SYPSolar &

SYPSolar Plus

ArchiBiz

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01. **Solar Engergy & Net Carbo Zero**

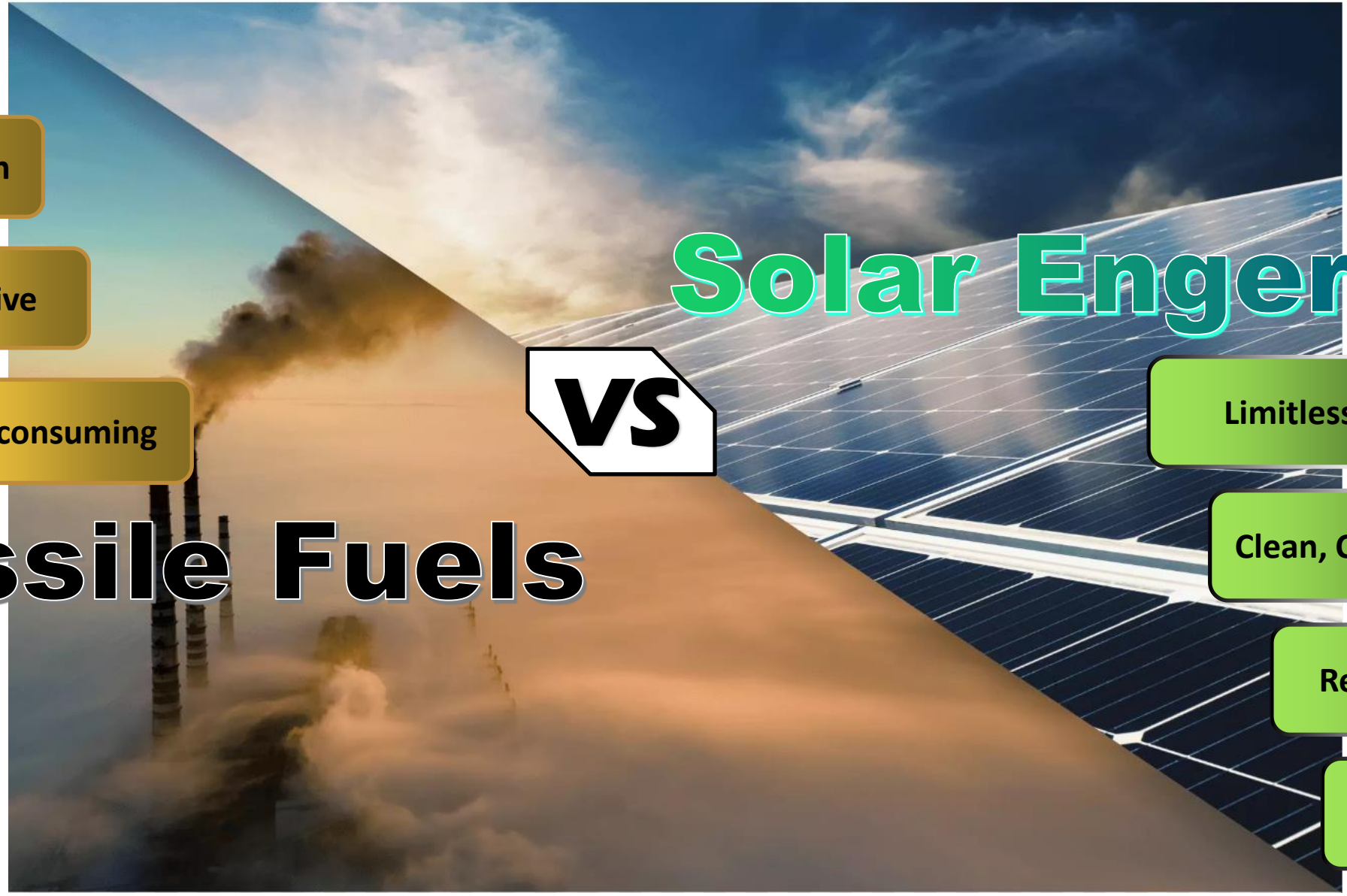
02. **BIPV, the BEST for curtain wall**

03. **SYP BIPV: SYPSolar & SYPSolar Plus**

Solar Energy is a safe, clean, green source of energy.

It doesn't release any greenhouse gasses.

Solar power is a GREAT way to reduce your carbon footprint.



Air Pollution

Expensive

Time-consuming

Fossile Fuels

VS

Solar Engery

Limitless

Clean, CO2-Free

Renewable

Low Operation Cost

For Buildings?

WHAT CAN WE DO?

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1) What is Singapore Government doing?

Singapore Commits to Achieve Net Zero Emissions by 2050 and to a Revised 2030 Nationally Determined Contribution; Public Sector and Jurong Lake District to Lead The Way with Net Zero Targets

25 OCT 2022

** https://www.nccs.gov.sg/media/press-releases/singapore-commits-to-achieve-net-zero/*

Singapore Green Building Masterplan (SGBMP)

Singapore is accelerating our transition towards a low-carbon built environment. Launched in March 2021 by the Building and Construction Authority (BCA) Singapore and the Singapore Green Building Council (SGBC), the Singapore Green Building Masterplan (SGBMP) was developed in conjunction with industry stakeholders and the community. It provides recommendations that capture our collective commitment to pursue more ambitious sustainability standards in the built environment. The SGBMP aims to deliver three key targets of "80-80-80 in 2030":

- 80% of buildings by gross floor area (GFA) to be green by 2030;
- 80% of new developments (by GFA) to be Super Low Energy (SLE) buildings from 2030 onwards; and
- 80% improvement in energy efficiency (compared to 2005 levels) for best-in-class green buildings by 2030.

** https://www.nccs.gov.sg/singapores-climate-action/mitigation-efforts/buildings/*

2 general integrated approaches to maximise the reduction of energy consumption:

1. Typical

2. Upgrade

Passive Design for the Tropics

Active Solutions with Optimised Control

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Building Integrated photovoltaic (BPIV)

the BEST Active Solutions for Curtain Wall.

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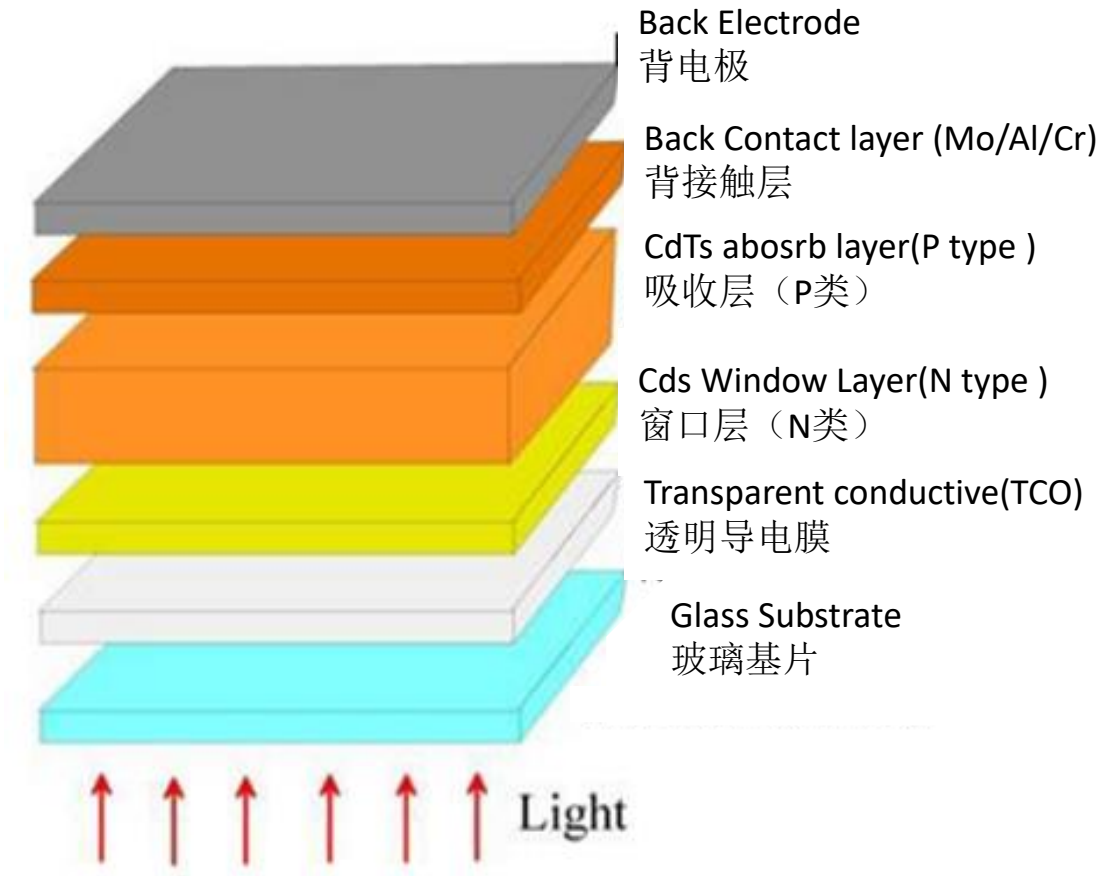
Cadmium Telluride Solar Cells

Nano cadmium telluride solar(CdTe) is a kind of **thin film solar cell** on P type CdTe and N type CdS. The active layers are just a few microns thick, or about a tenth the diameter of a human hair.

The transparent conductive film(TCO)and transparent high resistance(SnO2)transition film are deposited on the glass substrate,and the cadmium sulfide(N type) and cadmuim telluride(P type)films are deposited sequentially by **gas phase transport deposition method**.

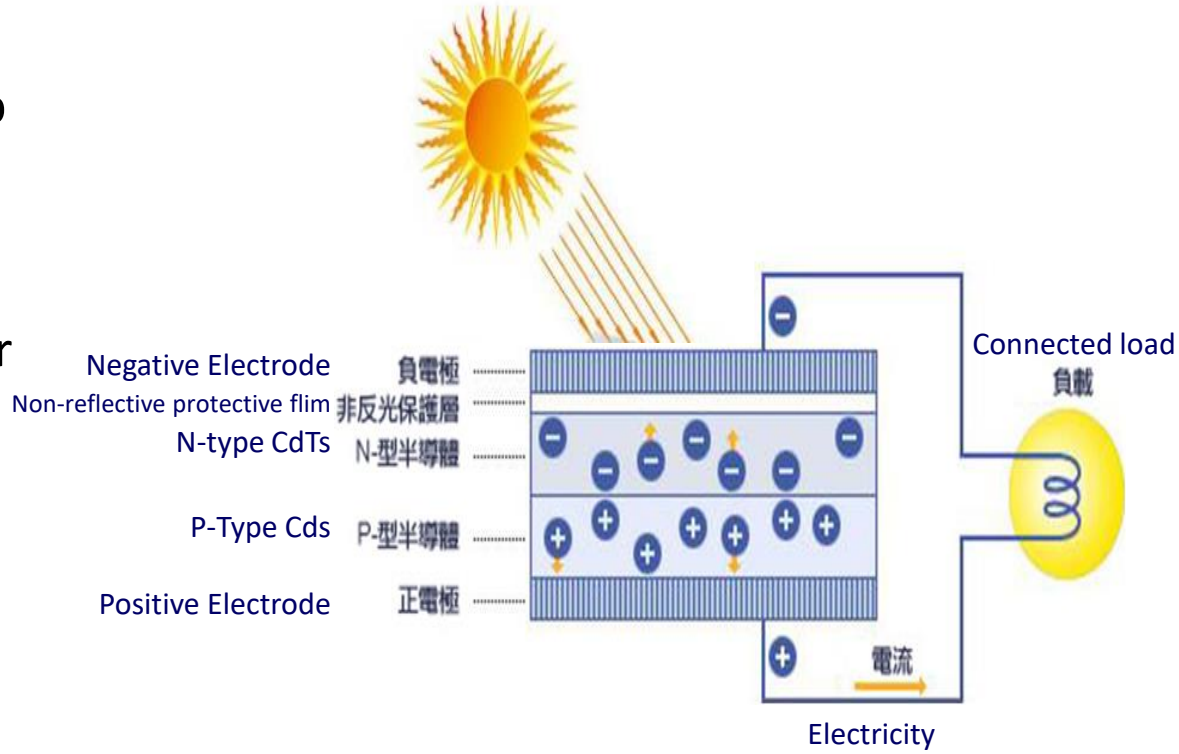
Then the crystal structure is improved by CdCi2 treatment activation and the PN junction is activated. Then PVD **magnetron sputtering** was used to gild Mo/Al/Cr electrode to form the structure of CD telluride cell as shown in the figure.



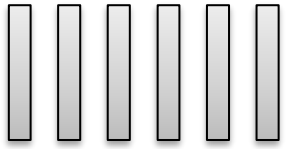
*** Glass substrate* *is photovoltaic grade* *3.2 or 2.5mm* *transparent conductive film(TCO)* *hard coating glass.*

Working principle of BIPV

- The sunlight illuminates the semiconductor p-n junction and forms a new hole-electron pair, the hole flows from the n region to the p region under the action of the p-n junction electric field, and the electron flows from the p region to the n region. When the circuit is switched on, the current is formed.
- This is the working principle of photoelectric effect solar cell, which absorbs photons, produces electron-hole pairs, and produces potential at both ends of PN junction. It connects the PN junction with wires to form current.

