

International Energy Agency
Photovoltaic Power Systems Programme





National Survey Report of PV Power Applications in China 2020







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 2020. Information from this document will be used as input to the annual Trends in photovoltaic applications report.

Authors

- Main Content: Lyu Fang, Xu Honghua, Yu Yang
- Data: CHINA PHOTOVOLTAIC INDUSTRY ASSOCIATION (CPIA)
- Analysis: Lyu Fang, Xu Honghua, Yu Yang

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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 2020 statistics if the PV modules were installed and connected to the grid between 1 January and 31 December 2020, although commissioning may have taken place at a later date.

1.1 Applications for Photovoltaics

The outbreak of COVID-19 in beginning of 2020 produced series impact on PV, the gridconnected PV installation in the first quarter in China decreased by 23% compared with that of last year. However, the situation changes since Q2 due to the rapid control of the epidemic in China, and the photovoltaic industry has rapidly returned to normal. In 2020, China's newly installed grid-connected photovoltaic capacity reached 48.2GW, a year-on-year increase of 60.1%, of which the installed capacity of centralized photovoltaic power plants was 32.7GW, a year-on-year increase of 82.68%; the installed capacity of distributed photovoltaic power plants was 15.5GW, a year-on-year increase of 27.04%. As of 2020, the cumulative grid-connected photovoltaic capacity reached 252.5GW, an increase of 23.6%. Among them, the cumulative installed capacity of centralized photovoltaic power stations is 159.57GW, and the cumulative installed capacity of distributed photovoltaic power stations is 74.83GW. The annual photovoltaic power generation capacity was 26.11 billion kWh, accounting for 3.5% of China's total annual power generation (741.70 billion kWh), an increase of 0.4% year-on-year.

1.2 Total photovoltaic power installed

	Installed PV capacity in 2020 [MW]	AC or DC
Decentralized	15500	DC
Centralized	32700	DC
Off-grid		
Total	48200	DC

 Table 1: Annual PV power installed during calendar year 2020



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 2020 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/
	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
2020	0	15500.00	32700.00	48200.00

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



Table 4: Other PV market information

	2020
Number of PV systems in operation in your country	Total installed 48.2GW except for Distributed PV 15.5GW (32.2%); Ground Mounted LS- PV 32.7GW(67.8%)
Decommissioned PV systems during the year [MW]	N/A
Repowered PV systems during the year [MW]	N/A

Table 5: PV power and the broader national energy market

	Data (2020)	2019
Total power generation capacities [GW]	2200.58 GW	2010.66 GW
Total renewable power generation capacities (including hydropower) [GW]	955.41 GW	794 GW
Total electricity demand [TWh]	7620	7230 TWh
New power generation capacities installed [GW]	190.87 GW	101.73 GW
New renewable power generation capacities (including hydropower) [GW]	138.53 GW (hyd. 13.23 GW, wind 71.67 GW, PV 48.2GW, Bio 5.43GW)	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])	261.1 TWh	224.3 TWh
Total PV electricity production as a % of total electricity consumption	3.5%	3.1%
Average yield of PV installations (in kWh/kWp)	1300 kWh/kWp	

1.3 Key enablers of PV development

	Description	Annual Volume	Total Volume	Source
Decentralized storage systems In PV [MW,MWh or #]			214.0MW	CPIA, 2021,6
Total PV storage systems			883.0MW	CPIA, 2021,6



2 COMPETITIVENESS OF PV ELECTRICITY

2.1 Module prices

Table 6: Typical module prices (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
2020	N/A		1.57



2.2 System prices

 Table 7: Turnkey PV system prices of different typical PV systems

Category/Size	Typical applications and brief details	Current prices [Yuan/W]
Off-grid 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. (write the typical off-grid application and since in your country)	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.	4.0-4.5
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.	3.5-4.0



