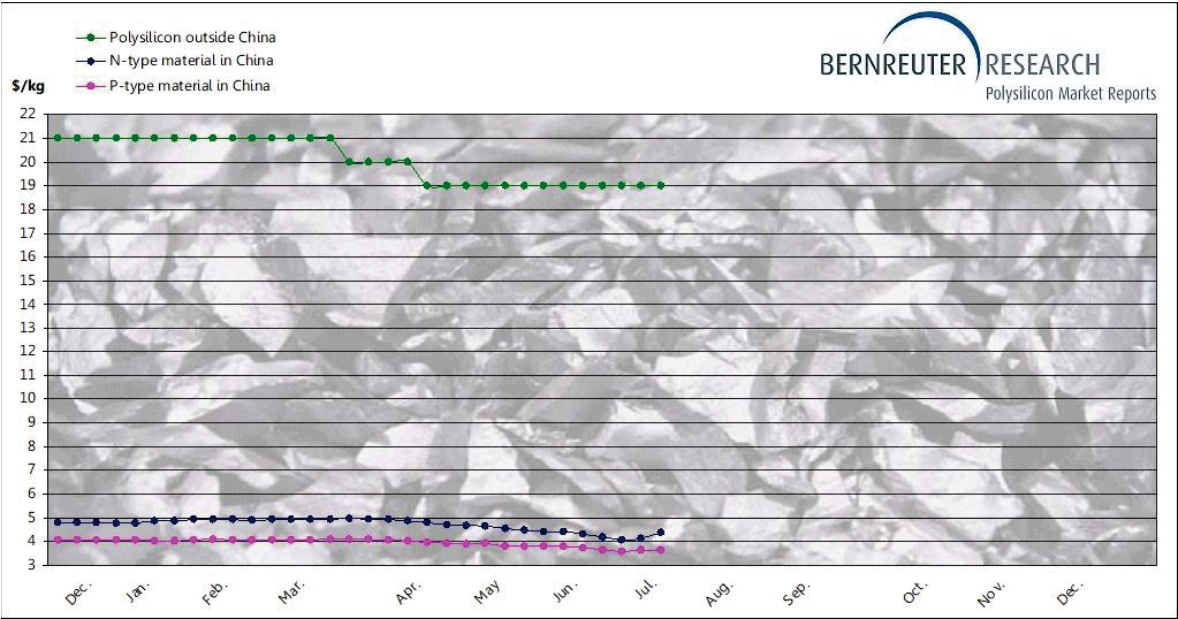
What is driving the roller-coaster ride of the polysilicon price?

The polysilicon price has seen many ups and downs over the last few decades. Which factors cause this volatility? What is the current spot price today? How good is the information from various price data providers? How has the polysilicon price developed since 1981? Here, you will find the answers to all these questions as well as charts that illustrate the price trend.

Current polysilicon spot price: US\$5.55 per kg +9.6%

Global polysilicon spot price average in 2025, updated every Wednesday or Thursday

Last update: July 16, 2025



HANWHA v. MAXEON
IPR2024-01198
HANWHA 1116

Price hikes by Chinese polysilicon manufacturers are accepted downstream

July 16:

Polysilicon outside China: US\$19/kg, unchanged

N-type material in China: CNY40/kg (incl. 13% VAT, US\$4.93/kg without VAT), +CNY4.5/kg

P-type material in China: CNY29.5/kg (incl. 13% VAT, US\$3.64/kg without VAT), unchanged

The next weekly price report will be published at the end of July.

Chinese polysilicon makers hike price quotes under pressure from Beijing

July 9: This week polysilicon manufacturers in China raised their price quotes considerably, but it is unclear how much transaction prices actually rose. Bernreuter Research assumes that the resulting global polysilicon price average increased by 4.4% to US\$5.07/kg.

On July 8, **Shanghai Metals Market (SMM)** reported that Chinese polysilicon companies “have begun to calculate their own full costs” – as if they didn’t know their costs previously – in order to increase their price quotes based on fully-loaded costs; some manufacturers suspended their quotations temporarily.

The reason for that move is political pressure from the central government in Beijing: After China’s Central Financial and Economic Affairs Commission stressed the regulation of “disorderly” low-price competition in a session on July 1, the Chinese Ministry of Industry and Information Technology pressed for action against low-price competition in the PV industry at the 15th Manufacturing Enterprise Symposium on July 3. Senior executives from 14 leading polysilicon and solar companies – among them Tongwei, GCL, Daqo, TCL Zhonghuan, Aiko, Jinko, Longi, JA Solar and Trina – pledged to participate in a “anti-cut-throat competition” initiative.

As a result, the Silicon Branch of the China Nonferrous Metals Industry Association reported that Chinese polysilicon manufacturers increased their quotations to a range of CNY40 to CNY50 per kg this week. Promptly, SMM and **PVinsights** raised their polysilicon price indices to CNY40/kg, up by CNY6/kg from CNY34/kg two weeks ago.

Obviously, these indices are based on quotations, not on transaction prices, which makes them useless. The Silicon Branch registered an increase of the average transaction price by CNY2.40/kg at most for high-quality polysilicon used to make n-type ingots, whereas **EnergyTrend** and **InfoLink** did not see a price movement at all.

Bernreuter Research largely follows the Silicon Branch and has raised the polysilicon price index for Chinese n-type material from CNY33.5/kg last week to CNY35.5/kg (including 13% value added tax, equivalent to US\$4.38/kg without VAT), but leaves the price for p-type material unchanged at CNY29.5/kg (US\$3.64/kg without VAT). The index of InfoLink for non-Chinese polysilicon is flat at US\$19/kg.

The Chinese website Hexun.com commented on the situation in China aptly: “The price increase lacks the support of spot transactions. Silicon wafer companies generally reduce production, and the demand for polysilicon purchases shrinks. The market is still in the game stage between expectations and reality.”

Hexun.com also indicated that the resumption of production at some polysilicon lines originally planned for July has been canceled and the weekly Chinese output has stabilized at 21,300 metric tons (MT). This would point to a slight reduction of the July volume to 95,000 MT instead of the widely expected increase.

Read our analysis:

Why the polysilicon price has been cemented and can’t rise soon (March 26, 2025)

The crash of the polysilicon price was merely a matter of time (June 15, 2023)

Polysilicon price slump accelerates, but will not last very long (January 6, 2023)

First rays of light at the end of the polysilicon high-price tunnel (December 2, 2021)

Has the polysilicon spot price rally reached its peak now? (June 10, 2021)

Why the spot price for polysilicon is going through the roof (April 12, 2021)

Explanations

In most cases, Bernreuter Research uses EnergyTrend as its data base for the spot price of mono-grade polysilicon in China. We calculate the global spot price average from EnergyTrend’s average prices of dense mono-grade (p-type material) and high-quality polysilicon (n-type material) in China and from InfoLink’s price of polysilicon outside China. Until August 2023, we also included our assumption for multi-grade polysilicon in China. The calculation factors have been updated as follows:

