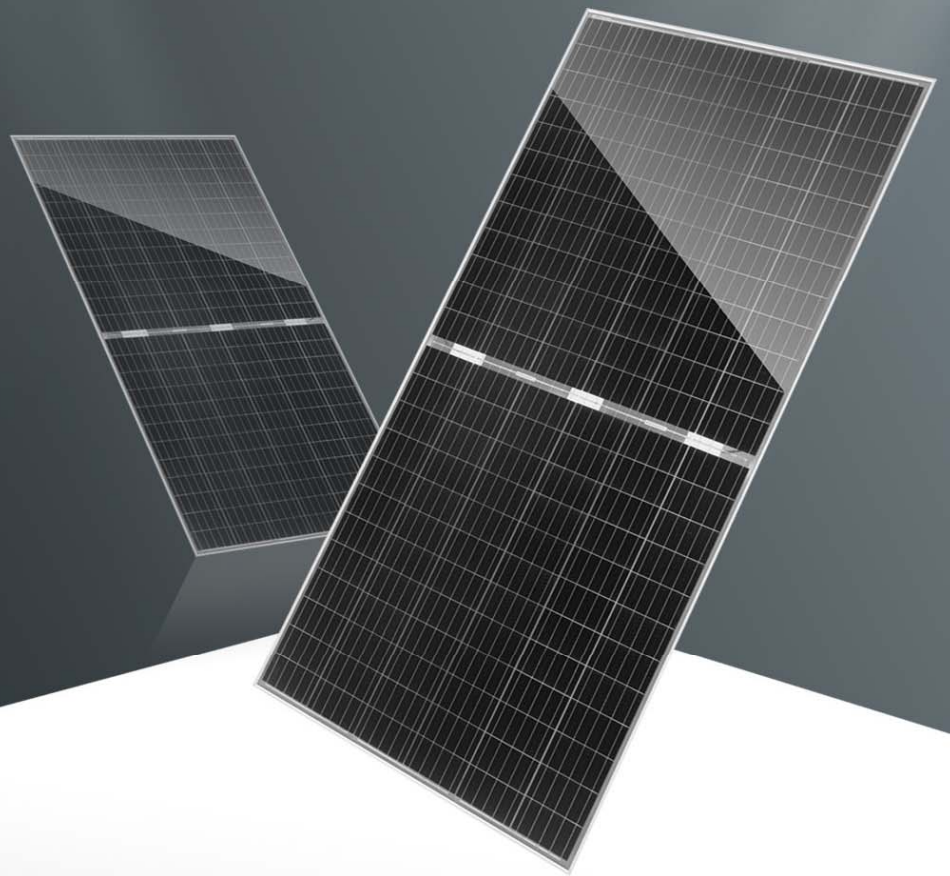
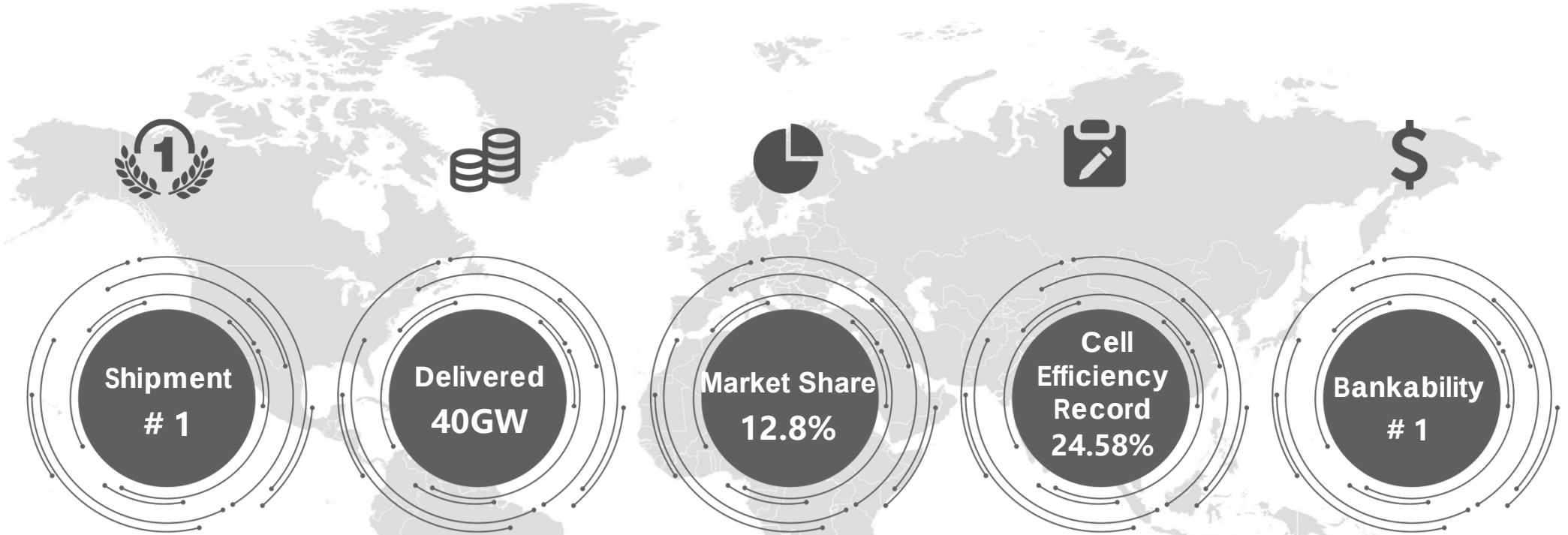
Swan Bifacial Module



JinkoSolar Co., Ltd.

