IEA INTERNATIONAL ENERGY AGENCY

National Survey Report of PV Power Applications in China

2013

PVPS

PHOTOVOLTAIC POWER SYSTEMS PROGRAMME

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Definitions, Symbols and Abbreviations

For the purposes of this and all IEA PVPS National Survey Reports, the following definitions apply:

PV power system market: The market for all nationally installed (terrestrial) PV applications with a PV power capacity of 40W or more.

Installed PV power: Power delivered by a PV module or a PV array under standard test conditions (STC) – irradiance of 1000 W/m^2, cell junction temperature of 25℃, AM 1,5 solar spectrum – (also see 'Rated power').

Rated power: Amount of power produced by a PV module or array under STC, written as W.

PV system: Set of interconnected elements such as PV modules, inverters that convert D.C. current of the modules into A.C. current, storage batteries and all installation and control components with a PV power capacity of 40W or more.

Module manufacturer: An organisation carrying out the encapsulation in the process of the production of PV modules.

Off-grid domestic PV power system: System installed to provide power mainly to a household or village not connected to the (main) utility grid(s). Often a means to store electricity is used (most commonly lead-acid batteries). Also referred to as 'stand-alone PV power system'. Can also provide power to domestic and community users (plus some other applications) via a 'mini-grid', often as a hybrid with another source of power.

Off-grid non-domestic PV power system: System used for a variety of industrial and agricultural applications such as water pumping, remote communications, telecommunication relays, safety and protection devices, etc. that are not connected to the utility grid. Usually a means to store electricity is used. Also referred to as 'stand-alone PV power system'.

Grid-connected distributed PV power system: System installed to provide power to a grid - connected customer or directly to the electricity grid (specifically where that part of the electricity grid is configured to supply power to a number of customers rather than to provide a bulk transport function). Such systems may be on or integrated into the customer's premises often on the demand side of the electricity meter, on public and commercial buildings, or simply in the built environment on motorway sound barriers etc. They may be specifically designed for support of the utility distributed power generation. Size is not a determining feature – while a 1 MW PV system on a rooftop may be large by PV standards, this is not the case for other forms of distributed generation.

Grid-connected centralized PV power system: Power production system performing the function of a centralized power station. The power supplied by such a system is not associated with a particular electricity customer, and the system is not located to specifically perform functions on the electricity grid other than the supply of bulk power. Typically ground mounted and functioning independently of any nearby development.

BIPV: BIPV is defined as building-integrated PV, which requires that the building team along the

entire supply chain - including architects, building designers, engineers, building owners and utility companies - work together to design and build the special designed PV modules into the building's very "skin" as an element, from the inception of the project onwards, which particularly stands for the adopting of solar building material, such as solar tiles, solar façade and shingles.

BAPV: BAPV is defined as building-attached PV. In this process, the photovoltaics are a retrofit, the normal PV modules are used and not necessary to use special designed PV module, simply added to the new built or existing buildings.

NDRC: China National Development and Reform Commission

FYP: China Five-Year Plan

CPIA: China Photovoltaic Industry Alliance

Turnkey price: Price of an installed PV system excluding VAT/TVA/sales taxes, operation and maintenance costs but including installation costs. For an off-grid PV system, the prices associated with storage solar cells maintenance/replacement are excluded. If additional costs are incurred for reasons not directly related to the PV system, these should be excluded. (E.g. If extra costs are incurred fitting PV modules to a factory roof because special precautions are required to avoid disrupting production, these extra costs should not be included. Equally, additional transport costs for installing a telecommunication system in a remote area are to be excluded).

Field Test Programme: A programme to test the performance of PV systems/components in real conditions.

Demonstration Programme: A programme to demonstrate the operation of PV systems and their application to potential users/owners.

Market deployment initiative: Initiatives to encourage the market deployment of PV through the use of market instruments such as green pricing, rate based incentives etc. These may be implemented by government, the finance industry, utilities etc.

Final annual yield: Total PV energy delivered to the load during the year per kW of power installed.

Performance ratio: Ratio of the final annual (monthly, daily) yield to the reference annual (monthly, daily) yield, where the reference annual (monthly, daily) yield is the theoretical annual (monthly, daily) available energy per kW of installed PV power.

Currency: The currency unit used throughout this report is EUR

RES: Renewable Energy Sources

PV support measures:

Feed-in tariff: an explicit monetary reward is provided for producing PV electricity; paid (usually by the electricity utility business) at a rate per kWh somewhat higher than the retail electricity rates being paid by the customer;

Capital subsidies: direct financial subsidies aimed at tackling the up-front cost barrier, either for specific equipment or total installed PV system cost

Foreword

The International Energy Agency (IEA), founded in November 1974, is an autonomous body within the framework of the Organisation for Economic Co-operation and Development (OECD) which carries out a comprehensive programme of energy co-operation among its 23 member countries. The European Commission also participates in the work of the Agency.

The IEA Photovoltaic Power Systems Programme (IEA-PVPS) is one of the collaborative R&D agreements established within the IEA and, since 1993, its participants have been conducting a variety of joint projects in the applications of photovoltaic conversion of solar energy into electricity.

The 24 participating countries are Australia (AUS), Austria (AUT), Belgium(BEL),Canada (CAN), China(CHN),Denmark (DNK), France (FRA), Germany (DEU), Israel (ISR), Italy (ITA), Japan (JPN), Korea (KOR), Malaysia (MYS), Mexico (MEX), the Netherlands (NLD), Norway (NOR), Portugal (PRT), Spain (ESP), Sweden (SWE), Switzerland (CHE), Thailand(THA),Turkey (TUR), the United Kingdom (GBR) and the United States of America (USA). The European Commission, the European Photovoltaic Industry Association and the US Solar Electric Power Association are also members.

The overall programme is headed by an Executive Committee composed of one representative from each participating country, while the management of individual Tasks (research projects / activity areas) is the responsibility of Operating Agents. Information about the active and completed tasks can be found on the IEA-PVPS website www.iea-pvps.org.

Introduction

The objective of Task 1 of the IEA Photovoltaic Power Systems Programme is to facilitate the exchange and dissemination of information on the technical, economic, environmental and social aspects of photovoltaic power systems. An important deliverable of Task 1 is the annual Trends in photovoltaic applications report. In parallel, National Survey Reports are produced annually by each Task 1 participant. This document is the China National Survey Report for the year 2013. Information from this document will be used as input to the annual Trends in photovoltaic applications report.

The PVPS website www.iea-pvps.org also plays an important role in disseminating.

1 Executive summary

In 2013, the annual PV installed capacity in China was 13.00GW, cumulated 19.70 GW in total.

1) Domestic market raising

In 2013, the PV domestic was not developed as expected. The total annual installation of PV approached 13.00GW, 306% increasing than previous year. In 2013, the annual PV installed capacity in China was 13.00GW, cumulated 19.70GW in total.

2) With the development of PV technology, production cost is continuously reducing

In 2013, although China PV enterprises generally were in a deficit state,technological level of production still kept improving due to key enterprises devoted themselves to accelerating technological research.China has world-class technology in the average conversion efficiency of solar cell. For polysilicon which is produced with industrialization it reached 17.8%,and for monocrystal reached 19.3%.The product power of mainstream modules has reached250-255KW,increased 6% than that of last year.The average comprehensive energy consumption of polysilicon decreased to 100KWh/kg,even reached 70KWh/kg in some enterprises. With the improvement of production technology, production cost was lower and lower too.Production cost of PV modules dropped to 0.5 dollar/W in some advanced photovaltic enterprises, and cost of polysilicon dropped to 14 dollar/kg. Moreover, installed cost of PV system researched by some enterprise decreased to RMB 8-9 Yuan/Wp, which is nearly 20% decrease compared with last year.

3) Export trade is continuously dropping

In 2013, China PV industry exports continued to decline. China's PV module exports was about 16.7GW, and exports value was about $ 10 billion, 20% down compared with 2012. The share of Chinese exports to the EU fell to 30 percent in 2013 and it was 67% in 2012, and Japanese leapt to the top. In 2013, PV modules export from China to Japan was approximately $ 2.2 billion, accounting for 22 percent of total exports.

1.1 Installed PV power

The domestic PV system market in 2013 showed an explosion compared to 2012. In 2013, off-grid and grid connected PV system with a total PV power of 13 GW have been installed, which represents 371% growth of the domestic market compared to the Year 2012.The cumulated total installed PV reaches 19.7 GW by the end of 2013.

Grid-tied applications more and more dominated the market for PV in 2013, with grid-connected system (GCS) accounting for about 12.92 GW of the total installed capacity in 2013,which represents 99.38% of the total installation. In 2013 only 80MWp were installed for rural electrification and off-grid industrial applications.

1.2 Costs & prices

In 2013, system prices for installed PV systems in China again dropped compared to the previous years. The reduction was 10-20%. In 2013, average system price for typical grid-tied systems is RMB 8-9 Yuan/Wp. It was decreased about 83% than 2008.

