

International Energy Agency
Photovoltaic Power Systems Programme





# National Survey Report of PV Power Applications in China 2019





# 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 Technology Collaboration Programme (TCP) was created with a belief that the future of energy security and sustainability starts with global collaboration. The programme is made up of 6.000 experts across government, academia, and industry dedicated to advancing common research and the application of specific energy technologies.

The IEA Photovoltaic Power Systems Programme (IEA PVPS) is one of the TCP's 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.

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 Cop- per 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 2019. Information from this document will be used as input to the annual Trends in photovoltaic applications report.

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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 2019 statistics if the PV modules were installed and connected to the grid between 1 January and 31 December 2019, although commissioning may have taken place at a later date.

## **1.1 Applications for Photovoltaics**

In 2019, even though China's photovoltaic installed capacity dropped again, the newly added and accumulated photovoltaic installed capacity continued to rank first in the world. In 2019, China's newly installed grid-connected photovoltaic capacity reached 30.1GW, a year-on-year decrease of 31.99%, of which the installed capacity of centralized photovoltaic power plants was 17.9GW, a year-on-year decrease of 22.9%; the installed capacity of distributed photovoltaic power plants was 12.2GW, a year-on-year increase of 17.3%. As of 2019, the cumulative grid-connected photovoltaic capacity reached 204.3GW, an increase of 17.1%. Among them, the cumulative installed capacity of centralized photovoltaic power stations is 141.67GW, and the cumulative installed capacity of distributed photovoltaic power stations is 62.63GW. The annual photovoltaic power generation capacity was 22.43 billion kWh, accounting for 3.1% of China's total annual power generation (723.41 billion kWh), an increase of 0.5% year-on-year.

## 1.2 Total photovoltaic power installed

		Installed PV capacity in 2019 [MW]	AC or DC
	Off-grid		
PV capacity	Decentralized	12200	DC
F V Capacity	Centralized	17900	DC
	Total	30100	DC

 Table 1: Annual PV power installed during calendar year 2019

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 2019 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/2020- 02/28/c_138827923.htm
	Additional comments on market and data collection, especially the estimated accuracy of data.



Year	Off-grid [MW] (including large hybrids)	Grid-connected distributed [MW] (BAPV, BIPV)	Grid-connected centralized [MW] (Ground, floating, agricultural)	Total [MW]
1999				
2000				
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	1095	50.00	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
2019	0	12200.00	17900.00	30100.00

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

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#### Table 4: Other PV market information

	2019
Number of PV systems in operation in your country (a split per market segment is interesting)	Total installed 30.11GW except for Distributed PV 12.19GW (40.5%); Ground Mounted LS-PV 17.92GW(59.5%)
Decommissioned PV systems during the year [MW]	N/A
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

	2018	2019
Total power generation capacities [GW]	1899.67 GW	2010.66 GW
Total renewable power generation capacities (including hydropower) [GW]	755.81 GW	794 GW
Total electricity demand [TWh]	6844.9 TWh	7230 TWh
Total energy demand [TWh]	N/A	N/A
New power generation capacities installed [GW]	124.39 GW	101.73 GW
New renewable power generation capacities (including hydropower) [GW]	79.83 GW (hyd. 9GW, wind 15.03GW, PV 53.06GW, Bio. 2.74GW)	65.75 GW (hyd. 4.17GW, wind 25.74GW, PV 31.11GW, Bio 4.73GW)
Estimated total PV electricity production (including self- consumed PV electricity) in [GWh] (or [TWh])	177.5 TWh	224.3 TWh
Total PV electricity production as a % of total electricity consumption	2.59%	3.1%



# 1.3 Key enablers of PV development

Table 6: Information on key enablers

	Description	Annual Volume	Total Volume	Source
Decentralized storage systems In [MW,MWh or #]			175.0MW	CPIA, 2020,6
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 (optional)	Highest price of a standard module crystalline silicon (optional)	Typical price of a standard module crystalline silicon (mandatory)
2010	N/A		11.11
2011	N/A		7.69
2012	N/A		3.85
2013	N/A		3.42
2014	N/A		3.25
2015	N/A		2.99
2016	N/A		2.65
2017	N/A		2.14
2018	N/A		1.81
2019	N/A		1.68