Jinko Solar
Building Your Trust in Solar

Short Introduction of JKS



6 Global Factories | ***34*** Sales Offices | ***80+*** countries where Modules are delivered | ***13.000+*** Employees

Data source: By the end of 2018

JKS Product Portfolio 2019

Cheetah FC

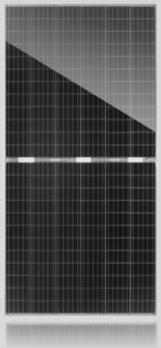
- 400Wp
- Efficiency 20.17%
- 25 Year Linear Power Warranty

Cheetah HC

- 410Wp
- Efficiency 20.38%
- 25 Year Linear Power Warranty

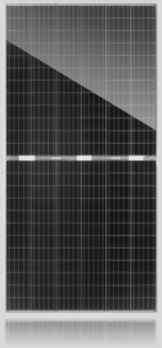
Swan Bifacial DG

- 400Wp(front only)
- Efficiency 19.54%
- 30 Year Linear Power Warranty



Swan Bifacial TB

- 400Wp(front only)
- Efficiency 19.54%
- 30 Year Linear Power Warranty
- Lower weight



Tiger Monofacial

- 460Wp
- 9BB
- Efficiency 20.78%
- 25 Year Linear Power Warranty

Tiger Bifacial TB

- 455Wp(front only)
- 9BB
- Efficiency 20.06%
- 30 Year Linear Power Warranty

Cheetah

Swan

Tiger

JKS Swan Bifacial Features

158.75 mm
cell dimension

Bifacial Energy Yield
500+ Total Watt

Front side max
power **415 Wp**

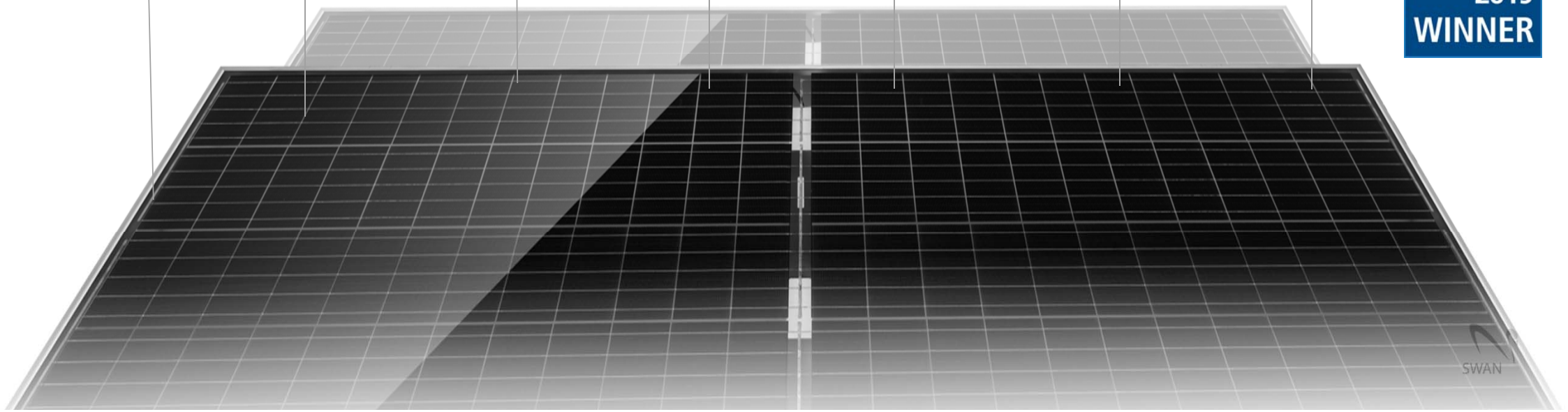
Rear side**: plus 5-25%**
Power Gain

Cheetah Cell up to
22.3% efficiency

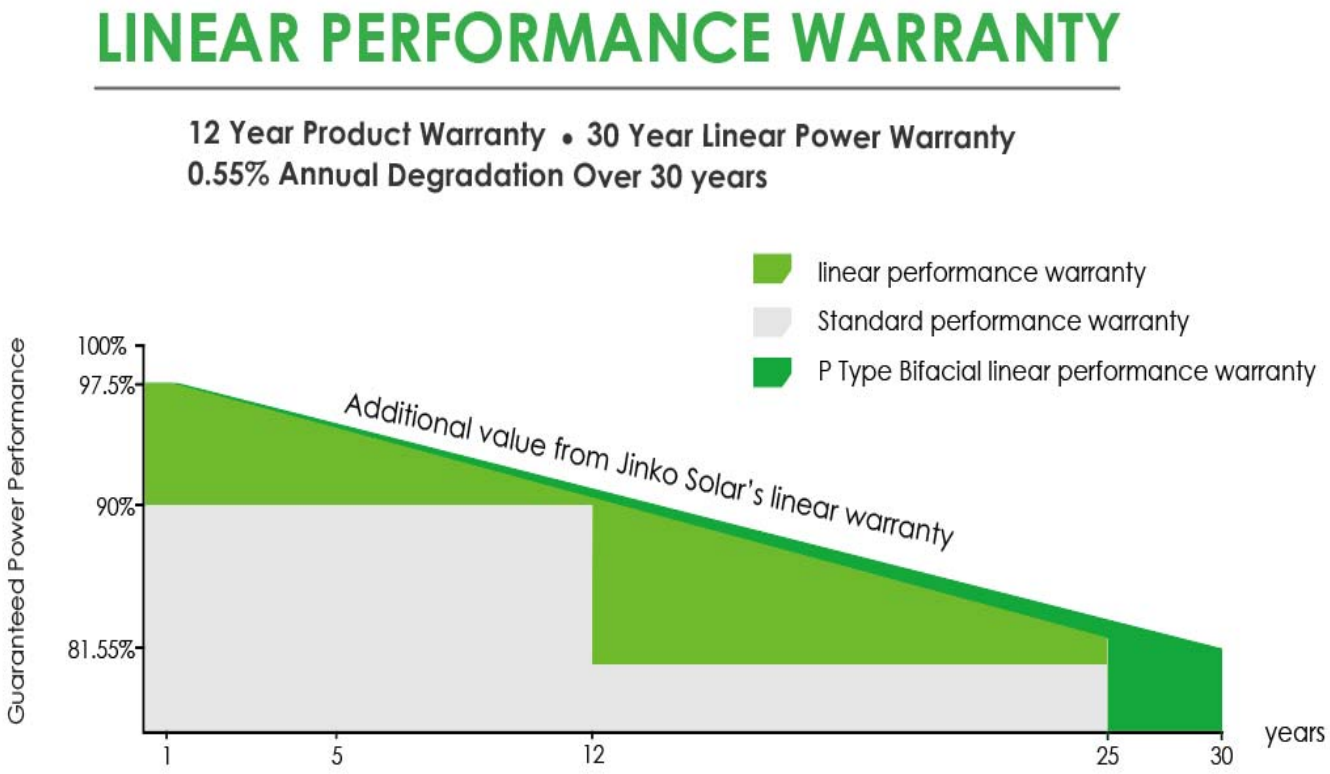
30 Years Linear