86% of PV module price has been reduced during last 6 years. It was RMB 30Yuan/Wp in 2008,and by 2013, it was RMB 4.2Yuan/Wp.

1.3 PV Production

In 2013, the global solar cell production capacity was more than 63 GW (excluding thin-film batteries, otherwise the capacity will be more than 70 GW), yield reached 40.3 GW (excluding thin-film batteries),increased 7.5% compared with 37.5 GW in 2012.The output of mainland China was 25.1 GW as No.1 in the world, about 63% of the global total output.

Global component production capacity reached more than 65 GW in 2013, production reached 41.7 GW, increased 12.1% from 2012. China has been in the first place in the world about pv cells/component production for seven consecutive years. In the world's top ten solar sell manufactures, China occupied six seats. China has been the world's largest polysilicon producer for three consecutive years, and polysilicon production of Jiangsu Zhongneng Polysilicon Technology Development Co. Ltd was the No.1 in the world.

1.4 Budgets for PV

In 2013, newly installed photovoltaic power capacity in China was 13.00 GW .LS-PV power station was 12.12 GW, accounted for 93.2%, distributed photovoltaic was 0.8 GW, accounted for only 6.2%.

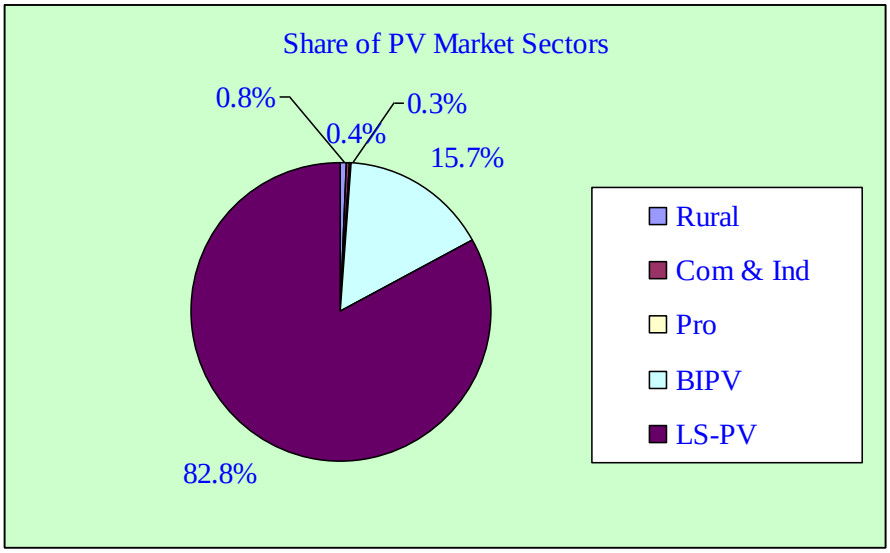
In August 2013, China's National Development and Reform Commission issued "Notice of making price leverage play role in promoting the healthy development of photovoltaic industry." It was mentioned in the notice to cancel the unified national benchmark price policy (uniform tariff was RMB 1 yuan/kWh), and use sub-regional benchmark price policy which means dividing China into three resource areas, the benchmark tariff levels were RMB 0.9,0.95,1 yuan / kwh. On the other hand, Chinese government practicing the policy subsiding in accordance with the full power of distributed PV , and the tariff subsidy standard was RMB 0.42 yuan/kWh (tax included).

2 Implementation of PV systems

2.1 Applications for photovoltaic

In 2013, China's State Council, Ministry of Finance, National Energy Administration, State Grid Corporation and other ministries, agencies had issued related policies, ranging from policy about construction of large-scale distributed PV demonstration area to distributed PV subsidy policy and regulatory policies of grid related processes. All these Policies reflected the national motivational guide for distributed photovoltaic power generation. However, distributed PV didn't have outstanding performance in 2013 due to the business model has not yet formed. In stark contrast, under the stimulation of sub-regional benchmark price, large centralized grid PV was still the main development model of the PV market. In the 13.00GW of new PV installed capacity in 2013, the large-scale photovoltaic power plants accounted for 12.12GW, i.e. 93.23%, distributed photovoltaic 0.8GW, i.e. 6.15% only. In national grid cumulative PV capacity 19.7GW, large-scale grid-connected photovoltaic and ground network capacity was 16.32Gw, which is 82.8%. Distributed photovoltaic power generation projects and grid capacity was 3.1GW, i.e.15.7%.

Figure 1: Share of PV market sectors by 2013 in China



Source: Wang Sicheng, 2014

2.2 Total photovoltaic power installed

The domestic PV system market in 2013 showed a significant increase compared to 2012. In 2013, off-grid and grid connected PV systems with a total PV power of 13 GWp have been installed, which represents a 306% growth of the domestic market compared to the year 2012. The cumulated total installed PV in China reaches 19.7GWp by the end of 2013 (Wang, 2014).

Grid-tied applications dominated the PV market more and more in 2012, with grid-connected systems (GCS) i.e. about 12.92GWp of the total installed capacity in 2013, which represents 99.4% of the total installation (Wang, 2014).

During the recent past years, the off-grid sector plays a minor role in China PV market. In 2013 only 80MWp were installed in this sector for rural electrification and off-grid industrial applications. Table 2 shows the PV power installed in five sub-markets during 2013.

Table 1: PV power installed during calendar year 2013 in five market sectors

2013 Domestic PV Market by Sectors			
No.	**Market Sector**	**Annu.Ins.**	**Share**
		（MWp)	（%）
1	Rural Electrification	50	0.38
2	Communication&& Industry	10	0.08
3	PV Products	20	0.16
4	BIPV & BAPV	800	6.15
5	Ground Mounted LS-PV	12120	93.23
	Total	13000	100.00

Source: Wang Sicheng, 2014

Table 2: The cumulative installed PV power in five sub-markets

Year	Rural electrification	Telecom and Industry	Distributed Generation	Building related PV	LS-PV	Annual Inst.	Cumulated Inst.
	(MWp)	(MWp)	(MWp)	(MWp)	(MWp)	(MWp)	(MWp)
2000	2.00	0.80	0.20	0.00	0.00	3.00	19.00
2001	2.50	1.50	0.50	0.01	0.00	4.50	23.50
2002	15.00	2.00	1.50	0.01	0.00	18.50	42.00
2003	6.00	3.00	1.00	0.07	0.00	10.00	52.00
2004	4.00	2.80	2.00	1.20	0.00	10.00	62.00
2005	2.00	2.90	1.50	1.30	0.20	8.00	70.00
2006	3.00	2.00	4.00	1.00	0.00	10.00	80.00
2007	8.50	3.30	6.00	2.00	0.20	20.00	100.00

2008	4.00	5.00	20.50	10.00	0.50	40.00	140.00
2009	9.80	2.00	6.00	34.20	108.00	160.00	300.00
2010	15.00	6.00	6.00	190.00	283.00	500.00	800.00
2011	10.00	5.00	5.00	680.00	2000.00	2700.00	3500.00
2012	20.00	10.00	10.00	1360.00	1800.00	3200.00	6700.00
2013	50.00	10.00	20.00	800.00	12120.00	13000.00	19700.00
SubT	150.00	70.00	60.00	3100.00	16320.00		19700.00

Source: Wang Sicheng, 2014

2.3 PV implementation highlights, major projects, demonstration and field test programs

The key projects of photovoltaic industry in 2013 are as follows:

1.China Power Investment Corporation Huanghe Hydropower PV station from

With an installed capacity of 500M, CPI Yellow River Hydropower PV Station was China's single largest photovoltaic power plant. The first phase covers an area of 5.6 square kilometers, of which installed capacity was 200M, with 500kVA centralized inverters. The installed capacity is 100M in the second phase. The third phase covering 4.2 square kilometers with an installed capacity of 200M will be grid connected by the end of September 2014.There was demonstration plots with an installed capacity of 5M, including fixed, flat uniaxial, oblique uniaxial, biaxial, 500 quadruple CPV, triple condenser. Two-thirds of installed configuration Huawei string inverter monomer 28kVA so that wireless communications, the DC line losses, mismatch losses and communication cables was greatly reduced because place boxes becomes 35kV, up to 330kV and transport to 750kV substation.

2.Shenguang high concentration CPV photovoltaic power plant

SG high concentration CPV photovoltaic power plants in Golmud Qinghai made innovation to 1090 times concentration and triple junction GaAs cells (1cm * 1cm, efficiency 42.3%) based on the second generation which use 500 times technology, which had high requirement of the DNI direct radiation, high tracking accuracy and ventilation. Plant's Monomer was 450 watts and a set of four monomers was 1.8 KW. The module whose thickness was 60cm,with the Fresnel lens of which focal length was 57cm,where internal temperature was about 60 degrees Celsius, needed to be cleaned once a half months and electricity costs was about 0.8 yuan/kWh. New product module's thickness lessened to 20cm and thinner so that the costs of module and tracking system were significantly reduced.