# 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]
<b>Off-grid</b> 1-5 kW	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.	5.0-5.5
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.	5.0-5.5
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.	5.0-5.5
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.	5.0-5.5
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.	4.5-5.0
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.	4.5-5.0



Year	Residential BAPV	Small commercial BAPV	Large commercial BAPV	Small centralized PV
	Grid-connected, roof-mounted, distributed PV system 5-10 kW <b>[currency/W]</b>	Grid-connected, roof-mounted, distributed PV systems 10-100 kW <b>[currency/W]</b>	Grid-connected, roof-mounted, distributed PV systems 100-250 kW <b>[currency/W]</b>	Grid-connected, ground-mounted, centralized PV systems 10-20 MW [currency/W]
2009				30
2010				20
2011		1	8	15
2012		1	4	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
2019	5.0-5.5	5.0	-5.5	4.5-5.0

#### Table 9: National trends in system prices for different applications

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

## 2.3 Cost breakdown of PV installations

The cost breakdown of a typical 5-10 kW roof-mounted, grid-connect, distributed PV system on a residential single-family house and a typical >10 MW Grid-connected, ground-mounted, centralized PV systems at the end of 2019 is presented in Table 2 and Table 3, respectively.

The cost structure presented is from the customer's point of view. I.e. it does not reflect the installer companies' overall costs and revenues. The "average" category in Table 2 and Table 3 represents the average cost for each cost category and is the average of the typical cost structure. The average cost is taking the whole system into account and summarizes the average end price to customer. The "low" and "high" categories are the lowest and highest cost that has been reported within each segment. These costs are individual posts, i.e. summarizing these costs do not give an accurate system price.



# Table 2: Cost breakdown for a grid-connected roof-mounted, distributed residential PV system of 5-10 kW

Cost category	Average [RMB Yuan/W]	Low [RMB Yuan/W]	High [RMB Yuan/W]
	Hard	ware	
Module	2.21	1.95	2.48
Inverter	0.53	0.35	0.71
Mounting material	0.88	0.27	1.06
Other electronics (cables, etc.)	0.18	0.09	0.27
Subtotal Hardware	3.81		
	Soft	costs	
Planning	0.28	0.00	0.28
Installation work	0.92	0.46	1.10
Shipping and travel expenses to customer	0.09	0.09	0.18
Permits and commissioning (i.e. cost for electrician, etc.)	0.18	0.18	0.28
Project margin	0.28	0.18	0.37
Subtotal Soft costs	1.75		
Total (excluding VAT)	5.56		
Average VAT	0.64		
Total (including VAT)	6.02		

Table 3: Cost breakdown for a grid-connected, ground-mounted, centralized PV systems of >10 MW  $\,$ 

Cost category	Average [RMB Yuan/W]	Low [RMB Yuan/W]	High [RMB Yuan/W]
	Har	dware	
Module	1.681	1.59	1.86
Inverter	0.177	0.16	0.19
Mounting material	0.265	0.25	0.31
Other electronics (cables, etc.)	0.885	0.80	0.97
Subtotal Hardware	3.009		



Soft costs					
Planning	0.047	0.02	0.08		
Installation work	0.367	0.32	0.46		
Shipping and travel expenses to customer	0.018	0.01	0.03		
Permits and commissioning (i.e. cost for electrician, etc.)	0.046	0.04	0.06		
Project margin	0.183	0.18	0.18		
Subtotal Soft costs	0.662				
Total (excluding VAT)	3.671				
Average VAT	0.449				
Total (including VAT)	4.120				



## 2.4 Financial Parameters and specific financing programs

 Table 4: PV financing information in 2019

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 5: 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 6: Country information

Retail electricity prices for a household [currency/W] (mandatory)	0.54804 RMB Yuan/kWh				
Retail electricity prices for a commercial company [currency/W] (mandatory)	0.82514 RMB Yuan/kWh				
Retail electricity prices for an industrial company [currency/W] (optional)	0.64397 RMB Yuan/kWh				
Population at the end of 2019 (mandatory)	1,400,050,000				
Country size [km <sup>2</sup> ] (mandatory)	9,634,057				
Average PV yield in [kWh/kW] (mandatory)	Zone 1: > 1500 Zone 2: 1200-1500 Zone 3: < 1200				
Name and market share of major electric utilities (optional)		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.