Power Warranty

Reduces BOS Cost by **3%**
Reduces O&M Cost by **5%**

inter solar award 2019 WINNER



30 Years Linear Power Warranty



Performance Warranty

- ✓ **30** years linear power warranty
- ✓ **2.5%** for 1st year and **0.55%** from year 2nd to 30th

Bifacial: Test Standard - BSTC

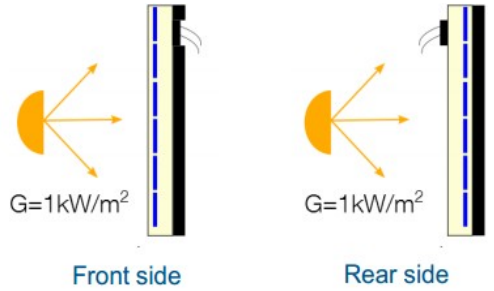
1. STC measurement *

$G_{front} = 1000\ \mathrm{W/m^2}$ $G_{rear} = 1000\ \mathrm{W/m^2}$

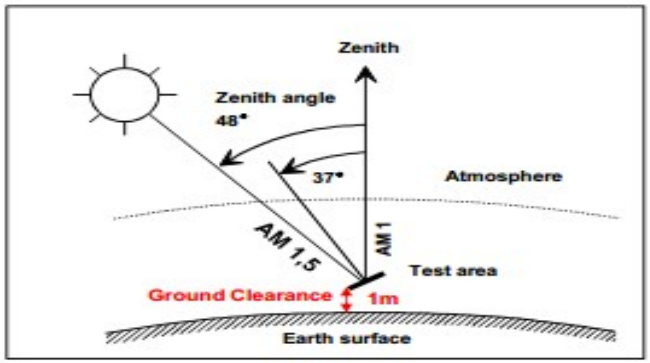
*The non-illuminated side was covered with non-reflective background and aperture.

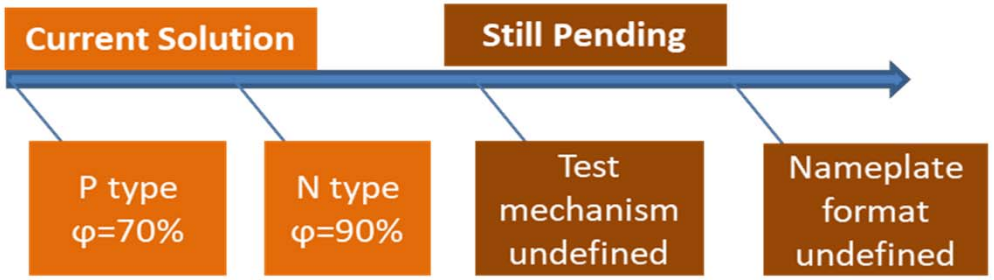
2. Determine bifaciality at STC

$$\varphi_{Isc} = \frac{Isc_{rear}}{Isc_{front}};\quad \varphi_{Voc} = \frac{Voc_{rear}}{Voc_{front}};\quad \varphi_{Pmax} = \frac{Pmax_{rear}}{Pmax_{front}};\quad \varphi = Min(\varphi_{Isc}, \varphi_{Pmax});$$



Referencestandard : BSTC



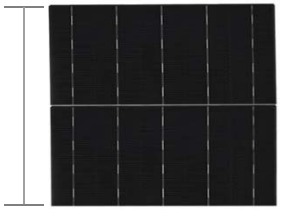


BSTC: Considering module with 1m height and 135W/m2 irradiance of backside

- Front irradiance: 1000W/m²
- **Rear irradiance: 135W/m²**
- **Equivalent irradiance:1000+ φ ▪135W/m²**
- Module temperature: 25° C
- Angle of Incidence: 0°
- Spectral irradiance: AM1.5G