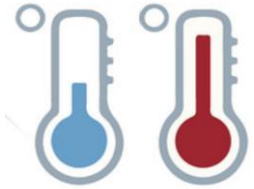


Advantage of Cadmium Telluride (CdTe)

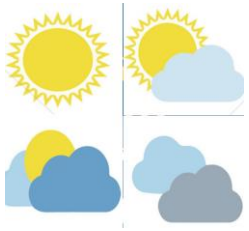


Strong shielding resistance

Safety-small hot spot effect



Low temperature coefficient



Good weak light performance

Small orientation dependence

Good appearance consistency

Small annual attenuation

Long service life

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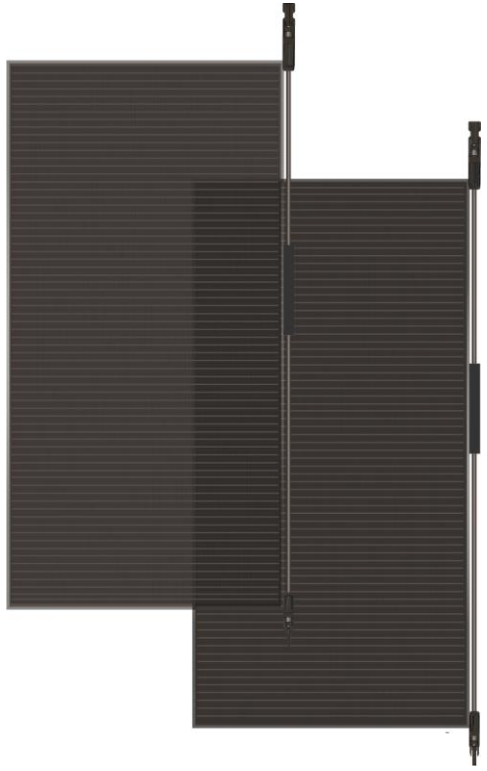
Comparation Between Different Solar Panels

CdTe



VS.

Polycrystalline Cells

Monocrystalline Cells

Safer, Less Risk of Hot Spot Hazard

CdTe

lower current

lower heat accumulation temperature

lower Hot Spot Hazard

Joule's law

Energy $Q=I^2 \cdot R \cdot t$

Q: Heat, I: Current, : Resistance, t: Work time

VS.

Crystalline Silion

EVA melting &yellowing

Product on fire

Backplane burning through

Hot Spot Hazard

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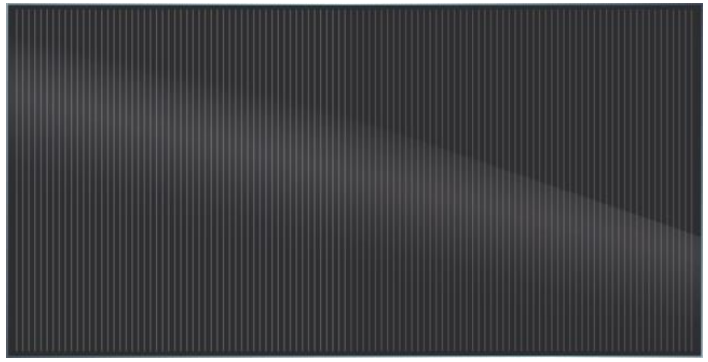
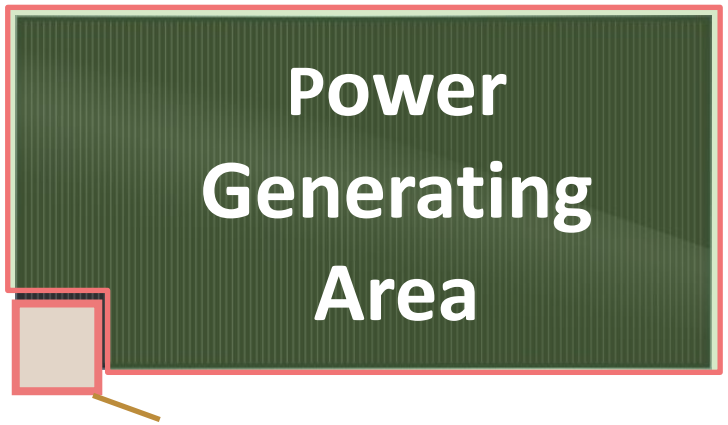
Less Impact When Shielded

CdTe

The strip-shaped subcell of CdTe solar cell has a small area, and the other subcells can work normally even if it is partially shielded.

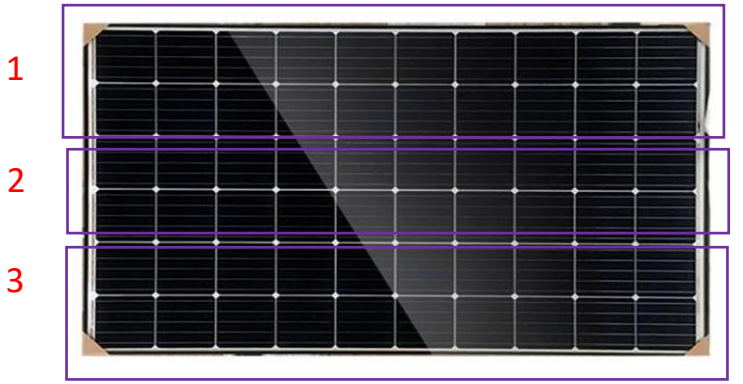


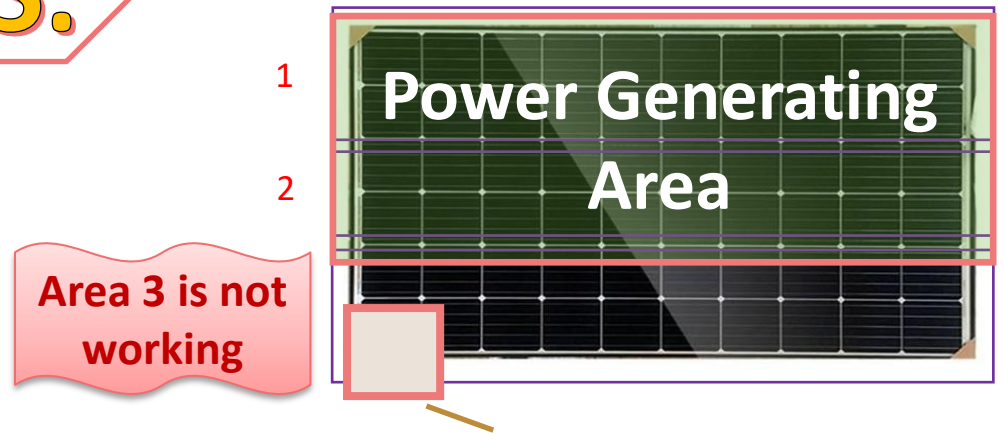


VS.

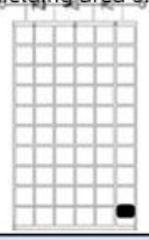
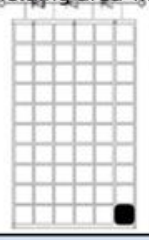
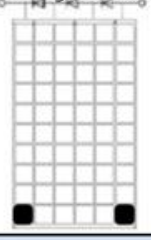
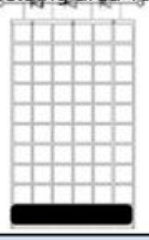
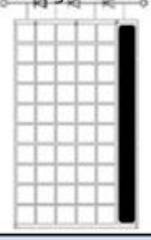
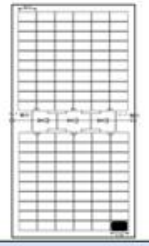
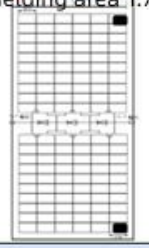
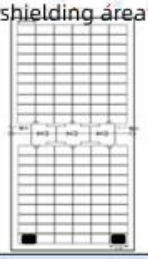
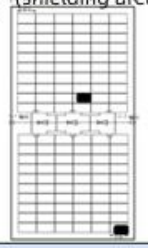
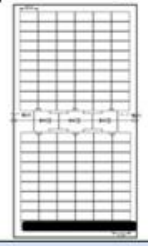
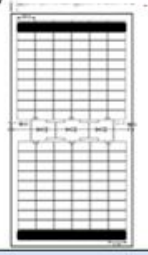
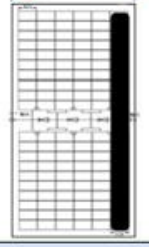
Crystalline Silicon

The crystalline silicon module is composed of three regions connected in series, with an anti-reflection diode between each region; When it is partially shielded, the loss of a single area is larger, the power generation amount is seriously affected, and there will be a fire hazard in case of high temperature.





Power Generation Loss of different solar products when Shield

Polycrystalline 	Shielding mode (c-Si- whole piece)	Method a: 50% of a piece (shielding area 0.8%) 	Method b: 1 piece (shielding area 1.7%) 	Method c: 50% of two pieces (shielding area 3.3%) 	Method d: 6 pieces in a row (shielding area 10%) 	Method e: 10 pieces in a row (shielding area 16.7%) 	-	-
	Power loss	⬇35%	⬇35%	⬇70%	⬇99%	⬇35%	Method f:	-
Monocrystalline 1/2 panel 	Shielding mode (c-Si- half piece)	Method a: 1 piece (shielding area 0.8%) 	Method b: 2 pieces on different sides of the same diode (shielding area 1.7%) 	Method c: 2 pieces on the same side of different diodes (shielding area 1.7%) 	Method d: 2 pieces on different sides of different diodes (shielding area 1.7%) 	Method e: 6 pieces in a row (shielding area 5%) 	12 pieces in a row on different sides (shielding area 10%) 	Method e: 10 pieces in a row (shielding area 16.7%) 
	Power loss	⬇35%	⬇35%	⬇44%或69%	⬇44%或71%	⬇47%或100%	⬇99%	⬇35%
CdTe  	Shielding mode (CdTe)	Method a: 0.8% 	Method b: 1.7% 	Method c: 1.7% 	Method d: 1.7% 	Method e: 5% (lateral shielding) 	Method f: 10% (lateral shielding) 	Method g: in a row (shielding area 16.7%) 
	Power loss	⬇0.8%	⬇1.7%	⬇2.5%	⬇1.7%	⬇48%	⬇82%	⬇16.7%

备注：以上数据来源于光伏业内公司的代表性实测分析报告

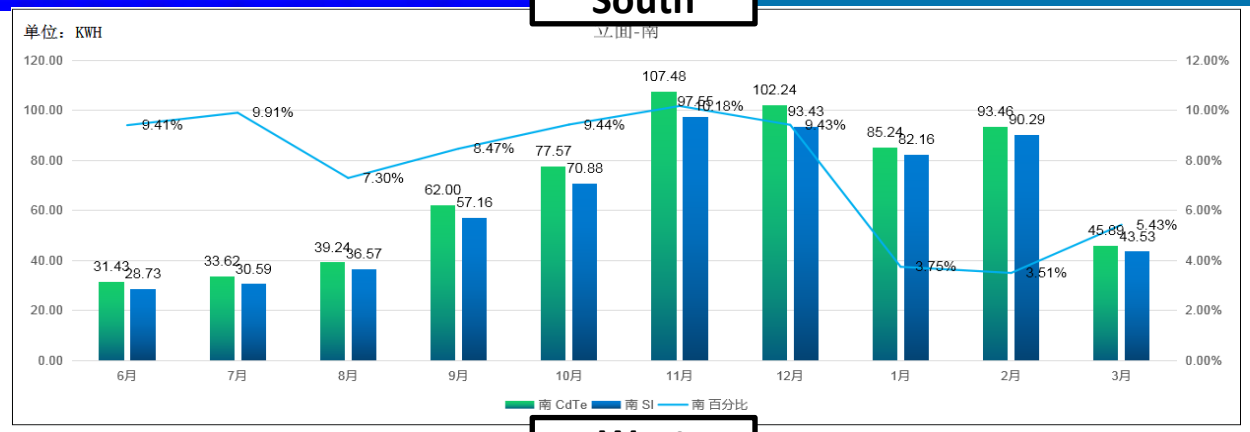
*** When CdTe is shielded at a point, the power loss is proportional to the shaded area, and only when it is shaded in a big area, and the whole short side is shielded, the power loss is larger.*

More Application Scenarios

No requirement for Installation Direction

Cumulative Power Generation

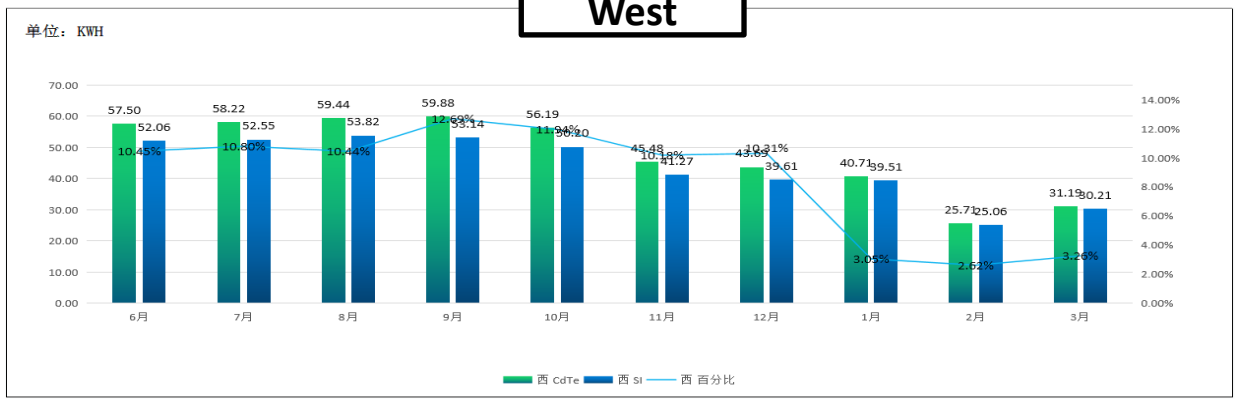
South



CdTe

7.7% ↑

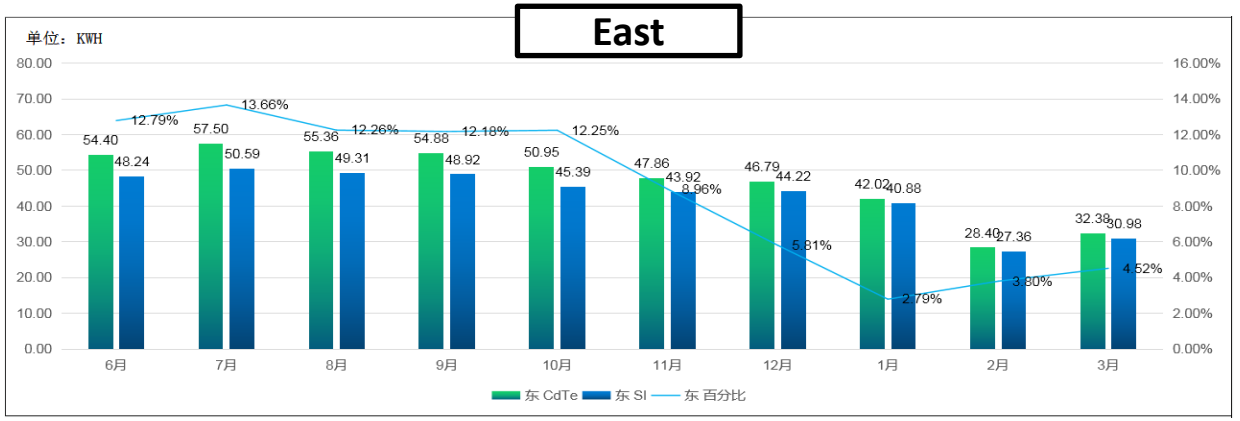
West



CdTe

8.5% ↑

East



CdTe

9.4% ↑

Monocrystalline

VS

CdTe

Vertical Installation

- Zhongshan City, Guangdong China
- 22°33'40” N, 113°26'45” E
- June 2020 to March 2021