3.Construction of off-grid wind / photovoltaic / storage / diesel micro-grid in Nanji Island

In 2013, Zhejiang Electric Power Corporation built the megawatt off-grid wind / photovoltaic / storage / diesel micro-grid in Nanji Island, Wenzhou and megawatt grid-connected wind / light /storage micro-grid demonstration project in Luxi Island, Wenzhou. The former's system consisted of wind turbine

for 1MW, photovoltaic for 545kw, Diesel generator for 1600kW, lithium batteries for 3000kWh.And it was helpful to solve the shortage of local power supply problems. Meanwhile, in order to protect the ecological environment, the introduction of electric automotive energy storage systems, the island's existing fuel vehicles were all replaced by electric vehicles. For the latter's system, there were wind turbine for 780kW, photovoltaic for 200kW, lead-acid batteries for 4000kWh, super capacitor for 500kW × 15s.It solved the problem of power shortage in the island, tested and verified the key technologies of micro-grid network.

2.4 Highlights of R&D

1.Current situation of R&D

(1)PV cell technology

1)Silicon PV cell

In 2013, average conversion efficiency of monocrystalline silicon and polysilicon reached 19.3% and 17.8% in China. Distributed PV would be the trend of future PV industry, especially PV power system combined with building which is lack of space so that it's necessary to develop high efficiency crystalline silicon sells. Many Chinese enterprises were expanding there crystalline silicon cell production lines. Such as, Suntech developed the "Pluto" monocrystalline silicon cell whose efficiency reached 20.3%,efficiency of products researched by China Sunergy reached 20.26% , efficiency of heterojunction cell researched by Trina Solar reached 20.54%, efficiency of PERC cell developed by Canadian Solar reached 20.12%, efficiency of Yingli's "Panda" cell was more than 21% cell, efficiency of N-type cell pilot researched by Silevo was more than 21%. Polycrystalline polysilicon cell's efficiency developed by high-efficiency polycrystalline technology from JA Solar, Yu Hui, LDK, and other enterprises technology reached more than 19%, while JA Solar's polysilicon cell efficiency with mass production reached 18.5%, which is a global leader. Production of high-efficency crystalline silicon cells is about 15% of total cell production, and the percentage was expected to reach 30% or more by 2015.

As national 863 R & D issue, Trina Solar Key Laboratory of Photovoltaic Science and Technology has been independently developed the industrial IBC cells with an area of 125mm × 125mm, photoelectric conversion efficiency was greater than 22% and 72 IBC solar cells components' power was up to 238 watts. These results have been tested and validated by the National Center of Supervision and Inspection on Solar Photovoltaic Products Quality.

2)Thin-film PV cell

In 2013, Silicon-based was still the main technology in the industrialization of thin-film batteries, some involving other technical route production of which was very limited.

Silicon-based thin-film solar cells: First, it has uniform color and is very easy to achieve nice-looking translucent colors, with excellent prospects in BIPV applications. Second, silicon thin film solar cells' temperature coefficient is low and adapted to operate in high temperature environments. Third, because of its good low light characteristics, in the same place, the same power station, the power

production is about 10% more than that of regular crystalline silicon cell .

Although the silicon thin film solar cells has been preliminarily industrialized, it is an important trend to further improve efficiency and reduce costs. Currently, major manufacturers in China about silicon thin-film batteries are Gongchuang PV, Hanergy, Taiwan United and so on. Stable conversion efficiency of silicon-based thin-film photoelectric cell module is between 9% -11%, both using amorphous silicon / microcrystalline silicon tandem structure. The highest conversion efficiency single-junction, double junction and triple junction silicon-based thin-film cells reached 10.9% (initial), 12.3% (stable) and 16.3% (initial) from International laboratory. And the data from China Nankai University was 10.19% (initial), 12.39% (initial) and 16.07% (initial), which is very close to the international advanced level. Hanergy Holding Group Ltd. from China has become the world's largest silicon thin-film manufacturers and has eight production bases, of which total capacity is 3GW.

CIGS thin-film cells: American, European and other developed countries involved in the research of CIGS solar cells earlier with leading technology and in a monopoly position. Among them, Japanese Solar Frontier company had 900MW capacity, and other companies had more than 100MW capacity such as Miasole, Solibro. China stepped in it very late and lack of ability to self-build line, of which advanced technology was imported from other countries. After acquiring the Solibro in German, Miasole in USA, Global Solar in USA, module efficiency of Hanergy Holding Group Ltd. was up to 15.7%,and it plans to build large-scale production lines. Currently the highest efficiency CIGS laboratory for 20.9%, the efficiency of a small area in the country between 15-20%, among which Shenzhen Institute of Advanced Technology of Chinese Academy is up to 19.4% (0.5cm × 1.0cm);

CdTe thin film cells: Foreign cadmium telluride solar cell technology developed rapidly recently. In the last three years, the maximum conversion efficiency was refreshed seven times, reached 21% which was the highest conversion efficiency of thin-film solar cells. First Solar in USA has been keeping a monopoly position in the new-type thin film cells market. Its annual production of cadmium telluride cells reached 1.8GW, module production line has reached an average efficiency of 14%, and had a maximum efficiency of 17.5% components, approaching efficiency of polycrystalline silicon cells. New technology transfers to module technology successfully in terms of industrialization, the maximum efficiency and average efficiency of component are improving step by step, with the corresponding components cost reduced to $ 0.56 / W, while the energy recovery period has been reduced to 0.9 years. Zhejiang Long Yan has successfully completed 30MW photovoltaic cadmium telluride photovoltaic cell production line, all the equipment has been localization. Efficiency of cell with small area is from 14% to 15%. In China, the average components efficiency is less than 12%, and the production line capacity is less than 30 MW. Technical bottlenecks of China cadmium telluride solar cells mainly are as follows: CdTe deposition technology to produce large-area components is not advanced enough, leading to productivity is difficult to improve, and design of the key equipment in production line is not mature enough, resulting in their reliability running repeatability is low.

(2)Power electronics, control and component of BOS

PV inverter is the key equipment to transfer current output by photovoltaic array from direct current into alternating current. In recent years, China Photovoltaic Inverter technology research progress rapidly, successfully developed China's first 150kW photovoltaic grid inverters in 2006, successfully developed 500kW photovoltaic grid inverters in 2008 which reached the level of similar foreign advanced technology. MW-class photovoltaic grid inverters also have entered the industrialization stage. At present, the domestic research on photovoltaic grid inverters on electrical performance indicators have reached or exceeded the international advanced level, reduction speed of production cost achieved above international universal level. But we should clearly see that the existing level of technological achievements is still in imitation (or "catch up") stage, that presents the international community forward functional requirements or performance requirements , we can achieve or exceed the effects in a short time, but innovative indicators are either proposed or realized by the foreign firm.

Similarly，the rapid reduction of production cost is entirely the result established on the basis of a disorderly situation of market competition. Different from the cost reduction caused by the healthy technological innovation and improvements, Apart from the fact that the bulk increase of production, the main reason for domestic cost reduction is due to the direct replacement of critical and expensive devices. Such replacement is often in consideration of cost but ignoring the requirements of technology completely.

For these reasons, we can find a phenomenon that the technology of domestic inverter products improves rapidly and the cost declines very quick. Reliability and safety issues of products are the most important problem which is unusually prominent in this hidden behind the prosperity, leading to such low system efficiency of the product so that the customer's query is growing.

With the upgrade of Photovoltaic inverter equipment, how to achieve the upgrade of weighed efficiency of grid high-power inverter, the rapid tracing of maximum power, harmonic suppression under the condition of multi-parallel low irradiation, safety protection and other controls, how to achieve new requirements for photovoltaic grid scheduling, high and low voltage ride through proposed by China’s power authorities are new challenge for the high-power grid inverter equipment

(3)Equipment

PV equipment industry was in a dismal year of 2013.Because of overcapacity of photovoltaic, photovoltaic equipment market demand in all aspects was mainly supplement and capacity upgrades other than expansion.

In the field of polysilicon, demands of equipment was mainly dependent on expansion of enterprises such as Feng Wei silicon industry, shield silicon industry and TBEA, the market scale was about RMB 800 million yuan.

Purpose of the period of pulling and wafering was mainly filling and supplement, of which market scale was about 800 million. Polycrystalline silicon ingot produced by polysilicon ingot furnace from Jingsheng Mechanical & Electrical have been able to produce high efficiency polycrystalline solar cells wafers whose photoelectric conversion efficiency exceeded 17.75%, and the unit energy

consumption was only 7.5kwh/kg. The zone melting single-crystal furnace researched by it successfully drawn out of FZ Silicon Single Crystal wafers in Tianjin Huanou of 8 inches, of which total length was about 1000mm,diameter was about 202.5mm , weight was 50.8kg, filled the blanks of related technology in China.

