

The Status of Photovoltaic Industry and Market Development in China

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- **Abstract:** *The status of PV industry rapid development in China is described in this paper, and the status of PV market slow development in China is described as well. Such extremely unbalanced development between PV industry and PV market is worth concerned and pond over seriously.*

1. Introduction

The development of PV industry is very fast recent years in China pushed by world PV market. The share of PV production reached 8% in 2005 from 1% of few years ago, only less than Japan and Europe, China has become one of the most important PV production countries. However, The development of PV market is very slow in China. A deep understanding of the PV development situation is very important for analysis of development potential and study of development strategy and taking active measures.

2. The status of photovoltaic industry and market development in China

The PV industry enters the period of fast development after 2001 in China. Especially since 2003, the PV industry development is fast with extraordinary speed, the production of solar cells reached 145.7MWp in 2005 with almost 3 times of 50MWp in 2004, and a more complete PV industry chain has formed including SG-Si ingots/wafers, solar cells/modules, PV systems and applications, manufacture industry of components of balance of system(BOS),materials and equipment for PV.

2. 1 Solar grade silicon(SG-Si)

SG-Si raw materials for PV are provided by manufactures of extra-pure polycrystalline Si original for semiconductor industry. Compared with other parts of PV industry chain, the complexity, capital invest, construction period of the manufacture of SG-Si are much more than others, its response speed for PV market initiated is much slower(about 3-4 years), therefore, it causes the shortage of SG-Si worldwide since the early 2004.According to estimated recently, such shortage situation of SG-Si will last to the late of 2008.

The technology and industry of SG-Si materials in China lag much behind that of developed countries, therefore, the contradiction of SG-Si shortage for providing is especially outstanding. For example,the price of SG-Si in the world market is about 40~50 USD/kg, but is about 100~200USD/kg in Chinese market. There was only Emei Semiconductor manufacture before the late of 2005 for producing extra-pure mc-Si with 100 ton/a capacity, and only few decades tons/a, which scale is too small and technology is far behind compared with above 2000tons/a economic scales manufactures with advanced technology in the world; Luoyang Zhonggui has setup a mc-Si production line with 300 tons capacity and put into production in the late of 2005 and plan to produce 240tons in 2006; Sichuan Xinguang has setup a mc-Si production line with 1260 tons capacity with Siemens technology in recent years,ant will be put into production in early of next year, its success of putting into production will be the breakthrough of more than 1000tons scale mc-Si industry. There are a lot of enterprices are planning to setup mc-Si production line with scale of more than thousand tons,whether their success depends on if they can get reliable technology.

The production of mc-Si was 80 tons and capacity was 400tons in 2005(LuoyangZhonggui 300tons and Sichuan Emei 100tons),there is a big difference between supply and demand, as shown in table 1, the supply of mc-Si substantially depends on import.

Besides of Sichuan Xinguang is in construction, Sichuan Emei and luoyang zhonggui are extending their capacities. According their plan goals, the total capacity of mc-Si production will reach4000 tons in late of

2008,as shown in table 2. It will be considerable formidable task.

Table 1 Supply and demand of mc-Si in China during 2004—2006

	2004	2005	2006(predicted)
Demand of semi conductor, tons	910	1060	1300
Demand of PV industry, tons	585	1596	3080
Total demand, tons	1495	2656	4380
Supply for PV,tons	57.5	80	340
Total short of supply, tons	1437.5	2576	4040
Short of SG-Si supply, tons	527.5	1516	2740

Note: Expending amounts of SG-Si are 13、12、11 tons/MWp in 2004、2005、2006 respectively, the production of C-Si solar cells will be 280MWp predicted)。

Table 2 The construction projets of mc-Si production in China

	Annu.capacity,tons	Completed time (predicted)
mc-Si production line for demonstration in Sichuan Emei	100	Late of 1999
SG-Si project in Sichuan Emei	200	2006
300tons mc-Si project in Luoyang Zhonggui	300	2005.12 put in production
700 tons mc-Si extending project of in Luoyang Zhonggui	700	The earky of 2007
mc-Si extending project of second phase in Luoyang Zhonggui	2000	2008
Sichuan Xinguang Silicon	1260	The middle of 2007
Total	4560	2007—2008

Note: The projects being planning are not included, Such as Nanbo in Yichang of Hubeietc.。

2. 2 SG-Si ingots/wafers

The development of SG-Si ingots/wafers industry is very fast since 2003. the total production of SG-Si ingots /wafers reached 2386 tons in 2005,in which mono-Si is 2086tons and mc-Si 300 tons, and capacity has reache5842 tons(mono-Si 4850tons and mc-Si 992 tons), as shown in table3. Jinglong group has furnaces more than 300 for SG-CZ-Si ingots pulling and produced 1126 tons in 2005 and become the largest manufacture of SG-Si ingots/wafers in the world; Baoding Tianwei-Yingli has 23 furnaces for SG-mc-Si ingots casting and produced 260 tons in 2005. Jinzhou Huari,Jiangsu Shunda,Changzhou Tianhe, and Ningbo Jingyuan produced 400、100、60 and 40tons SG-Si ingots respectively in 2005. The capacity of 100MW mc-Si casting ingots will be formed in Jiangxi Saiwei LDK by purchasing 100 casting furnaces of SG -Si ingots.

