

Analysis of the Import Trade of Polysilicon in China

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Abstract: Based on the national supporting of the new clean energy industry, it is developed rapidly in Chinese polycrystalline silicon industry. But in recent years, the development of Chinese polycrystalline silicon industry chain downstream depends on imports from abroad heavily. And the number of polysilicon importing accounted for more than 30% of domestic demand ever year, the environment of domestic polysilicon enterprises is not optimistic. Besides, frequent imports trade frictions affect the sustainable development of the polycrystalline silicon industry seriously. Therefore, it is practically significant to analyze the current situation of China's polycrystalline silicon imports. The paper introduces the present status of polysilicon imports in China, expounds the influential factors and analyzes the existing problems. Finally, some reasonable suggestions are thrown out for typical problems.

1. The status of import trade of polycrystalline silicon

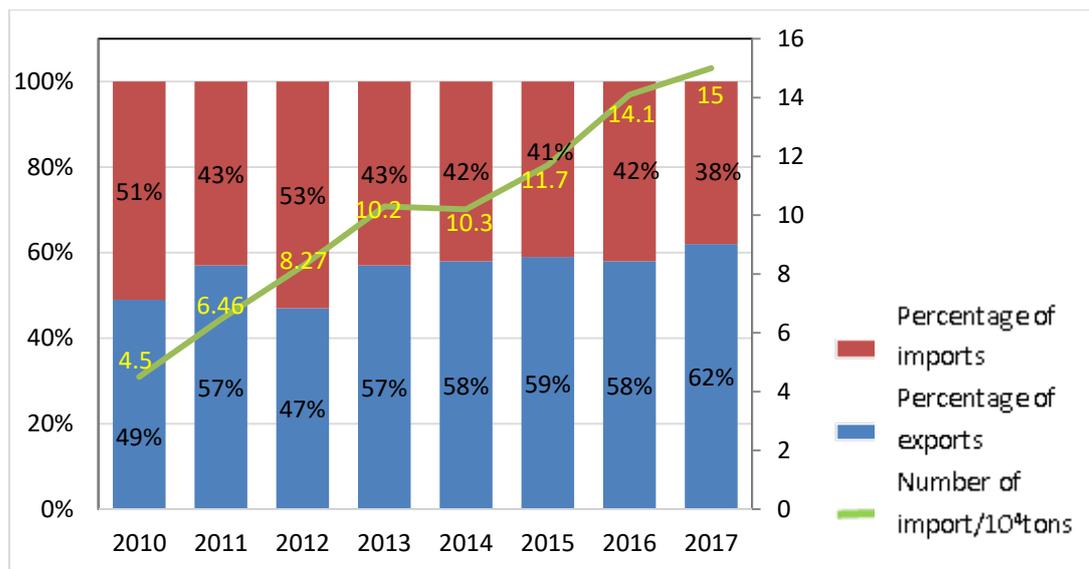
1.1 Significance of Polycrystalline Silicon and Photovoltaic Industry for our Development

Silicon industry was an important industry of non-ferrous metal industry, and polycrystalline silicon as a strategic variety, has been highly concerned by relevant industries at home and abroad in recent years^[1]. High purity polysilicon is classified into electronic grade polysilicon and solar grade polysilicon. Electronic grade polysilicon has properties of semiconductor and it's an extremely important excellent semiconductor material, which is mainly used in electronic equipment. Solar grade polycrystalline silicon, as the raw material of the solar energy industry chain, is often used to cast ingots or pull single crystal silicon to produce solar panels. Polycrystalline silicon and photovoltaic products are clean、safe and stable and well-off. In addition, they hold long life and low maintenance costs. They have become new materials and new energy industries vigorously supported by our country and have great potential for development^[2].

1.2 The Status of Import Trade of Polycrystalline Silicon

In recent years, due to the rapid development of photovoltaic industry, the domestic market demand for polycrystalline silicon is very strong. While the domestic production of polycrystalline silicon has increased steadily, the import volume has also continued to grow.

As shown in the figure 1, the domestic supply of polycrystalline silicon had been increasing from 148,600 tons in 2011 to 392,000 tons in 2017, and the import had also increased year by year, from 64,600 tons to 150,000 tons. Moreover, imports account to more than 38% of the total supply over the years, up to 53% in 2012. The dependence degree of polycrystalline silicon industry on foreign countries remained high, which seriously restricted the development of the industry.