Component link was mainly automated upgrading drive in production line. There were three factors leading to greatly demand for automation equipment from enterprises. First, because labor costs increased in 2013, enterprises were hard to hire workers. Second, enterprises had to use automatic welding equipment because market was focus on product quality. Third, industrial upgrading driven by the policy, such as plan about machines replaced humans in Zhejiang province. In addition some domestic enterprises such as Wuxi Xiandao, Ningxia XN made their automatic welding machine localization, it is expected in 2014 there will still have a larger market demand.

(4)Test technology and equipment

The large-scale grid connected photovoltaic power station field test platform developed by Institute of Electrical Engineering China Academy of Sciences (cooperative unit: China General Certification Center Co., Ltd) was the first field test platform in China. It can make the field test on the photovoltaic power station in different forms, structures, capacity, real-time collecting, displaying, processing and analysis of data, get the performance index of the power station by software calculation, and can carry out remote transmission and monitoring to meet the test requirements of different power plant. This platform not only collects data accurately, has high transmission rate, good synchronization, high testing capacity and good compatibility, but it is also mobile and flexible and easy to be installed. And it can be used for long term or short term test according to the requirement. The equipment of platform has the advantage of wide temperature,impact resistance, good stability and is very adaptable to the environment. The platform fills the blank of PV power station measurement field, has played a role in promoting technical support and the development of grid connected PV power station. It can provide service of testing data support to scientific research institutes, design of power plant unit, power plant, power plant integrated unit construction units, the plant owners, users , can also provide testing services for the national gold sun demonstration project, the Ministry of science and technology, MW photovoltaic power station .

2.5 Public budgets for market stimulation, demonstration/field test programmes and R&D

(1)Public budgets for market stimulation:

In August 2013, China's National Development and Reform Commission issued "Notice of making price leverage play role in promoting the healthy development of photovoltaic industry." It was mentioned in the notice to cancel the unified national benchmark price policy (uniform tariff was RMB 1 yuan/kWh), and use sub-regional benchmark price policy which means dividing China into three resource areas, the benchmark tariff levels were RMB 0.9,0.95,1 yuan/kwh respectively.

On the other hand, Chinese government practicing the policy subsiding in accordance with the full power of distributed PV , and the tariff subsidy standard was RMB 0.42 yuan/kWh (tax included). The power subsidy policy means that the distributed photovoltaic power system use part of electricity produced by itself. The starting point for the feed-in tariff is sale price of users (including the peak and valley price).In margin Internet part, starting price of feed-in tariff is the benchmark tariff of local desulfurized coal-fired.

Moreover, the government increased the additional tariff about renewable energy from 0.8 /kWh to 1.5 /kWh, and would use RMB 40 billion yuan a year to support the RE feed-in tariff, which would fully meet the requirements of RE feed-in tariff before 2015.

(2)Public budgets for R&D: Ministry of Science and Technology (MOST) is the government unit to be in charge of R&D of PV. Average annual investment for R&D from MOST is about 500 million Yuan and the supported fields cover all manufacture chain: poly-Si, wafer, solar cells, PV modules, thin-film technology, CPV, energy storage, BOS components and system engineering. During last decade, PV has got significant progress at R&D in China. Several leading companies have developed high efficiency and low cost PV products. Trina Solar, CSUN, Yingli Green Energy, Canadian Solar, SunTech, Silevo, etc. are all reached 20-21% cell efficiency and 30MW production scale.

Table 3 New FITs for PV Power Plants and the Subsidy Level for Distributed PV

Solar Irradiation Zone	PV Power Plant	Distributed PV Benefits	
	FIT	Subsidy for Self-Consumed PV Electricity	Subsidy for Surplus PV Electricity Feed-back to grid
	(Yuan/kWh)	(Yuan/kWh)	(Yuan/kWh)
I:	0. 90	Retail price of grid-electricity + 0. 42	Whole-sell Tariff of coal-fire power + 0. 42
II	0. 95		
III	1. 00		

Source: Wang Sicheng, 2014

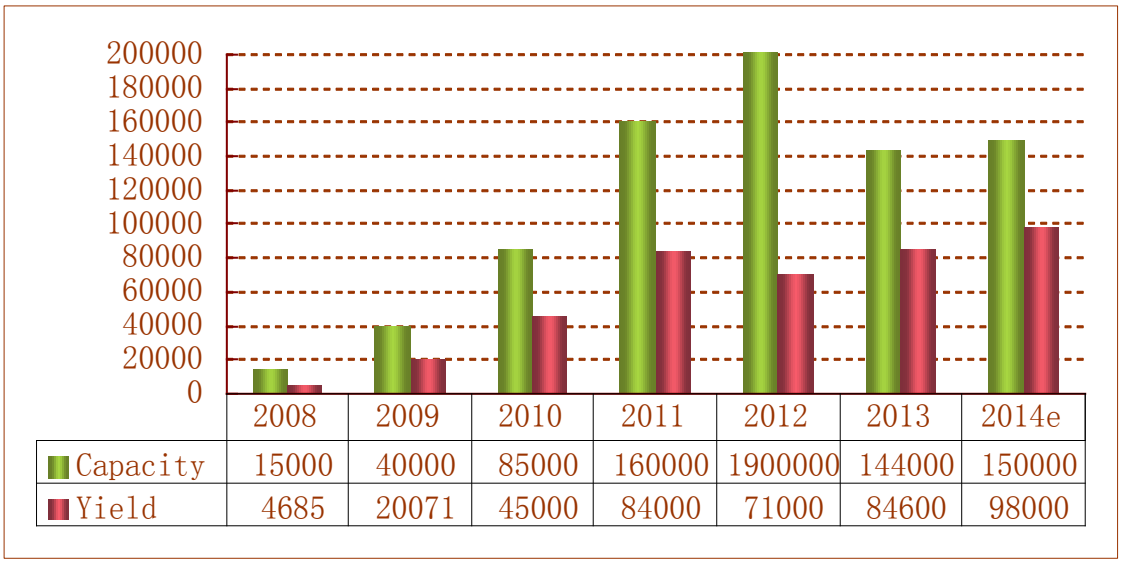
3 Industry and growth

In 2013, China had introduced a number of incentive policies, many of the domestic photovoltaic application market started, the main product prices increased steadily, and the scale of the industry achieves rapid growth. Yield of polysicilon reached 84600 tons in 2013, increased 19.2% than last year, counted for 34%of the world, 4 percentage points higher than 30% in 2012. The output of silicon wafer in 2013 reached 29.5GW, increased 13.5% than last year, counted from 72% in 2012 to 76% of the world in 2013. For components of solar cells, production in 2013 was 27.4GW, a year-on-year growth of 19.2%, the global proportion rose from 62% in 2012 to 65% in 2013.

In 2013, exports of PV module were about 16.7GW in China, the amount of export was about $10 billion, 20% decline than last year. With the effect of " anti-dumping and anti-bribery" from Europe, Japan became the largest importing country of PV module from China, and the export amount to Japan was about RMB 2.2 billion yuan, i.e.for 22% of total exports.

3.1 Production of feedstock, ingots, wafers and thin film photovoltaic components

In 2013, the annual polysilicon production reached 84600 tons, which was the top of the world, accounting for about 34% of the global total output, increased by 18% than 71000 tons in 2012. By the end of 2012 polysilicon enterprises that has production capacity was more than 50, production capacity reached 190000 tons. With influence by the rapid decline of Polysilicon prices, most small and medium-sized polysilicon enterprises have been discontinued. In the first half of the year, only 8 enterprises remained in production or low load operation. In the second half of the year, with the industry picking up, some enterprises also began their production. By the end of 2013, the number of polysilicon enterprises in operation increased to 16, the production capacity reached 144000 tons. Compared with the apparent consumption in 2013 which was 164000 tons (polysilicon production +polysilicon imports –polysilicon exports), there were still gaps.



	2008	2009	2010	2011	2012	2013	2014e
Capacity	15000	40000	85000	160000	1900000	144000	150000
Yield	4685	20071	45000	84000	71000	84600	98000

Figure 2: 2008-2013 Poly-silicon production capability and yield in China

Source：CPIA, April 2014

Table 4: Annual yields of China top 10 Poly-Silicon manufacturers in 2012-2013.