Year	Residential BAPV	Small commercial BAPV	Large commercial BAPV	Small centralized PV
	Grid-connected, roof-mounted, distributed PV system 5-10 kW [currency/W]	Grid-connected, roof-mounted, distributed PV systems 10-100 kW [currency/W]	Grid-connected, roof-mounted, distributed PV systems 100-250 kW [currency/W]	Grid-connected, ground-mounted, centralized PV systems 10-20 MW [currency/W]
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
2019	5.0-5.5	5.0-5.5		4.5-5.0
2020	5.0-5.5	5.0	5.0-5.5	

Table 8: National trends in system prices for different applications



2.3 Financial Parameters and specific financing programs

 Table 10: PV financing information in 2020

Different market segments	Loan rate [%]
Average rate of loans – residential installations	4.6% (float within the prescribed scope of 15%)
Average rate of loans – commercial installations	4.6% (float within the prescribed scope of 15%)
Average cost of capital – industrial and ground-mounted installations	3.5-5 Yuan/W

2.4 Specific investments programs

Table 11: 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		



2.5 Additional Country information

Table 9: Country information

Retail electricity prices for a household [Yuan/W] (mandatory)	Zone 1: < 210 kWh/month, 0.5469 RMB Yuan/kWh Zone 2: 210-400 kWh/month, 0.5969 Yuan/kWh Zone 3: > 400 kWh/month, 0.8469 Yuan/kWh
Retail electricity prices for a commercial company [Yuan/W] (mandatory)	0.8252 RMB Yuan/kWh Peak: 1.42585 RMB Yuan/kWh, Rush: 1.2693 RMB Yuan/kWh.
Retail electricity prices for an industrial company [Yuan/W] (optional)	Flat:0.8252 RMB Yuan/kWh, Trough electricity price: 0.43517 RMB Yuan/kWh
Liberalization of the electricity sector	Yes. Direct electricity transaction and contract electricity transfer (including priority power generation contract, base electricity contract and market transaction contract) etc.



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	Residen	Residential Commercial + Industrial		Centra	alized	
Measures in 2020	On-going	New	On-going	New	On-going	New
Feed-in tariffs	Yes Feed-in tariffs desulfurized coal benchmark price+ 0.08 yuan/kWh (include tax)	No	Yes Feed-in tariffs desulfurized coal benchmark price+ 0.05 yuan/kWh (include tax)	No	Feed-in tariff : on the basis of resource regions, 0.35, 0.4, 0.49 yuan/kwh respectively	The part of medium and long- term trading of electricity is determine d by the market
Feed-in premium (above market price)						
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	

Table 10: Summary of PV support measures



Sustainable building requirements						
BIPV incentives	Yes		Yes		Yes	
Other (specify)	-	-	-	-	-	-

3.1 National targets for PV

On September 2020, Chairman Xi Jinping made an important speech at the 75th United Nations General Assembly, to achieve carbon peak by 2030 and carbon neutralization by 2060. In March 2021, the central financial and Economic Commission put forward the basic idea of "building a new power system with new energy as the main body", which is to build a clean, low-carbon, safe and efficient energy system, implement renewable energy substitution actions, deepen power system reform and build a new power system with new energy as the main body.

On March 12, Xinhua News Agency announced the outline of the '14th-Five-Year-Plan' for China's national economic and social development and the long-term objectives for 2035. According to the plan, nine clean energy bases and four offshore wind power bases will be developed during the '14th-Five-Year-Plan' period.

Looking forward to 2021, China's new photovoltaic installed capacity is expected to be between 55GW and 65GW, 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 22.8%.

It is estimated that 182mm and 210mm silicon wafers will account for about 50% in 2021. High power module products represented by 500W + and 600W + will also be introduced into the market quickly, boosting the photovoltaic market into the era of parity. The proportion of 158.75mm size will be compressed to about 5%, and 156.75mm size silicon wafer will become history.