Experiment #2

Simulation of Roof / Skylight (20 degrees horizontal)

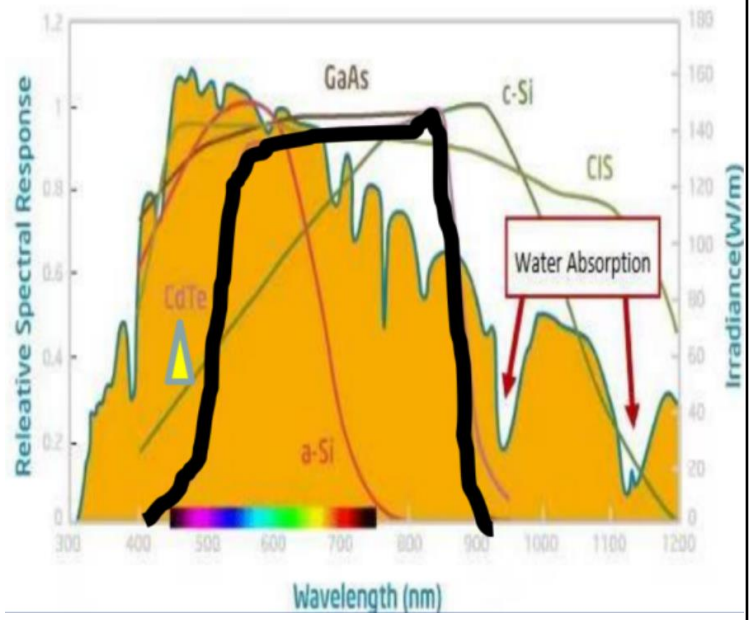
Cumulative Power Generation

CdTe 11% ↑

- Zhongshan City, Guangdong China
- 22°33'40” N, 113°26'45” E
- April 7 to 11 2021

Good Performance at Low Irradiance Condition

Strong full-spectrum absorption



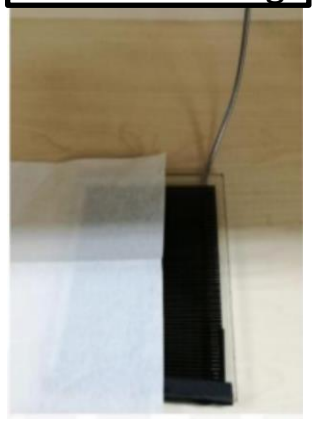
CdTe material has good full spectrum absorption capacity. As it is a direct gap material, it has obvious power generation effect in weak light conditions such as in early morning and evening.

Physical Experiment

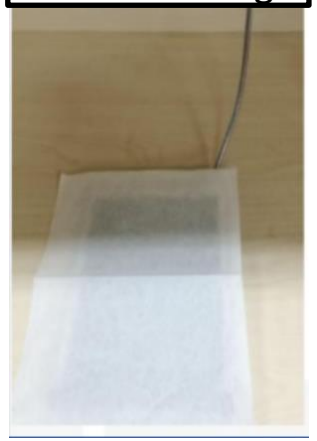
Rain Shielding

Snow Shielding

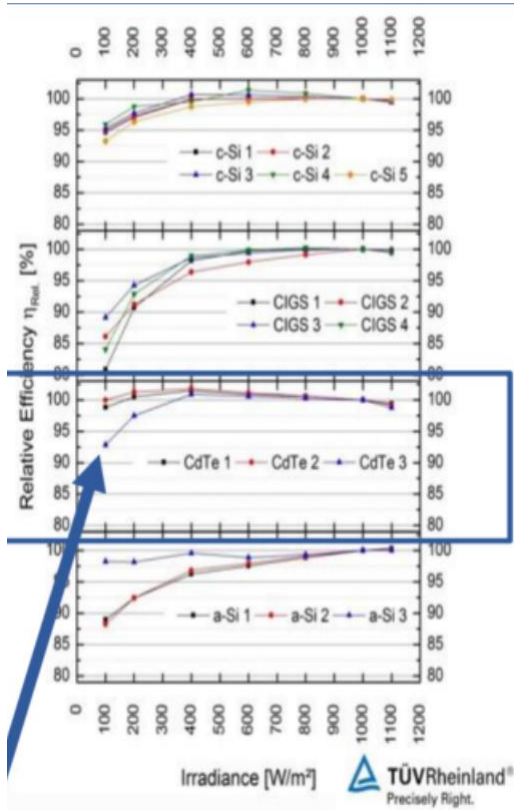
Paper Semi-Shielding



Paper Full-Shielding



TUV Beta Data



CdTe has the best relative power generation capacity at low irradiance

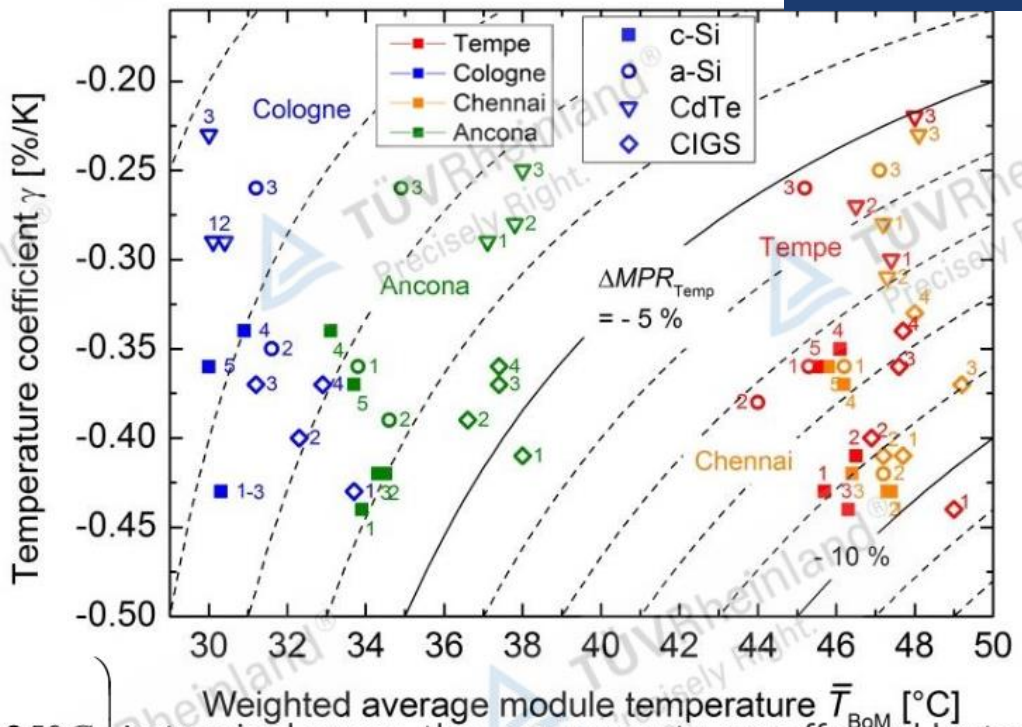
Higher Power Generation when Low Temperature

Data analysis
Temperature influence

TUV outdoor empirical data

Place	Loss of power generation due to temperature:
Germany	-1.2 % to -3.7 %
Italy	-2.6 % to -5.3 %
India	-5.3 % to -9.6 %
Arizona, United States	-5.1 % to -10.6 %

Minimum loss of power generation



$$\Delta MPR_{TEMP} = \gamma \left(\frac{\int_T T_{BoM} G_{PoA} dt}{\int_T G_{PoA} dt} - 25°C \right)$$

In tropical areas, the components are affected by temperature, resulting in great power loss

Compared with the other three modules, cadmium telluride module has the least loss caused by temperature

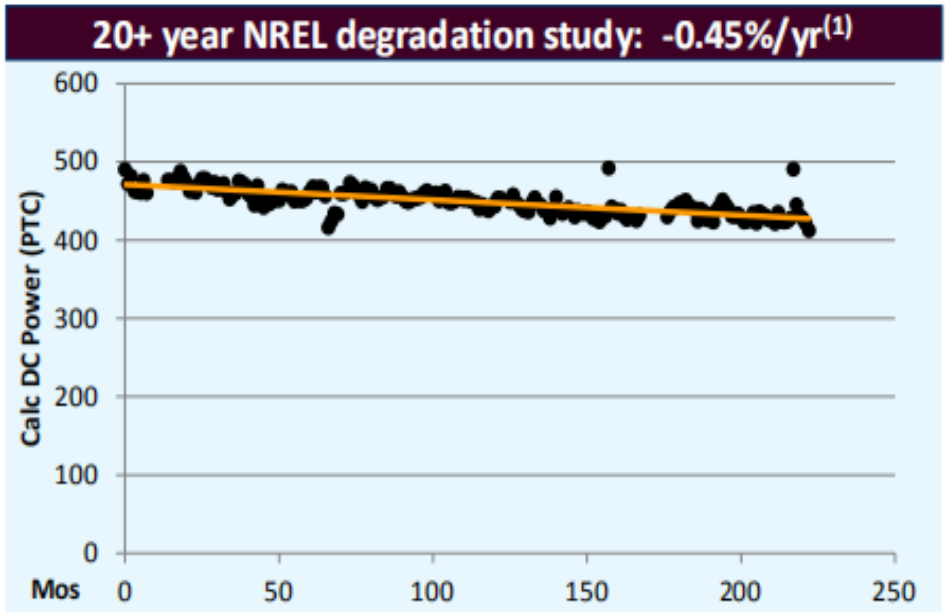
Better Coordination&Consistency with Architectural Appearance

CdTe photovoltaic cell

VS.

Traditional solar cell

Smaller Annual Degradation and Longer Power Generation Period.

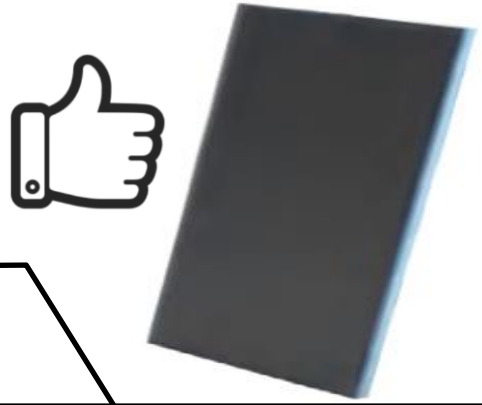


According to DOE NERL's 20-year degradation research, the cumulative degradation of CdTe products in 20 years does not exceed 9%, and the average degradation rate is only -0.45%/ year, far lower than the average annual degradation rate of -0.8% for c-Si cells.

SYP guarantee the power attenuation of CdTe solar product is not more than 20% within 25 years.

Longer Service Life

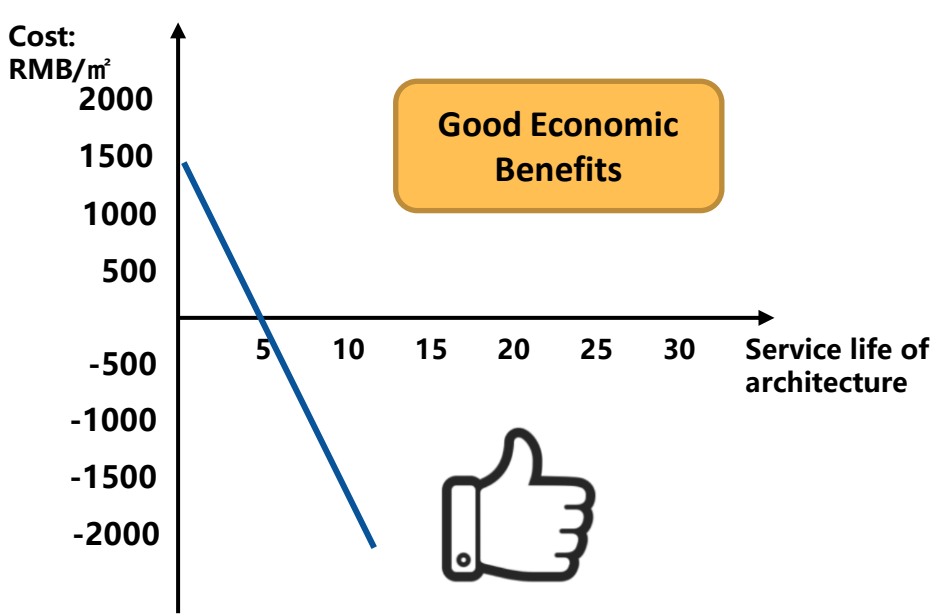
Bigger Size, joint cells

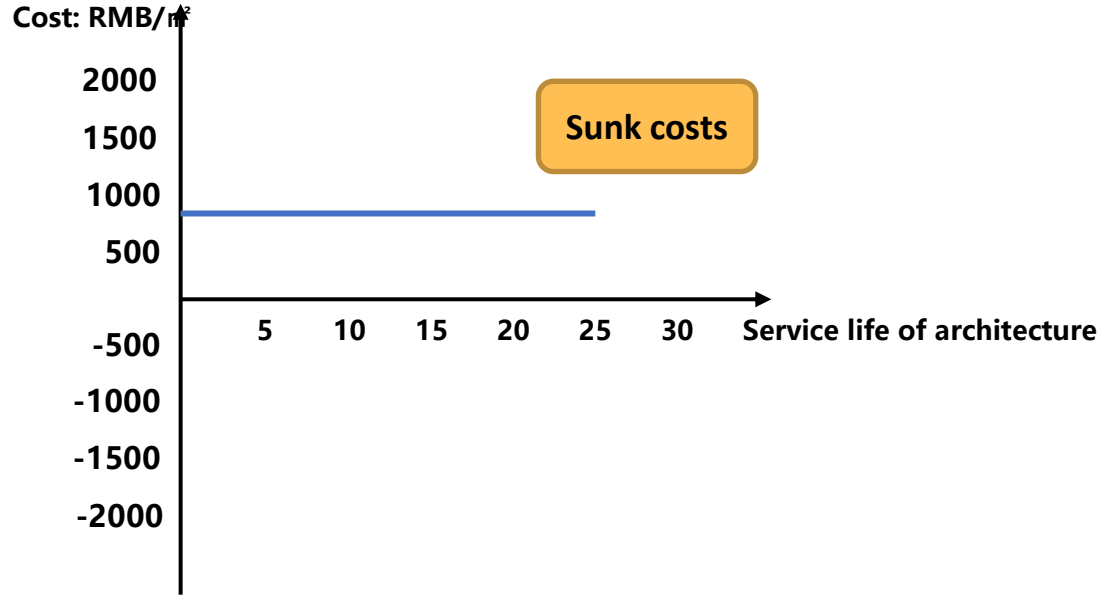
CdTe	Crystalline Silicon Photovoltaic Cell
 VS. 	
L*W: 1200*600 mm L*W: 1600*1200 mm Thickness: 3.5 mm	L*W: 182/215 mm Thickness: 120~160 um
Film Structure	**Sheet** Structure, brittle silicon wafer of 120~170um
laminated into the glass, and NOT easy to be damanged	**Exposed** to the elements, and easy to be damaged in the years of use

Long-term benefits

From the perspective of construction cost, the cost of photovoltaic building can be recovered and will get lower as time goes on. In the whole life cycle of the building, the cost can be recovered and the income can be created.