Data Source: Silicon Branch of China Nonferrous Metals Industry Association

Figure 1. Imported and domestic production of polysilicon from 2010 to 2017

2. Influence Factors and Existing Problems of Import Trade of Polycrystalline Silicon

2.1 The Main Factors Affecting the Import Trade of Polycrystalline Silicon

2.1.1 Price factor: low price dumping of foreign markets

The situation of polycrystalline silicon import trade in China is still grim and complicated in recent years. By virtue of the advantages of technology and cost, the giant polycrystalline silicon enterprises in the United States, Europe and Korea, with the support of preferential policies of their governments, continuously dumped polycrystalline silicon into the Chinese market at low prices around 2012, resulting in a substantial increase of polycrystalline silicon imported in China^[3]. The domestic market demand for polysilicon was about 145,000 tons in 2012. Among them, the imported polysilicon was 827,000 tons, which rose 28% than 646,600 tons in 2011, with a total value of more than \$2.1 billion. Affected by low-cost export dumping of polycrystalline silicon giants from Europe, America and South Korea, the domestic output of polycrystalline silicon in 2016 was 195,000 tons, with an increase rate of 14% over the last year, and the growth rate slowed down^①. The low-price dumping of foreign giant polysilicon enterprises was an important reason for the high import amount of polysilicon in China.

① Note: Domestic polysilicon output in 2015 was 170,000 tons, an increase of 28% over the last year.

2.1.2 Supply and demand factors: domestic demand

In recent years, the cost of polysilicon has been declining, the technology has been innovating, the capacity has been expanding continuously, the market has been booming both in supply and demand, and the supply exceeds demand^[1].

It can be seen that in recent years, the domestic market demand has become more and more vigorous, and the domestic output and import volume have also increased. The increasing domestic demand and import growth rate from 2014 to 2017 showed that domestic demand and import were positively correlative, and the growth rate of domestic output was not as fast as that of consumption in the same year. That was, with the increasing domestic demand, the import volume was also increasing, indicating that the relationship between supply and demand also restricted the quantity of imports.

Table 1. Supply and demand relationship of polysilicon from 2013 to 2017

year	2013	2014	2015	2016	2017
Consumption/10 ⁴ tons	15.7	17	22	26	39
Increase rate over the last year	8.3%	8.3%	29%	18%	50%
Domestic output/10 ⁴ tons	13.2	13.6	17	19.5	24.2
Increase rate over the last year	85.9%	3.0%	28.7%	14.7%	24.1%
Import volume/10 ⁴ tons	10.3	10.2	11.7	14.1	15
Increase rate over the last year	24.5%	-0.9%	14.7%	20.5%	6.4%

Data Source: Silicon Branch of China Nonferrous Metals Industry Association

2.1.3 Cost and quality factors

The modified Siemens process is still the main technology for producing polycrystalline silicon at present, but its power consumption is high. GCL-Poly upgraded the existing modified Siemens process with a new silane fluidized bed polycrystalline silicon production technology In 2015, which reduced the production costs to less than \$9/kg. Moreover, the comprehensive power consumption and reduction power consumption of some advanced enterprises had been reduced to less than 60 kWh/kg and 40 kWh/kg respectively. The domestic production and cost advantages had been further improved, and the import of polycrystalline silicon has begun to decrease gradually^[3]. Since the implementation of anti-dumping and countervailing sanctions in China in 2013, the import volume of polysilicon had declined and risen. On the one hand, the sanctions are not enough, on the other hand, it also shows that foreign polysilicon enterprises are still seizing the market of our country by means of price war. Therefore, it is particularly important to control the cost factors including technology cost and power consumption cost.

According to analysis, although domestic polysilicon has some international competitiveness, its performance is not stable and its quality is inferior to imported polysilicon. For example, the minority carrier lifetime specification of N-type single crystal silicon was more than 1000us, and the unqualified rate of domestic polysilicon was 15%-20% in 2016, while that of imported polysilicon was only 0.5%-0.9%^[5]. Therefore, because the quality of some domestic polysilicon is not as good as foreign countries, downstream enterprises can only choose to import polysilicon as raw materials from the United States, Europe, South Korea and other places.