Unit: Tons	2012	2013
Zhongneng Silicon Development Co., Ltd	37055	50440
TBEA Silicon Co., Ltd	3300	7900
Daqo New Energy Co., Ltd	4300	4800
Asia Silicon Co., Ltd.	4100	4050
Oriki Silicon Co., Ltd	1200	3500
Sichuan Renesola Ltd	3500	3050
China silicon Co., Ltd	4000	2300
Dunan Photovaltic Science and Technology Co., Ltd	1685	1900
Sichuan Yongxiang Polysilicon Co., Ltd	2300	2000
Huanghe Hydropower Development Co., Ltd	803	1550
Total	62243	82490

Source: CPIA 2014.4

By the end of 2013, the number of polysilicon ingot furnace of the nationwide 93 silicon ingot / silicon rod enterprise reached 4403, the total production capacity reached 23.5 tons, the total output is about 131400 tons, year-on-year growth of 5% than 125400 tons in 2012.Amout of single crystal furnace was about 6500, annual production capacity of silicon rods was nearly 74000 tons, the total output reached 41000 tons, year-on-year growth of 28% than 32000 tons in 2012. Wafer's total capacity reached 10.3 billion pieces, production reached 7.2 billion pieces. Because some of the silicon wafer 's size was 125mm*125mm, calculated according to 4.1 plates per watt, in 2013 the total output of silicon wafers was about 29.5GW in 2013, increased 13% compared to 26GW in last year, the global proportion reached 75%.

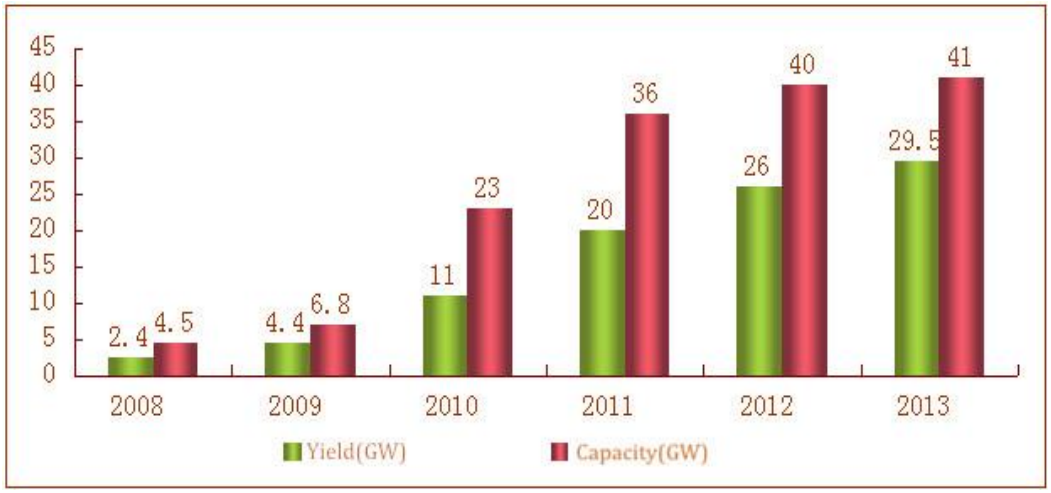


Figure 3: 2008-2013 China Annual Wafer production capability and yield

Source：CPIA, April 2014

From the perspective of enterprise development, the production capacity of national top ten enterprises of silicon wafer reached 26.4GW which is about 64% in the national total production capacity, the yield was about 21.5 GW accounted for about 73% of total output, productivity concentration was much higher than the part of solar cells and component. The capacity of GCL reached 10GW, production reached 8.6GW, accounted for about 29% of total output, ranked first in China. solar wafer production capacity of Baoding Yingli reached 2.8GW, the yield reached 2.3GW, ranked second in China. Production capacity of Rene Solar reached 2.2 GW, and production reached 2.1GW, ranked third in China. The three companies were also the world's top three silicon wafer production enterprises.

Table 5: 2013 Production capacity /Yield of China Top 10 Wafer manufactures (MW)

Manufactures	2013 Solar Wafer Annual Yield (GW)	2013 Solar Wafer Annual Production Capacity (GW)
GCL-Poly Energy Holdings Limited	8.6	10
Yingli green energy holding Co., Ltd	2.3	2.8
Rene Solar Co., Ltd	2.1	2.2
Jiangxi Sornid Hi-Tech Co. Ltd	1.6	1.8
LDK Solar	1.5	3.3
JinkoSolar Holding Co., Ltd	1.4	1.5
Xi'an LONGI Silicon Materials Corp	1.2	1.3
Trina Solar Co., Ltd	1.2	1.4

Huantai Group Development Co., Ltd	0.82	1.1
Zhonghuan Renewable Energy	0.8	1
Total	21.52	26.4

Source: CPIA, 2014

3.2 Production of photovoltaic cells and modules

The incomplete statistics data from the national 95 solar cell enterprises in production showed the national solar cell type capacity was 42GW, the yield reached 25.1GW, accounted for about 62% of the global total output, on top of the world, Compared with 21GW in 2012, the growth rate was about 20%,.Although in 2013, most solar cell type enterprises were in deficit, and new or expanded production enterprises were less, the increase in production capacity was mainly due to technological progress to make the cell's conversion efficiency continue to improve. The second reason was the yield increased leading to single output increasing and capacity improving. The type of most solar cell was polycilicon solar cell accounted for 78%.

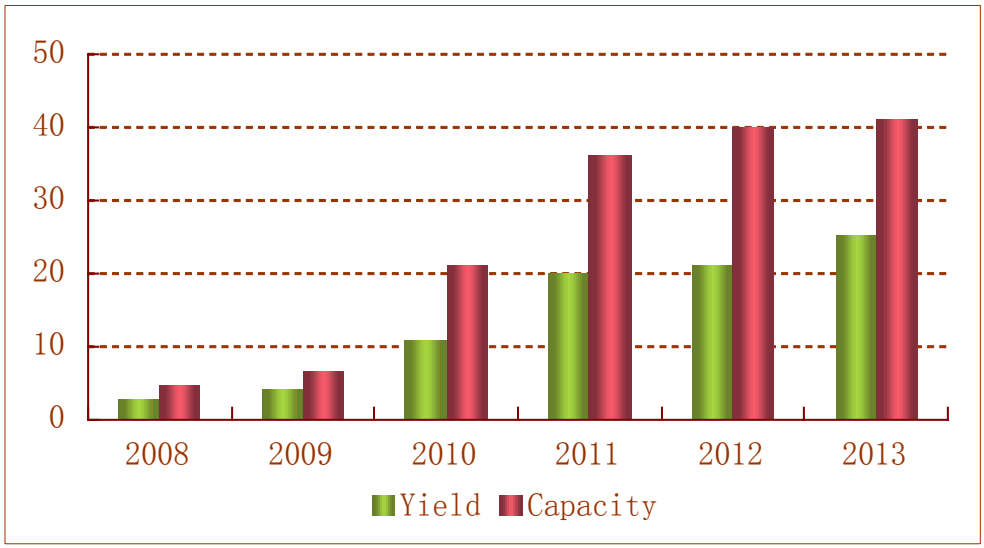


Figure 4: 2008-2013 China solar cell production capability and yield (GW)

Source: CPIA, 2014

In China, capacity of top ten solar cell type enterprises reached16.3GW, accounted for 40% in total production capacity in China, production output reached nearly 13.1GW, accounted for about 52% of total output. It reflected the serious shortage of capacity utilization rate in most small and medium enterprises in China 2013. There were 5 enterprises among the ten in the top 10 of the world, of which Yingli in Hebei was the No.1 in China and the world with production of 2.3GW, Trina Solar ranked second with 2.1GW, JA Solar was in third of China with 2.06GW.

Table 6: China top 10 solar cell manufacturers in 2013

Manufactures	2013 Annual solar cell production output (MW)	2013 Annual Solar cell module capacity(MW)
Yingli green energy holding Co., Ltd	2316	2800
Trina Solar Co., Ltd	2100	2450
JA Solar Holdings Co., Ltd	2061	2500
Jinko Solar Holding Co., Ltd	1683	1800
Canadian Solar Co., Ltd	1215	1500
Jiangsu Photovoltaic Co., Ltd	1013	1560
Hanhua Solar One Co., Ltd	886	1100
EGing Photovoltaic Technology Co.,Ltd	630	1000
Astronery Photovoltaic Technology Co., Ltd	544	600
Shunfeng Photovaltic International Limited	513	650

Source: CPIA, 2014.4

In 2013, The total capacity of the module in China was about 42GW, and the component production reached 27.4GW, increased by 19.1% than 2012, accounted for about 65.7% of the global total output. The output of crystalline silicon solar cell was about 27.1GW, accounted for about 98.9% of the total production. Yield of thin-film solar cell was about 260MW, the condensing component's output was about 90MW. Production capacity was increased because of improvement of the conversion efficiency and progress of components processing technology that reduced the efficiency loss of solar cell-module.

About the product concentration, production of top ten component enterprises in China reached 14.5GW, accounting for 53% of the total output in China. In these ten enterprises, Jiangsu took 6 seats, Hebei took 2 seats, Zhejiang and Jiangxi each took one seat. There were six enterprises in the global top ten, of which Yingli in Hebei was on top of the world with yields of solar cells and component, Trina Solar was the second in the world. Span of component production was large, Yingli in the first was 3.1GW, tenth was Tayo of which output was 0.7GW, the average number of 1.45GW.