Introduction to Double-sided Components

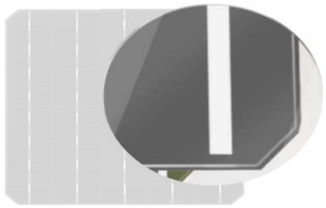
Front



JKS Bifacial Cell

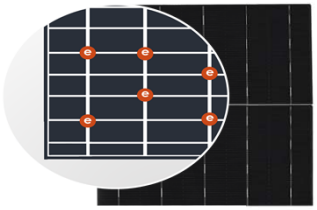
+

Rear



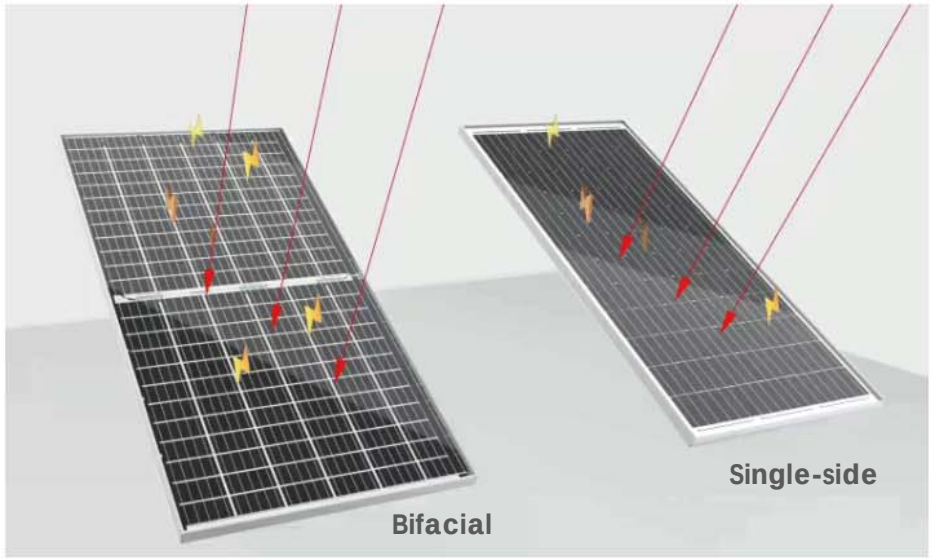
Conventional Cell

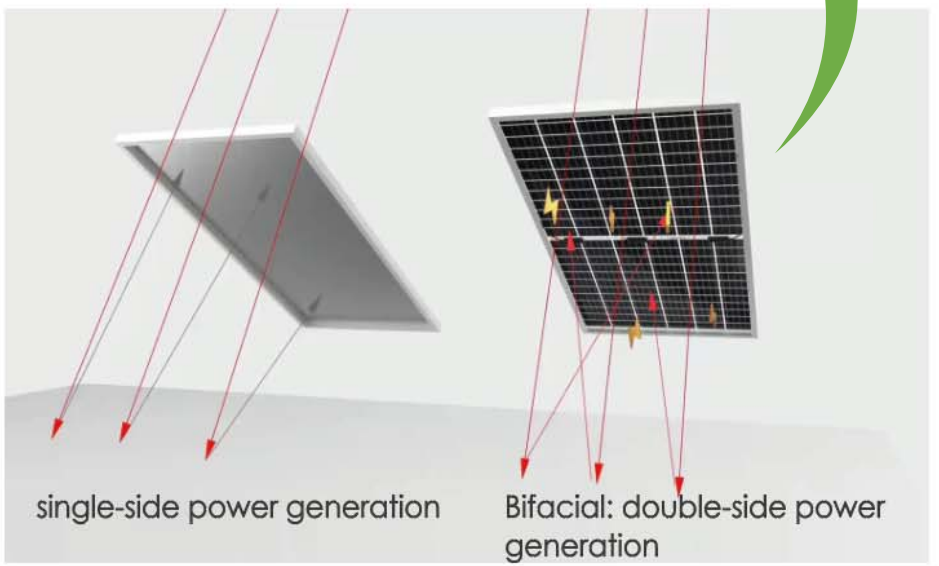
+



JKS Bifacial Cell

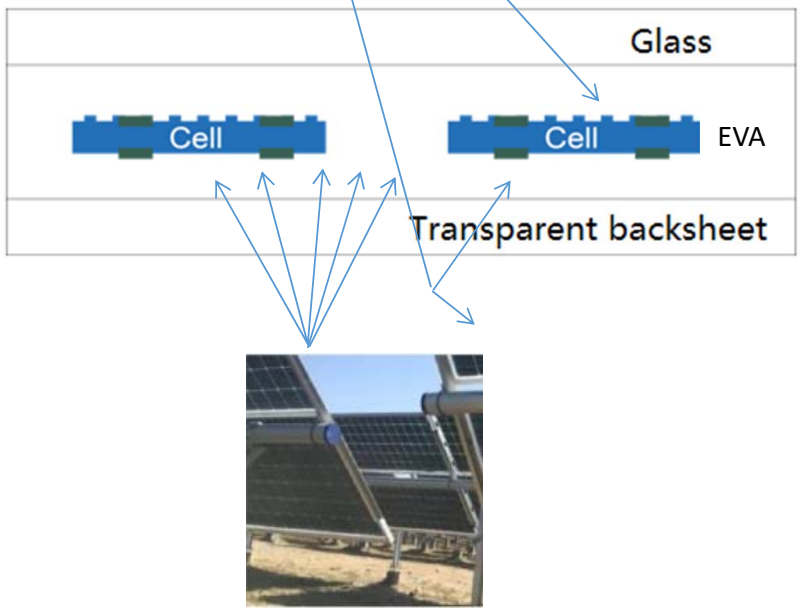
Power generation gain up to **25%**





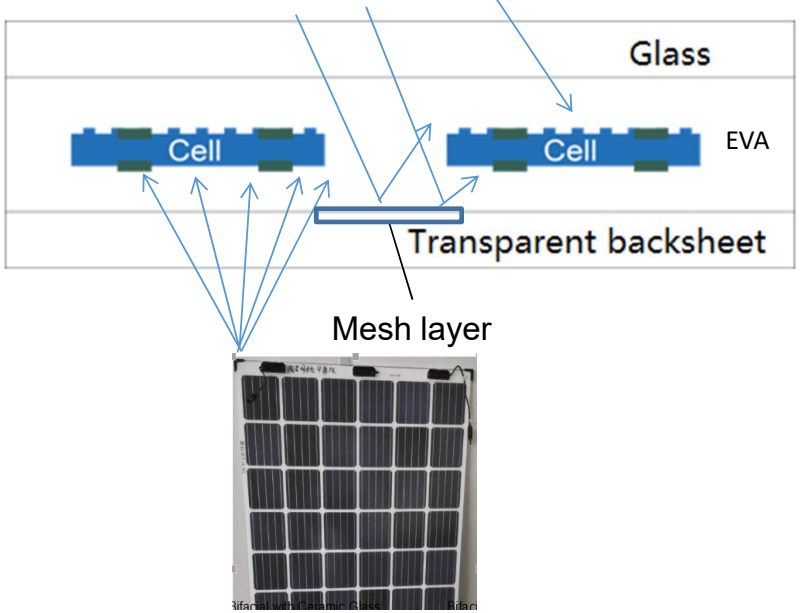
White Mesh Backsheet