- *March 12, 2025:* Split between polysilicon produced in China and material supplied by non-Chinese manufacturers revised to 95-5.
- *January 29, 2025:* Market share of n-type material in China adjusted to 88%
- *January 22, 2025:* Market share of n-type material in China adjusted to 88.25%
- *January 15, 2025:* Market share of n-type material in China adjusted to 88.5%
- *January 8, 2025:* Market share of n-type material in China adjusted to 88.75%
- *January 2, 2025:* Market share of n-type material in China adjusted to 89%
- *November 27, 2024:* Market share of n-type material in China adjusted to 89.75%
- *November 20, 2024:* Market share of n-type material in China adjusted to 89.5%
- *November 13, 2024:* Market share of n-type material in China adjusted to 89.25%
- *November 6, 2024:* Market share of n-type material in China adjusted to 89%
- *October 30, 2024:* Market share of n-type material in China adjusted to 88.75%
- *October 23, 2024:* Market share of n-type material in China adjusted to 88.5%
- *October 16, 2024:* Market share of n-type material in China adjusted to 88.25%
- *October 9, 2024:* Market share of n-type material in China adjusted to 88%
- *October 2, 2024:* Market share of n-type material in China adjusted to 87.75%
- *September 25, 2024:* Market share of n-type material in China adjusted to 87.5%
- *September 18, 2024:* Market share of n-type material in China adjusted to 87%
- *September 11, 2024:* Market share of n-type material in China adjusted to 86.5%
- *September 4, 2024:* Market share of n-type material in China adjusted to 86%
- *August 28, 2024:* Market share of n-type material in China adjusted to 85.5%
- *August 21, 2024:* Market share of n-type material in China adjusted to 85%
- *August 14, 2024:* Market share of n-type material in China adjusted to 84.5%
- *August 7, 2024:* Market share of n-type material in China adjusted to 84%
- *July 31, 2024:* Market share of n-type material in China adjusted to 83.5%
- *July 24, 2024:* Market share of n-type material in China adjusted to 83%
- *July 17, 2024:* Market share of n-type material in China adjusted to 82.5%
- *July 10, 2024:* Market share of n-type material in China adjusted to 82%
- *July 3, 2024:* Market share of n-type material in China adjusted to 81.5%
- *June 26, 2024:* Market share of n-type material in China adjusted to 81%
- *June 19, 2024:* Market share of n-type material in China adjusted to 80.5%
- *June 12, 2024:* Market share of n-type material in China adjusted to 80%
- *June 5, 2024:* Market share of n-type material in China adjusted to 79.5%
- *May 29, 2024:* Market share of n-type material in China adjusted to 79%
- *May 23, 2024:* Market share of n-type material in China adjusted to 78.5%
- *May 15, 2024:* Market share of n-type material in China adjusted to 78%
- *May 8, 2024:* Market share of n-type material in China adjusted to 77.5%
- *May 2, 2024:* Market share of n-type material in China adjusted to 77%
- *April 24, 2024:* Market share of n-type material in China adjusted to 76%
- *April 17, 2024:* Market share of n-type material in China adjusted to 75%
- *April 10, 2024:* Market share of n-type material in China adjusted to 74%
- *April 3, 2024:* Market share of n-type material in China adjusted to 73%
- *March 27, 2024:* Market share of n-type material in China adjusted to 72%
- *March 20, 2024:* Market share of n-type material in China adjusted to 71%
- *March 13, 2024:* Market share of n-type material in China adjusted to 70%
- *March 6, 2024:* Market share of n-type material in China adjusted to 69%
- *February 28, 2024:* Market share of n-type material in China adjusted to 68%
- *February 21, 2024:* Market share of n-type material in China adjusted to 67%
- *February 14, 2024:* Market share of n-type material in China adjusted to 66%
- *February 7, 2024:* Market share of n-type material in China adjusted to 65%
- *January 31, 2024:* Market share of n-type material in China adjusted to 64%
- *January 24, 2024:* Market share of n-type material in China adjusted to 63%
- *January 17, 2024:* Market share of n-type material in China adjusted to 62%
- *January 10, 2024:* Market share of n-type material in China increased to 61%
- *January 3, 2024:* Split between polysilicon produced in China and material supplied by non-Chinese manufacturers revised to 93-7. Market share of 60% introduced for n-type material in China versus 40% for p-type material in China

Please note that Chinese polysilicon price quotes in RMB always contain the value added tax (VAT, currently 13%). Our calculation is based on net prices without VAT.

Three Taiwanese market research firms provide weekly spot prices of the products in the **solar value chain** – solar-grade polysilicon, wafers, solar cells and panels – as well as background information on the price trend on their respective English websites: PVinsights, EnergyTrend and PV InfoLink. China-based SunSirs publishes daily spot prices for 100 commodities, including polysilicon, in China. In our short guide on these four providers, we will focus on the polysilicon segment.

PVinsights



Profile: The Taipeh-headquartered company keeps a very low profile: Its old-style website provides neither a local address nor a phone number, but only an e-mail address for contact. According to the comment of a PVinsights employee on www.glassdoor.com, however, the company has “strong business engagements with lots of Fortune Top 500 firms.”

Data: In 2009 PVinsights was the first that started publishing weekly photovoltaic (PV) spot price data on the web. Its coverage of the global polysilicon spot price average was expanded with data on the spot prices in and outside China in March 2015; however, this information as well as the monthly data on the polysilicon long-term contract price have gradually been shifted to the paid service since June 2017. Only an average price of polysilicon used to make p-type wafers is still accessible through a free membership which you have to register for with your e-mail address and a password. Often PVinsights is the first that identifies a new price trend – be it downwards or upwards – but it tends to be more bearish than the other data providers.

Methodology: PVinsights polls prices “from multiple contributors by telephone until the final price range is clear to us.” Until late 2014, its polysilicon spot price index was 2% to 5% higher than that of EnergyTrend on an annual average; after that, however, it was 2% to 7% lower. In 2019 this spread widened significantly from 7% in the first quarter to 16% in the fourth quarter. In 2020 it grew further to 19% in the first quarter before it returned to 7% in the fourth quarter. The pendulum swang to the other direction in the first half of 2021 when the index of PVinsights was 5% higher than that of EnergyTrend before it became 4% lower again in the fourth quarter. In 2022 the spread increased from 1% in the first quarter to 7% in the fourth quarter; in December it was even more than 10%.

The difference stems from how the single price points of a survey are weighted. PVinsights states only vaguely that “applying judgment to the price discovery process remains today the best method to determine privately traded solar PV component prices. Our experience in making informed, accurate judgments is one of the most important values we offer to PVinsights.com subscribers.” This self-praise cannot hide the fact that the data provider missed the rising market share of higher-priced mono-grade polysilicon for almost two years. Only from late 2020 through the third quarter of 2022 did it seem that **PVinsights’ polysilicon spot price index has overcome its bias** toward low-price multi-grade polysilicon. We do not regard the index as a reliable source anymore.

Weekly Report: The strength of PVinsights used to be its *Weekly Solar PV Snapshot* report. Although written in somewhat clumsy English, it lived up to the company name with insightful information on individual factors and events that drive supply and demand. In September 2021, however, the *PV Snapshot* was shifted to the paid service.

Website: <http://pvinsights.com>

EnergyTrend



Profile: Established in 2010 as the fourth of five research divisions within TrendForce Corp. – a market researcher focused on semiconductors, computers, smartphones, displays and light-emitting diodes – EnergyTrend is also headquartered in Taipeh. Besides price data on PV components and lithium batteries, its website also offers market analysis, features and news.

Data: In August 2018 EnergyTrend enlarged the scope of its polysilicon price survey. It began to cover the global spot price average as well as the spot prices outside China and for multi- and monocrystalline-grade polysilicon in China. With that, EnergyTrend provided the broadest data set on polysilicon spot prices publicly available among the three Taiwanese research firms. In May 2021, however, EnergyTrend stopped publishing a global average value; in October it also abandoned tracking multi-grade polysilicon. Since July 2023 the company has been providing price data on polysilicon outside China and three product categories in China: mono-grade dense polysilicon chunks and higher-quality material for recharging the crucible, both used to make p-type wafers, as well as premium material for n-type wafers.

Methodology: EnergyTrend says it surveys a pool of major manufacturers via telephone, questionnaires as well as site visits, and cross-surveys major buyers and suppliers throughout the supply chain. The company claims to take “a conservative attitude toward the enclosed price information” and explains: “All statistical numbers gathered are used to derive a particular price quote through weighted calculation.”

Weekly Report: EnergyTrend's weekly PV price trend report is available on its website without registration. It used to give only a broad overview on driving market forces; since the fall of 2023, however, it has become more and more detailed, structured and informative.

