Task 1 Strategic PV Analysis and Outreach

PVPS

National Survey Report of PV Power Applications in China 2018

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PHOTOVOLTAIC POWER SYSTEMS
TECHNOLOGY COLLABORATION PROGRAMME

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WHAT IS IEA PVPS TCP

The International Energy Agency (IEA), founded in 1974, is an autonomous body within the framework of the Organization for Economic Cooperation and Development (OECD). The IEA carries out a comprehensive programme of energy cooperation among its 30 member countries and with the participation of the European Commission. The IEA Photovoltaic Power Systems Programme (IEA PVPS) is one of the collaborative research and development agreements (technology collaboration programmes) within the IEA and was established in 1993. The mission of the programme is to "*enhance the international collaborative efforts which facilitate the role of photovoltaic solar energy as a cornerstone in the transition to sustainable energy systems.*"

In order to achieve this, the Programme's participants have undertaken a variety of joint research projects in PV power systems applications. The overall programme is headed by an Executive Committee, comprised of one delegate from each country or organisation member, which designates distinct 'Tasks,' that may be research projects or activity areas. This report has been prepared under Task 1, which deals with market and industry analysis, strategic research and facilitates the exchange and dissemination of information arising from the overall IEA PVPS Programme.

The IEA PVPS participating countries are Australia, Austria, Belgium, Canada, Chile, China, Denmark, Finland, France, Germany, Israel, Italy, Japan, Korea, Malaysia, Mexico, Morocco, the Netherlands, Norway, Portugal, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, and the United States of America. The European Commission, Solar Power Europe, the Smart Electric Power Alliance (SEPA), the Solar Energy Industries Association and the Copper Alliance are also members.

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WHAT IS IEA PVPS task 1

The objective of Task 1 of the IEA Photovoltaic Power Systems Programme is to promote and facilitate the exchange and dissemination of information on the technical, economic, environmental and social aspects of PV power systems. Task 1 activities support the broader PVPS objectives: to contribute to cost reduction of PV power applications, to increase awareness of the potential and value of PV power systems, to foster the removal of both technical and non-technical barriers and to enhance technology co-operation. 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 country National Survey Report for the year 2018. Information from this document will be used as input to the annual Trends in photovoltaic applications report.

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DISCLAIMER:

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1 INSTALLATION DATA

The PV power systems market is defined as the market of all nationally installed (terrestrial) PV applications with a PV capacity of 40 W or more. A PV system consists of modules, inverters, batteries and all installation and control components for modules, inverters and batteries. Other applications such as small mobile devices are not considered in this report.

For the purposes of this report, PV installations are included in the 2018 statistics if the PV modules were installed and connected to the grid between 1 January and 31 December 2018, although commissioning may have taken place at a later date.

1.1 Applications for Photovoltaics

In 2018, although China's PV installed capacity dropped, the added and cumulative PV installed capacity continued to remain the first in the world. In 2018, China's newly installed grid-connected PV capacity reached 44.26GW, down 16.6% year-on-year, of which centralized photovoltaic power plants installed 23.30GW, down 30.7% year-on-year; distributed PV installed capacity 20.96GW, increased 78% year-on-year. As of 2018, the cumulative PV grid-connected capacity reached 174.45GW, an increase of 33.9%. Among them, the cumulative installed capacity of centralized photovoltaic power plants was 123.84GW, and the cumulative installed capacity of distributed photovoltaics was 50.61GW. The annual photovoltaic power generation capacity was 17.5 billion kWh, accounting for 2.6% of China's total annual power generation (679.142 billion kWh), an increase of 0.8 percentage points year-on-year.

1.2 Total photovoltaic power installed

Table 1: Annual PV power installed during calendar year 2018.

		Installed PV capacity in 2018 [MW]	AC or DC
PV capacity	Off-grid		
	Decentralized	20960	DC
	Centralized	23300	DC
	Total	44260	

Centralized: any PV installation which only injects electricity and is not associated with a consumer (no self-consumption)

Decentralized: any PV installation which is embedded into a customer's premises (self-consumption)

Table 2: Data collection process.

If data are reported in AC, please mention a conversion coefficient to estimate DC installations.	N/A
Is the collection process done by an official body or a private company/Association?	Data on annual and accumulated PV grid-connected installation capacity in 2018 were published by National Energy Administration. Off-grid installation accounts for a very small scale in China so the data was estimated by PV experts.
Link to official statistics (if this exists)	http://www.nea.gov.cn/2019-03/19/c_137907428.htm
	Additional comments on market and data collection, especially the estimated accuracy of data.

Table 3: The cumulative installed PV power in 4 sub-markets.