Table 3 Production and capacity of SG-Si ingots in 2005 in China

manufacture	Si type	Ann.capacity tons	Production,tons
Jinglong group	Mono-Si	2250	1126
Jinzhou Huari	Mono-Si	800	400
Baoding Tianwei-Yingli	Mc-Si	770	260
Jiangsu Shunda	Mono-Si	350	100
Changzhou Tianhe	Mono-Si	180	60
Ningbo Jingyuan	Mc-Si	90	40
JinggongSolar	Mc-Si	132	0
Others	Mono-Si	1000	400
Total	5842 (mono-Si 4850, mc-Si 992)		2386 (mono-Si 2086, mc-Si300)

The one of features in SG-Si ingots industry is that the mono-Si take the main share, the ratio of mc-Si with mono-Si is about 1: 7, while the ratio in world is about 2: 1。 The main reason is that the pulling technology of mono-Si ingots in china is more maturer than mc-Si casting, the manufacture of mono-Si pulling furnace has realized localized production, and price is much cheaper than that of input. So the capital invest, construction and payback period of mono-Si are much smaller than mc-Si casting at present, which is the first option of smaller

enterprises.

2. 3 Solar cells

The development of solar cells industry is fast with extra-ordinary speed since 2003, the annual increase rate has reached 100%~300%. There are 12 manufactures for producing solar cells, the production of solar cells has reached 145.7MWp in 2005, in which c-Si cells 133MW, a-Si cells 12.7MWp, as shown in figure 1. Suntech is the largest solar cell manufacturer, and produced 82MWp with taking 82% share of total production in China. Others

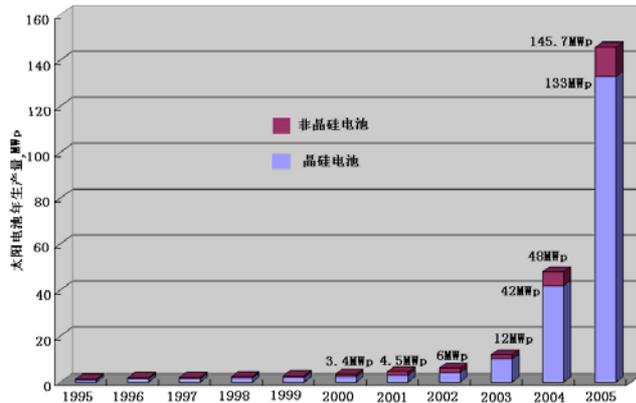


Figure 1 The development of solar cell production in china

are shown in table 4. In only 2-3 years, solar cell production increased from 1.07% to 8% of world, only after Japan and Europe. From table 4, the capacity of solar cell production will be 1645.5MW (1601MW for c-Si, and 44.5MW for a-Si) in 2006.

Table 4. Production of solar cell in 2005 and manufacture capacity in 2006

companies	Production in 2005, MW	Capacity in the end of 2006, MW
Suntech Power	82	270
Ningbo Solar	20	100
Shenzh Tuori	9.6 (3 for c-Si, 6.6 for a-Si)	68 (38 for c-Si, 30 for a-Si)
Guangdong quanxin (for yard grass land lighting)	9	20
Shanghai Taiyang	7	25
Nanjing Zhongdian	5	200
Tianwei Yingli	3	60
Yunnan Tianda	3	50
Tianjin Jingneng	2.1 (a-Si)	7.5 (a-Si)
Shenzhen Chuangyi	2 (a-Si)	5 (a-Si)
Shengzhen Riyuehuan	2 (a-Si)	2 (a-Si)
Jiangsu Linyang	1	100
others	0	738
Total	145.7 (133 for c-Si, 12.7 for a-Si)	1645.5 (1601 for c-si, 44.5 for a-Si)

2. 4 Solar modules

Solar module manufacture is the last link of PV industry chain. There are more than 500 production lines for module assembly as estimated and passed through TÜV, UL, etc. international certification. According recent statistics, PV module production reached 284MWp and capacity reached 874MWp in 2005 in China, as shown in figure 5.

Table 5 The assembly capacity of solar module in 2005 in china

Companies	Production,MW	Capacity,MW
Suntech Power	78	120
Shanghai Solar S&T	45	100
Tianwei Yingli	13	50
BP Jiayang	8	50
Ningbi Solar	15	50
Jiangsu Linyang	6	50
Changzhou Tianhe	10	50
Shenzhen Tuori	4	10
Yunnan Tianda	6	10
Shanghai Taiyang	5	10
Tianjin Jingci	8	10
Wuhan Rixin	8	10
Shzhen Xianxing	8	10
Orhwes	70	344
Total	284	874

2. 5 The development of Related Industry

Besides the development of above main chain of PV industry, related industry also get development with fast speed, homonious and balance mode, such as PV system and applications, components for balance of system(controlor,invert, battery,distribution system,support and cable etc.),equipment manufacture of PV industry(such as pulling furnace for CZ-Si,washing machine, plasma etching machine,diffusin furnace, firing furnace, cell sorting machine, semiauto-screen printer,assembly machine,lazer machine,solar module modeling,etc.) and special material industry(such as EVA,Ag and Al paste, glassetc.).The related industry for PV is an importan part of whole PV industry, and play a important role in reduction of PV cost.