2.1.4 The policy of customs

The customs policy is directly affects the import and export trade of mineral products. China had imposed two-year "double-anti" sanctions (anti-dumping and anti-subsidy) on solar polysilicon products imported from the United States, Europe and South Korea to restrict imports by imposing anti-dumping and anti-subsidy duties since 2014. China's investigative authorities ruled that if the anti-dumping duty against the EU was terminated in April 2016, the polycrystalline products imported from the EU would still be dumped against China and would cause damage to China's polycrystalline silicon industry. Therefore, the anti-dumping duty and countervailing duty would continue to be levied. As shown in figure 1, the import of polysilicon decreased in 2014 compared with the previous year under the influence of the "double- anti" policy[®]. At the same time, after the price commitment reached between China and Wake Germany, according to the relevant provisions of the agreement, "Guarantee that Wake Chemical Group, headquartered in Munich, will also be able to enjoy the conditions in line with the market rules when selling its polycrystalline silicon to China in the future"^[7]. The import of polysilicon from Germany jumped to the NO1, with a growth of 125% in March 2014 .And it created a record .

② Note: Other factors have little impact in 2014 and can be neglected.

2.1.5 The RMB exchange rate

There is a very close relationship between exchange rate fluctuation and import amount. In theory, the appreciation of RMB will increase the price of commodities that can be priced by RMB, and then imports increase, which will have a significant impact on a country's trade structure^[8].



Data source: China Gold Investment Network

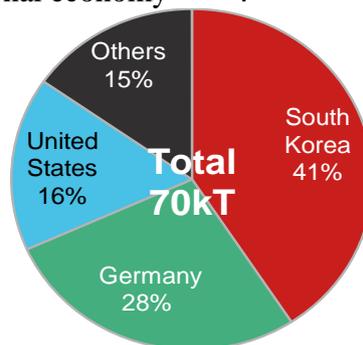
Figure 2. Time-split trend of the dollar exchange rate from 2012 to 2015

As can be seen from Fig. 1 and Fig. 2, the third quantitative easing policy (EQ3) was launched by the United States in 2012, which made the exchange rate of RMB to the United States dollar come to a head^[9]. As a result, the import ratio of polysilicon reached its highest value of 53% in recent years.

2.2 Existing Problems in Import Trade of Polycrystalline Silicon in China

2.2.1 Onefold trade partners and high degree of external dependence

In recent years, the subprime lending crisis in the United States has gradually improved. However, we can see that the economic crisis of the United States and the developed countries in Western Europe, as China's main trading partners, had reduced our foreign trade through these crises. Thus, trade at home and abroad competition was intensified, which has a great influence on our foreign trade and even the national economy^[10-11].



Data Source: Bloomberg Information Corporation

Figure 3. Share of international polysilicon exports to China 2015

Chinese polycrystalline silicon import trade partners are mainly concentrated in the United States, Germany, South Korea and other places. In a short period of time after the final ruling of the Ministry of Commerce in 2014, South Korea surpassed Germany and the United States and became China's largest source of polycrystalline silicon import^[12]. According to statistics, the import volume of polycrystalline silicon in China reached 195,000 tons in 2016, with a total amount of 14.8 billion yuan. The import dependence of polycrystalline silicon was up to 0.2%^③. For polycrystalline silicon, a single commodity, the degree of import dependence was still high. It can be predicted that once the market fluctuates, or because of other reasons such as trade wars, Europe

and the United States reduce production of photovoltaic products, restrict exports or raise prices. It will easily lead to the shortage of supply in the polycrystalline silicon market in China, leading to a huge influence of the photovoltaic industry and even economic strategic stability in China. Therefore, there are potential economic security risks for China in such a bilateral trade commodity structure.

③ Note: Import Dependence = Total Import Trade/GNP

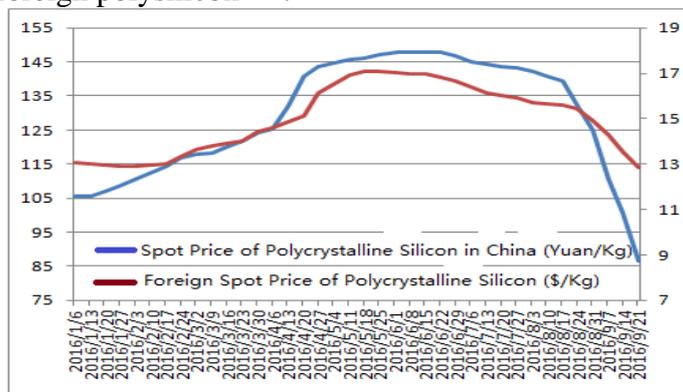
2.2.2 The situation of international trade disputes is still grim and the voice of the industry is not high enough.