Power generation curtain wall VS. **Ordinary curtain wall**

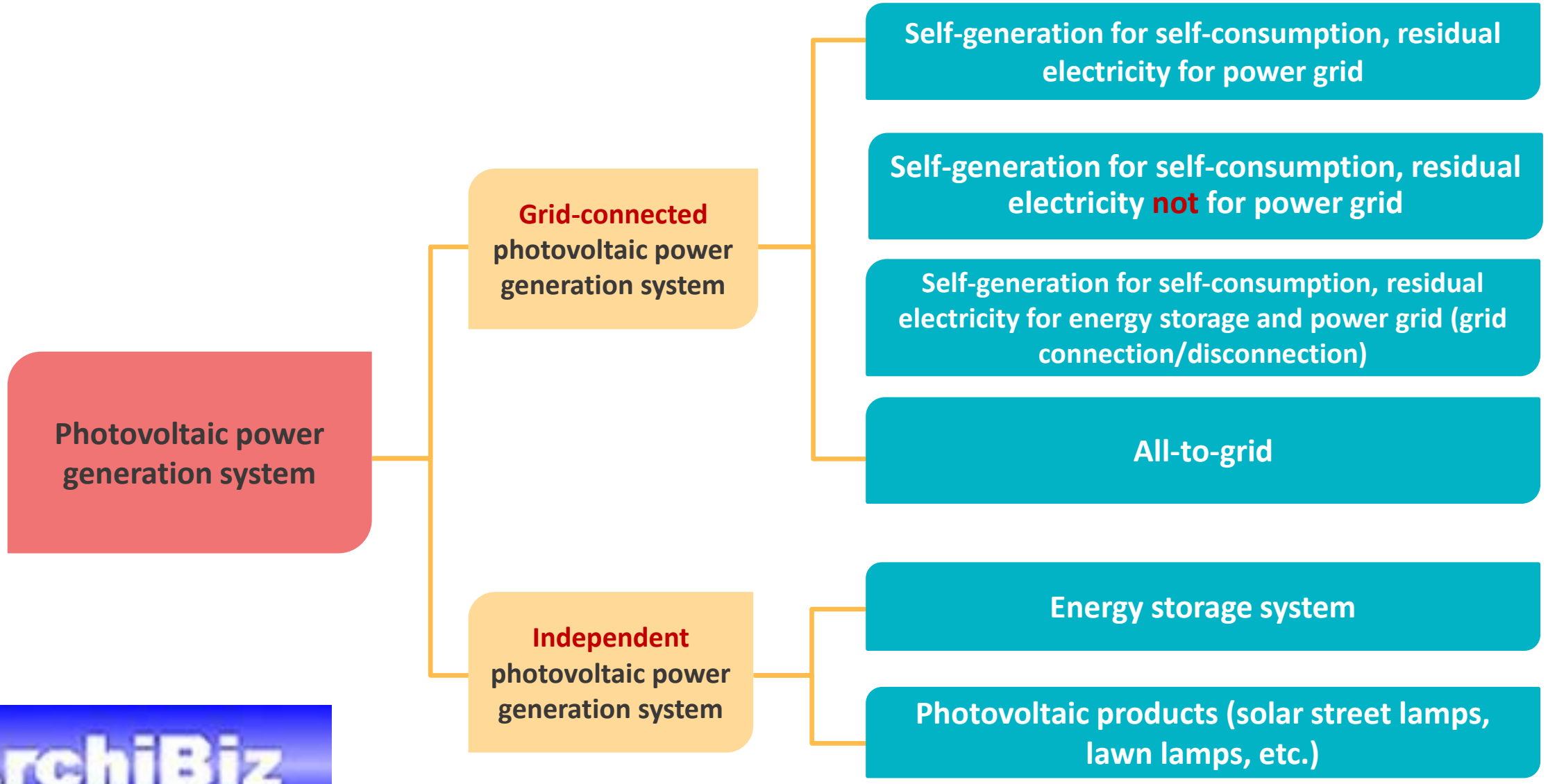




Conventional building curtain walls have no possibility of cost recovery.

The cost of BIPV building curtain wall can be recovered in 6-10 years .

Power Consumption Mode



Photovoltaic Power Generation

Item/ Light Transmittance		50%	40%	30%	20%	10%	0%
Rated Power	Pmpp (W)	50	60	70	80	90	100
Peak Voltage	Vmpp (V)	90	90	90	90	90	90
Peak Current	Impp (A)	0.56	0.66	0.77	0.88	1.00	1.11
Open Circuit Voltage	Voc (V)	117	117	117	117	117	117
Short Circuit Current	Isc (A)	0.62	0.74	0.87	0.99	1.13	1.25

The above data are test data under standard conditions (1000W/m2, AM1.5, 25℃),
Typical Size of 1200mm*600mm

Effiency in Singapore

15:10

statista

Society › Geography & Nature

Number of daily sunshine hours Singapore 2013-2022

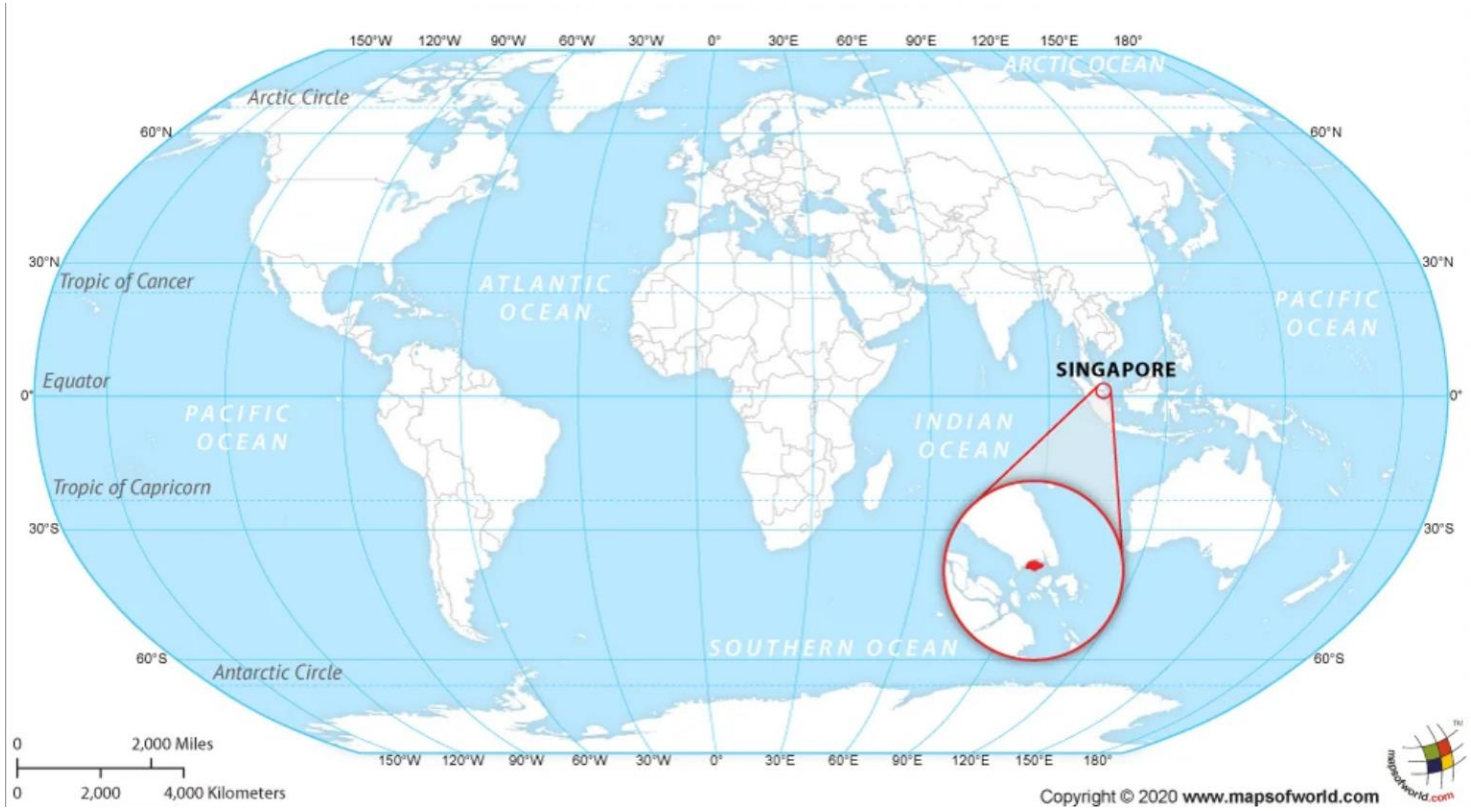
Published by Statista Research Department, May 10, 2023

In 2022, there were about 5.3 hours of sunshine on an average day in Singapore, indicating a slight decrease from the previous year. Singapore is a country with a tropical climate, meaning that it has a relatively constant temperature range all year round.

Number of daily sunshine hours in Singapore from 2013 to 2022

- Location: 1°17'22.81"N, 103°51'0.25"E
- Year round sunshine: **1932 hours**

100sqm BIPV products per facade?

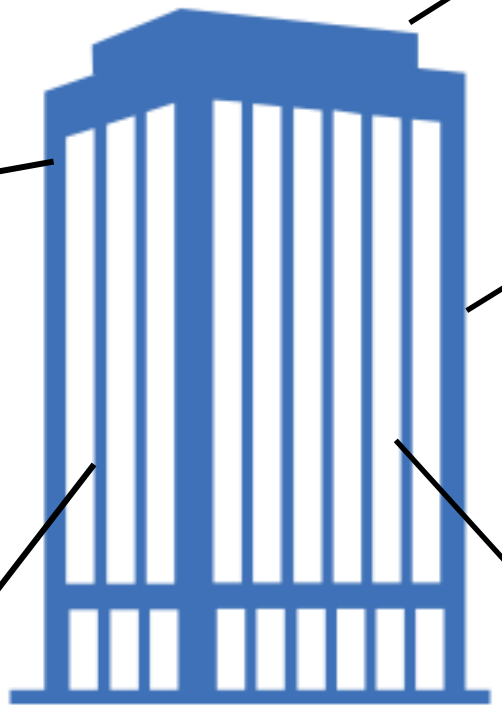


Example - Singapore

VLT	SUM	Roof	East	South	North	West
0%	75.2	25.4	13.8	11.1	11.1	13.8
20%	59.8	20	10.9	9	9	10.9
50%	37.8	12.8	6.9	5.6	5.6	6.9

Unit: K·kwh

Annual Electricity Production (100sqm of each surface)



ROOF
VLT 0% - 25400kwh
20% - 20000kwh
50% - 12800kwh

East
VLT 0% - 13800kwh
20% - 10900kwh
50% - 6900kwh

South
VLT 0% - 11100kwh
20% - 9000kwh
50% - 5600kwh

North
VLT 0% - 11100kwh
20% - 9000kwh
50% - 5600kwh

West
VLT 0% - 13800kwh
20% - 10900kwh
50% - 6900kwh

** The above calculation is for reference only, which should be subject to the actual situation of the project*

Why SYP BIPV?