Year	Off-grid [MW] (including large hybrids)	Grid-connected distributed [MW] (BAPV, BIPV)	Grid-connected centralized [MW] (Ground, floating, agricultural…)	Total [MW]
2001	4.50	0.01	0.00	4.51
2002	18.50	0.01	0.00	18.51
2003	10.00	0.07	0.00	10.07
2004	8.80	1.20	0.00	10.00
2005	6.40	1.30	0.20	7.90
2006	9.00	1.00	0.00	10.00
2007	17.80	2.00	0.20	20.00
2008	29.50	10.00	0.50	40.00
2009	17.80	34.20	108.00	160.00
2010	27.00	190.00	283.00	500.00
2011	20.00	680.00	2000.00	2700.00
2012	40.00	1360.00	1800.00	3200.00
2013	40.00	10950[1]		10990.00
2014	40.00	2050.00	8550.00	10640.00
2015	20.00	1390.00	13740.00	15150.00
2016	10.00	4230.00	30310.00	34550.00
2017	0	19440.00	33420.00	52860.00
2018	0	20960.00	23300.00	44260.00

[1]PV grid-connected installation capacity in 2013 was modified to 10950MW by National Energy Administration in 2014.

Table 4: Other PV market information.

	2018 Numbers
Number of PV systems in operation in your country (a split per market segment is interesting)	Total installed 44.26GW except for Distributed PV 20.96GW（43.36%）； Ground Mounted LS-PV 23.3GW（52.64%）
Capacity of decommissioned PV systems during the year [MW]	N/A
Capacity of repowered PV systems during the year [MW]	N/A
Total capacity connected to the low voltage distribution grid [MW]	N/A
Total capacity connected to the medium voltage distribution grid [MW]	N/A
Total capacity connected to the high voltage transmission grid [MW]	N/A

Table 5: PV power and the broader national energy market.

	2017 numbers	2018 numbers
Total power generation capacities [GW]	1777.03GW	1899.67
Total renewable power generation capacities (including hydropower) [GW]	670.93GW	755.81GW
Total electricity demand [TWh]	6307.7TWh	6844.9TWh
Total energy demand [TWh]	N/A	N/A
New power generation capacities installed in 2018 [GW]	133.72GW	124.39GW
New renewable power generation capacities installed in 2018 (including hydropower) [GW]	N/A	79.83GW (hyd. 9GW, wind 15.03GW, PV 53.06GW, Bio. 2.74GW)
Estimated total PV electricity production (including self-consumed PV electricity) in [GWh] (or [TWh])	118.2TWh	177.5TWh
Total PV electricity production as a % of total electricity consumption	1.87%	2.59%

1.3 Key enablers of PV development

Table 6: Information on key enablers.

	Description (optional)	Annual Volume (optional)	Total Volume (optional)	Source (optional)
Decentralized storage systems In [MW, MWh or #]			114.5MW	CPIA,2019,5
Residential Heat Pumps [#]				
Electric cars [#]				
Electric buses and trucks [#]				
Other (up to you)				

2 COMPETITIVENESS OF PV ELECTRICITY

2.1 Module prices

Table 7: Typical module prices for a number of years (Units: RMB Yuan).

Year	Lowest price of a standard module crystalline silicon	Highest price of a standard module crystalline silicon	Typical price of a standard module crystalline silicon
2010	N/A	-	13.0
2011	N/A	-	9.0
2012	N/A	-	4.5
2013	N/A	-	4
2014	N/A	-	3.8
2015	N/A	-	3.5
2016	N/A	-	3.1
2017	N/A	-	2.5
2018	N/A	-	2.1

2.2 System prices

Table 8: Turnkey PV system prices of different typical PV systems.

Category/Size	Typical applications and brief details	Current prices [/W]
Off-grid 1-5kW	A stand-alone PV system is a system that is installed to generate electricity to a device or a household that is not connected to the public grid.	N/A
Residential BAPV 5-10 kW	Grid-connected, roof-mounted, distributed PV systems installed to produce electricity to grid-connected households. Typically roof-mounted systems on villas and single-family homes.	5.5-6.0
Residential BIPV 5-10 kW	Grid-connected, building integrated, distributed PV systems installed to produce electricity to grid-connected households. Typically, on villas and single-family homes.	N/A
Small commercial BAPV 10-100 kW	Grid-connected, roof-mounted, distributed PV systems installed to produce electricity to grid-connected commercial buildings, such as public buildings, multi-family houses, agriculture barns, grocery stores etc.	5.5-6.0
Small commercial BIPV 10-100 kW	Grid-connected, building integrated, distributed PV systems installed to produce electricity to grid-connected commercial buildings, such as public buildings, multi-family houses, agriculture barns, grocery stores etc.	N/A
Large commercial BAPV 100-250 kW	Grid-connected, roof-mounted, distributed PV systems installed to produce electricity to grid-connected large commercial buildings, such as public buildings, multi-family houses, agriculture barns, grocery stores etc.	5.5-6.0
Large commercial BIPV 100-250 kW	Grid-connected, building integrated, distributed PV systems installed to produce electricity to grid-connected commercial buildings, such as public buildings, multi-family houses, agriculture barns, grocery stores etc.	N/A
Industrial BAPV >250 kW	Grid-connected, roof-mounted, distributed PV systems installed to produce electricity to grid-connected industrial buildings, warehouses, etc.	5.5-6.0
Small centralized PV 1-20 MW	Grid-connected, ground-mounted, centralized PV systems that work as central power station. The electricity generated in this type of facility is not tied to a specific customer and the purpose is to produce electricity for sale.	5.0-5.5
Large centralized PV >20 MW	Grid-connected, ground-mounted, centralized PV systems that work as central power station. The electricity generated in this type of facility is not tied to a specific customer and the purpose is to produce electricity for sale.	5.0-5.5