Website: <https://www.energytrend.com/solar-price.html>

InfoLink Consulting



Profile: The youngest among the three Taiwanese market researchers was established in March 2017. InfoLink Consulting (formerly: PV InfoLink) was originally focused on the PV supply chain; now it also covers energy storage systems and offshore wind power. Initially, most of the content on InfoLink's website was in Chinese; in November 2018, however, the company introduced an English subdomain, which was integrated into the main site with the relaunch in March 2020.

Data: For polysilicon, InfoLink used to provide the weekly spot prices for both multi- and mono-grade material in and outside China, but no global price average. In September 2021 the company reduced its coverage to the mono-grade price in China before it added price indices for polysilicon granules in China and polysilicon chunks outside China in January 2024. InfoLink's polysilicon price tracking is relatively inert, usually lagging behind other data providers by one week. Its price chart contains a forecast of the price change for the coming week, in one of the following five ranges: >3%, 0 to 3%, 0%, 0 to -3% or >-3%.

Methodology: InfoLink says it gathers price information from face-to-face and phone interviews and other ways of communication with more than 100 PV companies. It does not weight the raw data, but apparently looks for the common denominator: "We get our average price from the most common transactional data in the market (not weighted average), but prices are slightly adjusted every week according to market conditions." Whatever the latter may mean.

Weekly Report: InfoLink's weekly price report is freely available on its website. Its content used to be comparable with the early version from EnergyTrend to some degree, but became more detailed in late 2019. Conversely to EnergyTrend, however, InfoLink's weekly information has got thinner since 2024. Especially on wafers, solar cells and modules, the content mainly consists of long enumerations of price data that is already provided in InfoLink's survey table. The report segment on polysilicon prices still contains interesting observations once in a while, though.

Website: <https://www.infolink-group.com/spot-price>

Shanghai Metals Market (SMM)



The Leading Metals Information Provider

Profile: Founded as a metals market researcher in 1999, Shanghai Metals Market Information & Technology Co., Ltd. (SMM) has developed into a major provider of price data, news and market analysis for more than 100 nonferrous and ferrous metals, precious and minor metals, compounds, alloys and rare earths. Meanwhile, the Shanghai-headquartered company has also established itself as the most comprehensive and freely accessible data source on feedstock, auxiliary materials and products in the solar value chain: It provides prices for silicon powders, trichlorosilane, polysilicon, high-purity quartz sand and crucibles, wafers, silver pastes and screens, solar cells, PV glass, backsheets, EVA and POE films, frames and brackets, solar modules and inverters. The prices are updated on a daily basis although they do not change every day in practice.

Data: On polysilicon, SMM also offers the most comprehensive, publicly available set of price data for the following product variants: mono-grade popcorn, dense and recharge chunks and chips for p-type ingots, high-quality material for n-type ingots, polysilicon granules for p-type and n-type ingots (all from China) as well as non-Chinese polysilicon. Within the spectrum of all data providers, the prices from SMM mostly lie in the golden mean; the only exception is the price of non-Chinese polysilicon, which is unrealistically low and, hence, not usable.

Methodology: SMM hosts a document on its website that describes the price assessment methodology for its polysilicon price index in detail; similar documents are available for wafers, solar cells and modules. To assess polysilicon prices, SMM uses a pool of a dozen submitters each on the supply side (polysilicon manufacturers) and the demand side (mainly wafer and fully integrated solar module producers). The company collects price data via phone, fax, e-mail, QQ or WeChat on every trading day between 9:30am and 11:20am China Standard Time. The data include "traded prices within the day, and the most likely traded prices, bids and offers." The individual price points are weighted by transaction volume; actual transaction prices take precedence over bids and offers.

Weekly Report: The SMM website is difficult to navigate since the PV price info, daily summaries, weekly reports, statistics and analyses are scattered across various subpages (see below) without a common start page. All this information is freely accessible. The weekly reports include relatively thin descriptions of price structures and developments; since the second half of 2023, SMM's polysilicon volumes have significantly deviated from the data published by the Silicon Branch of the China Nonferrous Metals Industry Association.

Website:

PV price data: <https://www.metal.com/Solar>

Methodology: <https://www.metal.com/comp/methodology>

SunSirs



Profile: Established in 2011, SunSirs – China Commodity Data Group is a leading provider of data, spot prices and market news on commodities in China. Based in Hangzhou, the capital of the eastern Chinese province of Zhejiang, the company tracks and publishes the daily spot prices of 100 commodities, including polysilicon, on its website, which is loading very slowly.

Data: The only unique feature of SunSirs' polysilicon spot price data is its daily update. This, however, is of minor relevance as the polysilicon spot price does not fluctuate strongly within 24 hours. More importantly, the price quote of SunSirs is often far out of sync with the data from the three Taiwanese providers. Hence, its polysilicon price has little information value.

Website: <http://www.sunsirs.com/commodity-price/list-chemical.html>

Our recommendation

Bernreuter Research recommends that you look at PVinsights, EnergyTrend and PV InfoLink for comparison, rather than favoring the price data from just one provider.

Statements on the market trend can be contradictory from time to time. If, for instance, one data provider reports high polysilicon inventories in the value chain whereas the other claims low ones, the latter may be based on information from suppliers that are interested in playing down the scope of inventories in order to be in a better bargaining position vis-à-vis their customers. For this reason, it is always a good idea to base your judgment on several views and sometimes, you just have to live with information discrepancies.

Polysilicon price forecast: Projecting the future price trend

In October 2014 when the polysilicon spot price was at US\$20.70/kg, GTM Research predicted that polysilicon pricing would “be stable and possibly even increase through 2015, with pricing expected to be in the \$18 to \$24 per kilogram range.” In contrast, Bernreuter Research already forecasted in July 2014 that the spot price would climb up to \$23/kg before it would drop to a range of \$18 to \$20 per kg by the end of 2014 and then be on the downtrend going forward.

Neither was completely correct. The spot price did not rise to \$23/kg in the summer of 2014 as we expected, but remained largely stable, as GTM Research said, at \$21/kg throughout the second half of the year. But then it dipped below \$20/kg in late December. Unlike what GTM forecasted, the price did not remain stable or even increase in 2015. Instead, it fell continuously as we projected – close to \$13/kg at the end of 2015.

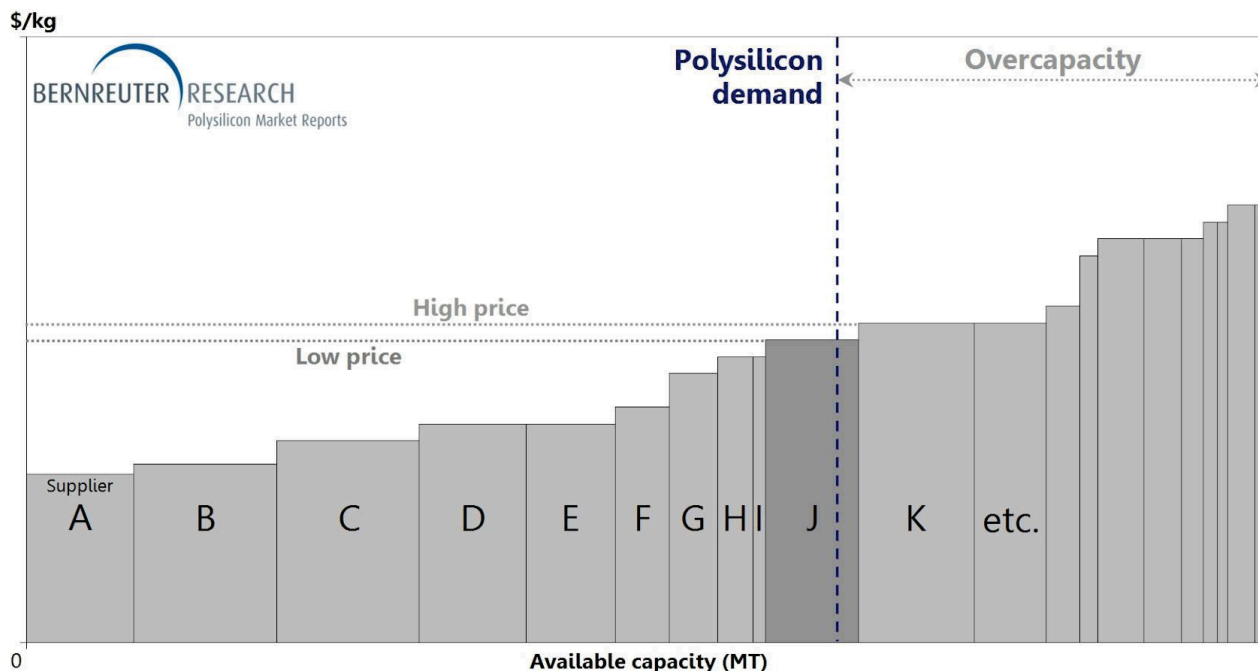
So forecasting the polysilicon spot price is obviously a challenging task. How are such predictions made?