Table7：2013 top 10 solar module manufacturers in China (Unit MW)

Manufacturer	2013 Module Annual Production Capacity (MW)	20123Module Annual Output(MW)
Yingli green energy holding Co., Ltd	2800	3100
Trina Solar	2450	2471
Canadian Solar Co., Ltd	2600	1800
Jinko Solar Holding Co., Ltd	2000	1700
JA Solar Holdings Co., Ltd	1800	1218
Hanhua Solar One Co., Ltd	1300	1082
Rene Solar Co., Ltd	1200	900
Hareon Solar Technology Co.,Ltd	1000	800
Astronery Photovoltaic Technology Co.,Ltd	800	692
EGing Photovoltaic Technology Co.,Ltd	1000	628
Total	16950	14391

Source: CPIA 2014.04

3.3Module price

86% of PV module price has been reduced during last 6 years; the historical PV module price in China was shown in figure 6. It was RMB 30Yuan/Wp in 2008,and by 2013, it was RMB 4.2Yuan/Wp.

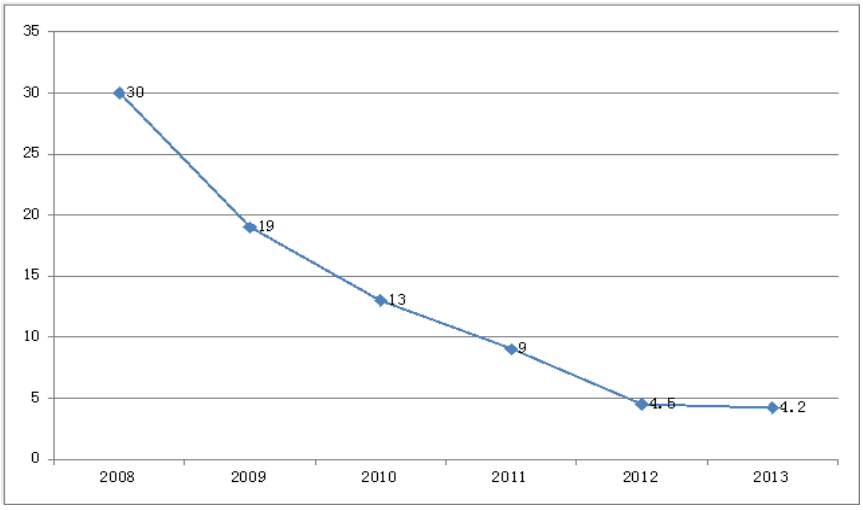


Figure 5: PV module price in China, 2008~2013

Source: Wang Sicheng, 2014

Table 8: Module price fall from 2008-2013（Yuan/Wp）

Year	2008	2009	2010	2011	2012	2013
Module Price（Yuan/Wp）	30.0	19.0	13.0	9.0	4.5	4.2

Source: Wang Sicheng, 2014

3.4 Manufacturers and suppliers of other components

1.Inverter

As the core components of the inverter in China gradually get rid of dependence on imports, a large number of outstanding domestic brands of photovoltaic inverter rapidly occupied the industry of photovoltaic inverter. According to incomplete statistics, the quantity of domestic inverter enterprises had exceeded 150 in 2011, while in 2013 there were nearly 300 enterprises with spotty quantity full of the inverter market. Since the second half of 2012, the market price of inverter declined rapidly, price of high-power products dropped from RMB 0.8 yuan to RMB 0.4 yuan per watt. It is no doubt a challenge for the enterprises to the cost control

With the strong growth of China PV market, shipments of inverter from Chinese enterprises were over 13GW, accounting for 26% of the global market. The shipment of the top ten enterprises such as Sun Energy, TBEA, Huawei accounted for 87% of the overall shipments. The sun energy accounted for 31%, TBEA accounted for 14%,and Huawei accounted for 7%. In 2013, the type of shipping products was still dominated by plant type, accounted for 89%, and string type accounted for 11%.

2. Tracking system

At present generalizing tracker products was very to promote domestically. The reasons are as follows: 1) The tracker was lack of stability.2)Cost-performance was too low. The overall costs of ground station installed by crystalline silicon component was 8 yuan /W which was low. in the market prices of tracker mostly was 1.6 yuan /W, relative fixed bracket was 0.7-0.8yuan /W. But if the overall costs of the station rises 0.8 yuan /W, costs increase10%, generating capacity will enhance 13-15%. At the same time the tracker project that wined the bid with low price had to reduce the quality, this circulation of low quality to low price caused the embarrassing situation now.

3.5 System prices

In 2013, system prices for installed PV systems in China again dropped compared to the previous years. The reduction was 10-20%. In 2013, average system price for typical grid-tied systems is RMB 8-9 Yuan/Wp. It was decreased about 83% than that of 2008.

The PV system price in China is continuing dropping since 2008, shown as in Table 9.

Table 9: PV system price, 2008-2013

Year	2008	2009	2010	2011	2012	2013
System Price (RMB Yuan/Wp)	50	35	25	17.5	10	8.0-9.0

Source: Wang Sicheng, 2014

3.6 Labour places

In 2013, Chinese photovoltaic industry alliance conducted an incomplete investigation on China photovoltaic industry, the investigation of enterprise number 374 (the independent legal person), covering manufacturing processes from polysilicon to component production all photovoltaic products, including R & D, sales income, income persons' data, is the enterprise data in 2012. Data show that a total of 374 enterprises in 2012,employing nearly 260000 people, of which more than 47000 technical personnel, accounted for nearly 20%.

3.7 Business value of installation

Table 10: China PV Industry Business Value in 2013

Sub-market	Capacity installed in 2013(MW)	Price per W	Value (RMB)	Totals (MRMB)
Grid-connected distributed	800	8 RMB/Wp	6,400,000	6400
Grid-connected centralized	12120	9 RMB/Wp	109,080,000	109080
Off-grid Systems	80	25 RMB/Wp	2,000,000	2000
Total	13000			117480
Export of PV products (module，etc.)			N/A	
Change in stocks held (module，etc.)			N/A	
Import of PV products (module，etc.)			N/A	
Value of PV business			N/A	

Source: Wang Sicheng, 2014

4 Framework for deployment (Non-technical factors)

4.1 Indirect policy issues

1.National policy

In 2013, in order to further expand the China PV market, reduce external dependence of industry and accelerate the recovery of Chinese photovoltaic industry, China made further support of photovoltaic application. The State Council issued the "Opinions on promoting the healthy development of photovoltaic industry" that pointed PV power installed capacity would increase to 35GW in the "twelfth plan of five year", and put forward new requirements and guidance on expansion of the PV market, standardize development and policy support of which up-regulated target of installed capacity, improve the standard and efficient support policy became the three major highlights. Subsequently, the National Development and Reform Commission, Ministry of Finance, National Energy Administration, State Grid Corporation and other departments launched intensively supporting documents to formulate and introducing new development goals on photovoltaic , policy of project management, feed-in tariff policy, tax policy and financing policy.

(1)Development goals

In the "Twelfth plan of five years on renewable energy" promulgated in 2012, the target of photovoltaic power generation was achieved 20GW by 2015 and reached 50GW by 2020. It was put forward in " Opinions on promoting the healthy development of photovoltaic industry" that photovoltaic power installed capacity reached 35GW by 2015, and new capacity of the year was 10GW.

(2)Feed –in tariff policy

In August 30, 2013, the National Development and Reform Commission issued the "Notice of making price leverage play role in promoting the healthy development of photovoltaic industry". It adjusted the benchmark price of photovoltaic power station, set the new feed-in tariff policy of the distributed photovoltaic power generation, and made clear that the period of photovoltaic benchmark price and feed-in tariff was 20 years. Benchmark price and feed-in tariff policy became one of the most advantageous of distributed generation policy to encourage the photovoltaic power generation .

- According to the solar resource level and construction cost, China was divided into three kinds of resources area, carry out 0.9 yuan per kilowatt hour, 0.95 yuan, 1 yuan price standard respectively. Partition benchmark price policy was applicable to photovoltaic power plant project which was filed(approved) after September 1, 2013, and those filed before 1 September 2013 but put into operation after January 1, 2014, this also made lots of power station installed in advance in Sept. to Dec. in 2013 in China's western region.

- According to the Notice of making price leverage play role in promoting the healthy development of photovoltaic industry."Chinese government will apply the policy subsiding in accordance with the

full power of distributed PV , and the tariff subsidy standard was RMB 0.42 yuan/kWh (tax included). The policy of implementing unified full power subsiding of distributed PV is based on two principles: first, the State Council document identified "spontaneous self use and allowance feed in the grid, grid regulation" of the distributed photovoltaic development principle, second, most of China's sales of electricity and solar energy resources is reverse distribution.

- On Sept.2013, the National Development and Reform Commission raised additional renewable energy tariff imposed standards, from the original 8 per cent / kWh to 1.5 cents / kWh, which means the funds that are expected to be levied nearly doubled to reach about RMB 4 million yuan to support the renewable energy power generation per year.