Table 9: National trends in system prices for different applications

Year	Residential BAPV Grid-connected, roof-mounted, distributed PV system 5-10 kW **[currency/W] (mandatory)**	Small commercial BAPV Grid-connected, roof-mounted, distributed PV systems 10-100 kW **[currency/W] (mandatory**	Large commercial BAPV Grid-connected, roof-mounted, distributed PV systems 100-250 kW **[currency/W] (mandatory**	Small centralized PV Grid-connected, ground-mounted, centralized PV systems 10-20 MW **[currency/W] (mandatory)**
2009	-	-		30
2010	-	-		20
2011	-	18		15
2012	-	14		12
2013	-	12		10
2014	13	8		8
2015	6-7	6-7		7-8
2016	6.0-6.5	6.0-6.5		5.5-6.0
2017	5.5-6.0	5.5-6.0		5.0-5.5
2018	5.5-6.0	5.5-6.0		5.0-5.5

Categories are the same as previous years but he names has been slightly changed.

2.3 Cost breakdown of PV installations

Table 10: Cost breakdown for a grid-connected roof-mounted, distributed residential PV system of 5-10 kW.

Cost category	Average [currency/W]	Low [currency/W]	High [currency/W]
Hardware			
Module	2.60		
Inverter	0.52		
Mounting material	0.20		
Other electronics (cables, etc.)	0.10		
Subtotal Hardware	3.42		
Soft costs			
Planning	/		
Installation work	0.70		
Shipping and travel expenses to customer	0.05		
Permits and commissioning (i.e. cost for electrician, etc.)	0.30		
Project margin	1.00		
Subtotal Soft costs	**1.05**		
Total (excluding VAT)	**3.903**		
Average VAT	0.567		
Total (including VAT)	4.470		

Table 11:Cost breakdown for a grid-connected, ground-mounted, centralized PV systems of >10 MW.

Cost category	Average [currency/W]	Low [currency/W]	High [currency/W]
Hardware			
Module	2.40		
Inverter	0.31		
Mounting material	0.73		
Other electronics (cables, etc.)	0.46		
Subtotal Hardware	**3.90**		
Soft costs			
Planning	0.08		
Installation work	0.35		
Shipping and travel expenses to customer	0.04		
Permits and commissioning (i.e. cost for electrician, etc.)	0.05		
Project margin	0.35		
Subtotal Soft costs	**0.87**		
Total (excluding VAT)	**4.153**		
Average VAT	0.617		
Total (including VAT)	**4.770**		

2.4 Financial Parameters and specific financing programs

Table 12: PV financing information in 2018.

Different market segments	Loan rate [%]
Average rate of loans – residential installations	4.9% (float within the prescribed scope of 15%)
Average rate of loans – commercial installations	4.9% (float within the prescribed scope of 15%)
Average cost of capital – industrial and ground-mounted installations	5.5-6.0 Yuan/W

2.5 Specific investments programs

Table 13: Summary of existing investment schemes.

Investment Schemes	Introduced in China
Third party ownership (no investment)	N/A
Renting	N/A
Leasing	N/A
Financing through utilities	N/A
Investment in PV plants against free electricity	N/A
Crowd funding (investment in PV plants)	N/A
Community solar	N/A
International organization financing	N/A
Other (please specify)	N/A

2.6 Additional Country information

Table 14: Country information.

Retail electricity prices for a household [currency/W]	0.54804 RMB Yuan/kWh			
Retail electricity prices for a commercial company [currency/W]	0.82514 RMB Yuan/kWh			
Retail electricity prices for an industrial company [currency/W]	0.64397 RMB Yuan/kWh			
Population at the end of 2018	1395380 000			
Country size [km^2]	9,634,057			
Average PV yield in [kWh/kW]	Zone 1: > 1500 Zone 2: 1200-1500 Zone 3: < 1200			
Name and market share of major electric utilities		Electricity production [%]	Share of grid Subscribers [%]	Number of retail customers [%]
		N/A	N/A	N/A
		N/A	N/A	N/A

3 POLICY FRAMEWORK

This chapter describes the support policies aiming directly or indirectly to drive the development of PV. Direct support policies have a direct influence on PV development by incentivizing or simplifying or defining adequate policies. Indirect support policies change the regulatory environment in a way that can push PV development.

Table 15: Summary of PV support measures.