Category	Resid	ential	Commercial + Industrial		Centralized	
Measures in 2019	On-going	New	On-going	New	On-going	New
Feed-in tariffs	Yes Feed-in tariffs desulfurized coal benchmark price+ 0.18 yuan/kWh (include tax)	No	Yes Feed-in tariffs desulfurized coal benchmark price+ 0.10 yuan/kWh (include tax)	No	Feed-in tariff : on the basis of resource regions, 0.4 , 0.45,0.55 yuan/kwh respectively	No
Feed-in premium						
Capital subsidies						
Green certificates	-	-	-	-	-	-
Renewable portfolio standards 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 requ.						
BIPV incentives	Yes		Yes		Yes	
Other (specify)	-	-	-	-	-	-

#### Table 7: Summary of PV support measures



## 3.1 National targets for PV

Looking forward to 2020, China's new photovoltaic installed capacity is expected to be between 32GW and 45GW, and the installed capacity trend is stable.

From a domestic perspective, the scale of various sectors of the industry has grown steadily, the export value and export volume have both increased, the amount of photovoltaic power generation has increased, and the rate of waste light has decreased. The conversion efficiency of industrialized P-type PERC single crystal and N-type single crystal cells both exceed 22%.

It is expected that the power of module products will exceed 500W, and the market share of monocrystalline will be reserved; high-efficiency cell using PERC technology will gradually replace traditional cell technology; module technologies such as half-cells and shingles will gradually follow the same way as bifacial cell technology Increase market share.

## 3.2 **Direct support policies for PV installations**

In 2019, the "531" policy of 2018 was continued, and the newly installed photovoltaic capacity remained declining, but photovoltaics were still the renewable energy source with the largest newly installed capacity. Continuing the policy of 2018, the national policy adjustments related to photovoltaic power generation mainly include the following aspects: adjustment and innovation of scale management mechanism, continuous decline in electricity prices and subsidies based on cost reduction, large-scale construction of large-scale projects, and strengthening Market environment supervision, and at the same time, many important mechanisms such as the restrictive distributed power generation market transaction mechanism and the renewable energy consumption mechanism are also being formulated and promoted.

### 3.2.1 Development plan and target

2019 is the first year of the wind and solar power generation market that focuses on bidding projects and non-subsidized projects. Among the first batch of non-subsidized projects announced in May 2019, photovoltaic installed capacity is 14,780 MW. In addition to 1470 MW distributed market mainly focus on photovoltaic power generation. The list of bidding projects for this year was announced in July 2019, including centralized power stations and industrial and commercial distributed photovoltaic projects, with an installed capacity of 22,790 MW.

The 2020 construction policy for photovoltaic power generation projects were introduced in March, basically continuing the 2019 mechanism. Bidding projects, non-subsidized projects of photovoltaic power plants and industrial and commercial distributed photovoltaic, household photovoltaics will be the main part of new domestic arrangements and new grid-connected installations in 2020.

### 3.2.2 Project management

Bidding allocation projects have shown their effectiveness in reducing electricity prices and subsidies, and discovering price demand.

With the support of the policy, the domestic household photovoltaic market began to accelerate in the second half of 2017. Some leading companies regard the household photovoltaic market as one of their main businesses. There are also a large number of small and medium-sized enterprises involved in household photovoltaic sales, installation and after-sales services and other businesses, so maintaining a relatively stable and continuous household photovoltaic market is also one of the policy goals.



According to the 2020 policy, the construction scale of household photovoltaics included in the national financial subsidies is calculated according to the annual utilization hours of 1,000 hours and relevant national price policies, and is determined according to the 500 MW range downwards, and a grace period of one month is added.

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 Taxation policy

In 2019, reducing the value-added tax rate once again has reduced the cost of photovoltaic power generation to a certain extent, but the preferential policy of 50% of the value-added tax on photovoltaic power generation has not been extended. In April 2019, the state once again adjusted the original 16% value-added tax rate to 13%. According to the investment level of photovoltaic power generation from 2019 to 2020, even if the impact on equipment prices is not considered, the cost of photovoltaic power generation can still be reduced by about 2%.

