

The 2014 Who's Who of Solar Silicon Production

Players, Technologies, Supply/Demand, Prices
Global Market Perspectives through 2017

Johannes Bernreuter



All You Need to Know about Polysilicon

Do you want to be up to date on the latest developments in the polysilicon industry? On its most recent technological innovations and the decisive market trends? *The 2014 Who's Who of Solar Silicon Production* provides you with all of that. It analyzes hundreds of data and details, presents them in a clear and compact form, and draws insightful conclusions to help you make the best strategic decisions.

- ▶ The **introduction** illustrates the connection between the polysilicon spot price and the number of manufacturers and lists all companies that have stopped production since 2011.
- ▶ The **technology chapter** re-assesses the technical viability and cost potential of 10 polysilicon manufacturing routes, including the dominant Siemens process and physical purification methods to obtain upgraded metallurgical-grade (UMG) silicon – all in light of the recent market development and new technological achievements.
- ▶ The **company chapter** covers capacity expansions and plant shutdowns, technological progress and project changes at 92 manufacturers and aspirants through concise updates, arranged according to world region and manufacturing approach. Each region is introduced by a brief summary of location factors and/or development trends.
- ▶ The **supply chapter** provides you with four different scenarios of production volumes and end-of-year capacities for 85 polysilicon and UMG silicon plants and projects from 2011 through 2017. It highlights the market shares of the top ten manufacturers and the distribution of the global output by world region.
- ▶ The **demand chapter** quantifies the polysilicon demand of the semiconductor and photovoltaic (PV) industries from 2012 through 2017. It uses an improved bottom-up approach, based on numerous forecasts for regional PV markets, in order to arrive at three different scenarios of global PV demand.
- ▶ The **balance chapter** compares the various demand and supply scenarios, explains consequences from the supply/demand balance for market participants, and discusses changes in the cyclical pattern of the polysilicon industry.
- ▶ The **price chapter** examines the factors that have influenced the polysilicon spot price since 2011 and uses data from customs statistics to assess the effect of Chinese anti-dumping duties. Based on an analysis of industry cost curves, it forecasts the development of the spot price through 2017.
- ▶ The **cost chapter** provides data and background on cash production costs and depreciation rates of 48 polysilicon and UMG silicon plants from 2012 through 2017.

The 2014 Who's Who of Solar Silicon Production comprises 124 pages. It is offered for a price of 1,199 euros. At www.bernreuter.com, you will find a comfortable online order form.



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Executive Summary

After more than 50 manufacturers – most of them small and medium enterprises in China and South Korea – suspended or abandoned production in 2011 and 2012, the polysilicon industry recovered from oversupply in 2013. Due to low utilization rates in the first quarter, the global output decreased to approx. 228,000 metric tons (MT), 4% down from 238,000 MT in 2012. In contrast, demand from the photovoltaics (PV) industry rose by a double-digit rate, driven by new PV system installations of approx. 36 GW. Thus, the large polysilicon inventories resulting from oversupply in 2011 and 2012 could be reduced significantly.

The outlook for 2014 and beyond shows two sides of the same coin. On the one hand, growth of new PV installations will accelerate; we cover the broad range of forecasts for 2014 with three scenarios, spreading from 43 GW (low case) to 46 GW (base case) and 49 GW (high case). On the other hand, a slowly rising polysilicon spot price induced several dormant Chinese manufacturers to resume production in the second half of 2013, and additional capacities from new entrants and existing producers will come on stream in 2014. As soon as these capacities have largely been ramped up, they will lead to new oversupply – in the low-case demand scenario already in 2014, otherwise in 2015. Consequently, at least half a dozen high-cost producers will be pushed out of business.

In the high-case scenario, the spot price for solar-grade polysilicon will rise from 18 \$/kg at the end of 2013 to a range of 21 to 24 \$/kg in the first half of 2014. Market participants should not, however, misinterpret such an increase as a sustainable price trend. As our analysis of industry cost curves through 2017 demonstrates, the spot price will drop to 16 \$/kg by the end of 2014 in all our scenarios. It will not recover before overcapacity has disappeared from the market.

Electronic-grade polysilicon for the semiconductor industry has not been included in our cost curve analysis since we regard solar-grade and electronic-grade polysilicon as two different commodity products. Apart from some fluctuation, demand from the semiconductor industry will remain stable in a range between 29,000 and 31,000 MT.

As far as new production methods for solar-grade polysilicon are concerned, fluidized bed reactor (FBR) technology based on monosilane will emerge as a viable alternative to the established Siemens process in 2014. Out of the nine alternative manufacturing routes that we have assessed, monosilane-based FBR technology is the first that promises a real breakthrough in the market. While maintaining high silicon purity, it entails manufacturing costs that are substantially lower than those of the Siemens process.

Although approaches to produce upgraded metallurgical-grade (UMG) silicon have made significant technical progress, they have lost much of their original cost advantage. Hence, UMG silicon will only have a chance of succeeding when the market price rises again.



Johannes Bernreuter

About the author

Johannes Bernreuter, 48, head of Bernreuter Research and author of the report. Bernreuter has become 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. In 2008 he founded Bernreuter Research to publish polysilicon market reports.

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What customers say about The Who's Who of Solar Silicon Production

As a market participant and reader of all previous editions of The Who's Who of Solar Silicon Production, my company and I also find the 2014 edition an important piece of information. Silicon Products Bitterfeld GmbH & Co. KG is active worldwide as a polysilicon producer and engineering company. Therefore, an all-encompassing market overview, as condensed in this report, constitutes an additional source of information to make the right strategic decisions. This report provides a wealth of figures and fascinating prospects well into 2017. Apart from few exceptions, these forecasts are also in accordance with our assumptions. I hope the optimistic trends are correct. This would be good for our climate and for the solar industry.

silicon products
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Dr. Hilmar Tiefel

CEO of [Silicon Products Bitterfeld GmbH & Co. KG](#)

The 2014 Who's Who of Solar Silicon Production fully ties in with the good quality of former Bernreuter publications. The report provides a comprehensive view of the solar silicon sector with interesting analyses of the supply and demand perspectives through 2017. Overall it's a positive contrast to commonplace reports and provides good value for money.



Peter Stumper

Product Marketing Manager at [SGL CARBON GmbH](#)

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