SYPSolar & SYPSolar Plus

ArchiBiz

Advantage of SYP

1. Abundant BIPV Products

2. Provide Professional Installation guideline

3. Rich experience on BIPV projects

SYPSolar & SYPSolar Plus

ArchiBiz

1. SYP - Abundant BIPV Products

- Wide Range of BIPV VLT: 0%, 10%, 20%, 30%, 40%, 50%
- Various of Colors
- Different Combination to Enhance the Performance
- Rich experience on BIPV projects

SYPSolar & SYPSolar Plus

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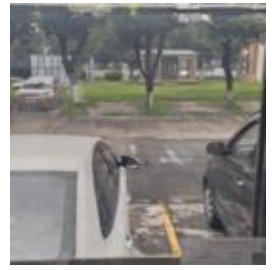
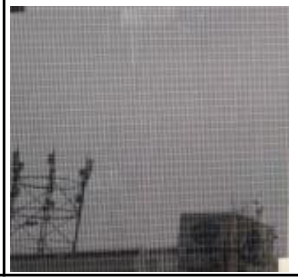
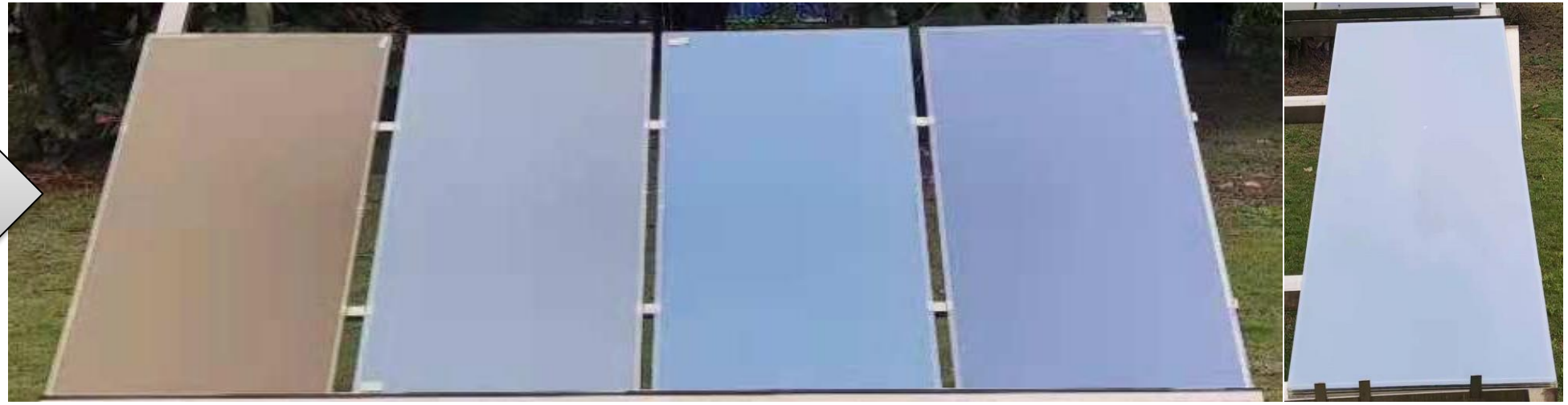
SYP BIPV Products: Wide Range of BIPV VLT

耀皮玻璃集团
Shanghai Yaohua Pilkington Glass Group Co.,Ltd.

View from	0%	10%	20%	30%	40%	50%
Interior of the building						
Exterior of the building						

SYP BIPV Products: Various of Colors for Appearance

View from Exterior

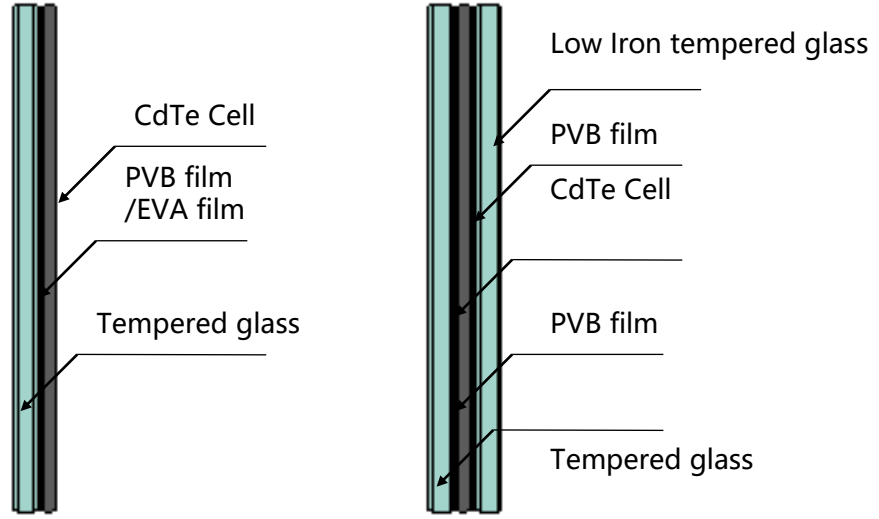


Brown | Grey | Sky blue | Dark blue | White

View from Interior

SYP BIPV Products: Different Combination

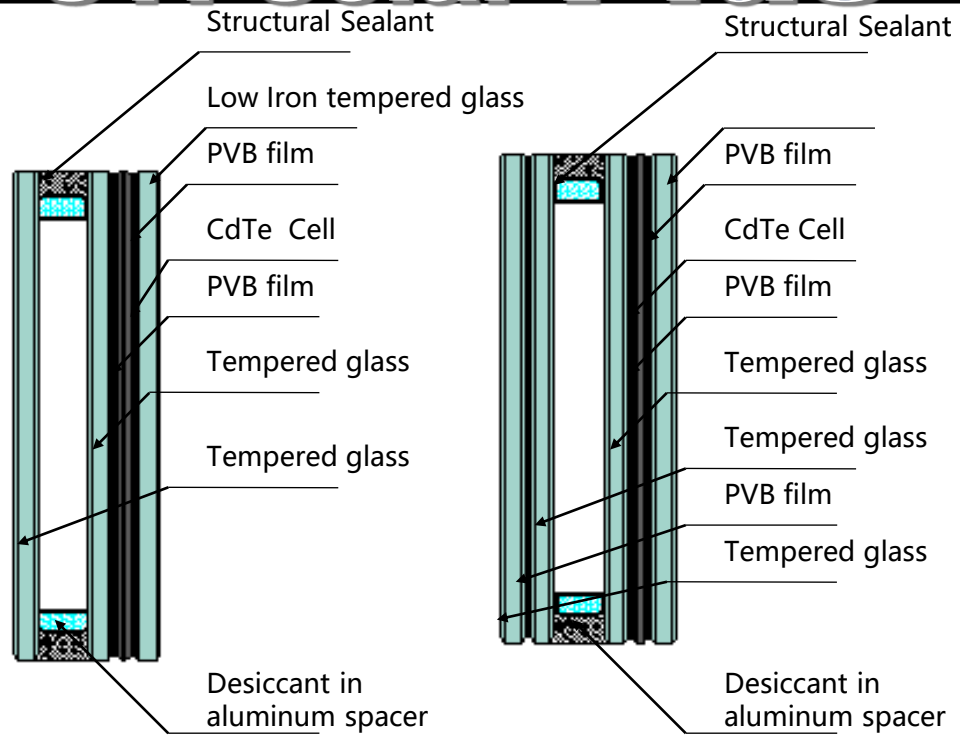
SYPSolar



Laminated Glass

Double Laminated Glass

SYPSolar Plus



Laminated DGU

Double-Laminated DGU

ArchiBiz

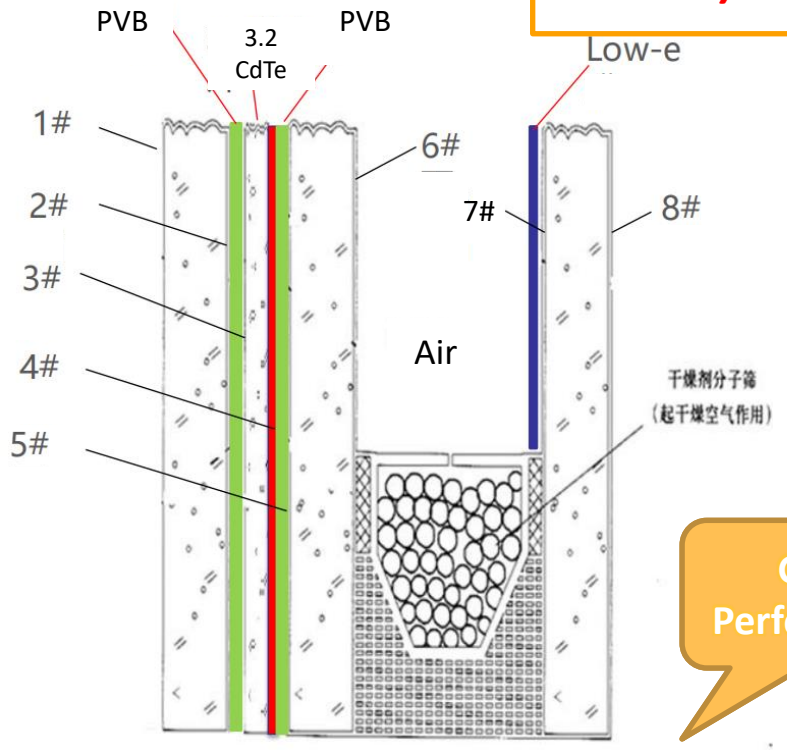
SYPSolar Plus

BIPV DGU with Low-E Coating

6 Low Iron+1.52PVB+3.2CdTe+1.52PVB+6Low Iron+12A+6Low Iron Low-E Coating #7

VLT: 20/30/50%

Single/Double/Tripe Low-E



Good Performance

☑Power generation function

☑Water tightness

☑Thermal/Heat Insulation

☑Decorative function

☑ Wind pressure resistance

☑ Air tightness

☑ Acoustic Insulation

DGU glass (The coating is on Surface #7)		VLT	SHGC NFRC 100-2010	U value W/(㎡•K) Summer
Single Low-E YST-0680	20% VLT CdTe	19	0.22	1.75
	30%VLT CdTe	27	0.25	1.75
	50%VLT CdTe	33	0.29	1.75
Double Low-E YNE-0675	20% VLT CdTe	18	0.18	1.60
	30%VLT CdTe	25	0.22	1.60
	50%VLT CdTe	31	0.25	1.60
Triple Low-E YTE-0670	20% VLT CdTe	16	0.15	1.58
	30%VLT CdTe	22	0.19	1.58
	50%VLT CdTe	29	0.22	1.58

2. Provide Professional Installation guideline

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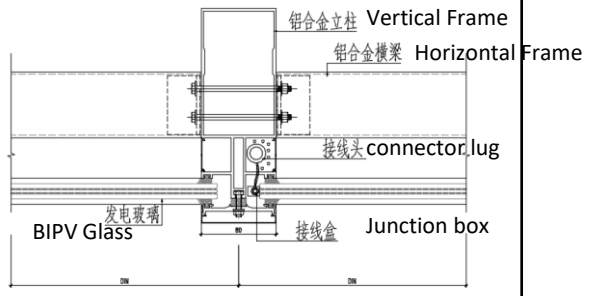
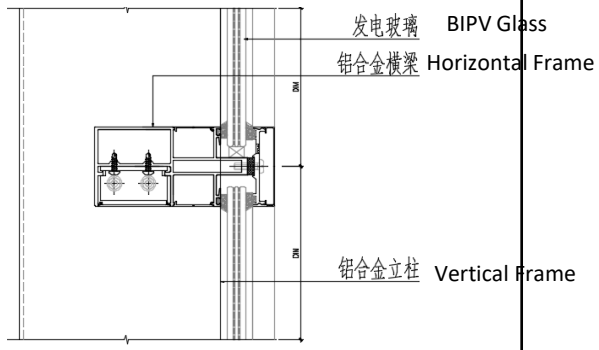
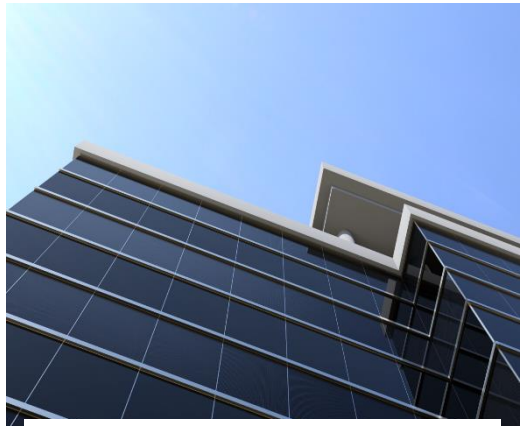
Section Drawing of Difference Type of Curtain Wall

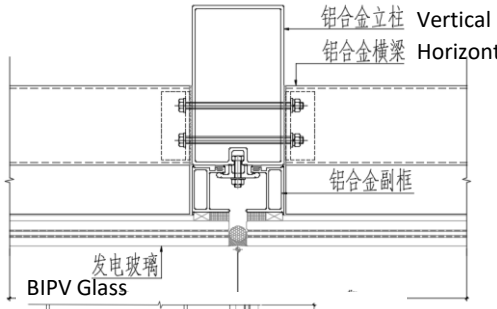
Exposed Frame Glass Curatin Wall

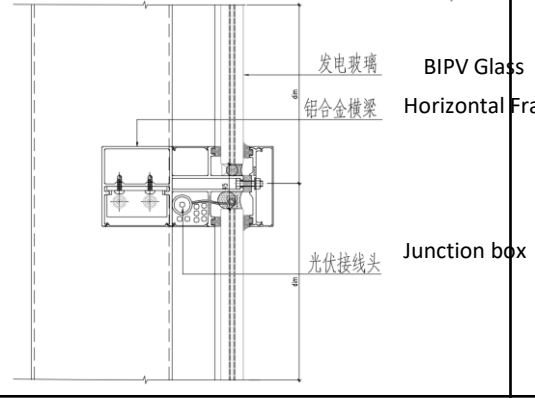




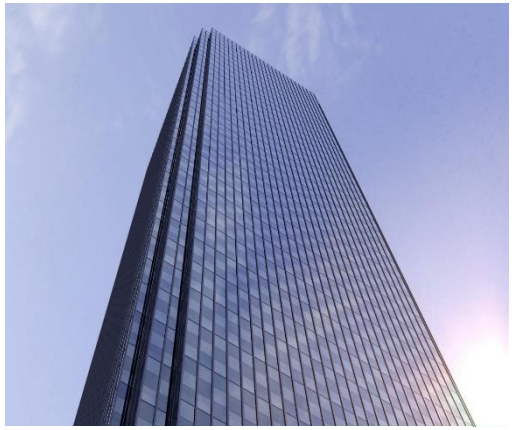
Semi-hidden Frame Curtain Wall (Horizontal fixed Metal Component)