3.2 Direct support policies for PV installations

The outbreak of COVID-19 in beginning of 2020 produced series impact on PV, the gridconnected PV installation in the first quarter in China decreased by 23% compared with that of last year. However, the situation changes since Q2 due to the rapid control of the epidemic in China, and the photovoltaic industry has rapidly returned to normal. Another factor is the time-line requirement of the grid-parity bidding projects held in 2019 and June 2020. These positive factors played a great role and the PV installation showed a positive growth in Q2 and Q3 in 2020 compared with that of 2019. On September 2020, Chairman Xi Jinping made an important speech at the 75th United Nations General Assembly. This stimulate the installed capacity of Q4 explosively increased. The annual installed capacity reaching 48.2GW in 2020, 60.1% increase compared with that of 2019. The cumulative installed capacity has reached 253GW, and the new and cumulative installed capacity kept the first in the world.



In addition, as the last year of "13th-five-year development", continuing the policy of 2019, 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. 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.

At the 75th United Nations General Assembly in September 2020, Chairman Xi Jinping further started China's commitment to reach CO2 emissions peak before 2030 and reach Carbon Neutrality by 2060. In order to achieve the goals of 2030 and 2060, China will vigorously develop the new energy industry. In the next 14th-Five-Year Plan and 15th-Five-Year Plan, China's photovoltaic and wind power industry will achieve a significant growth. The new installed capacity of PV is expected to reach 55-65GW in 2021 and 90-110GW in 2025.

Large-scale power plant will be the main stream of PV development in China for a long term. It shows that China is accelerating energy transformation. Large-scale power plant can rapidly expand the scale of clean energy assets of enterprises, and effectively improve the quality of power generation and economic benefits, which is an effective way to achieve carbon peak.

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.

3.2.3 Large size and high power products will be produced in large quantities quickly

Large size is an important way to reduce cost, which can effectively improve component efficiency and reduce manufacturing and power generation costs. With the market's acceptance and recognition of large-size and high-power products, the superposition of the



technical transformation of old production lines, the release of new production line capacity and the accelerated matching of large-width photovoltaic glass, backplane and EVA capacity, large-size and high-power products will enter the stage of rapid volume in 2021. It is estimated that 182mm and 210mm silicon wafers will account for about 50% in 2021. High power module products represented by 500W + and 600W + will also be introduced into the market quickly, boosting the photovoltaic market into the era of parity. The proportion of 158.75mm size will be compressed to about 5%, and 156.75mm size silicon wafer will become history.

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.

In December 2020, Zhang Jianhua, director of the NEA, answered reporters' questions at the 'white paper press conference on China's energy development in the new era'. He said, The biggest problem facing the development of new energy in the '13th-Five-Year-Plan' is the problem of consumption, and the '14th-Five-Year-Plan' faces the coexistence of consumption and access. Therefore, to solve the problem of consumption, first speed up the construction of a new power system suitable for the development of high proportion of renewable energy, that is, a new generation power system; On the other hand, effectively improve and implement the guarantee mechanism for renewable energy power consumption.

First, strengthen the responsibility of renewable energy power consumption, promote the inclusion of the consumption guarantee mechanism into relevant laws and raise it to a legal obligation. Second, strengthen the evaluation and assessment of the weight of renewable energy power consumption responsibility and incorporate it into the assessment system of local economic and social development. Third, promote the formation of a long-term mechanism for clean energy consumption from the aspects of enhancing regulatory capacity, improving market mechanism, innovating consumption mode and strengthening consumption supervision. Fourth, strengthen green power certificate trading and carbon market construction, further reflect the ecological and environmental protection value of renewable energy, and explore a new mode of green energy consumption.

3.2.5 Technical transformation of existing power stations

Recently, the new energy department of the NEA said that increasing the capacity ratio of stock power stations through technical transformation is in line with the national policy. The specific capacity ratio needs to refer to the code for efficiency of photovoltaic power generation system (NB/T 10394-2020), and select the appropriate capacity ratio, which is conducive to reducing the hourly power cost of the system and improving the overall economic benefit, but there are no statistics on the increase of power generation.