	On-going measures in 2018 – Residential	Measures introduced in 2018 – Residential	On-going measures in 2018 – Commercial + Industrial	Measures introduced in 2018 – Commercial + Industrial	On-going measures in 2018 – Centralized	Measures introduced in 2018 – Centralized
Feed-in tariffs	Yes Feed-in tariffs desulfurized coal benchmark price+ 0.42 yuan/kWh (include tax)	No	Yes Feed-in tariffs desulfurized coal benchmark price+ 0.42 yuan/kWh (include tax)	No	Feed-in tariff : on the basis of resource regions, 0.65, 0.75,0.85 yuan/kwh respectively	Feed-in tariff, on the basis of three catalogue regions, decreased 0.15 yuan/kwh respectively
Feed-in premium (above market price)						
Capital subsidies						
Green certificates						
Renewable portfolio standards (RPS) with/without PV requirements						
Income tax credits						
Self-consumption						
Net-metering	No	No	No	No	No	No
Net-billing	No	No	No	No	No	No
Collective self-consumption and virtual net-metering	No	No	No	No	No	No
Commercial bank activities e.g. green mortgages promoting PV	Yes		Yes		Yes	
Activities of electricity utility businesses	Yes		Yes		Yes	
Sustainable building requirements						
BIPV incentives	Yes		Yes		Yes	
Other (specify)	-	-	-	-	-	-

3.1 National targets for PV

Looking forward to 2019, China's newly installed PV capacity is expected to be between 35 and 45 GW, and the trend of installed capacity is stable. From the domestic point of view, the integration of the technology pacemaking base projects in 2019 will also drive the market demand for high-efficiency products. It is expected that the conversion efficiency of industrialized P-type PERC single crystal and N-type single crystal cell will exceed 22%, and the power of mainstream component products will reach 310W or more, and the market share of single crystal will be reversed; traditional cell technology will gradually be replaced by high-efficiency cell using PERC technology; while half-cell, stacked tile and other component technologies will gradually increase the market share in the same way as the double-sided battery technology. It is expected that the shipment will be on the level of 10GW in 2019.

3.2 Direct support policies for PV installations

2018 is a year of great change in China's photovoltaic power generation policy mechanism. The national policy adjustments related to photovoltaic power generation is mainly in the following aspects: adjustment and innovation of scale management mechanism, electricity prices and subsidies continue to drop based on cost reduction, scaled promotion of construction of parity projects, and strengthening market environment supervision, etc. Meanwhile, a number of important mechanisms, such as distributed power generation market-oriented trading mechanism and renewable energy consumption mechanism with binding effect are also in the process of being formulated and promoted.

3.2.1 Development plan and target

In 2018, the State implemented a strict scale management policy for photovoltaic power generation projects that require subsidies from the National Renewable Energy Development Fund. On May 31, 2018, the National Development and Reform Commission, the Ministry of Finance, and the National Energy Administration issued a notice on matters related to photovoltaic power generation in 2018 (Development and Reform Energy [2018] No. 823). In terms of scale management, the scale of construction of ordinary photovoltaic power stations in 2018 would not be arranged; and 10 million kilowatts would be allocated the same year to support the construction of distributed photovoltaic projects, and the grid connected distributed photovoltaic power generation before May 31 (inclusive) will be clarified and included in the scope of scale management approved by the state, and projects that are not included in the scope of nationally recognized scale management would be supported by local governments.

Unsubsidized Photovoltaic parity projects are important incremental markets. In January 2019, the National Development and Reform Commission and the National Energy Administration issued the "Notice on Actively Promoting the Work of Parity Grid-connection without Subsidy for Wind and Photovoltaic Power Generation (Development and Reform Energy [2019] No. 19)", and launched a scaled unsubsidized parity market for wind and PV power.

3.2.2 Project management

The direction of project management is a comprehensive implementation of competitive configuration of PV power generation. According to the exposure draft of 2019 Photovoltaic Power Generation Management Policy Plan, the competitive project deployment will be fully implemented except household PV and PV poverty alleviation.

Strengthen the role of market environmental monitoring and evaluation mechanism in photovoltaic power generation. In December 2017, the National Energy Administration promulgated the “Notice on Establishing a Market Environment Monitoring and Evaluation Mechanism to Guide the Healthy and Orderly Development of Photovoltaics”, marking that after wind power, the government departments also started to conduct market environment

monitoring and evaluation on a regular basis every year. in terms of management, macro and pre-warning, process monitoring and post-event evaluation were emphasized. The purpose is to optimize the photovoltaic power generation construction and operation environment and guide the rational investment of enterprises.

3.2.3 Electricity price and subsidy

In 2018, the national price management authority adjusted the photovoltaic power generation benchmark price and the distributed photovoltaic power generation subsidy level for the "spontaneous generation and consumption, surplus feed in grid" mode at the beginning of the year and in June respectively, continuing the process of unsubsidized photovoltaic power generation. After two adjustments in 2018, the benchmark price of photovoltaic power generation was reduced by 0.15 yuan/kWh, and the electricity price levels in I, II and III resource zones (from June 2018) were 0.5, 0.6, 0.7 yuan/kWh, respectively; distributed photovoltaic power generation per kWh subsidy reduced 1.2 yuan / kWh, to the level of 0.32 yuan / kWh from June 2018.