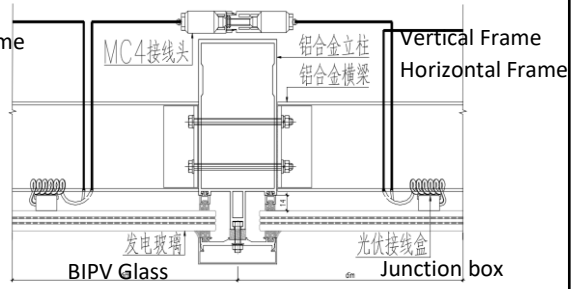


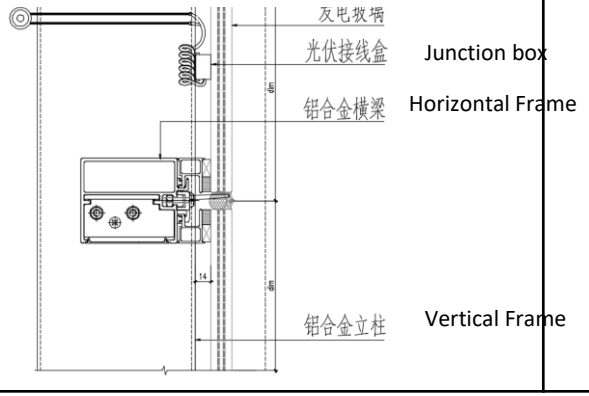




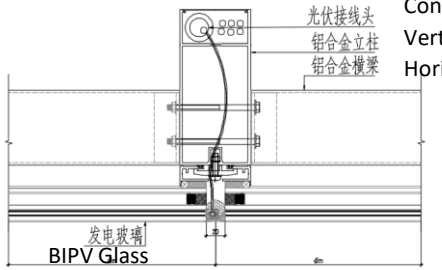
Semi-hidden Frame Curtain Wall (Vertical fixed Metal Component)

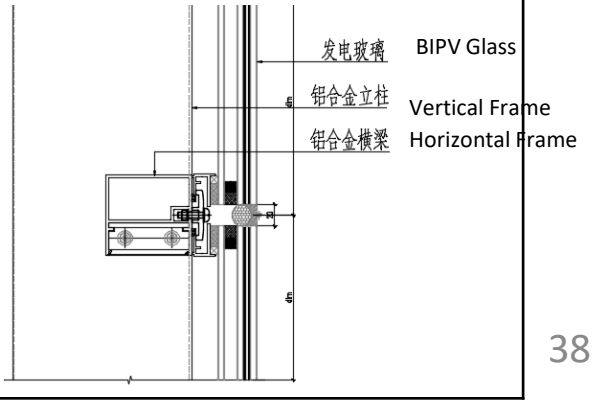




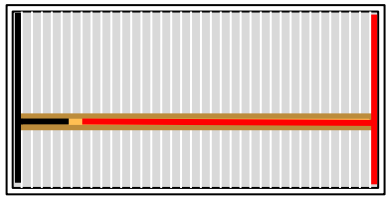


Hidden Frame Curtian Wall

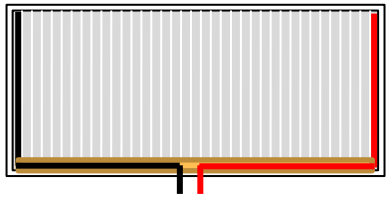




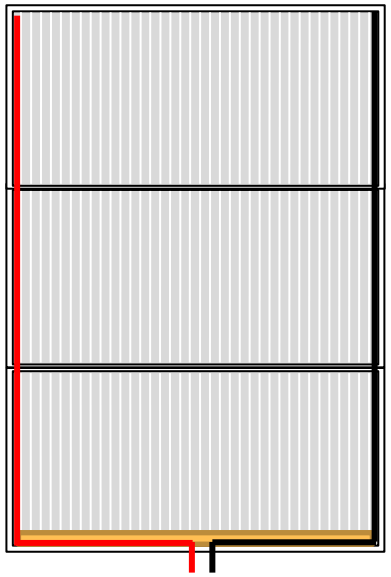
2. SYP - Provide Professional Installation guideline



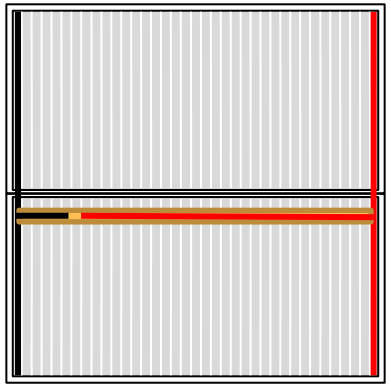
Single piece-on the back



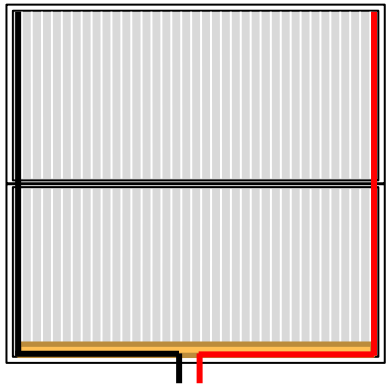
Single piece-on the side



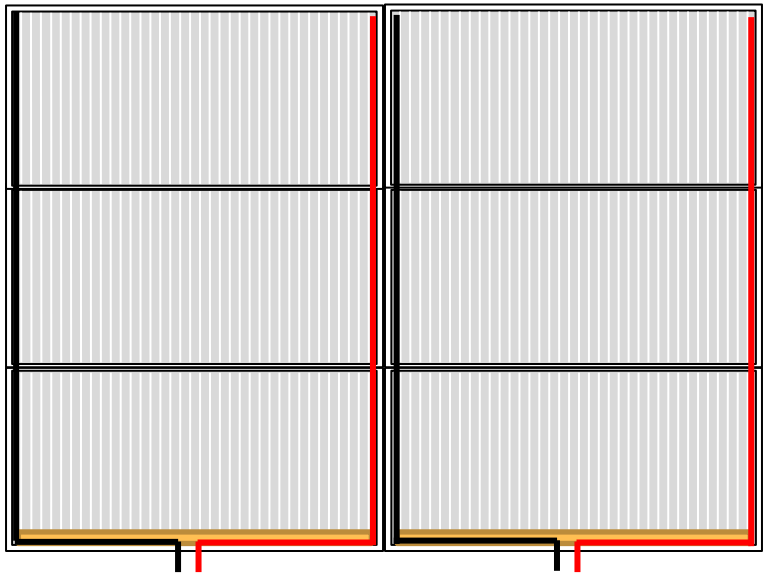
Three-piece splicing-on the side



Double-piece splicing-on the back



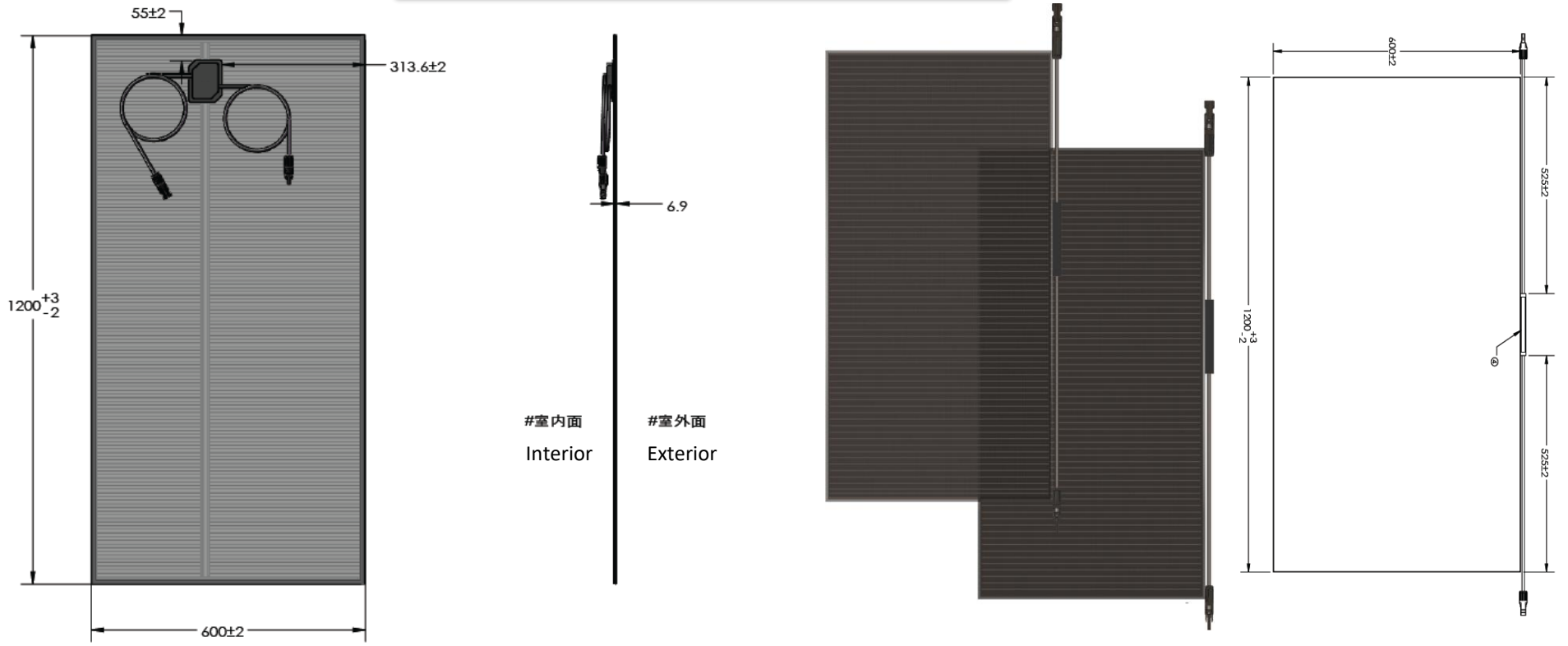
Double-piece splicing-on the side



Six-piece splicing Double junction box side connection

Schematic diagram of chip splicing

Junction Box



Integrated back-connected junction box

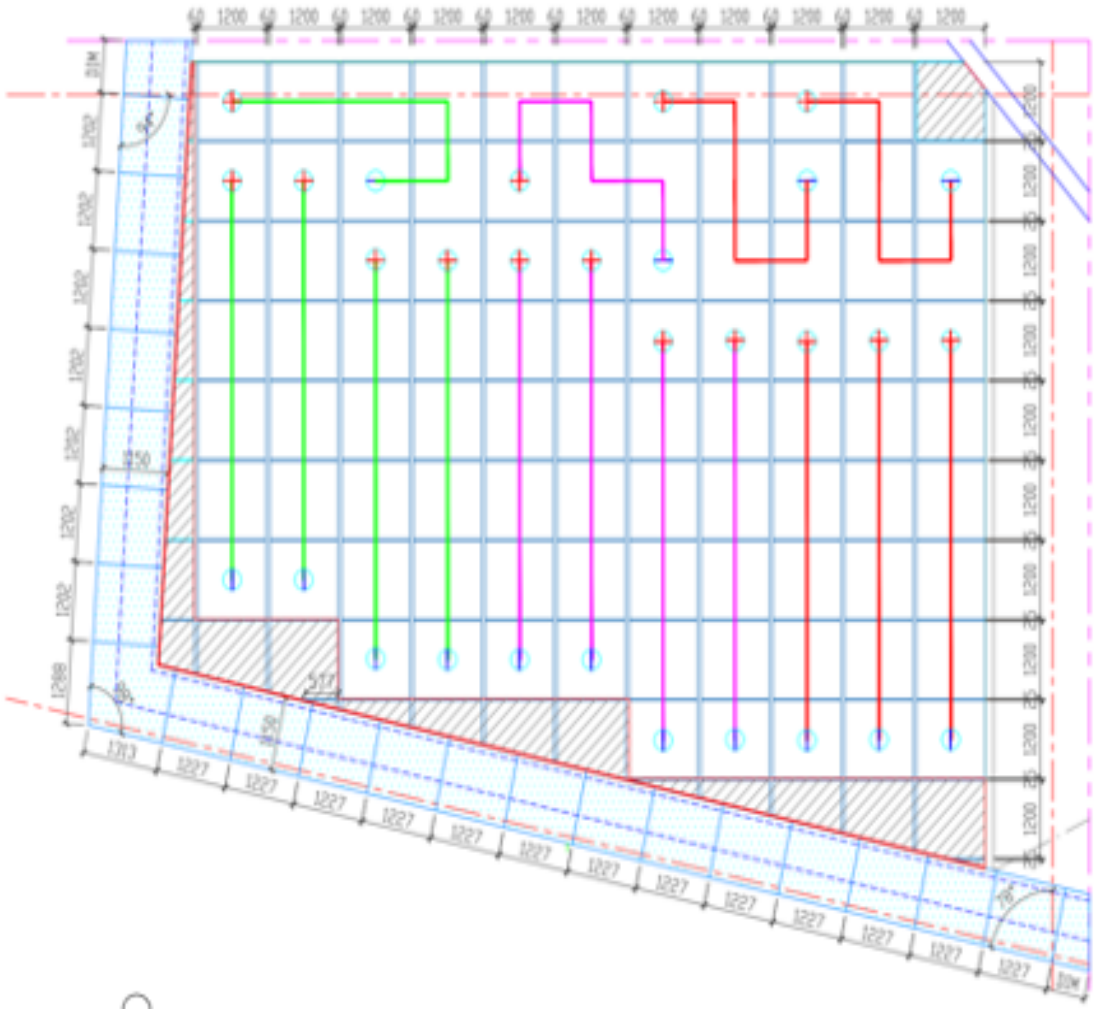
- The external dimension of the junction box is 95*75*16mm
- The conventional cable length is (+650mm)/(-650mm)
- For special cable, the length needs to be customized.