#### 3.2.4 Development space and power consumption

On May 10, 2019, the National Development and Reform Commission and the National Energy Administration jointly issued the "Notice on Establishing and Improving the Guarantee Mechanism for Renewable Energy Power Consumption" to establish a development mechanism led by renewable energy power consumption through certain binding weights and responsibilities. Especially in the early days of the "14th Five-Year Plan", when the conditions for accessing the Internet without subsidies are generally available and the subsidies are fully eliminated, consumption will be the most important factor affecting its development speed and scale. The implementation of the weighting of responsibilities is directly linked to the process of power market construction, especially the power marketization and trading system. In addition, it has also considered the connection with renewable energy green power certificates and energy efficiency assessment systems.



## 3.3 Self-consumption measures

#### Table 8: Summary of self-consumption regulations for small private PV systems in 2019

PV self-consumption	1	Right to self-consume	Yes	
	2	Revenues from self-consumed PV	Savings on the electricity bill + bonus	
	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 Real-time compensation of fluxes		
	6	Geographical compensation (virtual self-consumption or metering)	None	
Other characteristics	7	Regulatory scheme duration	20 years	
	8	None		
	9	Grid codes and/or additional taxes/fees impacting the revenues of the prosumer	None	
	10	Regulations on enablers of self- consumption (storage, DSM)	None	
	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.

In July 2019, the National Energy Administration announced the results of the 2019 national subsidy bidding for photovoltaic power generation projects. 3,921 projects in 22 provinces were included in the scope of the 2019 bidding subsidy projects, with a total installed capacity of 22790 MW.

The effect of bidding configuration projects in reducing electricity prices and subsidies and discovering price demand has already appeared.

# 3.6 Other utility-scale measures including floating and agricultural PV

N/A

## 3.7 Social Policies

#### 3.7.1 PV Poverty Alleviation

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.

In 2019, the established policy of 2018 was maintained. 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.

### 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 are 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 streetlights, 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 2019, the price and subsidy of photovoltaic power generation continued to decline, and at the same time, the mechanism was changed. The original benchmark price was changed to a guide price, which is the upper limit of competitive allocation projects. In 2019, the guide price levels of I, II and III resource areas are 0.4 yuan/kWh, 0.45 yuan/kWh, 0.55 yuan/kWh, respectively, which are 0.1 yuan/kWh, 0.15 yuan/kWh, and 0.15 yuan/kWh respectively lower than in 2018. The subsidy level for self consumption has dropped from 0.32 yuan/kWh to 0.10 yuan/kWh, and the subsidy level for household photovoltaics has dropped from 0.32 yuan/kWh to 0.18 yuan/kWh.

In 2020, photovoltaic power prices and subsidies continue to decline.



# **4 INDUSTRY**

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

#### 4.1.1 Polycrystalline silicon material

China's polycrystalline silicon production remained continued increase in 2019 to reach 34.2\*10<sup>4</sup> tons output, accounting 67.3% of global total output.

Manufacturers (or total national production)	Process & technology	Total Production (tons)	Product destination	Price
GCL-Poly Energy Holdings Co., Ltd.	mc-Si	7.7*104		
Sichuan Yongxiang Co., Ltd.	mc-Si	6.5*10 <sup>4</sup>		
Xinte Energy Co., Ltd	mc-Si	5.0*10 <sup>4</sup>		
Xinjiang Great New Energy Co., Ltd.	mc-Si	4.2*10 <sup>4</sup>		
East Hope Co. Ltd	mc-Si	2.8*10 <sup>4</sup>		
Asia Silicon Co., Ltd	mc-Si	2.0*10 <sup>4</sup>		
DunAn Holding Group Co., Ltd	mc-Si	0.9*10 <sup>4</sup>		
Rest	mc-Si	5.1*104		
Total	mc-Si	34.2*10 <sup>4</sup>		

Table 9: Silicon feedstock, ingot and wafer producer's production information for 2019

Source: CPIA,2020.4

### 4.1.2 Silicon wafer

In 2019, mainland China's wafer production capacity was about 173.7GW, was an increase of 18.6% year-on-year, benefited from investment to expand production of monocrystalline silicon wafer, and the increase in production capacity brought by technological progress and cost control. China's wafer production is about 134.7 GW, an increase of 25.8% year-on-year, accounting for 97.4% of global wafer production, of which the output of monocrystalline silicon wafer was 83GW, and polycrystalline silicon wafer was 51.7GW, accounting for 62% and 38% respectively.