3.2.4 Taxation policy

Regulate land use policies to reduce land costs and unreasonable charge. In April 2018, the National Energy Administration promulgated the "Notice on Reducing the Burden of Enterprises in the Field of Renewable Energy. The energy management department of each region should compile the development and utilization plan of renewable energy in connection with land use, agriculture, animal husbandry, forestry, and ecological environmental protection, giving priority to the unused land, encouraging composite land use, and reduce costs associated with sites of renewable energy projects.

3.2.5 Development space and power consumption

Power system consumption capacity is an important precondition for new projects in the future. In October 2018, the National Development and Reform Commission and the Additional Energy Bureau promulgated the Issuance of the Notice on Clean Energy Consumption Action Plan (2018-2020) (Development and Reform Energy Regulation [2018] No. 1575), which put forward quantitative targets for reduction of wind, water and PV power abandonment in some key provinces.

3.3 Self-consumption measures

Table 16: Summary of self-consumption regulations for small private PV systems in 2018.

PV self-consumption	1	Right to self-consume	Yes
	2	Revenues from self-consumed PV	Yes
	3	Charges to finance Transmission, Distribution grids & Renewable Levies	Yes
Excess PV electricity	4	Revenues from excess PV electricity injected into the grid	Yes
	5	Maximum timeframe for compensation of fluxes	Savings on the electricity plus a self-consumption bonus（4.2Yuan/kWh).
	6	Geographical compensation (virtual self-consumption or metering)	None
Other characteristics	7	Regulatory scheme duration	Market price plus a bonus（4.2Yuan/kWh).
	8	Third party ownership accepted	Real-time
	9	Grid codes and/or additional taxes/fees impacting the revenues of the prosumer	On site only
	10	Regulations on enablers of self-consumption (storage, DSM…)	20 years
	11	PV system size limitations	6 MW
	12	Electricity system limitations	None
	13	Additional features	None

3.4 Collective self-consumption, community solar and similar measures

N/A

3.5 Tenders, auctions & similar schemes

Since 2016, China started to explore competitive method to decide renewable energy project developers and power price, and implemented bidding for PV “leading runner” technology bases and regular PV power station projects. The competitive projects deployment represented by PV “leading runner” bases facilitated the speeding up of the process for PV power grid parity.

According to the exposure draft of 2019 Photovoltaic Power Generation Management Policy Plan, the competitive project deployment will be fully implemented, except household PV and PV poverty alleviation. The competition configuration will be organized by the local energy authority. For projects without owners and enterprises that have not yet carried out preliminary work, the localities can use various forms such as bidding and competitive optimization to determine the project owner. The specific rules and organization implementation will be worked out by local authorities. For projects with clear ownership or an enterprise has already carried out the preliminary work, the local authority will confirm the project, and the enterprise needs to report corresponding information and electricity price. Finally, all projects at the national level are determined according to the revised electricity price ranking for final selection. The national sorting method will likely have a fierce bidding situation, overcoming the shortcomings of the previously organized local competition with limited electricity price reduction. Special or demonstration projects implemented at state level will also be carried out by local organizations by means of competitively deployment, but not participate in the uniformed national sequencing.

3.6 Other utility-scale measures including floating and agricultural PV

N/A

3.7 Social Policies

3.7.1 PV Poverty Alleviation

The government will build around 5kW PV for each poor family and the family can get 3000 Yuan each year by selling PV electricity to grid. This project will help 2.8 million poor families and 15.5GW of PV already approved.

In March 2018, the Ministry of Finance, the National Development and Reform Commission, the National Energy Administration, and the State Council Office of Poverty Alleviation issued the Notice on the Announcement of the Supplementary Renewable Energy Tariffs (PV Poverty Alleviation Project). The eligible PV poverty alleviation projects will be included in the catalogue of renewable energy tariffs.

3.8 Retrospective measures applied to PV

N/A

3.9 Indirect policy issues

3.9.1 Rural electrification measures

By the end of 2015, China already announced that whole China has been electrified and there is no un-electrified people at all. So, there is no government supported projects for off-grid rural electrification any more since 2016.

PV industry applications, like communication, signal system for navigation, railways, highways, remote weather stations, remote satellite TV, etc., are sponsored by industry units and there is no special policy for such sector. The market is about several MW annually.

PV commercial products, like solar street lights, lawn lights, moveable solar chargers, solar watches, solar fans, etc., are all directly selling on market without any government subsidy. The market size is about few MW each year.

3.9.2 Support for electricity storage and demand response measures

N/A

3.9.3 Support for electric vehicles (and VIPV)

N/A

3.9.4 Curtailment policies

N/A

3.9.5 Other support measures

N/A

3.10 Financing and cost of support measures

In 2018, the national price management authority adjusted the photovoltaic power generation benchmark price and the distributed photovoltaic power generation subsidy level for the “spontaneous generation and consumption, surplus feed in grid” mode at the beginning of the year and in June respectively, continuing the process of unsubsidized photovoltaic power generation. After two adjustments in 2018, the benchmark price of photovoltaic power generation was reduced by 0.15 yuan/kWh, and the electricity price levels in I, II and III resource zones (from June 2018) were 0.5, 0.6, 0.7 yuan/kWh, respectively; distributed photovoltaic power generation per kWh subsidy reduced 1.2 yuan / kWh, to the level of 0.32 yuan / kWh from June 2018.