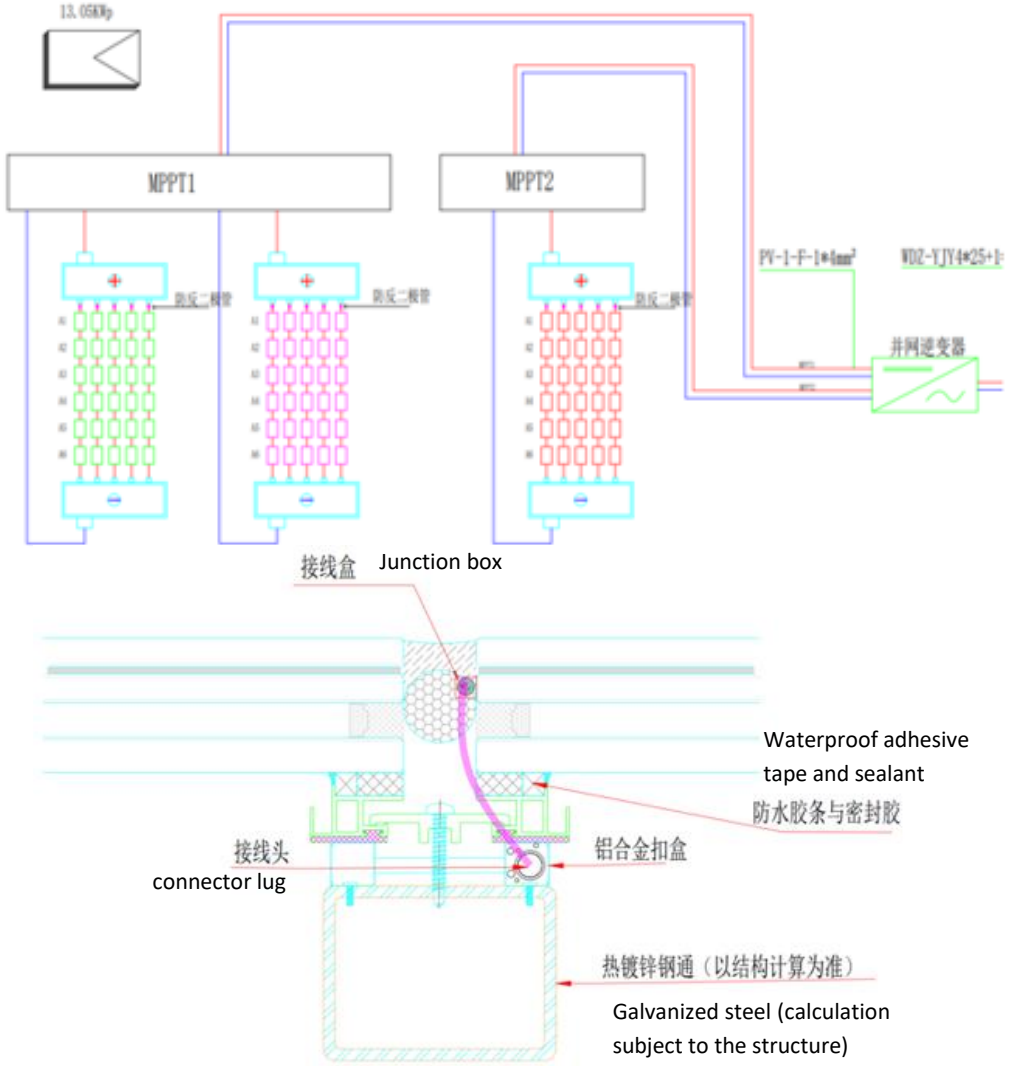
Integrated side-connected junction box

- The external dimension of the junction box is 150*13*11mm(11 corresponds to the side of glass)
- The conventional cable length is (+650mm)/(-650mm)
- For special cable, the length needs to be customized.

Example of Grid-connection Electrical Diagram

图例：
仿发电组件 Simulation BIPV Glass
发电组件 BIPV Glass



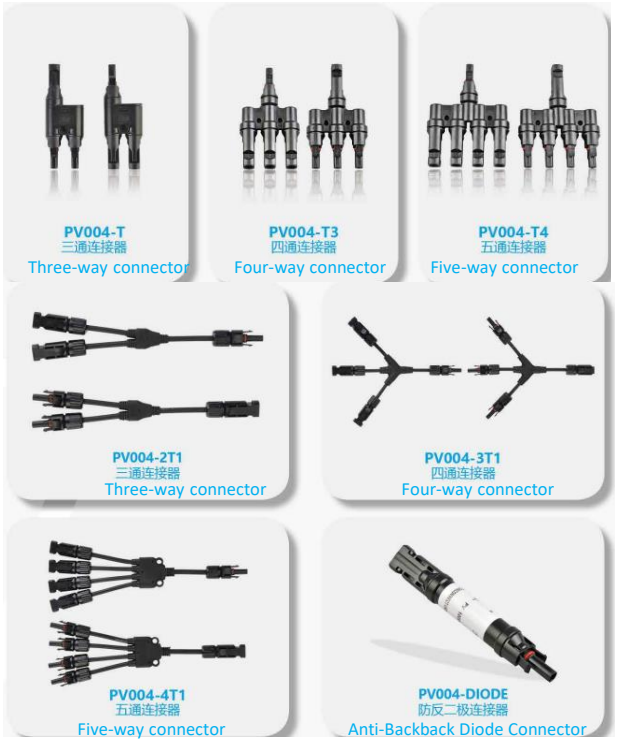


Grid -connected inverter

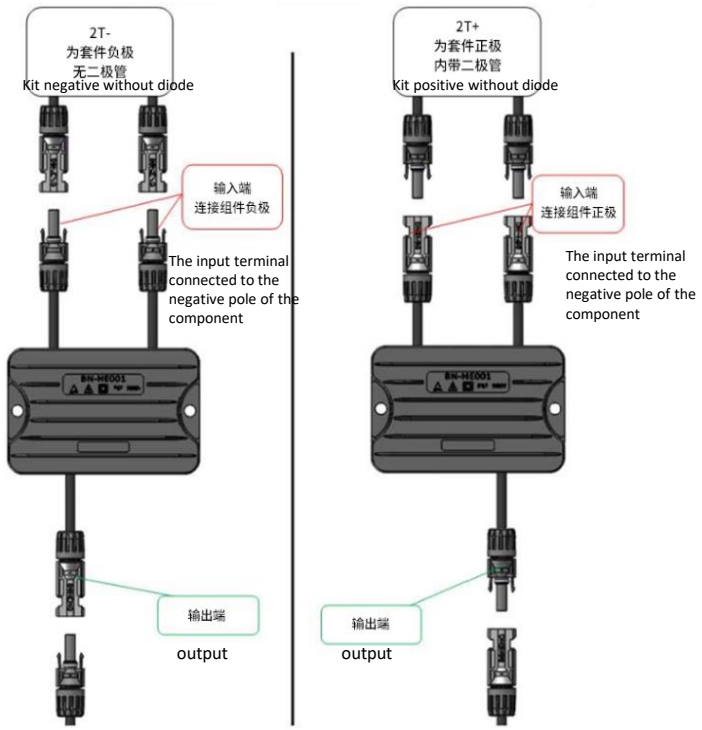
Accessories - Series combined convergence

The photovoltaic square array changes the voltage and current output by the photovoltaic array through series-parallel connection; When connected in parallel, the following devices are needed, which are selected according to the parameters such as the number of output paths, the maximum working current and the maximum output power of the photovoltaic array.

Convergence Device



Convergence Device



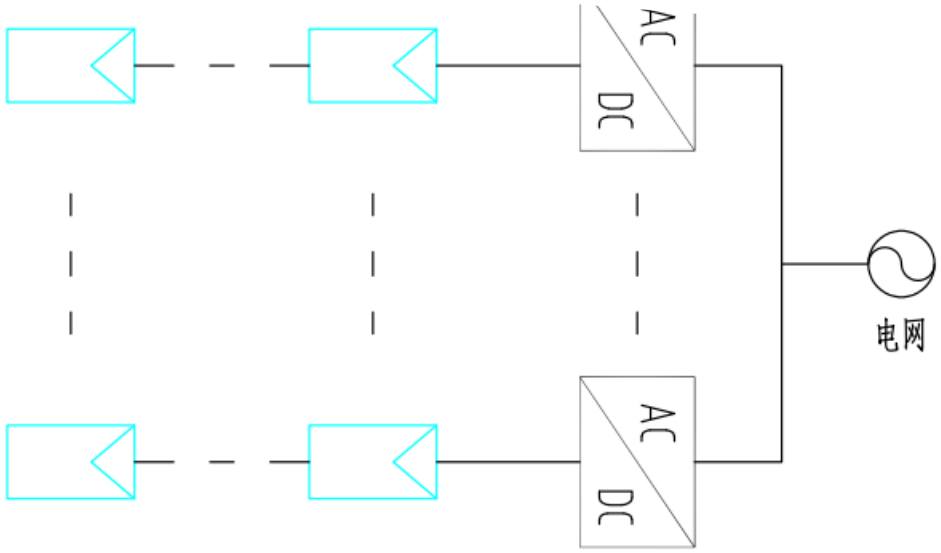
DC combiner box

Accessories - Inverter

Single installation

Multi-unit installation

Wiring principle of inverter

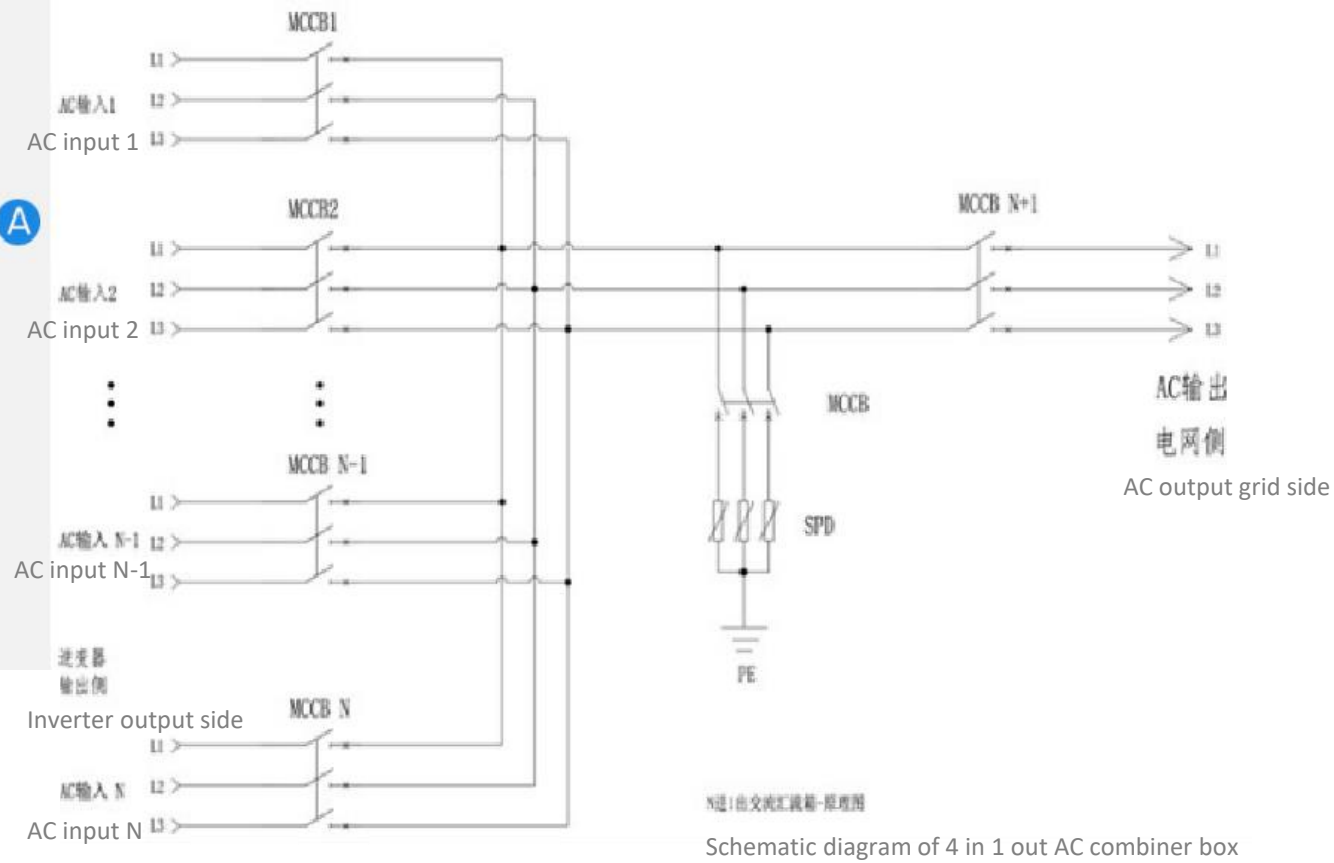


组串式逆变器
String inverter

Accessories - AC combiner box

AC combiner box is applied to photovoltaic power generation system with a large number of inverters, and installed between inverters and grid connection points; Main functions: to combine the output current from multiple inverters, disconnect the output of inverters, so as to improve the security of the system.