The United States and Europe announced a "double-anti" investigation on photovoltaic products exported to China around 2012. Then, a number of polycrystalline silicon manufacturers headed by GCL-Poly, LDK Solar, SINOSICO and DAQO NEW ENERGY submitted to the Ministry of Commerce an application for anti-dumping investigation on polycrystalline silicon in Korea and an application for anti-dumping and anti-subsidy investigation on polycrystalline silicon enterprises in the United States, and tried to levy more than one. The import tariff of crystal silicon would counteract the import tariff of Europe, America and other countries [13]. According to the investigation by the Ministry of Commerce of China, there were dumping and subsidy phenomena in imported solar-grade polysilicon produced in the EU, the United States and South Korea. The domestic polysilicon industry in China had suffered substantial damage, and there was a causal relationship between dumping, subsidy and substantial damage [14].

In recent years, trade frictions of photovoltaic products, including the "double-anti" investigation and the Sino-US trade war which began in March 2018, are still frequent, and the situation of foreign trade is still grim. Moreover, the United States and Europe still evade taxation by means of re-exporting to Taiwan, processing trade [15]. Which also shows that China's voice in photovoltaic products and silicon industry is insufficient, and the dominance and voice of international trade are insufficient. The pricing power of polycrystalline silicon is almost entirely in the hands of developed countries in the United States and Europe.

2.2.3 Overseas dumping

The production cost of polysilicon is generally lower than that of domestic enterprises, because foreign enterprises occupy the advantages of low technology cost, low power consumption cost and high government subsidies [4]. Consequently, the sales price of polysilicon is also superior to that of domestic enterprises, resulting in the domestic photovoltaic industry passively accepting the low-price dumping of foreign polysilicon [16].



Data Source: Report of 2016 China International Silicon Industry Conference

Figure 4 .Spot price of polysilicon at home and abroad from Jan to Sep of 2016

As can be seen from the chart above, taking September 2016 as an example when the price difference between domestic and foreign countries was the smallest, the domestic spot price of polycrystalline silicon was about 86.5 yuan/kg, while the international spot price of polycrystalline silicon was about 12.7 dollars/kg in the same period, which was still lower than the domestic price [5]. In other periods, foreign prices were lower than domestic prices, and domestic downstream

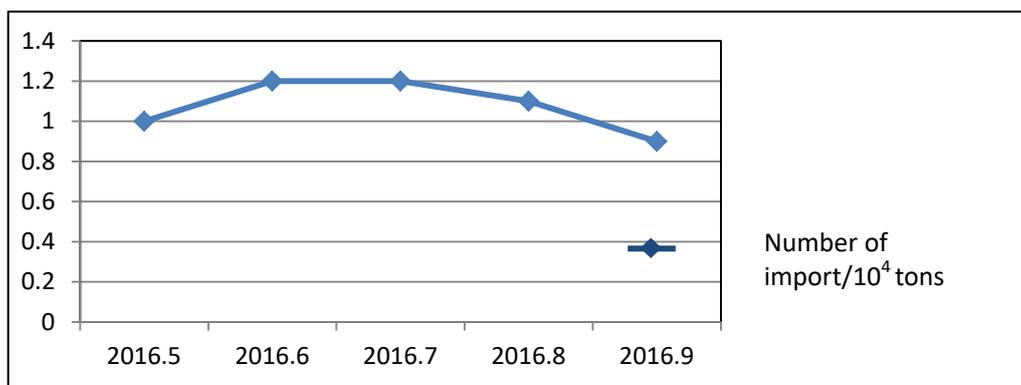
polycrystalline silicon enterprises would naturally import raw materials from overseas. Even some foreign polysilicon giants would rather lose money and dump at a low price with the support of their governments, overwhelming China's polysilicon enterprises, seizing the domestic photovoltaic market, and then making huge profits^[17].

④ Note: The cost of foreign advanced enterprises has been controlled below 12 US dollars/kg, while only a few domestic enterprises such as "GCL-Poly" and "Xinjiang DAQO" can control the production cost to the international advanced level.

⑤ Note: The exchange rate of RMB to US dollar in September 2016 was about 6.67, and the spot price of international polysilicon after conversion was about 84.7 yuan/kg.

2.2.4 Unbalanced supply and demand in the market

China's polycrystalline silicon market is generally in excess of demand at present, but more than 30% of polycrystalline silicon dependent on imports because a considerable part of the low-efficiency production are filled with market. The domestic market demand was strong, and the import volume also increased during the "630" rush to install downstream photovoltaic modules in 2016^[3].



