

SILICON FOR SOLAR CELLS – AVAILABILITY, PRODUCTION AND PRICE PROGRESS

Milan Bělík

Abstract

The usage of solar cells is growing up, but the availability of pure silicon – the main element of cells is almost stagnating. This article describes the situation on the silicon market and evolutions in behaviour of the leading companies.

Progress overview

The raw silicon is the second most abundant element on the planet Earth (after oxygen), but a shortage of a highly purified version of the stuff is shaking up the solar-power industry, giving companies that didn't exist a few years ago a chance to challenge with longtime leaders in this industry.

The refined silicon, the most costly and crucial element of solar panels, has been in short supply for the past four years. There are only about a half-dozen companies world-wide that can purify silicon completely from sand and quartz crystal, but they haven't built new refineries fast enough to keep up with rising demand on the commodity. That has left solar-panel manufacturers, who must also compete with computer-chip makers (typically Intel and AMD) for silicon, to grapple with high prices from straitened supplies just as politicians and clean-energy advocates are pressing them to cut the steep cost of solar to compete with cheaper, less environmentally friendly fuels like coal.

Most panel makers have signed costly long-term supply contracts for silicon with fixed prices and huge upfront payments, and pay even stiffer prices for silicon on the spot market if those contracted supplies fall short. At the same time, some have developed a slew of new strategies - from recycling castoff bits of silicon to re-engineering their production lines to make thinner, more efficient cells. Some are even building or buying their own factories to make the silicon wafers that are sandwiched inside solar panels or purify their own silicon. Those companies that tackled the problem early have gained ground against more established rivals. After Michael Rogol, a solar-industry consultant for Photon Consulting in Aachen, Germany, were the biggest players much slower to move and the biggest companies lost their steam as the result. Sharp Corp., Mitsubishi Electric Corp., and BP PLC subsidiary BP Solar have all seen their growth slow after dominating the industry for years.

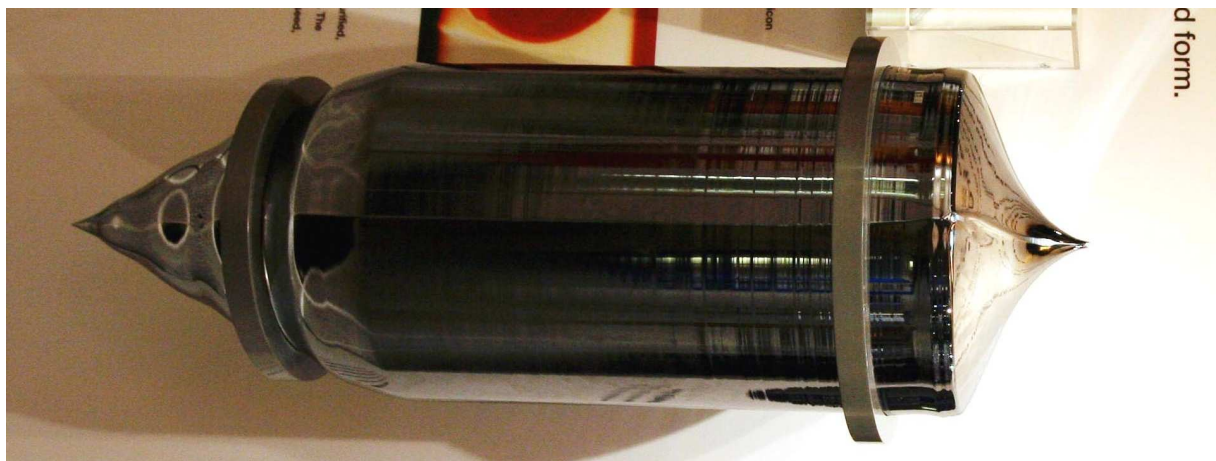


Fig. 1: Pure silicon ingot

Market leaders and the others

Sharp, the market leader by volume for the past seven years, has stumbled after several years of double-digit growth, in large part because it didn't move to cope with the shortage quickly enough. Last year it produced panels that could generate 434 megawatts of electricity, or the equivalent of a single gas-fired power plant, about the same amount it made in 2005. Ron Kenedi, vice president of Sharp Solar Energy Solutions Group, conceded that Sharp's growth rate had slowed because of the silicon shortage, but that the firm was "working on all fronts" to be able to grow as fast as possible.

To address the shortage, Sharp has signed long-term contracts, reduced waste and started recycling silicon at its factories, as well as invested in new technologies like thinner cells. It has also tried to climb up the supply chain. Sharp already makes most of its own silicon wafers, and it spent \$40 million on its own silicon refinery in Toyama, Japan, that can produce 1,000 tons of purified silicon a year. Sharp declines to say how much of its total consumption of silicon is satisfied by the new refinery, but analysts estimate that 1,000 tons is enough to account for about 20% of the panels Sharp made last year.