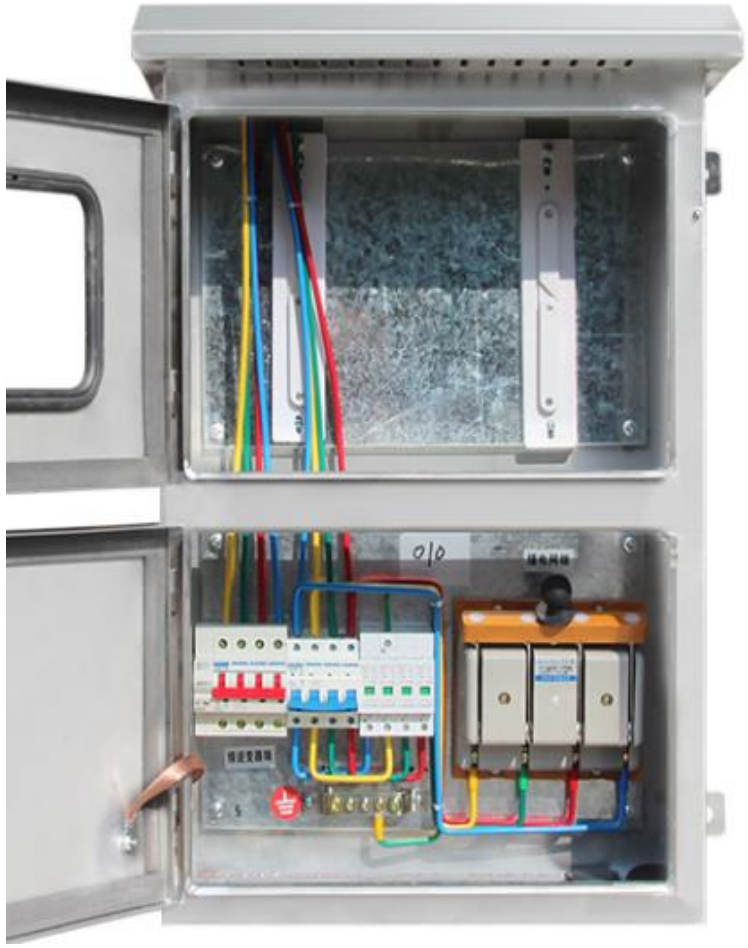
A. Circuit-breakers
B. AC Lightening Proector
C. Fuse Rubbar Sealing
D. Ground wire
E. Triangle Lock
F. Strip

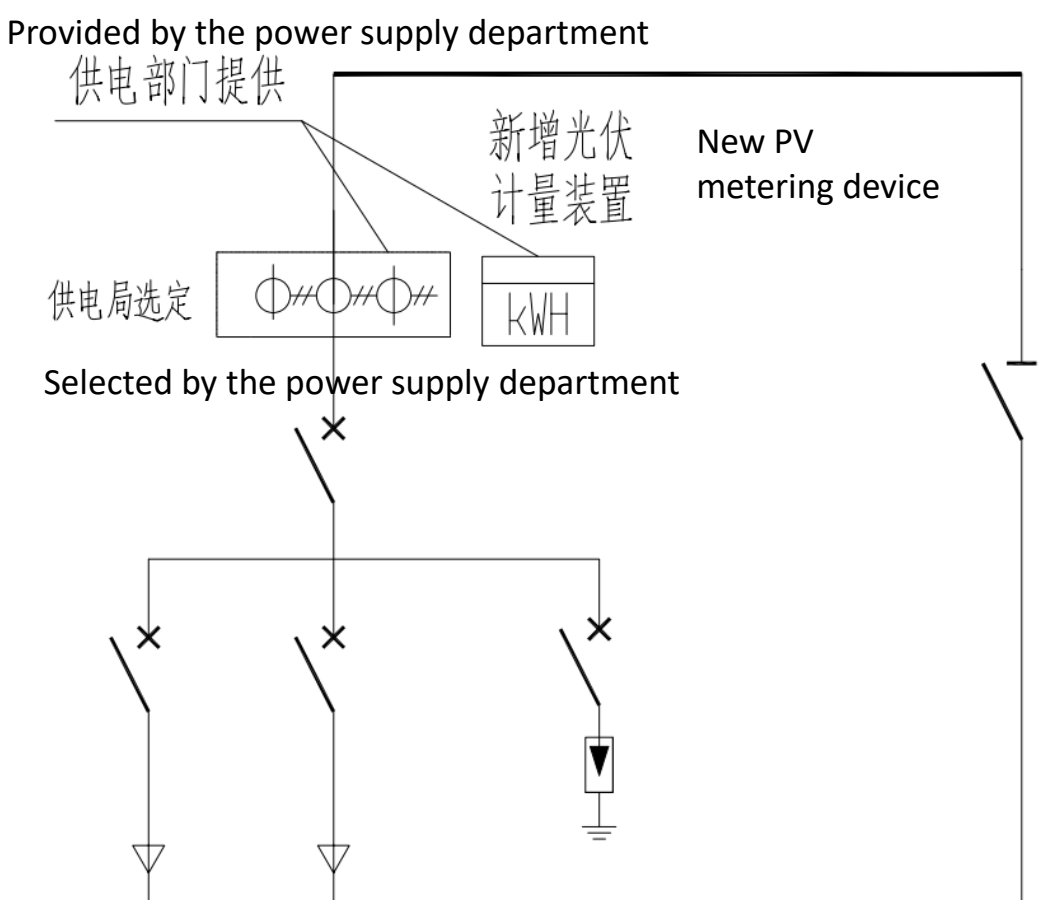


Schematic diagram of 4 in 1 out AC combiner box

Accessories - Grid-connection box

Photovoltaic grid/cabinet is a power distribution device connecting photovoltaic power station and power grid, which mainly serves as the dividing point between photovoltaic power generation system and power grid.





3. Rich experience on BIPV projects

- SYP BIPV PROJECTS -

SYPSolar & SYPSolar Plus

ArchiBiz

Cisen Pharmaceutical Co., Ltd. R&D Center, China

济宁辰欣药业研发中心

SYPSolar

8+1.52PVB+3.2 CdTe+1.52PVB+8 digital print frit

Changqing Campus of Shandong University of Art & Design

山东工艺美术学院-长清校区

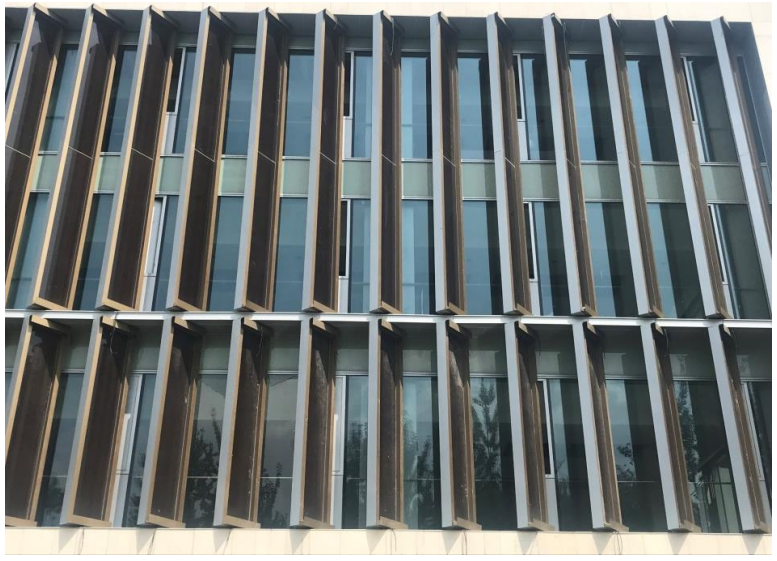
Before cable connection

After cable Connection

SYPSolar Plus

China Life Insurance (Beijing) Data Center

中国人寿（北京）数据中心

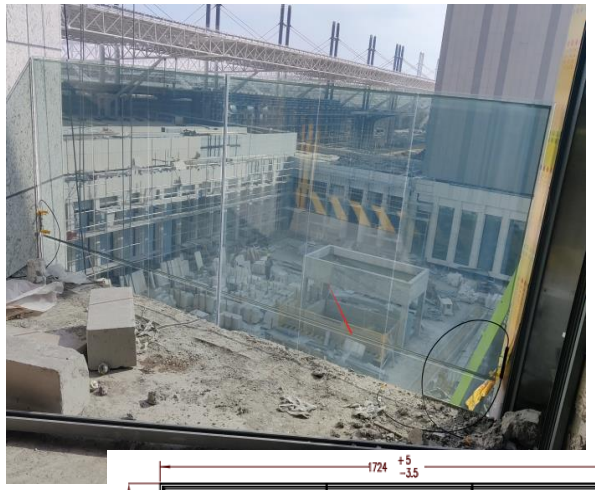


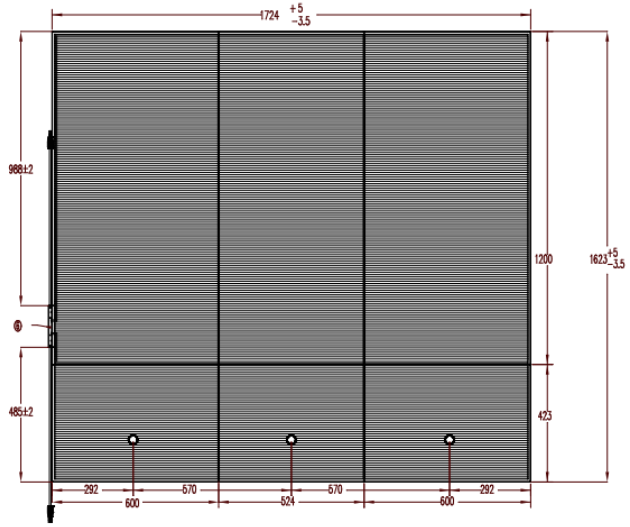
- 6+1.52PVB+3.2 cdte+1.52PVB+6
- Rotatable power generation glass decorative wing
- Combination of decoration, practicality and power generation function

SYPSolar

Huanghai Wetland Museum Yancheng, Jiangsu, China

盐城黄海湿地博物馆

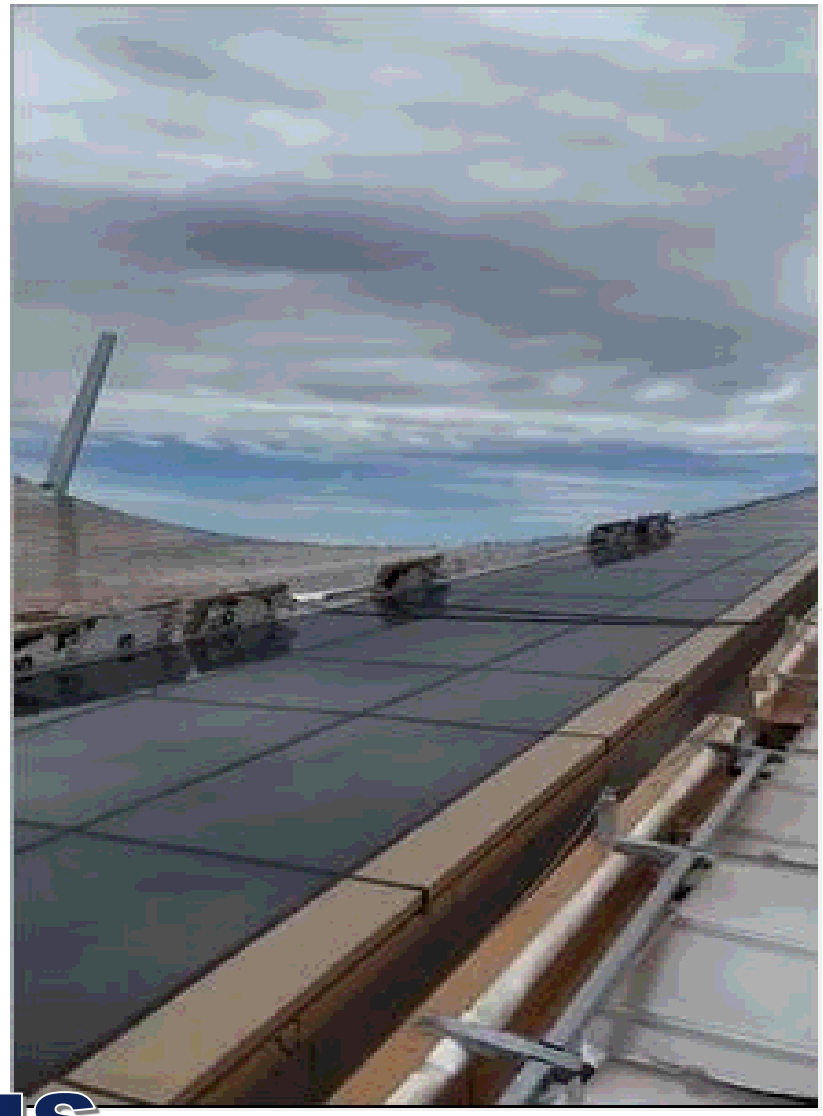




SYPSolar

Roof of Grand Canal Museum Beijing China

北京大运河博物馆采光顶



- Product structure: 6+1.52PVB+3.2 cdte+1.52PVB+6+12A+6 Low-E+1.52PVB+6
- Power generation glass daylighting roof
- Matching of practicality and color

SYPSolar Plus

SYP BIPV Project Summary

NO	Project	Sqm(m2)	Product	Remark
1	Xiongxian Second Hospital (Hospital), Beijing 北京雄县二院（医院）	301.33	SYPSolar Plus	6 Low-E#2+16Ar+5+1.14PVB+3.2CdTe+1.14PVB & 1.52PIB+5 (w holes) 6+16Ar+6 digital print#3+2.28PVB+6 (Curve Tempered)
2	DINKO Laboratory, Shanghai 上海顶科实验室	705.82	SYPSolar Plus	6+1.52PVB+3.2CdTe+1.52PVB+6+12Ar+8 Low-E#7+1.52PVB+8
4	Zuoquan 1941 Museum (Jinzhong City, Shanxi Province) 左权1941博物馆（山西晋中市）	570.25	SYPSolar Plus	3.2+1.14PVB+3.2CdTe+1.14PVB+5Low-e+12Ar+6+1.14PVB+6 6Low-E#2+12A+6+1.14PVB+6
5	Corridor of Boao Conference Center, Hainan 海南博鳌会议中心连廊	1139.47	SYPSolar	6+1.14PVB+3.2CdTe+1.14PVB+6
6	Sub-center Grand Canal Museum, Beijing 北京副中心大运河博物馆	550.00	SYPSolar Plus	8+1.52+3.2CdTe+1.52PVB+8+12Ar+8Low-E#7+1.52PVB+8
7	Ordos project sample , Inner Mongolia 内蒙古鄂尔多斯项目样品	24.00	SYPSolar	5 ceramic frit#2+1.52PVB+3.2CdTe+5
8	The Bauhinia Hotel, HK 香港宝轩酒店	1000.00	SYPSolar	8+1.52PVB+3.2CdTe+1.52+6
9	Norton Mock-up 诺盾样板间	14.40	SYPSolar	5+1.52+3.2CdTe+1.52PVB+5
10	Beijing Zhongdian Yijie Technology Co., Ltd. 北京中电易捷公司	7.92	SYPSolar	5+1.52+3.2CdTe+1.52PVB+5
11	Ooredoo Maldives 马尔代夫ooredoo -	155.00	SYPSolar	8+1.52PVB+3.2CdTe+1.52PVB+8Crsytal Grey solar reflective #4
12	Central Park中央公园	500.00	SYPSolar	8 ceramic frit#2+1.52PVB+3.2CdTe+1.52PVB+8
	Summary	**4968.19**		

Please contact us to personalize your BIPV projects.

THANKS

Contacts

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