3.3 Self-consumption measures

Table 11: Summary of self-consumption regulations for small private PV systems in2020

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 compensation of fluxes	Real-time
	6	Geographical compensation (virtual self-consumption or metering)	None
Other characteristics	7	Regulatory scheme duration	20 years
	8	Third party ownership accepted	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

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 2020, for projects requiring national electricity price subsidies, the policy of 2019 was continued, and the construction mechanism of photovoltaic power generation projects with the overall idea of "market orientation, competitive allocation, revenue and expenditure determination, classified management and seeking progress in stability" was continued. In addition, household PV will continue to be supported in the double fixed way of fixed total subsidy amount and fixed kWh subsidy.

In general, the construction and management policy of photovoltaic power generation projects in 2020 basically continues the policy of 2019 and maintains the stability of the policy. In 2020, the photovoltaic power generation market increased on a large scale, and the new installed capacity increased from 30.1GW in 2019 to 48.2GW, and the scale of newly arranged projects reached about 77GW in 2020. It is expected that the scale of photovoltaic market in 2021 will continue to increase significantly on the basis of 2020.

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 2020, the established policy was maintained. As the last year of Poverty Alleviation, The official website of the Poverty Alleviation Office of the State Council released the latest progress of recent key poverty alleviation work, which summarized the national poverty alleviation work as of March 20, and highly affirmed the key role of photovoltaic poverty alleviation in winning the battle against poverty. The government will build not only distributed photovoltaic and photovoltaic power plants for poor family and village.



On June 17, 2020, the Ministry of Finance announced the final accounts data of the National Renewable Energy Fund for 2019 and the budget data for 2020. Among them, photovoltaic subsidies account for about 51%, accounting for the largest proportion, followed by wind power, accounting for about 43%, and biomass energy, accounting for about 6%. Among the photovoltaic subsidy projects, photovoltaic poverty alleviation projects, natural person distributed projects with a single installed capacity of less than 50KW, and photovoltaic projects determined by bidding in 2019-2020 shall be allocated in full priority (distributed at a proportion of 100%); The "leader" project determined by the state (connected to the grid before the end of 2019) gives priority to ensuring that 50% of the subsidy funds payable by the project are allocated; Other renewable energy projects included in the list are estimated to be distributed in the proportion of 30% - 40%.

3.8 Retrospective measures applied to PV

N/A

3.9 Retroactive measures applied to PV

N/A

3.10 Indirect policy issues

3.10.1 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.

3.10.2 Support for electricity storage and demand response measures

On March 12, Xinhua News Agency announced the outline of the '14th-Five-Year-Plan' for China's national economic and social development and the long-term objectives for 2035. According to the plan, nine clean energy bases and four offshore wind power bases will be developed during the '14th-Five-Year-Plan' period. In this plan, the nine clean energy bases are equipped with quantitative energy storage projects to combine renewable energy with energy storage to form an integrated low-carbon clean energy base. In the 14th five year plan, energy storage will enter a stage of rapid development.

By December 2020, five provinces have defined the PV energy projects should be equipped with storage as well in 'the 14th-Five-Year-Plan'.



In March 2020, Xinjiang Development and Reform Commission solicited opinions for the second time on the notice on carrying out the pilot construction of power generation side energy storage power station, and proposed that in principle, the energy storage project shall not be less than 15% of the installed capacity of photovoltaic power station, and the energy storage market at rated power shall not be less than 2 hours.

In the same period, the Energy Bureau of Inner Mongolia Autonomous Region issued the competitive allocation plan for photovoltaic power generation projects in 2020, which made it clear that priority should be given to supporting the construction of 'photovoltaic + storage' projects. The duration of energy storage system shall be 1 hour or more, and the configured capacity shall reach 5% or more of the construction scale.