Transparent backsheet



375W / 380W / 385W / 390W

White mesh backsheet



380W / 385W / 390W / 395W

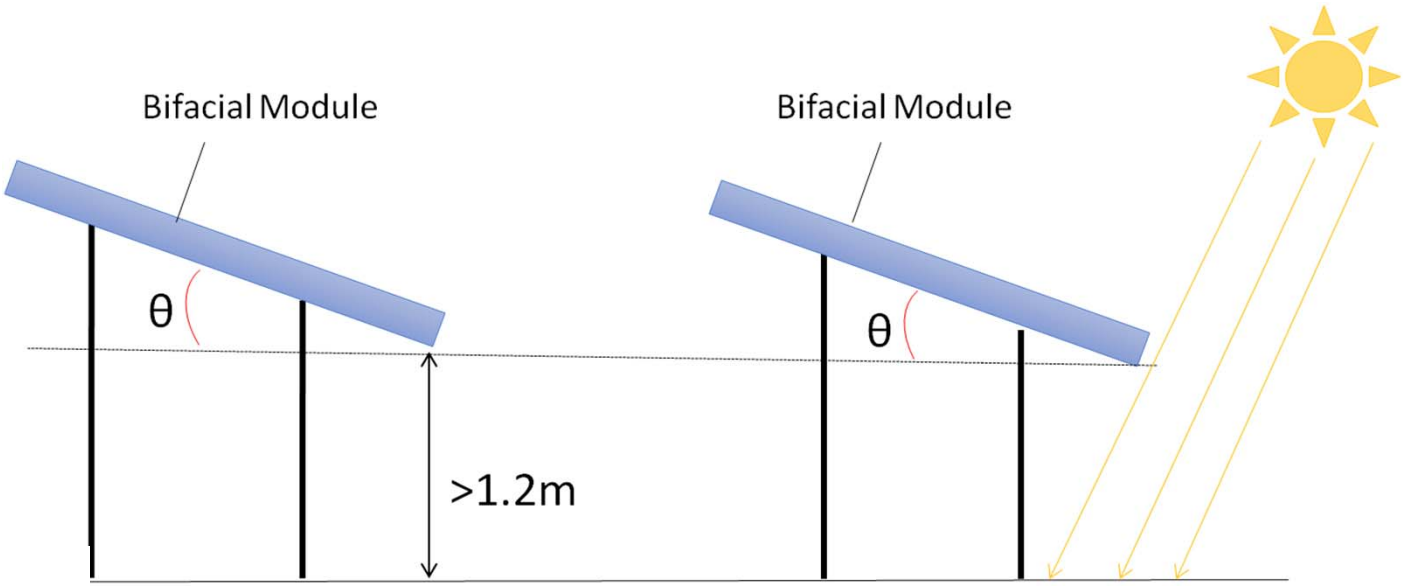
Transparent mesh backsheet enhances front-side power generation: **5 Wp** improvement.

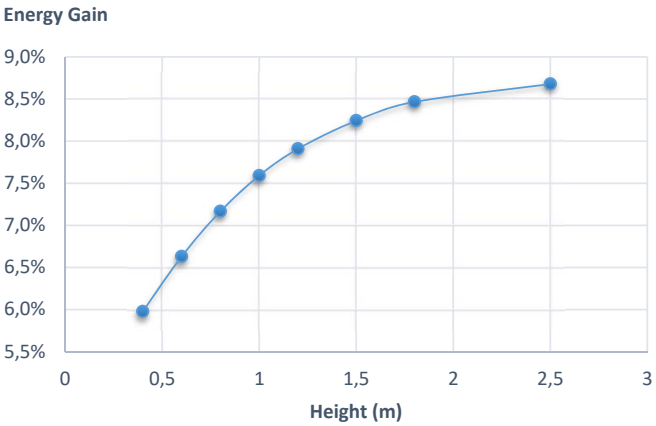
Notes: transparent mesh backsheet has one more mesh layer with high reflectivity and UV-resistance.

Installation Design: Angle & Height

Install tilt Angle:

1. Latitude : 30 °(N)~30°(S)
   Θ=30 °
2. Latitude: >30°(N or S)
   Θ=latitude





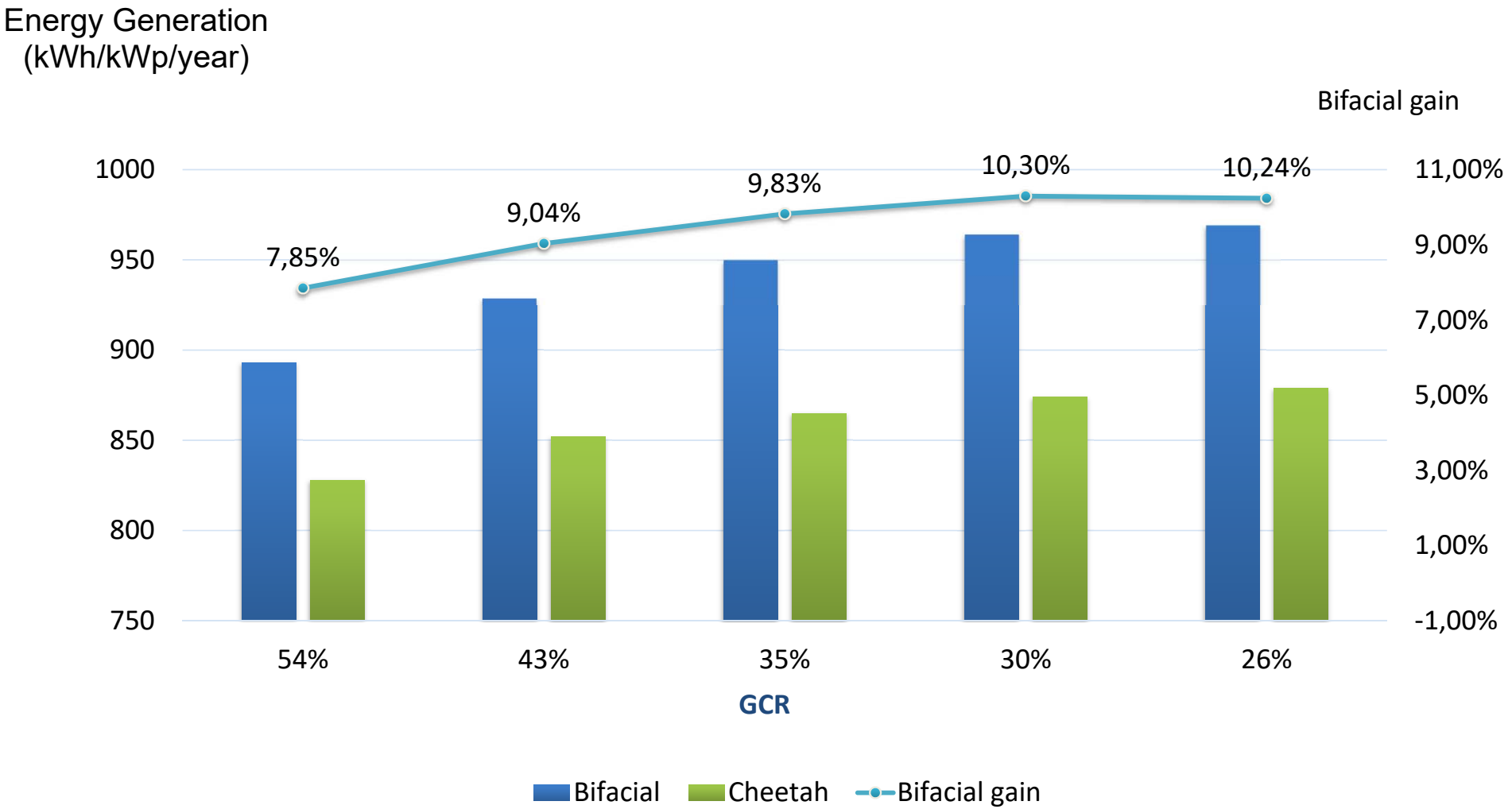
Mounting Height:

1.2 m is recommended for fixed racks and 1.5m for trackers

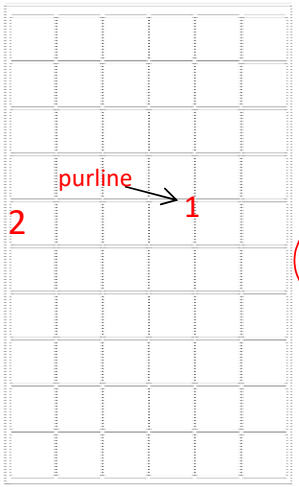
<1.2 m → Decreasing rear side energy generation gain

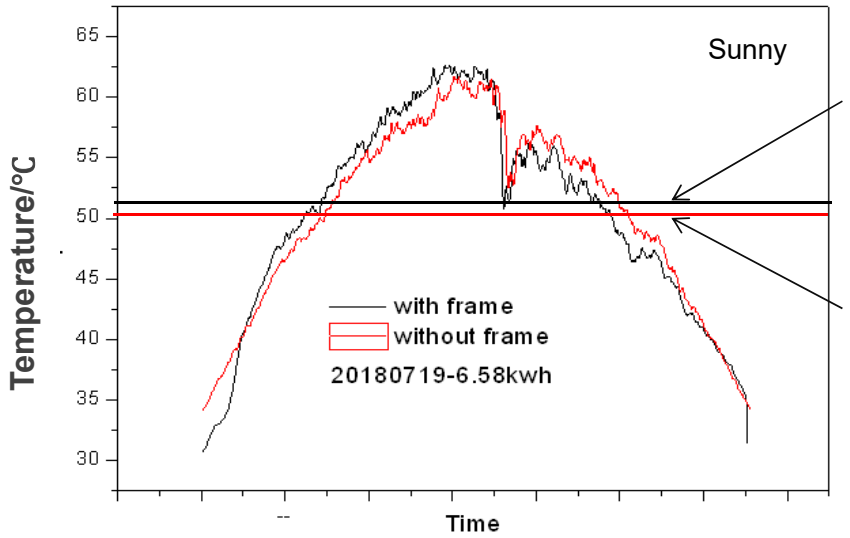
>1.2 m → Increasing mounting construction cost