(3)The finance and taxation policy

In 2013, after the State Council document identified in generating real-time electricity subsidy mechanism for grid connected distributed, targets and support range of golden sun demonstration project and other PV investment policy was adjusted accordingly. In February 2013, the Ministry of Finance and other three ministries jointly issued the "Notice on the liquidation golden sun and photovoltaic building demonstration projects in 2012", stipulated to cancel the demonstration and recover the allocated subsidy funds of the projects which hadn't been built and grid connected. After that, the economic policy of grid connected photovoltaic was mainly the benchmark price and feed-in tariff, the scope of investment focused on off grid photovoltaic power station and residential photovoltaic system in the area without electric, the fiscal arranged the corresponding funds in 2013.

From 2009 to 2012, PV subsidies policy in China was divided into initial investment subsidies and feed-in tariff was mainly applicable to large-scale photovoltaic power station on the ground of the installation, and the initial investment subsidies was suitable for the "golden sun demonstration project" and "photoelectric building" and other distributed photovoltaic power generation project. Since the second half of 2012, the country continuously introduced a number of PV incentive policy, the main characteristic was from the initial investment subsidy to electricity price subsidies, price and the main supporting policies are as follows:

1) On July 4, 2013, the State Council issued "some opinions on promoting the healthy development of photovoltaic industry" (China (2013) No. 24) referred to as: eight country policies cleared the strategic position of China PV industry development goals and policy support;

2)On Jul. 24, 2013, Ministry of Finance (MoF) released the "Notice on Relevant Issues concerning the Policy of Subsidizing PV Power Generation Based on Output of Electricity Generated" (No. 390 [2013] of MoF), specifying the principle for issuing solar PV tariff subsidies and offering a solution to the delays in paying subsidies over the past few years.

3) On Aug. 9, 2013, NEA released the "Notice on Carrying out Construction of Distributed Solar PV Power Generation Demonstration Zones" (No. 296 [2013] of NEA), which approved a total of 18 demonstration zones aimed at achieving a capacity of 749MW by 2013 and total demonstration capacity of 1823MW by 2015. This marked the official launch of efforts to scale up distributed Solar PV power generation in China.

4) On Aug. 22, 2013, NEA, China Development Bank (CDB) jointly issued the "Opinions on Supporting Financial Services for Distributed PV Generation" (No. 312 [2013] of NEA), which proposed a plan for supporting distributed PV projects financing and establishing a financing platform;

5) On Aug. 26, 2013, NDRC released the "Notice on Matters Regarding Adjustment to Electricity Price Surcharge Standard for Renewable Energy and Environmental Protection Electricity Price" (No. 1638 [2013] of NDRC), raising the RE price surcharge from 0.8 cent/kWh to 1.5 cents/kWh and hence generating a 40 billion-Yuan subsidy fund per year for supporting RE power generation, which may fully satisfy the need of covering RE power generation subsidies by 2015 (with an installed wind capacity of 100GW, solar PV capacity of 35 GW, biomass capacity of 13 GW and solar thermal power capacity of 1GW).

6) On Aug. 27, 2013, NDRC issued the "Notice on Giving Play to the Role of Price Leverage in Promoting Healthy Development of the Solar PV Industry" (No. 1651 [2013] of NDRC), a document specifying the long-expected FIT policy for PV generation based on solar zones and the subsidy standard for distributed PV;

7) On Aug. 29, 2013, NEA issued the "Management Rules for PV Power Plants" (No. 329 [2013] of NEA), which clarified the application procedures and administrative methods for large-scale PV power plants.

On Sep. 27, 2013, MoF and SAT (State Administration of Taxation) jointly issued the "Notice on PV Power Generation VAT Policy" (No. 66 [2013] of MoF), providing for a reduction of 50% VAT for PV electricity sales (from 17% to 8.5%).

9)On November 18, 2013, the NEA issued the "Interim procedures for the distributed photovoltaic power generation project management"(No.433 [2013] of NEA), which clarified the way for filing procedures and management of distributed photovoltaic power generation project.

10) On November 19, 2013, the Ministry of Finance issued "Notice on the power of distributed photovoltaic power consumption shall be exempted from the spontaneous issues related to government funds (No.103 [2013] of MoF), exempted from additional renewable energy tariff, major national water conservancy construction funds, large and medium-sized reservoir resettlement supporting funds, rural owing on the loan funds four government funds to distributed photovoltaic power consumption of spontaneous.

In a word, through the adjustment to the existing policies of photovoltaic power generation and about 20 new policies published, support system in China about the development of photovoltaic power generation basically established. Especially for distributed photovoltaic, there was a comprehensive policy support system consisting of more than 10 policies, so the year of 2013 can be regarded as the first year of China's distributed photovoltaic power generation support policy.

Table 11： Support policies set by Chinese government in the second half year of 2013

Policy Categories	Time	Department	Name of Documents

Guiding Documents	2013.07	the State Council	Some Opinions on Promoting the Healthy Development of Photovoltaic Industry
Project Manage	2013.08	NDRC	Management Rules for Distributed Photovoltaic Power Generation
	2013.08	NEA	Management Rules for PV Power Plants
	2013.11	NEA	Management Rules for the Distributed Photovoltaic Power Generation Project Management
	2014.9.2	NEA	The Relevant Policies Concerning the Further Implementation of Distributed Generation
Price ,Finance and Taxation	2013.08	NDRC	Notice on Giving Play to the Role of Price Leverage in Promoting Healthy Development of the Solar PV Industry
	2013.08	NDRC	Notice on Matters Regarding Adjustment to Electricity Price Surcharge Standard for Renewable Energy and Environmental Protection Electricity Price
	2013.07	MOF	Notice on Relevant Issues concerning the Policy of Subsidizing PV Power Generation Based on Output of Electricity Generated
	2013.09	MOF	Notice on PV Power Generation VAT Policy
	2013.09	MOF	Notice on PV Power Generation VAT Policy
	2013.11	MOF	Notice on the power of distributed photovoltaic power consumption shall be exempted from the spontaneous issues related to government funds
Supervision	2013.11	NEA	Management Rules for Photovoltaic Power Generation Operation Supervision
	2013.08	NEA、CDB	Opinions on Supporting Financial Services for Distributed PV Generation
	2013.11	MIIT、CDB	Notice on Supporting Major Project in PV Industry
Industry	2013.09	MIIT	Standard Conditions on PV Manufacturing Industry
	2013.10	MIIT	Management Rules for Standard Conditions on PV Manufacturing Industry

Standard Testing and Identification	2014.02	CNCA、NEA	Opinions for Strengthening Testing and Identification on PV Products
	2014.03	NEA	To Strengthen the Testing Work Scheme of Photovoltaic Industry Information
Grid	2013.11	SG	Relevant Opinions and Standards on Distributed Power Grid (Revised edition)
	2013.11	SG	Work Opinions on Distributed Power Grid Service
	2013.11	CSG	Distributed Photovoltaic Power Generation Service Guide in South Power Grid Corp(Interim)

Source: CPIA, 2014.4

2. Local policy

Considering stimulating demand, the local governments especially those from Jiangsu,Shandong, Zhejiang and other provinces where the photovoltaic industry concentrated, generally chose to develop subsidies incentive project to promote the regional market. In addition, the local governments also promoted the development of regional photovoltaic industry through the formulation of regional planning, simplify the approval process and other ways, representative of the local policies in 2013 include:

(1)Shanghai: Subsidies for personal distributed photovoltaic amounted to 0.4 yuan/kWh

"Support Way for Renewable Energy and New Energy Development Special Funds"

To further support Shanghai city of renewable energy and new energy development, promote energy-saving emission reduction and energy structure adjustment, stimulate and promote the development of strategic emerging industries, the Municipal Development and Reform Commission, the Municipal Finance Bureau jointly with the relevant units revised " Support Way for Renewable Energy and New Energy Development Special Funds in Shanghai", and submitted to the municipal government for examination.

For wind power, photovoltaic project, according to the actual generation power, government rewarded for project investment subject, bonus time for 5 consecutive years. The annual individual project award amount is not more than RMB 50 million yuan.

(2)Inner Mongolia: Three views of development planning

"The Inner Mongolia Autonomous Region Solar Power Development Planning in 2013~2020"

On December 31, 2013,the Inner Mongolia Autonomous Region issued "Notice of The Inner Mongolia Autonomous Region Solar Power Development Planning in 2013~2020" and put forward three main views. They are to strengthen planning guidance, optimize the layout of the building; priority distributed utilization based on the absorptive; strengthen the power grid construction

and implement the consumption market.

(3)Tianjin: Differentiated management subdivision interests

"PV Power Generation Project of Power Grid Service Workflow"

To actively promote the development of photovoltaic power generation project in Tianjin, and further optimize the grid connection process, simplify procedures, improve service efficiency, according to the National Energy Bureau issued the "Management Rules for the Distributed Photovoltaic Power Generation Project Management" and " Management Rules for Photovoltaic Power Plant Project Management", Tianjin Development and Reform Commission, Tianjin electric power company of the State Grid jointly developed the "Procedure for Grid Service of Photovoltaic Power Generation Project in Tianjin" to facilitate the easy formalities the of electric power grid.