In April 2020, 'the report on power grid consumption capacity of applying for parity wind power and photovoltaic power generation projects in 2020' issued by State Grid Henan Electric Power Company proposed that the scale of wind power and photovoltaic power generation in Henan Province has exceeded the boundary conditions of 'the 14th-Five-Year-Plan', and the rejection rate of wind power and photovoltaic power generation in Henan Province has exceeded the consumption line, so there is no room for new scale. It is suggested that wind power and photovoltaic power generation projects included in the government's development plan in the future should be equipped with sufficient energy storage facilities to improve peak shaving capacity.

In June 2020, State Grid Shandong issued the letter of 'Opinions on photovoltaic projects to be applied for bidding in 2020', requiring the photovoltaic projects applying for bidding to promise that the energy storage configuration scale is considered as 20% of the installed scale of the project, and the energy storage time is 2 hours, which can be constructed in stages synchronously with the project body.

In the same period, Shanxi Electric Power Company issued 'the consumption opinions on the proposed photovoltaic projects in 2020', which suggested that the new photovoltaic projects should comprehensively consider the whole industry chain projects with certain power load, be equipped with 15 \sim 20% energy storage, and implement the consumption agreement.

At present, many provinces in China have carried out the pilot of photovoltaic + energy storage. In 2021, more provinces will specify the configuration requirements of "photovoltaic + energy storage".

3.10.3 Support for electric vehicles (and VIPV)

In November 2020, the State Council officially issued the new energy vehicle industry development plan (2021-2035), which proposed to promote the efficient coordination between new energy vehicles and renewable energy. Promote the information sharing and integration of new energy vehicles and meteorological and renewable energy power forecasting systems, coordinate the coordinated scheduling of new energy vehicle energy utilization, wind power generation and photovoltaic power generation, and improve the application proportion of renewable energy. Encourage the construction of "optical storage, charging and discharging" (distributed photovoltaic power generation---energy storage system---charging and discharging) multi-functional integrated station. Support qualified regions to carry out commercial demonstration operation of fuel cell vehicles. There will be more and more integration of new energy vehicles and photovoltaic, which will bring new development opportunities to photovoltaic sheds.



3.10.4 Curtailment policies

N/A

3.10.5 Other support measures

In November 2020, the Ministry of ecology and environmental protection issued 'the implementation plan for setting and allocating the total amount of national carbon emission trading quotas for 2019-2020 (power generation industry) (Draft for comments)'. Enterprises in the power generation industry (including self owned power plants in other industries) that emit 26,000 tons of carbon dioxide equivalent (comprehensive energy consumption is about 10000 tons of standard coal) or more in any year from 2013 to 2018 will be included in the list of key emission units under the quota management of the national carbon market from 2019 to 2020, and directory management will be implemented. According to the screening results, 2267 key emission units in the power generation industry will be included in the national carbon market from 2019 to 2020. The national carbon trading market has entered the substantive implementation stage.

3.11 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. The photovoltaic subsidy policy in 2020 continues the policy in 2019, but the guide price continues to decrease.

In 2020, the guide price levels of I, II and III resource areas are 0.35 yuan/kWh, 0.4 yuan/kWh, 0.49 yuan/kWh, respectively, which are 0.05 yuan/kWh, 0.05 yuan/kWh, and 0.06 yuan/kWh respectively lower than in 2019. The subsidy level for self consumption has dropped from 0.10 yuan/kWh to 0.05 yuan/kWh, and the subsidy level for household photovoltaics has dropped from 0.18 yuan/kWh to 0.08 yuan/kWh.

In April 2020, the National Development and Reform Commission issued the announcement on the continuation of the enterprise income tax policy for the western development (Announcement No. 23 of the Ministry of Finance in 2020), which made it clear that: From January 1, 2021 to December 31, 2030, enterprises in encouraged industries located in the western region will be subject to enterprise income tax at a reduced rate of 15%.

In January, the National Development and Reform Commission issued 'the catalogue of encouraged industries in the western region (2020 Edition)'. Wind power and PV projects have become one of the most important encouraged directions in the catalogue, and have entered the encouraged catalogue in all western regions.