Sharp's struggles have left an opening for Q-Cells AG, the world's second-largest panel maker. Chief Executive Anton Milner started to secure silicon supplies in early 2004 when spot prices began creeping upward. The firm refused to sign long-term contracts at high, fixed prices. Instead, it insisted on variable price contracts and looked for other ways to sweeten the pot for silicon suppliers, such as dispatching engineers to their factories to help them improve their efficiency and quality control, and then splitting the resulting savings with them. Mr. Milner recalls he used to handle most of the work buying silicon with only one other manager; today, a team of 10 stationed in several countries works on it full time. In February, Q-Cells acquired a 17.9% stake of its main supplier, REC Group, based in Oslo, the biggest maker of silicon wafers in the world. Q-Cells, which was founded in 1999 and made its first solar cells in 2002, also started building a new factory at its headquarters in Thalheim, Germany, to make its own silicon wafers.

Q-Cells's production grew 52% to reach 253 megawatts in 2006, and the company says it now has enough silicon supply to manage its rapid growth targets over the next decade. But Mr. Milner warns that soaring silicon prices will dog the industry. "Some companies are booking themselves into nasty cost positions for the future," he said.

That is the situation that could be facing Germany's Ersol Solar Energy AG. Last year it produced only 55 megawatts of solar cells despite having the capacity to churn out more than three times that. "Our growth has been constrained by the silicon situation," said Ersol's director of investor relations, Sonja Teurezbacher. Because it refuses to buy silicon on the expensive spot market, Ersol has had to wait several years for suppliers with whom it signed long-term contracts in 2005 to begin deliveries. The company used some of the proceeds from its initial offering and another roughly \$80 million capital increase this summer to fund additional fixed-price supply contracts through 2018. Ersol also bought a California company that recycles silicon in an effort to find an alternative source. Ms. Teurezbacher dismissed concerns that Ersol could get caught overpaying for silicon in the next decade if the shortage lifts: "We are very happy with the prices we paid."

For China's Suntech Power, the fastest-growing solar-cell maker over the past few years, the calculus was different from rivals. Unlike some of its competitors, Suntech said it was willing to spend for expensive spot-market silicon to ensure that it kept growing and winning customers. "We can do that because we drive down costs on everything else like labor and manufacturing," said Steven Chan, chief strategy officer of the company. The downside of this approach was seen in this year's first quarter when some of Suntech's suppliers didn't deliver, and it was forced to buy large amounts of silicon on the spot market at sometimes triple the usual price. Margins dropped to 19.9% in the quarter, compared with

30.7% in the year-earlier period. "Wall Street was not too happy with it," says Mr. Chan, adding that problem has been resolved. Suntech now has the fourth-largest market share, and some analysts think it could one day be the biggest solar company in the world.

Development and progress

While panel makers have been trying to lock in supplies, keep some flexibility in costs and find alternative supplies, one of the most effective ways to confront the silicon shortage is to use less of it. Sharp, along with a slew of venture-capital-backed start-ups and its archrival Q-Cells, is also pouring money into developing new solar cells that use less silicon or none at all. Some panel makers are adding mirrors or lenses to concentrate the sun's rays and increase efficiency.

Phoenix, Ariz.-based First Solar Inc. recently came to market with the first thin-film solar panels that use only 1% of the silicon found in conventional solar panels. The firm's revenues are booming, and its share price has zoomed up to \$103 at the close of trading yesterday since going public on the Nasdaq at \$20 a share in June 2006.

Sharp management is upbeat about the industry's ability to come up with such new technologies and innovations to solve the silicon supply issue. In a sense, it's a good problem to have because it means the demand for our products is very high. It is forcing the manufacturers to do it better.

The silicon shortage has implications beyond solar companies' bottom lines. Despite decades of hype and hope, solar still accounts for less than 1% of the world's energy needs and is significantly more expensive than coal-generated power. It costs 35 to 45 cents to produce a kilowatt-hour of electricity from solar panels, compared with about three to five cents burning coal, according to the International Energy Agency.

Governments, including Japan, Germany, Spain, and the states of California and Nevada among others, have created huge subsidy programs for solar. The hope has been that as the technology spread it would achieve economies of scale and become less expensive. Yet the price of solar installations actually rose 20% from mid-2004 to mid-2006 in part because of the silicon shortage, said Alistair Bishop, a renewable-energy analyst with the German investment bank Dresdner Kleinwort. They have since fallen about 10%. "The silicon supply is a huge issue for the industry," said Mr. Bishop. Silicon refiners - including the two largest, Germany's Wacker Chemie AG and the U.S.'s Hemlock Corp. - are rapidly building new refineries, but the tight supply isn't expected to let up before 2009.

Solar-panel makers are feeling the heat. The politicians expect cost reductions, but how the silicon supply situation turns out will go a long way will determine whether solar is viable.

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Authors' address

Ing. Milan Bělík, Ph.D., belik@kee.zcu.cz