Data Source: Silicon Branch of China Nonferrous Metals Industry Association

Figure 5. Imports of polysilicon from May to September 2016

There was a downward trend as analysed by industry, the average monthly import price and import volume of Customs in July, mainly doing to the rapid cooling of domestic downstream photovoltaic industry demand after the "630" node. Polycrystalline silicon import volume came into the downstream channel^[18].

3 Terms of settlement

3.1 Expanding overseas emerging markets and diversifying trade partners

It is the background of the outbreak of the economic crisis that we are more aware of the importance of diversification of trading partners. More attention should be paid to trade with emerging economies and third world countries. In Latin America, India and Japan have accelerated their development, resulting in a more balanced geographical distribution of import sites and avoiding the risks of economic fluctuations in the world's major economies by virtue of the diversification of trading partners^[19].

3.2 Upgrading industry and establishing a mature trade model

The structure of foreign trade of a certain industry in a country is also a reflection of its industrial structure. Polycrystalline silicon, the upstream raw material of photovoltaic industry in China, is heavily dependent on imports. This shows that a considerable part of polycrystalline silicon produced in China is not only inferior to advanced foreign enterprises in quality, but also can not be reasonably controlled in cost and price. Therefore, we should speed up the elimination of backward production capacity, promote industrial upgrading, strengthen independent innovation of technology and products. Particularly, measures should be taken to continue to optimize smelting production

process, improve product quality and economic and technological indicators, and vigorously promote the use of energy-saving and environmental protection. Finally, cost-saving and efficiency-enhancing new technologies are created, new progress and breakthroughs are achieved in energy conservation, emission reduction and comprehensive utilization of resources. Consequently, it's a general trend to produce high-quality, low-cost and high-added products^[3, 19, 21, 22].

3.3 Establishing and improving relevant regulations and policies

The policy of improvement trade was originally proposed to promote the export of photovoltaic industry, but the policy foundation of encouraging import of improvement trade has long disappeared with the transformation of photovoltaic industry from simple processing to high-end manufacturing mode. As a result, the policy of processing trade was abused by overseas enterprises. Import of polycrystalline silicon by means of processing trade has been simply used as a channel to evade tariffs, which has deviated from the original intention of the policy. Hence, processing trade policy no longer meets the needs of the development of China's photovoltaic industry. Therefore, the abolition of this policy will play a more positive role in the development of China's photovoltaic industry^[23, 24].

In addition, there has been a phenomenon that foreign enterprises evade tariffs by means of re-exporting to Taiwan, especially polycrystalline silicon enterprises in the United States, since the implementation of the "double-anti" policy in China to Europe, America and South Korea. According to the statistics of the Silicon Industry Branch, the total import volume of polycrystalline silicon from Taiwan in the first quarter of 2014 accounted for 10.2% of the total import volume in the same period. Therefore, we must establish relevant laws, regulations and policies, and timely plug these loopholes represented by processing trade and transit to Taiwan^[23-27].

3.4 Establishing early warning and protection mechanism to deal with malicious dumping

We must abide by the laws and rules of WTO and free trade zones in international trade. However, once other countries launch trade barriers against us, which will damage our interests (such as the United States announced they would impose a 25% tariff on China's aerospace, information and communication technology, machinery and other products in March 2018, opening the prelude of the China-US trade war), China must have corresponding response mechanisms to prevent other countries from abusing trade relief measures^[28]. We should reasonably lobby, actively defend, handle the investigation cases objectively, fairly and prudently, and safeguard China's legitimate rights and interests with the help of the International Trade Promotion Committee and other institutions^[29, 30].

4. Expectation

The polysilicon industry is facing a series of problems, such as weak demand, overheated investment expectations and frequent international trade disputes. On the whole, the import trade of polysilicon in China is still developing healthily and steadily. And under the background of national support for the development of new materials and new energy industries, the industry constantly strengthens technological innovation, promotes industrial upgrading, and gradually improves international competitiveness. In the future, the development potential of polysilicon industry is tremendous. Chinese polysilicon industry should strengthen cooperation among industrial chains, enhance its comprehensive competitiveness and gradually replace imports through independent innovation, industrial upgrading and improvement of driving modes. Reducing trade frictions in the foreign trade of polycrystalline silicon, further enhancing the voice in the international polycrystalline silicon market, and contributing to the photovoltaic industry and even to the economic construction of our country. At the same time, the relevant policies and regulations are supposed to be established and improved in conjunction with the industry to develop the photovoltaic industry healthily and stably.

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