According to the latest version of the catalogue, in 12 provinces (autonomous regions and cities), wind power and PV projects are encouraged projects, and can enjoy a 15% income tax preference. In addition, the catalogue of some provinces also includes items such as PV modules, silver powder for PV cells, PV power station detection, PV tracking support, PV glass, etc.



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 2020 to reach 39.6*10⁴ tons output, accounting 76% of global total output.

In terms of production capacity, China's polysilicon production capacity will account for 75.2% of the global production capacity in 2020, an increase of 6.2% compared with 69.0% in 2019. In terms of output, China's polysilicon output accounted for 76% of global output in 2020, an increase of 8.7% compared with 67.3% in 2019.

Manufacturers	Process & technology	Total Production Output	Product destination	Price
Sichuan Yongxiang Co., Ltd.	mc-Si	8.62*10 ⁴		
Xinjiang Great New Energy Co., Ltd.	mc-Si	7.728*10 ⁴		
GCL-Poly Energy Holdings Co., Ltd.	mc-Si	7.5*10 ⁴		
Xinte Energy Co., Ltd	mc-Si	6.5*10 ⁴		
East Hope Co. Ltd	mc-Si	4.0*10 ⁴		
Asia Silicon Co., Ltd	mc-Si	2.1*10 ⁴		
Rest	mc-Si	3.152*10 ⁴		
Total	mc-Si	39.6*10 ⁴		

Table 12: Silicon feedstock, ingot and wafer producer's production information for 2020

Source : CPIA,2021.6

4.1.2 Silicon wafer

In 2020, mainland China's wafer production capacity was about 240GW, was an increase of 38.2% 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 161.4 GW, an increase of 19.8% year-on-year, accounting for 96.2% of global wafer production. In 2020, China's silicon wafer export volume is about 27GW, which is basically the same as that of 27.3GW in 2019, accounting for about 16.7% of China's silicon wafer output. Among them, the export volume of monocrystalline



silicon wafer was about 23.9GW, a year-on-year increase of 24.5%, and the export volume of polycrystalline silicon wafer was about 3.1GW, a year-on-year decrease of 61.7%.

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

Module manufacturing is defined as the industry where the process of the production of PV modules (the encapsulation) is done. A company may also be involved in the production of ingots, wafers or the processing of cells, in addition to fabricating the modules with frames, junction boxes etc. The manufacturing of modules may only be counted to a country if the encapsulation takes place in that country.

4.2.1 Solar cell

In 2020, the total production capacity of China's solar cell was 201.2GW, up 22.8% year-onyear, accounting for 80.7% of global production capacity; the output was about 134.8GW, up 22.2% year-on-year, about 82.5% of the annual global production.

In 2020, China's annual export volume of solar cell was about 0.99 billion US dollars, decrease 32.7% year-on-year, accounting for 6.7% of the total export value of photovoltaic products, and the export volume of solar cell was about 9GW, decrease 13.5% year-on-year

4.2.2 PV module

In 2020, the total production capacity of PV module was about 244.3GW, and the output was 124.6GW, a year-on-year growth of 61.4% and 26.4%.

The value of PV module export amounted to approximately US\$16.99 billion in 2020, up 2.6% year-on-year, accounting for 86% of total PV product exports, up 2.6 percentage points year-on-year; export volume was approximately 78.8GW, make an new record of mudule export, accounted for 63.2% of the total output.

Total PV cell and module manufacture together with production capacity information is summarised in Table below.