Suntech has stepped into the rank of top eight solar cell/module producers in the world, and its stock got success in New york Exchange market last year,Jinglong group has become the largest manufacture of CZ-Si for the PV industry in the world,which has produced 1126 tons in 2005;and Ningbo solar, Baoding yingli, Jiangsu Tianhe,jiangsu linyang,and Nanjing Zhongdian,etc.,attracted the world concerned with their production quality and scale. All these marked that PV industry in China are going forward specialization ,mass production and internationalization.More manufactures will appear in 2006 with more than hundreds MWp of ingots or solar cells. The development of PV indutry build up a excellent team of PV enterpricer and a team of PV specialists.

3.The status of PV market development

PV is the renewable energy electricity generation technology with most ideal features of sustainable development which attract very much attention of the world. It is proved that grid-connected PV application is the newable energy technology which has most rapid development speed with 60%annual increase rate since 2000. So high dvelopment speed is due to implement of promoting laws and policies for newable energy in lot of countries.

The PV market development although is progress with time, the total speed is slow. 《having electricity to villages》 project in 2002-2003 had increased PV market in china in short period, after that the PV market comeback low speeddevelopment, annual PV installation is about 5MWp in 2005. Up to the late of 2005, the total accumulation of PV system was about 70MWp.The development of PV market since 1990 in china is shown in figure 2. It can be seen that annual increase rate of PV installation is about 17%, much lower than 30%~40%of the world in same period.The shares of different PV applications up to now are shown in table 6,in which 54.3%is commertial applications(communication and PV products), 45.7%is the market of the projects supported by government(electrialization in villages and grid-connection). Among of them, the grid-connection PV application only 2MWp with market share only 3%, much lower than average share 60% of the world.

The PV installation only 5MWp in 2005, is about 3.4% of 145.7MWp solar cell production in 2005, the output reached above 96%.The PV market lagging behind PV indutry so much will cause serious results for sustainable development of energy and PV industry, it is a worth cconcerned and thinkable issue.

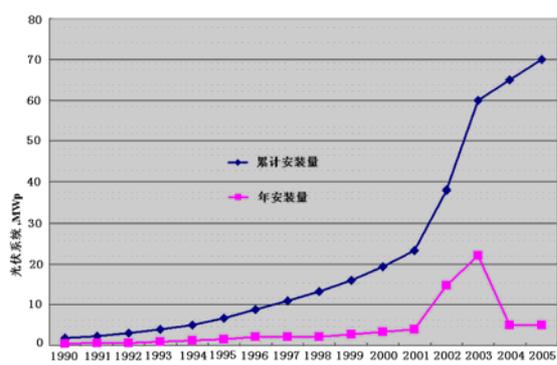


Figure 2.The PV market development trend in China

Table 6 The shares of different PV applications up to the end of 2005

Applications	Accumulated installation,MW	Shares,%
Village electrialization	30	43.0
Communication and Industry	28	40.0
Solar PV Products	10	14.0.3
Grid connection	2	3.0
total	70	100

4 The econmic and social benefits

1) The econmic benefits

According to the recent suevey and statistics, the total sales revenue of PV industry in 2005 in China is about 12.8 billion Yuan(in which SG-Si materials 0.04 billion Yuan、 Si ingots /Si wafers 2.4 billion Yuan、 solar cells/modules 8.7 billion Yuan、PV engineering 0.3 billion Yuan、PV products(yard lighting lamps etc.) 1.0 billion Yuan、 equipment manufacture 0.3 billion Yuan、 special materials for the PV(EVA, glass, Ag&Alpasteetc.)0.06 billion Yuan), benefit and tax& total about 2.56 billion Yuan [1].The PV industry has the best economic benefit in all the renewable industries in China.

2) Social benefits

According to the recent suevey and statistics, the total employees in PV industry are about 13810 people [1].

PV industry provides excellent opportunities for society. It draws much attention of whole society..A lot of local governments have PV industry as a important strategic direction of industry development,such as Jiangsu province,Hebei provinc,Hubei provinc,etc., and Wuxi,Changzhou, Baoding,Nantong,Nanjing city,etc..

5 Summary(omit)

6 Reference

- [1] ZHAO Yuwen , WU Dacheng, WANG Sicheng, LI Xudong, WANG Wenjing, LIU Zuming, SONG Shuang, 《China PV Industry Development Report》 (2004—2005)
- [2] Dr.Eric Martinot,"Renewables 2005 Globle status report", Beijing International Renewable Energy 此 conference(BIBEC) 2005。