4.2 Standards and codes

As of 2013 December, China has formulated and issued 95 standards related photovoltaic products manufacturing, photovoltaic applications, related materials, equipments and other standards, of which 67 national standards, 28 industry standards.

In Chinese present standards, photovoltaic standard equipments, photovoltaic materials standards, photovoltaic components standards and standards of photovoltaic application are independently formulated primarily. Solar cell and component standards and photovoltaic system standards mainly are IEC standard based transformation.

Table 12: The Photovoltaic Standards and Code Published in 2013.

NO	Standards and codes	Standards Name
1	GB 30252-2013	Limit consumption of unit product energy of photovoltaic glass rolling
2	GB/T 29849-2013	Measuring method to inductively coupled plasma mass spectrometry with surface metal silicon impurity content of photovoltaic cells
3	GB/T 29850-2013	Measuring method to silicon material compensation degree of photovoltaic cells
4	GB/T 29851-2013	Measuring method to two secondary ion mass spectrometry used in silicon B, Al acceptor impurity content of photovoltaic solar cell

5	GB/T 29852-2013	Measuring method to two secondary ion mass spectrometry used in silicon As, Sb acceptor impurity content of photovoltaic solar cell
6	GB/T 29848-2013	Ethylene-vinyl-acetate copolymer with PV module encapsulation (EVA) film
7	GB/T 29595-2013	Photovoltaic component sealing material and silicone rubber sealant on the ground
8	GB/T 13539.6-2013	Low voltage fuses - Part sixth: Supplementary requirements for fuse links of solar photovoltaic system protection
9	GB/T 30427-2013	Technology requirements and test methods of grid connected photovoltaic for special inverter
10	GB/T 30153-2013	Photovoltaic power station real time monitoring technology requirements of solar energy resource
11	GB/T 30152-2013	Technical specification of photovoltaic power generation system connected to distribution network
12	GB/T 50865-2013	Design specification of photovoltaic power intervention for distribution network
13	NB/T 32005-2013	Technical specification for testing of photovoltaic power station of low voltage ride
14	NB/T 32006-2013	Detection procedures for quality of photovoltaic power station power
15	NB/T 32007-2013	Tutorial detection technology of photovoltaic power station power control capability
16	NB/T 32011-2013	Technical requirements of photovoltaic power station power prediction system
17	NB/T 32013-2013	Testing procedures of photovoltaic power station voltage and frequency response
18	NB/T 32014-2013	Technical specification of photovoltaic power station for anti islanding detection
19	GB 29551-2013	Solar PV laminated glass in building
20	GB/T 29759-2013	Solar photovoltaic hollow glass building

21	NB/T 32017-2013	Solar photovoltaic water pump system

Source: China Electronics Standardization Institute, CPIA, 2014.

5.Highlights and prospects

5.1 Stakeholder initiatives and awareness raising

With the high-speed development of China economy, we are facing dual pressure of energy and environment. China's conventional energy reserve production ratio is far lower than the average level of the world, and has become the world's largest energy consumer, coal import, electricity consumption and electricity installed country, crude oil and natural gas external dependence is as high as 60% and 30%, and the "heart lung trouble" of China's large range and continuous haze air pollution is also an alarm to the existing energy structure system that is heavily dependent on fossil fuels such as coal.

Optimizing and adjustment of energy and industrial structure, greatly reduce the proportion of coal consumption, effectively improve the proportion of renewable energy will be the measure to deal with the energy shortage and the continuous deterioration of the environment, and the implement of the work for prevention and control of atmospheric pollution. Vigorously develop solar energy and other renewable energy and the strategic emerging industry is a hundred year project of China and is to kill haze from its source and is also one of the main roads for the sustain development of China's energy and environment.

In 2009, Chinese has been in the Copenhagen climate change conference proposed "strategic objectives in 2020 near the middle of non fossil energy n primary energy consumption should reach 15%". Recently China has focused on a new energy system on renewable energy as the main energy long-term, mid-term energy development goals and strategic research.

In many energy development path, a high proportion of renewable energy development scenarios is a path of the most clear, most practical, the cleanest, most sustainable low carbon energy. According to this situation, in the future China fossil energy ratio will not exceed 1/3; power will account for the terminal energy consumption in the proportion of 60-65%, it will be a Chinese type of energy revolution.

5.2 Prospects

According to the "research Chinese solar roadmap:" in the next forty years(to 2050), through technological innovation, scale development, the electric power system and other supporting the progress of technology, solar energy will transfer from a supplementary energy to alternative energy sources, and gradually become one of the main energy in China's "independence, low carbon, sustainable energy system" .

The basic goal of Chinese solar development set in the roadmap is: to 2020, 2030 and 2050, photovoltaic power generation installed capacity will reach 100 million kW, 400 million kW and 1 billion kW. By 2050, solar power will meet 18% of their electricity demand; the application of solar energy in primary energy demand accounted for about 15%;

The positive goal of Chinese solar development roadmap is: to 2020, 2030 and 2050, photovoltaic power generation installed capacity will reach 200 million kW, 800 million kW and 2 billion kW, 500 million kW and 2411 GW_{th}. By 2050, solar power will meet 40% of their electricity demand; the application of solar

energy in primary energy demand accounted for about 32%.

Can be predicted, in the future:

Battery technology R & D - solar photovoltaic power generation and active,to improve the conversion efficiency and reduce the manufacturing cost is still the main direction of future development.

With the technology progress of the balance component, the emergence of new integrated technology, the cost of photovoltaic power generation will maintain downward trend. This will not only directly accelerate the other countries in the world to achieve photovoltaic parity on the in grid, China will also in 2025 the full realization of photovoltaic grid parity.

Centralized PV power station and distributed photovoltaic system will be the two main forms of photovoltaic scale using. Distributed PV in policy orientation will be from the current 16% of the market share gradually expanding, will focus on the development of flat near and medium term, each accounted for about half the market; from the long-term view, the distributed photovoltaic facing building resources potential close to developing the saturation limit tends to market stability, and centralized photovoltaic power station will likely be more robust development potential due to strength enough desert Gobi resources, power grid construction and absorptive capability.

Annex A: References, methods and accuracy of data.

[1] Annual Report of China, 2014

[2]CPIA, Annual Report of China PV Industry 2013, April, 2014.

[3]Wang Sicheng, Current Status of PV in China 2014

[4]2014 Annual Review and Outlook for China Solar PV Industry

[5]Xu Honghua, Lv Fang, Wang Sicheng. Solar Energy Roadmap in China 2020, 2030, 2050. 2013.

Annex B: Country Information

This information is simply to give the reader some background about the national environment in which PV is being deployed. It is not guaranteed to be 100 % accurate nor intended for analysis, and the reader should do their own research if they require more detailed data.

1) Retail electricity prices - household, commercial, public institution

The tariffs in China are varying based upon different geographic locations, user categories and time using electricity.

2) Typical metering arrangements and tariff structures for electricity customers (for example, interval metering, time-of-use tariff)

- Regular metering, or prepaid card metering. The interval for regular metering is one month.

- Summer price is carrying out, which is high than other seasons.

- Common, peak and valley price structure is used. Peak price is much high than valley price so as to shift the peak load.

3) Typical household income

Table 13: Typical household income in 2013

	per capita disposable income of urban dwellers	per-capita net incomes for rural families
	Amount (Yuan)	Amount (Yuan)
2013	26955	8896

Source: China Statistical Yearbook 2013

4) Typical mortgage interest rate

The mortgage interest rates in China varies time by time and varies by different bank, the following table was the rate effective in 2013 by Bank of China.

Table 14: The mortgage interest rates in China

Terms	Annual interest rate %
1 Year	5.7500

5) Voltage (household, typical electricity distribution network)

- Household: 220V

- Distribution network: single phase, 220V, three phase 380V, 10KV, 35KV, 100KV, 220KV,

330KV, 500KW, and 1000KV.

6) Electricity industry structure and ownership

Five major power generation corporations: Northeast China grid company, North China Grid company limited, Center China Grid company limited, East China Grid company limited, Northwest China Grid Company Limited.

These companies all belong to State Grid Corporation of China (SGCC), and China Southern Power Grid Co., Ltd. (CSG).

They are all state-owned enterprises.

7) Retail prices of oil

The retail price of oil in China is different by different city, take the Beijing as the example, the retail price of oil in Beijing updated by 13rd Dec.2013 (The final modify in 2013)。 :

Gasoline

90#： 7.35 Yuan/liter

92#: 7.86 Yuan/liter

95#: 8.36 Yuan/liter

Diesel oil: 7.81 Yuan/liter

(Data updated by Dec, 2013 Source: http://data.eastmoney.com/cjsj/yjtz/20131213.html)