Cell/Module	Technology	Total Production [MW]		<u>Maximum</u> capacity	production / [MW/yr]			
manufacturer		Cell	Module	Cell	Module			
Wafer-based PV r	Wafer-based PV manufactures							
Tongwei Group		21400		27500				
Aikosolar Ltd		13300		22000				
LONGi Group		12200	245000	23250	50000			

Table 13: P	V cell a	nd module	production	and	production of	canacity	information	for	2020
	v ucii a	ina module j	production	anu		Japacity	momation	IUI	ZUZU



JinkoSolar Holding Co., Ltd.		7000	17600	7000	31000
JA Solar Holdings Co., Ltd.		10000	14000	16500	23000
Trina Solar Co.,		5250	12360	9200	22100
Canadian Solar		5300	11400	6400	16150
Risen Energy Co.,Ltd.			7007		14100
Suntech Power Holdings			3800		9000
GCL System Integration			3500		9000
TOTAL			109521		191950
Thin film manufact	turers				
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
Advanced Solar Power (Hangzhou) Co., Ltd.	CdTe				80
Hanergy GSE (USA)	CIGS				50
Hangzhou Shangyue Optoelectronics	CIGS				50
Shenhua Manz (Germany)	CIGS				50



Cells for concentration					
Manufactory 7		g		h	
Totals					

Source : CPIA,2021.6



4.3 Manufacturers and suppliers of other components

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

In the first three quarters of 2020, China's newly added PV installed capacity was 18.7GW, higher than the level of the same period of last year. In the fourth quarter, it showed explosive growth, making the annual newly added installed capacity reach 48.2GW, including 32.68GW of centralized PV and 15.52GW of distributed PV. Due to the obvious effect of large-scale electricity price reduction, the proportion of centralized PV continued to rise to 68%, The household market doubled and the installed capacity reached 10.1GW, exceeding the total installed capacity of households in the previous four years. Considering the inverter supply cycle and project carry forward, the inverter enterprise's shipment in the domestic market will be about 50GW in 2020. According to incomplete statistics of CPIA, the total output of inverter in China in 2020 is about 100GW (excluding the OEM output of foreign brands), with a year-on-year increase of 36%.

• Storage batteries

According to the incomplete statistics of CNESA global energy storage project library, by the end of 2020, the cumulative installed capacity of photovoltaic configuration energy storage projects put into operation in China had reached 883.0mw, accounting for 27.0% of the total scale of electrochemical energy storage projects in China, with an annual growth rate of 132.0%.

- Battery charge controllers
- DC switchgear
- 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 14: Estimated PV-related full-time labour places in 2020

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 and installations	N/A
Other	N/A
Total	N/A



5.2 Business value

Table 15: Rough estimation of the value of the PV business in 2020 (VAT is excluded)

Sub-market	Capacity installed [MW]	Average price [Yuan/W]	Value	Sub-market
Off-grid	0			
Grid-connected distributed	15500	3.38	52,390,000,000	
Grid-connected centralized	32700	3.99	130,473,000,000	
Value of PV busine	182,863,000,000			



6 INTEREST FROM ELECTRICITY STAKEHOLDERS

6.1 Structure of the electricity system

N/A

6.2 Interest from electricity utility businesses

In 2020, the national solar photovoltaic power generation will continue to maintain double-digit growth, reaching 260.5 billion kWh, a year-on-year increase of 16.1%. In 2020, the average utilization hours of solar power generation equipment in China was 1160 hours, a year-on-year decrease of 125 hours. The average utilization hours of solar photovoltaic power generation equipment in 16 provinces and regions exceed 1200 hours.

In 2020, the State Grid Corporation of China will vigorously promote the construction of power market, improve the medium and long-term market mechanism, and accelerate the construction of power spot market. Implement the renewable energy power consumption guarantee mechanism and carry out excess consumption trading. Expand the scale of inter provincial and intro provincial transactions, constantly innovate transaction varieties, organize and carry out Winter Olympic green power transactions, special new energy transactions, etc. the annual new energy market-oriented transaction electricity was 157.2 billion kWh, including inter provincial transaction electricity of 91.5 billion kWh and intra-provincial transaction electricity of 65.7 billion kWh.