4 INDUSTRY

4.1 Production of feedstocks, ingots and wafers (crystalline silicon industry)

Please complete the following table if appropriate.

Give in Table below the following information for the year:

a) List by name all manufacturers operating in your country. Alternatively, please report a total figure for your country.

b) Type of process and technology e.g. polysilicon, silicon ingots, EFG ribbon wafers, silicon wafers and so on.

c) Total production of each manufacturer for 2018.

4.1.1 Polycrystalline silicon material

China's polycrystalline silicon production remained continued increase in 2018 to reach 259,477 tons output, accounting 58.1% of global total output.

Table 17: Silicon feedstock, ingot and wafer producer's production information for 2018.

Manufacturers (or total national production)	Process & technology	Total Production（tons）	Product destination (if known)	Price (if known)
Jiangsu Zhongneng Polysilicon Technology Development Co. Ltd	mc-Si	63540		
Xinte Energy Co., Ltd	mc-Si	34019		
DAQO New Energy Corp.	mc-Si	23350		
Sichuan Yongxiang Co. Ltd.	mc-Si	19277		
SINOSICO	mc-Si	16000		
East Hope Co. Ltd	mc-Si	15890		
Asia Silicon Co., Ltd	mc-Si	14250		
Jiangxi LDK Solar Hi-Tech Co. Ltd	mc-Si	9712		
DunAn Holding Group Co., Ltd	mc-Si	9557		
Jiangsu Combo PV Co. Ltd	mc-Si	8800		
Yichang CSG Polysilicon.Co.,Ltd	mc-Si	7692		
Erdos Group	mc-Si	6500		
Shaanxi Tianhong Silicon Material Co., Ltd.	mc-Si	5400		
Guodian Inner Mongolia Jingyang Energy Co., Ltd.	mc-Si	5395		

Manufacturers (or total national production)	Process & technology	Total Production（tons）	Product destination (if known)	Price (if known)
Inner Mongolia Shenzhou Silicon Industry Limited Liability Company	mc-Si	5048		
Sichuan ReneSola Silicone Materials Co., Ltd.	mc-Si	1689		
Kunming Yeyan New Materials Co., Ltd.	mc-Si	1306		
Rest	mc-Si	8352		
Total	mc-Si	259477		

Source: CPIA,2019.5

4.1.2 Silicon wafer

In 2018, mainland China's wafer production capacity was about 146.4GW, was an increase of 39.4% year-on-year, benefited from investment to expand production of monocrystalline silicon wafer, and the increase in production capacity brought by technological progress. China's wafer production is about 107.1Gw, an increase of 16.8% year-on-year, accounting for 93.1% of global wafer production, of which the output of monocrystalline silicon wafer was 49.2GW, and polycrystalline silicon wafer was 57.9GW, accounting for 45.9% and 54.1% respectively.

4.2 Production of photovoltaic cells and modules (including TF and CPV)

4.2.1 Solar cell

In 2018, the total production capacity of China's solar cell was 128.1GW, up 54.7% year-on-year, accounting for 73.7% of global production capacity; the output was about 85GW, up 18.1% year-on-year, about 74.8% of the annual global production.

In 2018, China's solar cells were exported to 150 countries and regions. The annual export volume of solar cell was about 800 million US dollars, down 18.9% year-on-year, accounting for 5% of the total export value of photovoltaic products, and the export volume of solar cell was about 4.8GW.

4.2.2 PV module

In 2018, the total production capacity of PV module was about 130GW, and the output was 83.4GW, a year-on-year growth of 12.3%, accounting for about 64.5% of global production, mostly crystalline silicon PV module in terms of product type.

The value of PV module export amounted to approximately US$12.99 billion in 2018, up 24.4% year-on-year, accounting for 80.6% of total PV product exports, up 8.7 percentage points year-on-year; export volume was approximately 41.6GW, an increase rate of 32.1%.

Table 18: PV cell and module production and production capacity information for 2018.

Cell/Module manufacturer (or total national production)	**Technology** (sc-Si, mc-Si, a-Si, CdTe)	**Total Production (MW)**		**Maximum production capacity (MW/yr)**	
		Cell	Module	Cell	Module
Wafer-based PV manufactures					
JA Solar Holdings Co., Ltd.		6000	7324	6100	8160
JinkoSolar Holding Co., Ltd.		3300	6755	3700	9000
Lerri Solar		3500	6500	4500	6500
Trina Solar Co., Ltd.		4520	6058	5590	7600
Canadian Solar		4000	5700	5000	6430
GCL System Integration			4100		4800
Risen Energy Co.,Ltd.		4000	3115	3300	6300
Hanwha Solar			2248		2500
Suntech solar power electric power Co., Ltd.			1986		2200
Jinergy Group		2000	1865	2000	2000
Chint Group			1694		2000
Yingli green energy holding Co., Ltd.		2120	1682	3740	4300
Talesun Solar Co., Ltd.			1473		3000
Jinzhou Yangguang Energy Co., Ltd.			1362		2200
Eging PV			1341		2000
Jiangsu Seraphim			1259		1500
Znshine Solar			1168		1500
Econess Energy			706		868
Tangshan Haitai New Energy Technology Co., Ltd.			680		1300
AKCOME			659		1400
Aiko solar		4180		5400	