Forecast tool: The industry cost curve

Polysilicon price forecasts are usually based on the **industry cost curve**. In the early 1980s the consulting company McKinsey popularized this microeconomic graph that is ideally suited to predicting the price of commodity products like polysilicon.

The chart maps the available production capacities of all manufacturers (or a manufacturer's single production units if they differ in technology or cost structure) in metric tons (MT) incrementally along the x-axis in order of increasing cash production costs. The y-axis measures the cash costs because the marginal producer will stay in business as long as the market price covers its cash production costs.

The market price settles down between the cost of the supply unit that the vertical line of demand intersects – i.e. the last producer needed to satisfy demand (Supplier J, dark grey column in the chart below) – and the cost of the first unit of unneeded capacity (Supplier K).



On the industry cost curve, the future market price of polysilicon levels off between the manufacturer's cash cost that the vertical line of expected demand intersects and the cash cost of the first unit of unneeded capacity – Chart: Bernreuter Research

By applying a modified interpretation of the industry cost curve, Bernreuter Research has achieved a good **track record**. First of all, it is important to get the basics right:

- The **cash cost** data or estimates for all **polysilicon manufacturers** have to be as precise as possible.
- The **production capacity** figures must be up to date. New capacities that are just being ramped up can only be counted partially.
- The forecast of global **PV demand** should be realistic, which is not easy. Price forecasts should always disclose which PV installation volume they are based on.

Two other factors are equally relevant:

- The **time lag** between polysilicon production and PV installations has to be taken into account.
- The volume of polysilicon **inventories** in the value chain influences the spot price as well.

To account for the latter can be especially tricky. Thus, short-term inventory build-ups have sometimes spoiled our annual forecasts to a certain degree. With a delay of a few weeks or months, however, the forecasts have still come true.

2019 price forecast and result: Fall below \$9/kg predicted

In its **newsletter** issued in December 2018, Bernreuter Research predicted: “In a first approximation, we have assumed new PV installations of 110 to 120 GW in 2019. The polysilicon spot price may then rise to a range of \$10-11/kg during seasonal demand peaks; but it will return to a range of \$9-10/kg by the end of next year. Should high inventory levels persist, the price could approach or even undercut \$9/kg.”

A seasonal demand peak remained at bay in 2019; however, the second part of our forecast came true: The global polysilicon spot price average undercut \$9/kg in late August and closed the year at \$8.50/kg (see the polysilicon price history: **2019: Chinese low-cost plants amplify price pressure**).

2020 price forecast and result: \$10.40/kg close to our model

2020 saw a wild ride of the polysilicon spot price: first being driven down by demand weakness in the wake of the Covid-19 pandemic to a record low of around \$6.75/kg in late June, then spiking to \$12.45/kg in mid-September after explosions at Xinjiang GCL in mid-July and a flood at Sichuan Yongxiang in mid-August temporarily removed a capacity of 68,000 MT from the market.

In mid-December the spot price bottomed out at \$10.40/kg. With a deviation of just 20 \$Cents/kg, our forecast model for the end of 2020 shown in *The Polysilicon Market Outlook 2024* has been validated once again.

Get Your In-depth Report: The Polysilicon Market Outlook 2029

- ✓ Benefit from **102 pages** full of rich data, in-depth analyses and detailed forecasts on the polysilicon, solar and semiconductor industries



- ✓ Learn all about the latest developments of polysilicon **manufacturing technologies** (Siemens process, fluidized bed reactor, upgraded silicon kerf loss from wafer sawing)
- ✓ Obtain comprehensive data on **production volumes** and capacities of 41 solar-grade and electronic-grade polysilicon plants from 2023 through 2029
- ✓ Gain insight into decisive **market trends**, based on four sophisticated scenarios of **supply and demand** through 2029
- ✓ Get valuable guidance with **cash cost** data on 27 solar-grade polysilicon plants and spot **price forecasts** through 2029

[Go to the Report](#)

Learn all about the polysilicon market

Polysilicon price history: A roller-coaster ride from 1981 through 2023

Overview

1981 - 2004: Regular pork cycle of the contract price

2003: The spot price reaches its bottom

2004: The first warning shot goes unheard

2005: The PV industry reacts to the soaring spot price

2006: The polysilicon bottleneck curbs PV growth

2007: Scrap silicon and thin-film modules fill the gap

2008: The price peak is crossed

Chart: Polysilicon spot price 2004 - 2023

2009: Oversupply induces a “flight to quality”

2010: Surprising surge in demand

2011: The market correction begins

2012: Dumping of inventories

2013: Anti-dumping tit for tat

Chart: Closer view – spot price 2011 - 2023

2014: Short-lived price recovery

2015: Oversupply sends the spot price south

2016: Cold shock after the spring rally

2017: Hiccup before the installation rush

2018: Spot price below the historical mark of \$10/kg

2019: Chinese low-cost plants amplify price pressure

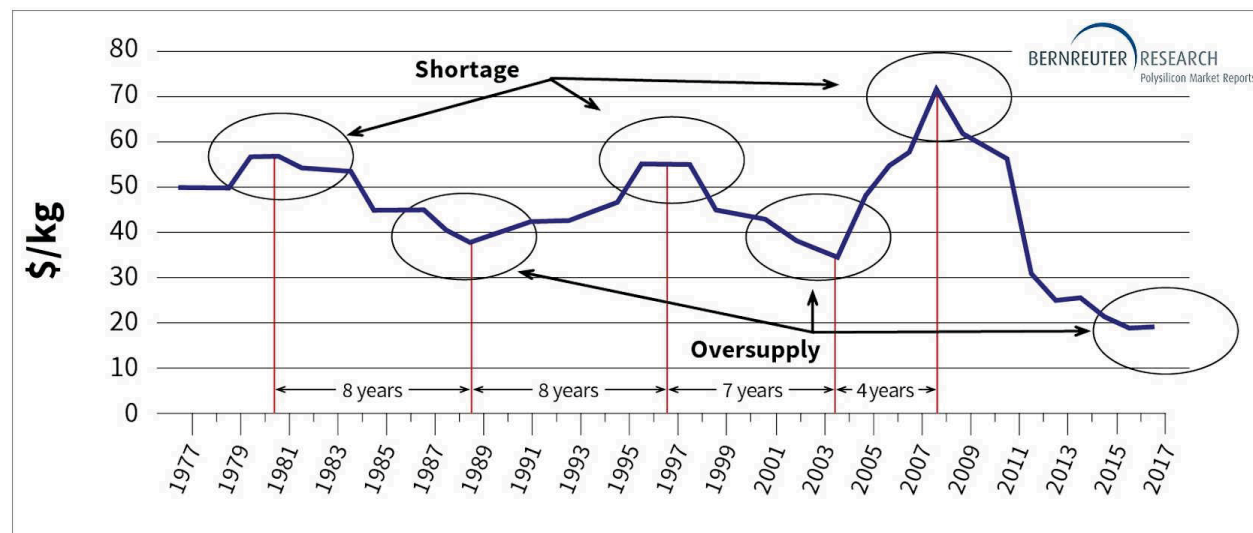
2020 - 2023: The pork cycle returns to the market



Cartoon: Brett Lamb/Dreamstime.com

Historical data collected by the equipment provider GT Advanced Technologies show that the long-term contract price for high-purity polysilicon oscillated between peak and trough, and vice versa, in regular intervals of seven to eight years from 1981 through 2004. As explained in our [polysilicon market analysis](#), the reason for that phenomenon is a pork cycle from oversupply to shortage to oversupply again.