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

### 4.2.1 Solar cell

In 2019, the total production capacity of China's solar cell was 163.9GW, up 27.9% year-onyear, accounting for 77.7% of global production capacity; the output was about 108.6GW, up 27.7% year-on-year, about 77.5% of the annual global production.

In 2019, China's solar cells were exported to 150 countries and regions. The annual export volume of solar cell was about 1.47 billion US dollars, up 83.8% year-on-year, accounting for 7.1% of the total export value of photovoltaic products, and the export volume of solar cell was about 10.4GW.

#### 4.2.2 PV module

In 2019, the total production capacity of PV module was about 98.6GW, 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%.

Cell/Module	Technology (sc-Si, mc-Si, a-Si, CdTe	Total Production [MW]		<u>Maximum</u> production capacity [MW/yr]			
national production)	CIGS)	Cell	Module	Cell	Module		
Wafer-based PV manufa	Wafer-based PV manufactures (Top 10)						
JA Solar Holdings Co., Ltd.		9200	10600	11000	12000		
JinkoSolar Holding Co., Ltd.		6600	9000	10600	12400		
LONGi Group		8400	7280	13800	12450		
Risen Energy Co.,Ltd.		4500	7200	8000	11000		
Trina Solar Co., Ltd.		6850	6850	7270	7900		
Canadian Solar		6500	6600	9600	9440		
Zhejiang Chint New Energy Development Co., Ltd.			3900		4200		

Table 10: PV cell and module production and production capacity information for 2019



GCL System Integration			3660		6600		
Jiangsu Seraphim Photovoltaic System Co., Ltd.			2300		3600		
Tangshan Haitai New Energy Technology Co., Ltd.			2200		2200		
Total		42050	60130	60270	80790		
Thin film manufacturers							
Hanergy Group	CIGS				850		
CNBM Trisun Technology	CIGS				300		
CNBM Avancis (Korea/Germany)	CIGS				200		
Hanergy Miasole (USA)	CIGS				160		
Zhongshan Ruike New Energy Co., Ltd.	CdTe				100		
Hanergy Solibro	CIGS				90		
CNBM CTF Solar (Germany)	CdTe				85		
Hanergy GSE (USA)	CIGS				50		
Hangzhou Shangyue Optoelectronics	CIGS				50		
Shenhua Manz (Germany)	CIGS				50		
Advanced Solar Power (Hangzhou) Co., Ltd.	CdTe				40		
Total					1975		
Cells for concentration							
TOTALS		42050	60130	60270	82765		

Source: CPIA,2020.4



## 4.3 Manufacturers and suppliers of other components

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

Under the policy guidance, China's new photovoltaic installed capacity decreased in 2019 compared with the previous year, and the annual new installed capacity was approximately 30.11GW. Among them, the new installed capacity of centralized photovoltaics was 17.91GW, and that of distributed photovoltaics was 12.2GW. The new installed capacity of centralized and distributed photovoltaics declined for two consecutive years since 2017. Taking into account the inverter supply cycle and project transfer, the actual shipment of inverters in the domestic photovoltaic market in 2019 is about 33.5GW. According to statistics from the China Photovoltaic Industry Association (CPIA), the total domestic inverter output in 2018 was about 73.5GW (excluding the output of foreign brands, about 12GW), an increase of 11.9% year-on-year.

• Supporting structures

Due to the low market threshold of the traditional photovoltaic support industry, with the rapid development of the national photovoltaic industry, the number of companies participating in the support structure has increased sharply, market competition is fierce, product quality is unbalanced, and the overall profit industry development speed is not high.

The characteristics of China's supporting structure industry are: the industry concentration has further increased, the average profit rate of the industry has decreased, the industry has moved to overseas markets, and the development of the tracking system has accelerated.



# **5 PV IN THE ECONOMY**

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

## 5.1 Labour places

#### Table 11: Estimated PV-related full-time labour places in 2019

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	N/A
System and installation companies	N/A
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 12: Rough estimation of the value of the PV business in 2019 (VAT is excluded)

Sub-market	Capacity installed [MW]	Average price [RMB/W]	Value	Sub-market
Off-grid	0			
Grid-connected distributed	12200	6.02	73 444 000 000	
Grid-connected centralized	17900	4.12	73 748 000 000	
Value of PV busin	ess in 2019			147 192 000 000



# **6 INTEREST FROM ELECTRICITY STAKEHOLDERS**

## 6.1 Structure of the electricity system

N/A

## 6.2 Interest from electricity utility businesses

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.