6.3 Interest from municipalities and local governments

Household PV has become the main force in the development of distributed PV. According to the data released by the National Renewable Energy Information Center, the installed capacity of household PV projects included in the scale of national financial subsidies in 2020 is 10.12 million KW, accounting for 65% of the new installed capacity of all distributed PV.



7 HIGHLIGHTS AND PROSPECTS

7.1 Highlights

7.1.1 Development goals

In 2020, China's photovoltaic installed capacity has grown rapidly. According to data released by the National Energy Administration, the cumulative total installed capacity of photovoltaic power generation in China in 2020 was 253GW, a year-on-year increase of 23.8%. As photovoltaics gradually enter the era of parity and 14-five-year plan, the installed capacity will show a more rapid growth trend.

7.1.2 Improvement of financing environment

According to the incomplete statistics of CPIA, 16 enterprises in China's photovoltaic industry completed 18 financing projects in 2019, with a corresponding financing scale of 36.27 billion yuan. In 2020, 32 enterprises completed 36 financing projects, with a year-on-year increase of 260%, and the corresponding financing scale was 71.414 billion yuan, with a year-on-year increase of 96.9%, of which 18 refinancing projects accounted for a large proportion, with a corresponding financing scale of 58.3 billion yuan. Followed by 12 IPO Financing, the corresponding financing scale is RMB 13.1 billion, which is far higher than the level in the same period in 2019.

7.1.3 Market

In 2020, total annual installation is reach to 48.2GW. Among them, the distributed PV is 15.5GW, shared 32.2%.

Market Sec.	Annual	Cumulative	Share
	(MWp)	(MWp)	(%)
Distributed	15500	78940	31.12
Power Plant	32700	174340	68.74
Off-grid		360	0.14
Total	48200	253640	100

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 PV Production and China Share in 2020

Sectors	World	China	Share (%)
Poly-Silicon (10 ³ Ton)	52.1	39.6	76.0
Silicon Wafer (GW)	167.7	161.4	96.2



PV Cells(GW)	163.4	134.8	82.5
PV Modules (GW)	163.7	124.6	76.1

Source: CPIA

7.1.5 R&D

CPVS has been publish the Solar Cell Best-Efficiency Table of China for three years since 2017. Last month, CPVS published the 2020 Solar Cell Best-Efficiency Table of China:

No	Technology	Cell Efficiency (%)	Area (cm2)	
1	HIT	25.11±0.35	244.54 (t)	
2	TOPCon (bifacial)	24.87±0.16	267.80 (t)	
3	TOPCon (bifacial)	24.90±0.35	235.80 (t)	
4	TOPCon (bifacial)	24.40±0.34	267.50 (t)	
5	TOPCon (bifacial)	23.81±0.3	246.44 (t)	
6	CZTSSe (on glass)	11.563±0.088	0.1066 (ap)	
7	Perovskite (minimodule)	18.04±0.58	19.276 (da)	
1. Hanergy 2. Jinko 3. Jinko 4. Jinko 5. Canadian Solar				
6. NJU 7. Microquanta				

Table 24 Lab. Level Highest Cell Efficiency

Source: CPVS 2021.7

7.2 Prospects

2020 is the last year of "The 13th Five-Year National Plan" and 2021 is the first year of "The 14th Five-Year National Plan". In 2021, the cost of PV is already reached to the level of grid-parity, except PV home systems, the other PV projects will have no subsidy anymore and the Grid Co. will purchase PV electricity with the price the same as coal-fire power plants. Since 2021, the total PV market quota will not be controlled by NDRC or NEA, the PV installed capacity will be arranged by provincial government according to the "Mandatary Share of Non-Hydro Renewable Energy Power", issued by NEA just like RPS in western countries. For the target of 2030 reach to CO2 peak and 2060 reach to "carbon neutral", PV market will be expanded further more. It is estimated that during the 14th 5-year plan (2021-2025), annual PV installation in China will be at least 50GW. Photovoltaic will help clean and low-carbon development in many fields