Cell/Module manufacturer (or total national production)	**Technology** (sc-Si, mc-Si, a-Si, CdTe)	**Total Production (MW)**		**Maximum production capacity (MW/yr)**	
		Cell	Module	Cell	Module
Jiangsu Shunfeng Photovoltaic Technology Co., Ltd.		3700		4100	
UNIEX New Energy		3200		4500	
TALESUN		2270		3000	
Henan Pingmei North Control Clean Energy Co., Ltd		2000		2000	
DMEGG		1760		2000	
Total		52250	57675	67630	76858
Thin film manufacturers					
Hanergy Group	CIGS				*850*
Triumph Group	CIGS				*300*
SHENHUA	CIGS				*50*
SUNHARMONICS	CIGS				*50*
Advanced Solar Power (Hangzhou) Co., Ltd.	CdTe				*40*
CNBM (chengdu) Optoelectronic Materials Co., Ltd	CdTe				*100*
Total					*1390*
Cells for concentration					
TOTALS		52250	57675	67630	78248

4.3 Manufacturers and suppliers of other components

- PV inverters (for grid-connection and stand-alone systems) and their typical prices

Under policy guidance, the newly added installation of PV capacity in China declined in 2018 compared with the previous year, and the newly installed capacity for the whole year was about 44.26GW. Compared with the installed capacity of PV in January 2018 was about 7GW, the installed capacity in January 2019 is only 3.5GW. Considering the inverter supply cycle and over-provisioning problem, the actual demand for inverters in the domestic PV market in 2018 was about 43GW. According to the statistics of China Photovoltaic Industry Association (CPIA), the total domestic inverter output in 2018 was about 65.7GW, the same as the previous year.

- Storage batteries
- Battery charge controllers
- DC switchgear
- Supporting structures

Due to the low market threshold of the traditional photovoltaic bracket industry, with the rapid development of the country's PV industry, the number of companies engaging in supporting structure increase dramatically, the market competition is fierce, the product quality is uneven, and the overall profit rate of the industry is not high.

The characteristics of the supporting structure industry in China include: industrial concentration further increased, the average profit rate of the industry is reduced, the industry is transferred to the overseas market, and the development speed of the tracking system is accelerating.

5 PV IN THE ECONOMY

This chapter aims to provide information on the benefits of PV for the economy.

5.1 Labour places

Table 19: Estimated PV-related full-time labour places in 2018

Market category	Number of full-time labour places
Research and development (not including companies)	N/A
Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D	N/A
Distributors of PV products	
System and installation companies	
Electricity utility businesses and government	N/A
Other	N/A
Research and development (not including companies)	N/A
Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D	N/A
Total	N/A

5.2 Business value

Table 20: Rough estimation of the value of the PV business in 2018 (VAT is excluded).

Sub-market	Capacity installed in 2018 [MW]	Average price [currency/W]	Value	Sub-market
Off-grid	0		*0*	
Grid-connected distributed	20960	5.7	119 472 000 000	
Grid-connected centralized	23330	5.5	128 315 000 000	
Value of PV business in 2018				247 787 000 000

6 INTEREST FROM ELECTRICITY STAKEHOLDERS

6.1 Structure of the electricity system

n/a

6.2 Interest from electricity utility businesses

China's continues to deepen its power system reform. In electricity market trading in 2018, the market-oriented power trading accounted for more than 30% of the total national volume, and eight power spot trading markets were established. In the first half of 2019, eight spot trading markets will start trial operation.

In March 2019, the National Energy Administration issued the "Pilot Work on Further Promoting the Construction of Power Spot Market (Draft for Comment), which reflected the policy orientation. The Exposure Draft proposed to establish a spot trading mechanism to promote clean energy consumption. In the initial stage of the spot market operation, clean energy can be used to participate in the spot market transactions by means of put forward volume without quotation, priority is given to clean energy as a price recipient to clearing out and achieve priority consumption.

6.3 Interest from municipalities and local governments

According to the 2019 Photovoltaic Power Management Policy Exposure Draft, the competitive project deployment mode will be fully implemented except household PV and PV poverty alleviation. The competition configuration will be organized by local energy authorities. For projects without owners and projects nobody have yet carried out preliminary work, the localities can use various forms such as bidding and competitive optimization selection to determine a project owner. Specific rules and organization implementation would be completed by local authorities. For projects with clear ownership or have carried out preliminary work, the local government will provide confirmation, and project owners need to report corresponding information and electricity price. Finally, all projects at the national level are determined according to the revised electricity price ranking to determine the finalists. The national sorting method will likely experience a fierce bidding, overcoming the shortcomings of previous locally organized competitive selection with limited reduction of electricity price. Special projects or demonstration projects implemented by the state will also be arranged by local authorities by means of competitive deployment, but not included in the unified national ranking system.