In 2019, all six provincial-level power spot market pilots in the State Grid's operating areas have started trial operation to encourage new energy to participate in the market and take advantage of low marginal costs to achieve consumption. In August, all eight provincial-level power spot markets were put into trial operation.

## 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

In 2019, China's photovoltaic installed capacity has grown steadily. According to data released by the National Energy Administration, the cumulative total installed capacity of photovoltaic power generation in China in 2019 was 204.3GW, a year-on-year increase of 17.1%. As photovoltaics gradually enter the era of parity, their installed capacity will show a more rapid growth trend.

## 7.1.2 Policies

In 2019, reducing the value-added tax rate again has reduced the cost of photovoltaic power generation to a certain extent, but the preferential policy of 50% of the value-added tax on solar power generation has not been postponed. In April 2019, the state once again adjusted the original 16% value-added tax rate to 13%. According to the level of investment in photovoltaic power generation from 2019 to 2020, the value-added tax will be reduced by 3%. Even if the impact on equipment prices is not considered, the cost of photovoltaic power generation can still be reduced by about 2%, equivalent to 0.7-1.0 cents/kWh.

#### 7.1.3 Market

In 2019, total annual installation is reach to 30.11GW. Among them, the distributed PV is 12.19GW, shared 40.5%.

Markat Saa	Annual	Cumulative	Share	
Warket Sec.	(MWp)	(MWp)	(%)	
Distributed	12190	63440	40.5	
Power Plant	17910	141640	59.5	
Total	30100	205080	100	
0 0 0 0 1 4				

Table 22 PV Installation by Sectors in 2019

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:

Table 23 P\	Production	and China	Share in 2019
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Sectors	World	China	Share (%)
Poly-Silicon (10 <sup>3</sup> Ton)	51.9	33.1	63.78
Silicon Wafer (GW)	140	136.4	97.43
PV Cells(GW)	135	112	82.97
PV Modules (GW)	130	100	76.92

Source: CPIA



#### 7.1.5 **R&D**

CPVS has been publish the Solar Cell Best-Efficiency Table of China for three years since 2017. On November 5th on PVSEC-29 conference, CPVS published the 2019 Solar Cell Best-Efficiency Table of China:

No	Technology	Cell Efficiency (%)	Area (cm2)
1	HIT	24.85±0.35	244.54 (t)
2	TOPCon (bifacial)	24.58±0.34	244.62 (t)
3	PERC	24.03±0.34	244.59 (t)
4	PERC	22.8±0.32	246.66 (t)
5	GaAs (single junction)	29.1±0.58	0.9980 (da)
6	CIGS (on glass)	22.92±0.33	0.9856 (da)
7	CIGS (flexible)	20.56±0.13	0.8657 (ap)
8	Perovskite (cell)	23.7±0.76	0.0739 (ap)
9	Perovskite (cell)	22.2±0.1	1.146 (da)
10	Perovskite (minimodule)	17.25±0.55	19.277 (da)
11	Perovskite (submodule)	14.30±0.35	300.74 (da)
12	Organic Solar Cell	16.48	0.04137
1. Hanergy 2. Trina Solar 3. LONGi 4. Canadian Solar			
<ol> <li>Hanergy 6. Hanergy 7. Hanergy 8. Institute of Semiconductor, CAS 9.NJU</li> <li>Microquanta</li> </ol>			
11. Microquanta 12. SCUT			

Table 2 Lab. Level Highe	est Cell Efficiency
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Source: CPVS



## 7.2 Prospects

After the development of the "13th Five-Year Plan", China's photovoltaic power generation has entered a critical period of improving quality and efficiency and reducing costs. With the joint efforts of all parties, China's photovoltaic power generation has achieved rapid development, and the scale of development and construction has continued to expand. The proportion continues to increase; the level of technical equipment has been significantly improved, and the diversified application system has been further improved; the cost of photovoltaic power generation has been drastically reduced, and the grid will gradually move towards parity; the policy support system has been improving day by day to escort sustainable and healthy development.

The next five years are an important period for the development of China's photovoltaic industry. Looking forward to 2020, due to the impact of the new crown epidemic, CPIA has reduced the scale of China's photovoltaic grid connection in 2020, and lowered the forecast scale of 35-45GW to 32-45GW