Intervals between peaks and troughs of the contract price for high-purity polysilicon 1981 - 2008



Between 1981 and 2004, the contract price for high-purity polysilicon fluctuated between peaks and troughs in regular intervals of seven to eight years – Sources: GT Advanced Technologies (GTAT), PVinsights; Chart: GTAT/Bernreuter Research

During this period, polysilicon demand was dominated by the semiconductor industry ([polysilicon uses](#)). When global PV installations exploded in 2004, however, the market dynamics began to change.

Therefore, we will focus on the short-term price for solar-grade polysilicon on the spot market in the following sections. The blue year boxes show the rounded-off annual spot price average based on several sources.

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2003: The spot price reaches its bottom

As reported both by market researcher Richard Winegarner, President of Sage Concepts, and market participants like Hubert Aulich, at the time a board member of silicon ingot and wafer manufacturer PV Crystalox Solar, the spot price for solar-grade polysilicon rose to \$36/kg in 2001 before in 2003 it fell back to \$28/kg – the level it already touched in 2000 when the dotcom bubble burst.

This time, however, the spot price reached its bottom definitely, one year before the long-term contract price did so as well.

According to Winegarner, scrap silicon from the semiconductor industry – until 1998 the only feedstock for the PV branch – was traded at \$14/kg in 2003. That is probably the reason why the “Sun Screen” study from Credit Lyonnais Securities Asia (CLSA) quoted an average selling price of \$24/kg for polysilicon in 2003.

2003
\$28/kg

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2004: The first warning shot goes unheard

On January 1, 2004, an amendment of the German Renewable Energy Law significantly raised the feed-in tariff for electricity from solar power. This change triggered a run on PV systems, in particular among farmers: New PV installations in Germany more than quadrupled in 2004; on a global scale, PV deployment rocketed by 90%. In the same year, demand for semiconductor wafers also saw a high growth rate of 23%.

These two developments were the perfect ingredients for a polysilicon shortage. By the end of the year, the spot price for solar-grade polysilicon had almost doubled from its low of \$28/kg to approx. \$55/kg.

2004
\$45/kg

The increase, however, was not strong enough to scare solar cell and module producers. With a specific silicon consumption of 14 grams per watt (g/W) and a spot price of \$28/kg, polysilicon made up costs of \$0.39/W or 12.6% of the average wholesale solar module price (\$3.10/W) in 2003. Due to the strong demand and the higher polysilicon costs, the average module price increased to \$3.35/W in

2004. With a specific silicon consumption of 13 g/W and an annual spot price average of \$43/kg, the share of the higher polysilicon costs (\$0.56/W) in the module price (\$3.35/W) rose only slightly to 16.7 % in 2004.

The PV branch widely thought that polysilicon manufacturers would expand their production capacities to meet increasing demand. It did not take into account, however, that those manufacturers were burnt by the downturn of the semiconductor sector in 1998 after they had heavily invested in new capacities.

In 2004 polysilicon manufacturers began to demand long-term contracts with prepayments from potential customers to secure their investments. “If you can’t be certain about selling the material at a specific price, you won’t be able to find investors,” said Karl Hesse, project director at Wacker’s polysilicon division, at the first Solar Silicon Conference in Munich in April 2004.

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2005: The PV industry reacts to the soaring spot price

The polysilicon spot price had to climb still higher until PV companies were ready to sign long-term purchase contracts with hefty prepayments. When the second Solar Silicon Conference took place in April 2005, the spot price already stood at \$80/kg. Wacker, then the world’s second-largest polysilicon manufacturer, announced that it had secured the first long-term contracts, and Hemlock Semiconductor, at the time the world market leader, convinced prospective customers to sign such contracts at the end of the conference.

2005
\$115/kg

A resolution of the big polysilicon shortage, however, was still far away as it took the manufacturers 18 to 24 months to expand their production capacities. Consequently, inventories were scraped together from every nook and cranny of the value chain. The thickness of wafers was significantly reduced so that the specific silicon consumption dropped from 13 to 10 g/W. Thus, the PV market was still able to grow by 35% in 2005.

Nonetheless, the polysilicon spot price soared to \$185/kg by the end of the year.

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2006: The polysilicon bottleneck curbs PV growth

In 2006 the polysilicon shortage got even worse. The last available inventories were running low. In July Peter Woditsch, at the time CEO of wafer manufacturer Deutsche Solar AG, a subsidiary of the now defunct Solarworld group, told us: “I presume that by the end of 2006, all stocks will be fully exhausted.”

2006
\$250/kg

Moreover, the additional volume that polysilicon plants churned out was mainly consumed by the semiconductor industry whose wafer production increased by 21% in 2006.

In this situation, Dow Corning presented **upgraded metallurgical-grade (UMG) silicon** from its factory in Brazil as an alternative feedstock at the 21st European PV Solar Energy Conference and Exhibition in Dresden (Germany) in September. However, the purity of the material was so poor that the company only recommended a 10% ratio for blending UMG silicon with virgin polysilicon.

In times of strong shortage, this was still a welcome source of additional feedstock, but by far not enough to ease the situation. The growth rate of global PV installations went down from 35% in 2005 to 19% in 2006. At the end of the year, the polysilicon spot price crossed the mark of \$300/kg.

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2007: Scrap silicon and thin-film modules fill the gap

At a rate of 8%, production of semiconductor wafers in 2007 grew less strongly than in 2006. At the same time, the PV industry managed to tap 60% more scrap silicon from the semiconductor sector: nearly 4,000 metric tons (MT) compared to 2,500 MT in the prior year.

2007
\$330/kg

Moderately increasing polysilicon output and further declining specific silicon consumption created additional room for PV growth. Above all, however, the production of thin-film solar modules, which do not require crystalline silicon, more than doubled. All these factors together facilitated an amazing growth rate of 62% for global PV installations in 2007.

Coming from an already high level, the polysilicon spot price slowed down its ascent. At the end of the year, it reached a value of \$350/kg.

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Despite its astronomic height, the surge of the spot price was not over yet. In March 2008 it made another leap to a peak of \$475/kg. Nevertheless, Trina Solar, one of the leading Chinese integrated manufacturers of solar modules, announced in April it would discontinue developing its own polysilicon plant with an annual capacity of 10,000 MT. Trina pointed to “recent favorable changes in the polysilicon supply environment,” or more concretely: better access to long-term contracts with improved delivery and payment terms.