Installation Design: Ground Coverage Ratio



Installation Design: Shading and Frame



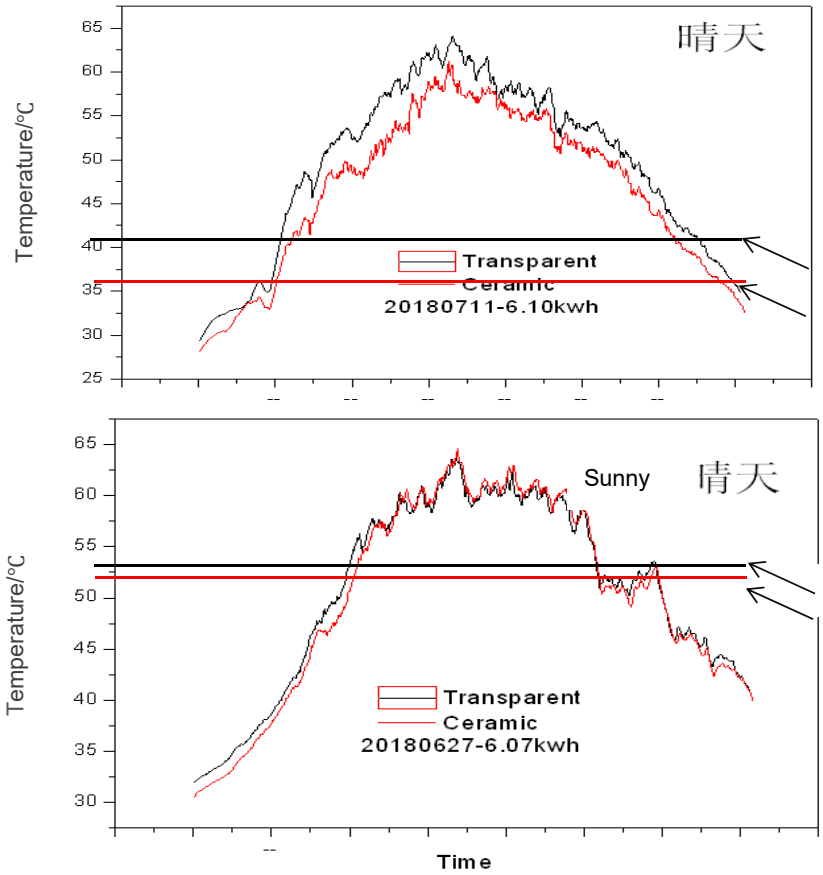


Temperature at the test point 2 varying on time

The temperature of shading area on bifacial module with frame is very close to that of frameless module

→ Influence of frame shading is negligible

Installation Design: Shading and Temperature



Position 2: transparent bifacial with junction box temperature is higher than ceramic grid bifacial.

Transparent bifacial: 41.19℃

Ceramic grid bifacial: 36.74℃

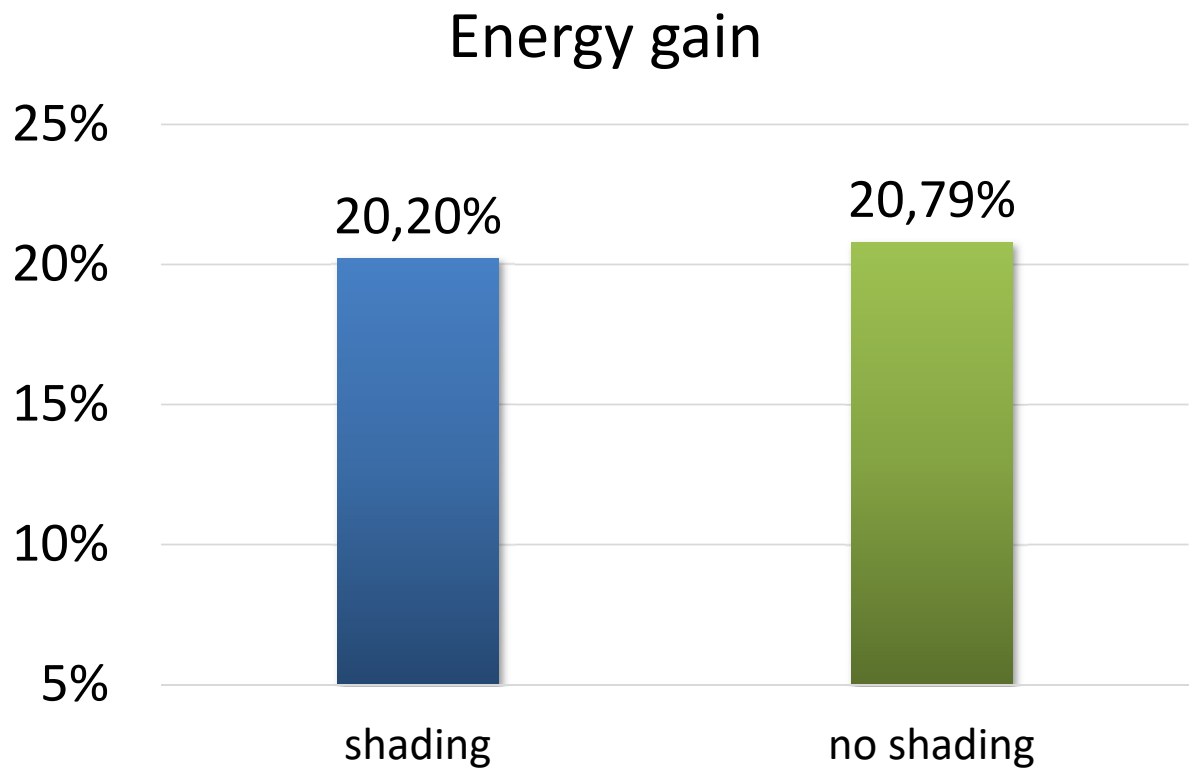
Transparent bifacial: 50.75℃
Ceramic grid bifacial: 50.26℃

Position1: Ceramic grid bifacial temperature of shading cell are consistent with transparent bifacial.

