

Déjà vu on the polysilicon market

Haven't we been here before? The polysilicon industry is shifting from shortage to oversupply. But a few things are different from market cycles of the past, as Bernreuter Research founder Johannes Bernreuter explains.

No sooner had a shortage of solar-grade polysilicon triggered a rise in the spot price, than the first new polysilicon projects were being announced in China. Construction sites mushroomed all over the country. By 2010, when the spot price crashed from its exorbitant April 2008 peak of \$475/kg to \$55/kg, there were already 41 Chinese polysilicon manufacturers, up from just two in 2005.

Although many manufacturers ran tiny production facilities with annual capacities of between 300 metric tons (MT) and 1,500 MT, the boom was enough to create oversupply. Around 135,000 MT of mainly Chinese production capacity were pushed out of the market between late 2010 and early 2013. The number of Chinese manufacturers shrank to nine before six dormant companies resumed production by the end of 2013.

Non-Chinese poly still commands more than

\$20/kg

Overcapacity concerns

Fast forward to 2021-24 and there is a strong sense of déjà vu. After years of weak PV demand, the market shifted from polysilicon oversupply to shortage, and the resulting spot price rally has provoked another flood of new polysilicon projects. Bernreuter Research has counted announcements from 38 new Chinese

polysilicon makers so far. More important, though, is massive expansion by the top Chinese manufacturers – particularly market leader Tongwei. In total, all running and announced Chinese production capacities add up to a staggering 7.55 million MT. Of that, at least 2.35 million MT only exist on paper, and another 800,000 MT are unlikely to be completed.

That still leaves an enormous solar-grade capacity of around 4.4 million MT by 2026, plus roughly 400,000 MT outside China. In an optimistic scenario, global wafer production would grow to 1,425 GW in 2026, which would require around 2.75 million MT of polysilicon. Under less ambitious assumptions, 1,150 GW of wafer output would consume approximately 2.2 million MT of polysilicon in 2026, making up only 46% of the potential production capacity.

The Silicon Branch of the China Non-ferrous Metals Industry Association was already warning about overcapacity and a long-term price collapse in March 2022. The organization's call for companies to "not only pursue immediate interests" went unheard. Local governments generally play a major role in the Chinese investment frenzy. Vying for new industrial settlements with incentives such as free land, reduced tax rates, and preferential electricity tariffs, they compete with dozens of other local authorities that do the same. In 2021 and 2022, the herd of investors only saw the high polysilicon price and a rosy outlook of strongly rising PV demand. The inevitable consequence was overcapacity. A couple of new polysilicon projects were even announced after the first price crash in May and June 2023.

Michael Parr, executive director at the Ultra Low Carbon Solar Alliance, said: "The Chinese solar industry does not operate in a fully market-based environment. Subsidization of various forms shields them to some degree from actual



Top Chinese polysilicon manufacturers have significantly expanded production capacity.

market forces such that we see these periods of wild overcapacity and resulting retrenchments. It is not particularly healthy for global solar to have these recurring oversupply/undersupply conditions and resulting cost gyrations.”

Betting on granular

In contrast, Chinese players seem to regard this cycle of overcapacity and shakeout as a sort of natural law. Rather than speaking of consolidation, they use the term “*nèi juǎn*,” meaning “inner revolution” or “inner change.” This alludes to the introduction of new, more competitive technology induced by overcapacity in the market; the elimination of old capacity is seen as an inevitable side effect. “*Nèi juǎn* has always existed,” Zhu Gongshan, chairman of China’s second-largest polysilicon manufacturer, GCL Technology, said in reference to oversupply at the company’s

2023 annual results presentation. “Without *nèi juǎn*, there is no competition and without competition, there is no progress.”

GCL is now fully betting on monosilane-fed fluidized bed reactor (FBR) technology to produce polysilicon granules, because in mid-2023 it shut down its Jiangsu Zhongneng production facility in Xuzhou, Jiangsu province, for polysilicon rods using the conventional Siemens process. The annual capacity at its four locations – in Leshan (Sichuan province), Baotou and Hohhot (both in Inner Mongolia), and Xuzhou – has hit 420,000 MT and is expected to increase to 500,000 MT by the end of 2024.

GCL never tires of lauding its FBR technology, but its claims have to be taken with a pinch of salt. For instance, the company said that 83% of its granular output in the first quarter of 2024 was suitable for n-type wafers that are used to make high-efficiency

Photo: Wacker Chemie AG



Polysilicon chips before processing.

solar cells. The carbon concentration in the granules, however, is still much higher than that of high-quality polysilicon rods. Likewise, the cost advantage is not as big as advertised, so GCL's cash costs are around 10% below those of the best Chinese players using the Siemens process.

GCL could build a

120,000MT

poly plant in Saudi Arabia

About the author

Johannes Bernreuter is the founder and head of Bernreuter Research, a market research firm that specializes in the polysilicon industry and the solar and semiconductor industries. Bernreuter is the author of the series "Who's Who of Solar Silicon Production" and "Polysilicon Market Outlook." More information on the latest report, *The Polysilicon Market Outlook 2027*, is available at www.bernreuter.com



N-type transition

Nevertheless, this edge puts GCL in a good position to weather the storm of the coming shakeout. In the first quarter of 2024, polysilicon manufacturers still benefited from large wafer production volumes and the corresponding strong demand for polysilicon. However, when swelling wafer inventories pushed wafer prices below cash costs, demand for polysilicon plummeted. Consequently, the price of high-quality polysilicon for n-type wafers, and of dense polysilicon for p-type wafers in China, broke through the thresholds of \$7/kg and \$6/kg, respectively, and fell to new historic lows in April 2024.

Just waiting until the large wafer inventories have been depleted and polysilicon

demand returns will not save second-tier polysilicon manufacturers and new entrants, due to their higher costs and low output of n-type material. The overcapacity in the market is simply too overwhelming and the PV industry's transition to n-type solar cells will separate the wheat from the chaff. This will become obvious during the second quarter of 2024, when top manufacturers Tongwei and Daqo plan to ramp up new capacities of 200,000 MT and 100,000 MT, respectively.

Beyond China

Three years ago, record-low prices would still have got the few polysilicon manufacturers outside China into serious trouble. However, the Uyghur Forced Labor Prevention Act in the United States, which prohibits the import of any product containing materials from the Xinjiang Uyghur Autonomous Region of northwestern China, has created a separate market segment for non-Chinese polysilicon since mid-2022. As demand is higher than supply, the price of non-Chinese polysilicon has remained above \$20/kg.

Despite this strong demand, new polysilicon projects outside China are rare. The lack of non-Chinese wafer manufacturers as potential customers, high electricity rates, and other limiting cost factors are holding investors back. In the United States, Highland Materials Inc. is planning to revive an improved version of the metallurgical silicon-aluminum purification process from the defunct Silcor Materials business and build a 16,000 MT polysilicon plant in Surgoinsville, northeastern Tennessee, by late 2026. In India, industrial giants Reliance and Adani are aiming at polysilicon production on a similar scale by 2026 and 2028, respectively.

Once again, Chinese players are faster. In March, United Solar Holding Inc. laid the foundation stone for a 100,000 MT polysilicon plant in the Sohar Port and Freezone of Oman. The company was established by Chinese investors led by Zhang Longgen, who resigned as chief executive officer of Daqo in August 2023. GCL also said in its 2023 results announcement that it would start construction of a granular polysilicon project in the Middle East in 2024, which will probably be a 120,000 MT plant in Saudi Arabia. "Venturing abroad has become an inevitable trend for industry development," explained the company. ^{PV}

Johannes Bernreuter