2008
\$360/kg

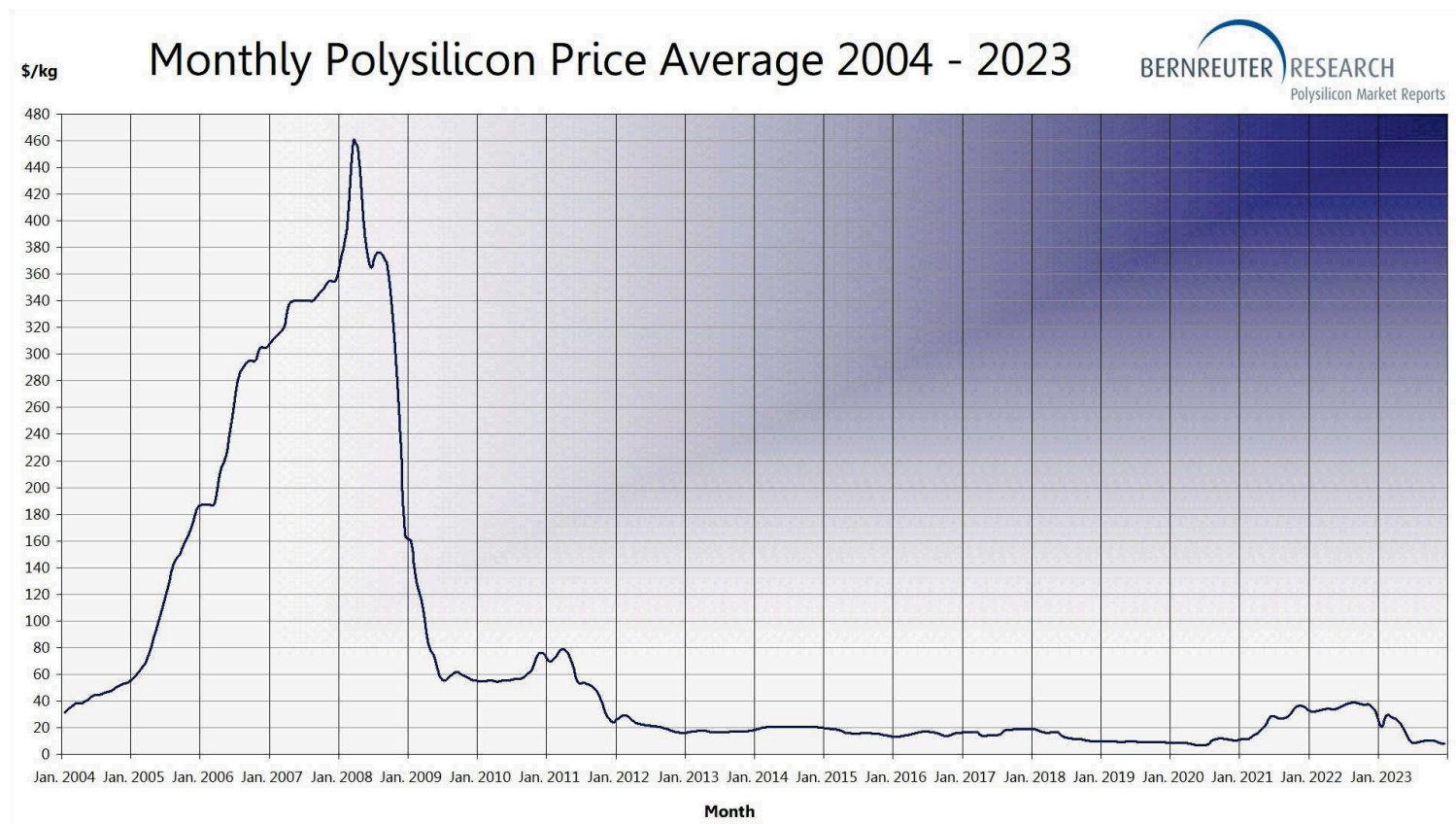
The company correctly expected polysilicon prices to decrease in the mid-term with significant amounts of new production capacities coming on stream. Already in 2008, considerable additional volumes kicked in. Trina’s decision was an early indicator that the polysilicon shortage would draw to a close. And indeed: In May the spot price began to descend from its plateau above \$450/kg.

Four months later, two other events marked a real turning point. After the U.S. investment bank Lehman Brothers collapsed on September 15, the financial crisis, already smoldering on the U.S. real estate market, began to impact the world economy. The credit crunch affected the demand side of the PV market with funds shrinking for large-scale solar power plants.

The second event was the deadline for the lucrative feed-in tariff awarded to PV systems in Spain on September 28. It had spurred a staggering 2.5 GW of newly installed capacity in 2008. More importantly, however, the revised incentive scheme introduced an annual cap of 500 MW for eligible PV plants beginning in 2009. In fact, this meant that all of a sudden an annual demand of 2 GW was withdrawn from the PV market.

Consequently, the polysilicon spot price plummeted from approx. \$375/kg in August to \$165/kg in December.

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The polysilicon shortage from 2004 to 2008 drove the spot price to astronomic heights above \$400/kg before it crashed down to \$55/kg within 15 months – Data sources: UBS/BNEF/PVinsights (2004 - 2010), EnergyTrend (2011 - 2023); Chart: Bernreuter Research

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2009: Oversupply induces a “flight to quality”

In 2009 the global financial crisis fully unfolded. While demand for semiconductor wafers fell by 18%, global PV installations still grew by a remarkable 25% (compared to 116% in 2008); however, solar module prices dropped by more than 30%.

Massive module oversupply spurred a “flight to quality”: The price pressure forced cell and module producers to more quickly reduce their manufacturing costs. The key lever to achieve this is higher cell efficiency: At the time, an increase by one percentage point reduced the cost per Watt by approx. 6%. High efficiency, in turn, requires high quality of the silicon feedstock. Wacker reported it was

producing polysilicon at full capacity throughout the year 2009 even though it had brought its new 'Poly 8' plant on line earlier than scheduled.

Overall, however, new production capacities tipped the balance on the polysilicon market to oversupply. Starting at \$160/kg in January, the spot price further tumbled until it finally stabilized in a range from \$55 to \$60 per kg in the second half of the year.

In view of the overcapacity, many polysilicon players slammed on the brakes. OCI delayed completing its third plant in South Korea to late 2010; LG Chem shelved its plan to build a polysilicon factory. Chinese wafer producer LDK Solar ran into serious financial problems with a huge debt load and deferred the ramp-up of its 16,000 MT polysilicon plant to 2010. Many other polysilicon projects in China and all over the world were postponed as well; most of them were abandoned later.

The big losers in 2009 were the manufacturers of upgraded metallurgical-grade (UMG) silicon. Producers of solar modules made of UMG silicon, such as Canadian Solar and Photowatt, completely shifted back to polysilicon feedstock in the second half of the year. Photowatt was one of three customers that terminated their UMG silicon contracts with Canadian UMG manufacturer Bécancour Silicon in 2009. In the fourth quarter, Bécancour sold only 2 MT. Consequently, it stopped production.



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2010: Surprising surge in demand

Until early September 2010, the average polysilicon spot price remained very steady on a level of \$54 to \$57 per kg. Then, the price began to climb gradually, followed by a steep jump to \$80/kg in November, before it relaxed in the seasonally weak December.

What drove this rally? First of all, very strong demand. Polysilicon imports into China, which leads the world's solar module production, increased almost in lock-step with the spot price. 2010 will go down in solar history as the year with the highest growth rate of new PV installations worldwide, namely 158%.

Moreover, GCL-Poly Energy Holdings increasingly used polysilicon from its subsidiary Jiangsu Zhongneng in-house for wafer production, thus reducing the polysilicon volume for the spot market. Speculative purchases by Chinese brokers additionally pushed the price upwards.



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2011: The market correction begins

After a slight drop in the winter season, the spot price returned to \$79/kg – close to its 2010 high – in March 2011. It lulled small Chinese polysilicon manufacturers into a false sense of security, which would soon after be shattered. In May and June 2011 the price fell back to its long-time level of \$55/kg it had in the first half of 2010; it remained above \$50/kg until mid-September. Then, however, the downward trend accelerated: Within just one quarter, the spot price plummeted by \$20/kg and broke through the \$30/kg line.

Several factors contributed to this rapid decline. At the beginning of the year, producers in the downstream part of the PV value chain were too optimistic about demand; they built up a huge solar module inventory of approx. 10 GW worldwide in the first half of 2011. Together with already existing overcapacities, this put pressure on prices along the whole value chain.

In the second half, the major polysilicon manufacturers Wacker Chemie, OCI Company and in particular Jiangsu Zhongneng Polysilicon brought large new capacities on line. In addition, REC Silicon launched increasing volumes on the spot market as the wafer production facilities of its parent and customer REC ASA in Norway stumbled under the price pressure; these facilities were ultimately shut down in the second quarter of 2012.