7 HIGHLIGHTS AND PROSPECTS

7.1 Highlights

7.1.1 Development goals

On May 31, 2018, the National Development and Reform Commission, the Ministry of Finance, and the National Energy Administration issued a notice on matters related to photovoltaic power generation in 2018. In terms of scale management, the scale of construction of ordinary photovoltaic power plants in 2018 would not be arranged; and about 10 million KW in 2018 to support the construction of distributed photovoltaic projects would be approved.

7.1.2 Policies

In 2018, the national price authorities adjusted the benchmark price of photovoltaic power generation and the scale of distributed photovoltaic power generation subsidies in the "spontaneous generation and consumption, surplus feed in grid" mode at the beginning of the year and in June respectively. After 2018 adjustments, the benchmark price of photovoltaic power generation reduced 0.15 yuan/kWh, and the price of electricity in 2018 in the I, II and III resource zones was 0.5, 0.6, 0.7 yuan/kWh, and the subsidy level of distributed photovoltaic power generation was 0.32 yuan / kWh, a reduction of 0.1 yuan/kWh starting from Jun. 2018.

7.1.3 Market

In 2018, even PV market in China was suffered strike by 5.31 new policy, total annual installation is still reach to 44.26GW. Among them, the distributed PV is 20.96GW, shared 47.4%.

Table 21 PV Installation by Sectors in 2018

Market Sec.	Annual	Cumulative	Share
	（MWp)	（MW)	（%）
Off-Grid		360	0.2
Distributed	20960	51250	29.2
Power Plant	23300	123730	70.6
Total	44260	175340	100

Source: CPIA

7.1.4 Industry

China has been the largest producer of PV modules in the world since 2007. PV productions of whole manufacture chain in 2018 are shown in Table 23:

Table23 PV Production and China Share 2018

Sectors	World	China	Share (%)
Poly-Silicon (103 Ton)	447.9	258.9	57.80
Silicon Wafer (GW)	121.9	109.2	89.58
PV Cells (GW)	120.2	87.2	72.55
PV Modules (GW)	119	85.7	72.02

Source: CPIA

7.1.5 R&D

Leading by "Top Runner Plan", PV technologies get big progress in PV cell efficiencies and mass production of hi-efficiency PV modules is achieved. The upgrade progress data is listed below:

Table 24 Capacity for High-Efficiency Tech

Technology	Manufacture Capacity (MW)
P-PERC	60000.0
N-PERT	4000.0
HJT	600.0
IBC	100.0
MWT	1500.0
Bifacial Modules	15000.0

Source: CPVS

Table25 shows the highest Lab. level cell efficiencies in China for various type of PV cells. And in Table 26, the industry level average cell efficiencies are provided.

Table 25 Lab. Level Highest Cell Efficiency

No.	Technology	Cell Efficiency (%)	Area (cm^2)
1	P-PERC (mono)	23.1±0.46	244.37
2	P-PERC (multy)	22.0±0.44	245.83
3	N-PERT	23.1±0.45	244.1
4	IBC	25.0±0.30	243.2
5	HJT	23.7	242.5
6	GaAs (1-Junction	28.9±0.20	1
7	GaAs (2-Junction)	31.6±1.90	1
8	GaAs (3-Junction)	34.5±4.00	1.002
9	CIGS	21.2±0.42	1
10	Perovskite	23.32	0.0739
1. Longi 2. Jinko 3. Trina Solar 4. Trina Solar 5. Hanergy 6. Hanergy 7. Hanergy 8. Derong Tech 9.Hanergy 10. Institute of Semiconductor, CAS			

Source: CPVS

Table 26 Industry Level Cell Average Eff.

No.	Type	Tech.	Cell Eff.（%）
1	P-Multi-Si	PERC	20.3
2	P-Mono-Si	PERC	21.8
3	N-Mono-Si	N-PERT	21.5
4	N-Mono-Si	HJT	22.5
5	GaAs		25.1

6	CdTe	14.5
7	CIGS (glass assembly)	18.7
8	CIGS (flexible)	17.8
9	Perovskite	16.0

Source: CPVS

7.2 Prospects

In September 2018, the General Affairs Department of the National Energy Administration issued the "Notice on sorting out the information on wind and photovoltaic power generation projects since the 12th Five-Year Plan", requesting provinces included in the planning since the "Twelfth Five-Year Plan" to sort out status for the completed wind and PV projects. According to preliminary statistics, by the end of 2018, the scale of photovoltaic construction was about 15 million kilowatts. According to the competitive deployment policy of photovoltaic power generation, comprehensive calculation for the needed subsidy for the newly installed capacity of PV in 2019 was conducted taking overall consideration of the 1.5 million kilowatts technology pacemaking bases, the carryover of the second and third batches of application pacemaking base projects, and 1.673 million kilowatts photovoltaic poverty alleviation projects, as well as 3 million kilowatts matching and demonstration project, it is estimated that the newly added PV will reach 35 to 40 million kilowatts in 2019.