The resulting price slump hit the Achilles' heel of small and medium enterprises in China because they sold their polysilicon output largely on the spot market. Almost 30 companies suspended or abandoned operation between September 2011 and mid-2012. Cost-competitive manufacturers from the USA, South Korea and Germany filled the gap that domestic companies left.



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In 2011/2012 many Chinese polysilicon makers, such as Sichuan Xinguang (image), shut down – Image: Sichuan Leshan Auction Center

2012: Dumping of inventories

Even the established manufacturers, who sell most of their output via long-term contracts, did not remain unaffected by the development on the spot market. In June 2011 the spot price had already undercut the average contract price; when the gap between both widened in the fourth quarter, it forced the top producers to renegotiate the contracts with their customers.

In order to clear their inventories, Chinese polysilicon manufacturers that abandoned operation threw out their stocks at dumping prices before closing down. Likewise, cash-strapped wafer producers dumped their polysilicon inventories on the spot market in order to retain liquidity. In October 2012 Wacker consequently announced it would introduce short-time work at its Burghausen plant; the overall utilization rate of the company's polysilicon plants in Burghausen and Nünchritz dropped to 66% in the fourth quarter. Utilization at OCI Company in South Korea even sank to 40% by the end of 2012.

It took some time until the free fall of the spot price was stopped. After the average price had undercut the mark of \$20/kg in September, it further tumbled to a record low of \$15.35/kg (PVinsights) or \$15.90/kg (EnergyTrend) in the second half of December before it began to recover slowly in January 2013. Over the whole year, the spot price crashed by 47% after it had already plummeted by 59% in 2011.

The severe price decay prompted a second wave of plant shutdowns in South Korea and in China, where even larger manufacturers suspended operation in September/October 2012.

2012
\$22/kg

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2013: Anti-dumping tit for tat

The last straws Chinese manufacturers clutched at were punitive duties on polysilicon imports into China. In reaction to the anti-dumping and countervailing (anti-subsidy) duty investigation the US Department of Commerce had started on solar modules containing China-made cells in November 2011, the Chinese Ministry of Commerce (Mofcom) opened an investigation against U.S. and South Korean polysilicon suppliers in July 2012.

Many Chinese observers first expected a Mofcom ruling in February 2013, then in April. The spot market anticipated this move and drove the average polysilicon price up to an interim high of \$18.60/kg in early April. Mofcom, however, postponed its decision. When the preliminary duties were finally published on July 18, the spot price had fallen back to \$16.60/kg.

Only in mid-August, as late as four weeks after the Mofcom ruling, did the spot market start a short rally. The average price jumped to values above \$18/kg, but sank below that mark again in early October. It was less due to the new Chinese duties themselves, but to the fact that the Chinese customs now demanded a certificate of origin for imported polysilicon; if not provided, the highest anti-dumping

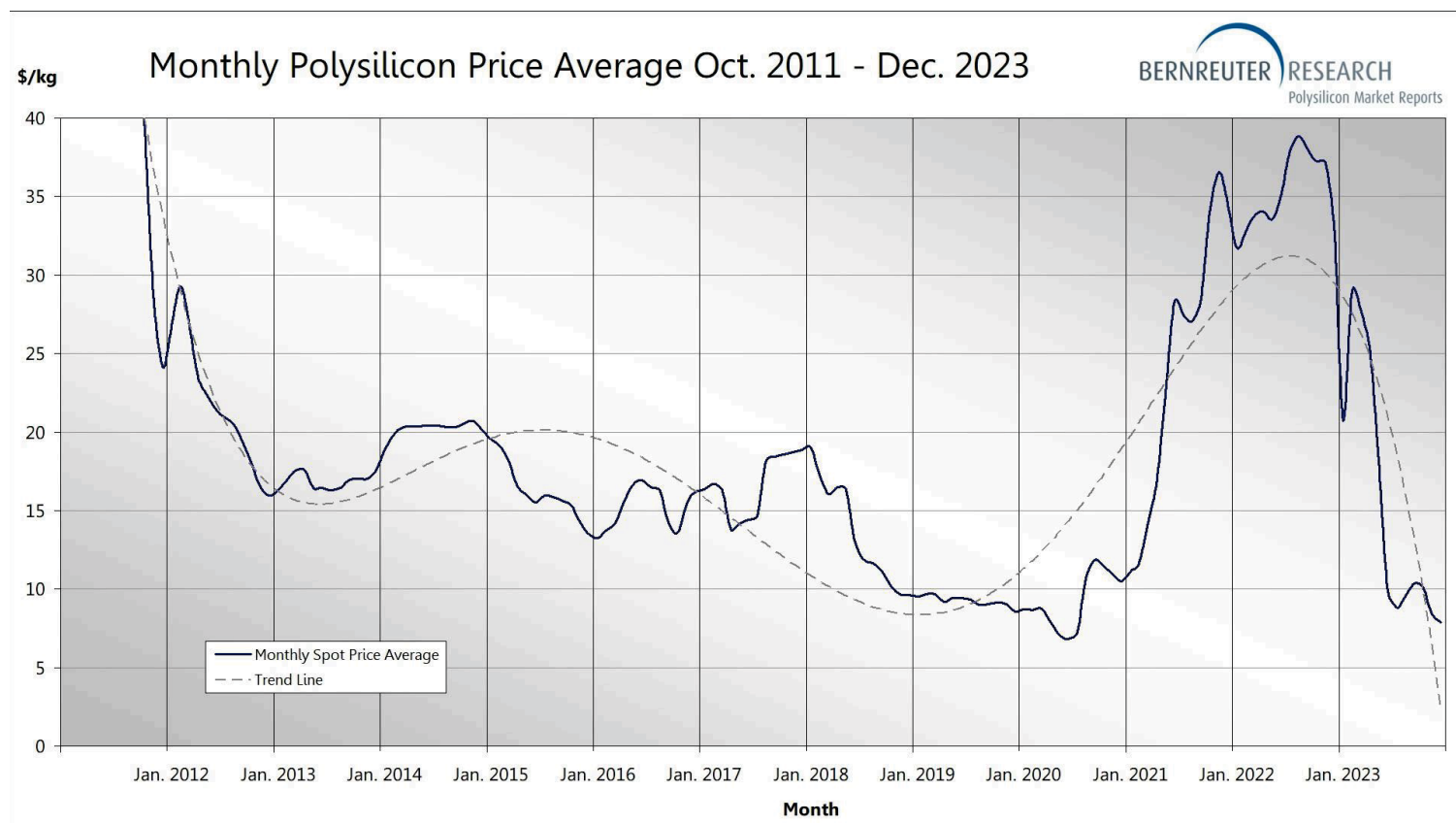
2013
\$17/kg

rate would be imposed. Until importers had adapted themselves to the new requirement, a short-term bottleneck in polysilicon supply occurred.

The duties had a limited impact on the spot price not only because the rate is very low for OCI and zero for Wacker, but also because of a big loophole: So-called processing trade was exempt from any duties. It can be conducted with imported goods (polysilicon) that are processed into products (wafers, cells, modules) destined for export from China.

As the price on the Chinese spot market climbed higher than it did internationally, several domestic polysilicon manufacturers resumed production when the average spot price in China rose up to \$18.85/kg after the Mofcom ruling.

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Apart from temporary fluctuations, it took twelve years from the price peak in 2008 to the trough in 2020 – Chart: Bernreuter Research

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2014: Short-lived price recovery

The positive trend continued into the first quarter of 2014 until the spot price reached a peak of \$22.60/kg in early March. For the rest of the year, the price declined slowly, but steadily; however, it still was above \$19/kg at the end of 2014 – practically the same value from which it started out at the beginning of the year.

As fewer new polysilicon capacities with low production costs came on stream than expected, the downward trend after March remained relatively soft. Two thirds of the new capacity was added in China. When Mofcom announced in August 2014 that the loophole offered by processing trade would be closed, it was the start signal for a couple of large and mid-sized domestic producers to increase capacity even further.

2014
\$20.5/kg

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2015: Oversupply sends the spot price south

The Chinese expansion became fully visible in 2015: 76% of the global capacity additions were implemented in China. Within just two years, the production capacity worldwide had thus increased by 100,000 MT.

This rapid rise exceeded the growth rate of the PV market. Consequently, the polysilicon spot price fell continuously throughout the year. Starting at more than \$19/kg in early 2015, it undercut the 2012 low in June and further tumbled close to \$13/kg by the end of the year.

2015
\$16/kg

2016: Cold shock after the spring rally

In early 2016 the spot price went even further south until it reached a new record low of \$13/kg in late January. All the more surprising was the vibrant price rally that started after the Chinese New Year holidays in mid-February, driven by the spot market in China. Within just three months, the Chinese spot price soared by \$4.70/kg to \$18.20/kg in the middle of May.

The massive expansion of wafer production capacities and strong increase of new PV installations in China ahead of the feed-in tariff cut on July 1 cannot completely explain this rapid price surge as polysilicon production rose significantly as well. There was also a good deal of market psychology at play.

Two events triggered hoarding purchases so that tight polysilicon supply became a self-fulfilling prophecy: Shortly after U.S.-based manufacturer REC Silicon announced in February that it would temporarily shut down its polysilicon plant in Moses Lake, Washington, the spot price began to rise. The second event was a flurry of media reports in mid-April that the Chinese customs had started investigations of polysilicon “smuggling,” which raised fears that supply would further tighten. After that, the price surge accelerated.

As REC Silicon still was a major player on the spot market at the time, it was not overly surprising that the price rally came to an end when REC announced in early May that it would restart production in Moses Lake. After the installation rush in China was over, the rest of the PV value chain already saw significant price declines; at the same time, Wacker ramped up its new U.S. polysilicon plant to the full capacity of 20,000 MT. Chinese polysilicon manufacturers tried to resist the downward price trend; in late August, however, their inventories had piled up so high that they were forced to succumb to the price pressure.

On September 20, Bernreuter Research warned in its **newsletter** that the spot price could fall below \$12/kg if manufacturers did not curtail production sufficiently. Three days later, REC Silicon announced it would reduce its utilization rate in Moses Lake to 50%. Promptly, the spot price stopped its plunge at \$12.65/kg (PVinsights) or \$13.10/kg (EnergyTrend) in early October. By the end of 2016, it recovered to a range of \$15 to \$16 per kg.

2016
\$15/kg

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Until 2018, U.S.-based polysilicon manufacturer REC Silicon was a major player on the spot market – Image: REC Silicon

2017: Hiccup before the installation rush

Obviously driven by restocking of inventories in expectation of high end demand, the polysilicon spot price climbed further by almost another dollar per kilogram until early March 2017. Then, however, it started a rapid decline by 20% within less than two months, coming close to its low reached in October 2016. While polysilicon manufacturers in and outside China were ramping up new capacities,

global PV demand did not develop as strongly as anticipated.

Only in late April did the spot price begin to recover, propelled by the Chinese PV installation rush that set in ahead of the feed-in tariff cut on July 1. After a short phase of weakness in June and July, the spot price made a significant leap in August when many Chinese polysilicon manufacturers suspended production for annual maintenance. Supply was further reduced in early September: After a hydrogen explosion, Wacker had to shut down its 20,000 MT polysilicon plant in the U.S. for several months.

Thus, the spot price continued its upward trend until the end of the year when it reached values between \$17.50/kg (PVinsights) and \$19/kg (EnergyTrend). In the first place, this high level was due to strong PV demand after the initial hiccup in spring: China reached a record installation volume of around 54 GW, an annual increase of 60%, driving global installations to a growth rate of more than 30%.

There was, however, another factor that pushed up the spot price, in particular towards the end of the year: The world's two largest producers of monocrystalline solar wafers, Longi and Zhonghuan Semiconductor, were building up large inventories of high-purity polysilicon as they expanded their production capacities significantly.



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2018: Spot price below the historical mark of \$10/kg

In January 2018 Longi's and Zhonghuan's strategic inventory stocking kept up the polysilicon spot price before it declined to a range of \$15 to \$16 per kg due to the usual seasonal weakness of demand.

Unlike in 2017, however, no signs of a Chinese installation rally appeared in April. On the contrary, in May information surfaced that several Chinese provinces stopped approvals of new PV power plants after the National Energy Administration indicated in draft documents issued in mid-April that it was going to enforce annual installation targets more strictly. On May 31 the extent of control became clear: The central government announced a subsidy cap on most segments of the domestic PV market for 2018.

The news hit the PV industry like a bombshell. The polysilicon spot price immediately plummeted by \$1.60/kg; it was the starting shot for a sustained descent. Beginning in June, more than half of all polysilicon manufacturers in China suspended production; one quarter did not resume operation again. This stabilized the spot price, but only for a few weeks in August.

Those manufacturers that returned to the market in the fall increased the pressure on the price. Moreover, new polysilicon plants and factory expansions in China with very low production costs and a total capacity of 152,000 MT came on stream in the fourth quarter. As a result, the spot price fell below the historical mark of \$10/kg in late October and closed the year at around \$9.50/kg.



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2019: Chinese low-cost plants amplify price pressure

Until late July 2019, the polysilicon spot price remained relatively stable, hovering around its new low of \$9.50/kg. In August, however, the ramp-up of new Chinese low-cost plants became visible on the market: The spot price began to crumble and fell below \$9/kg at the end of the month.

Many market observers expected that PV installations in China would surge massively in the fourth quarter and thus fuel polysilicon demand. Contrary to these assumptions, the surge hardly materialized whereas polysilicon production in China continued to grow. Consequently, the recovery of the spot price starting in mid-September was short-lived: In late November it undercut \$9/kg again and slid to \$8.50/kg by the end of the year.



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2020 - 2023: The pork cycle returns to the market

After the spot price stabilized in the first quarter of 2020, it was again pulled downward by weakening demand in the wake of the Covid-19 pandemic in the second quarter. Although OCI and Hanwha had shut down their solar-grade polysilicon capacities in South Korea in February and Wacker reduced the utilization rate of its German plants to 70% in May, the global spot price average reached a historical low of around \$6.75/kg in late June.

However, an explosion at Xinjiang GCL's plant in mid-July and a flood at Tongwei's subsidiary Sichuan Yongxiang in mid-August changed the picture completely: Since a capacity of 68,000 tons was temporarily not available, the spot price spiked to \$12.45/kg in mid-September. The subsequent drop to \$10.50/kg was just the usual seasonal decline at the end of the year. As it should turn out, the spike in September was only a weak sign of things to come.

In a turbulent roller-coaster ride, the spot price soared from the trough of \$6.75/kg in June 2020 to a peak of \$39/kg in August 2022 within little more than two years, and it went down close to the historical low again by the end of 2023 within less than one and a half years.

It took twelve long years from the historical peak of \$460/kg in March 2008 until the polysilicon spot price reached its trough of \$6.75/kg in June 2020. Why did the price down-cycle last so long after the price had already sunk below \$16/kg in December 2012? And why did the shortage come back to the polysilicon market so abruptly in 2021? Read our analysis of **why the pork cycle has returned to the polysilicon market**.

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About the author

Johannes Bernreuter is head of the polysilicon market research specialist Bernreuter Research. Before founding the company in 2008, Bernreuter became one of the most reputable photovoltaic journalists in Germany because of his diligent research, clear style and unbiased approach. He has earned several **awards**, among others the prestigious RWTH Prize for Scientific Journalism from the RWTH Aachen University, one of the eleven elite universities in Germany.

Originally an associate editor at the monthly photovoltaic magazine *Photon*, Bernreuter authored his first analysis of the upcoming polysilicon bottleneck and alternative **production processes** as early as 2001 ([Publication List](#)). After preparing two global polysilicon market surveys for *Sun & Wind Energy* magazine in 2005 and 2006, he founded Bernreuter Research to publish in-depth **polysilicon industry reports**.



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