Temperature curve over time (at the test point)

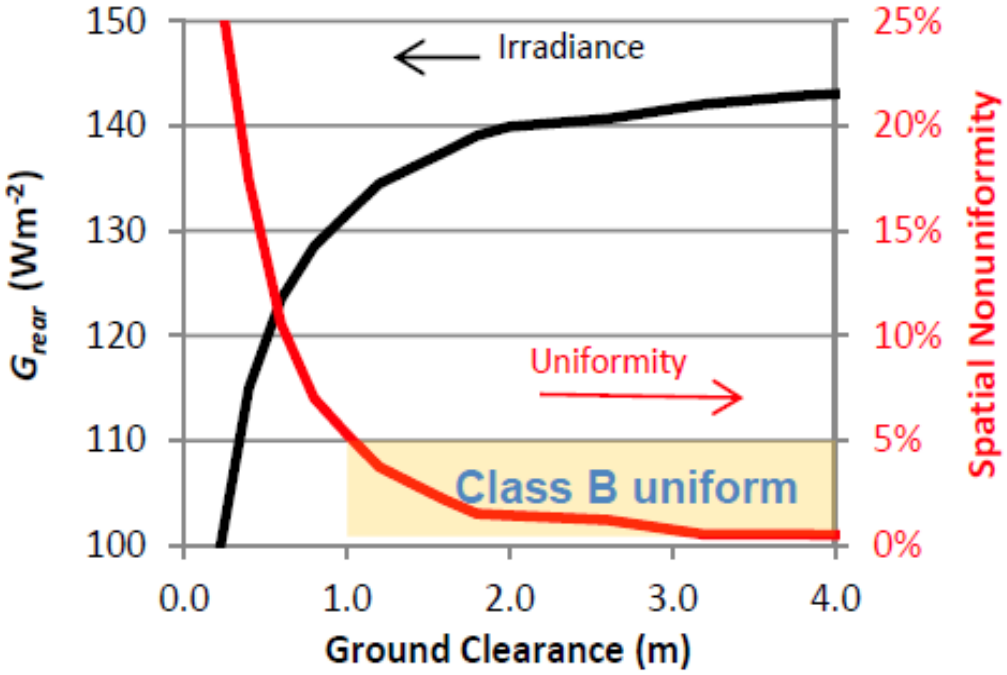
Source: Jinko R&D

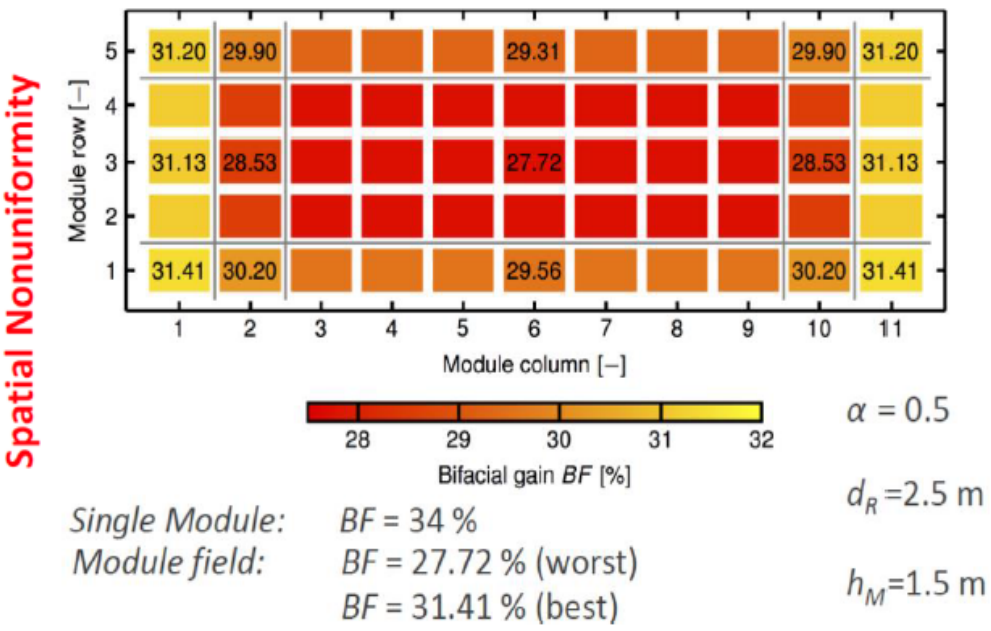
Installation Design: Shading and Temperature



- High albedo ground surface condition
- 50mm wide black backsheet with a distance of 50mm to the module

Installation Design: Mismatch loss of bifacial modules

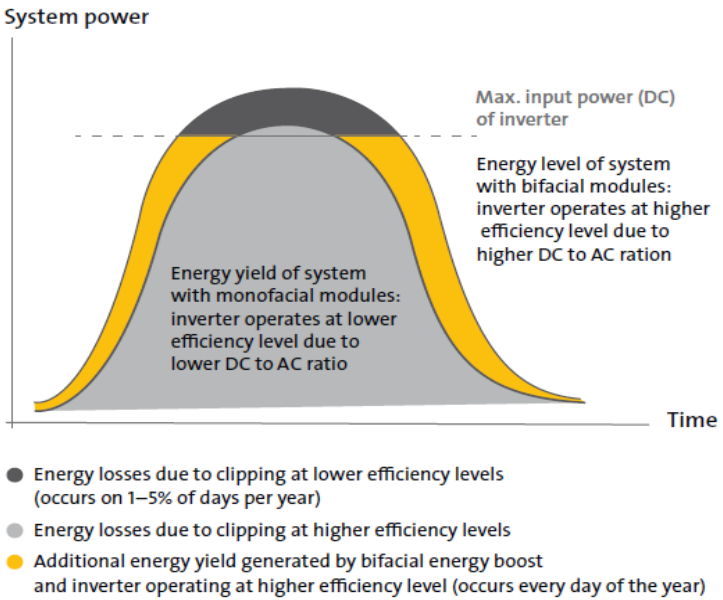


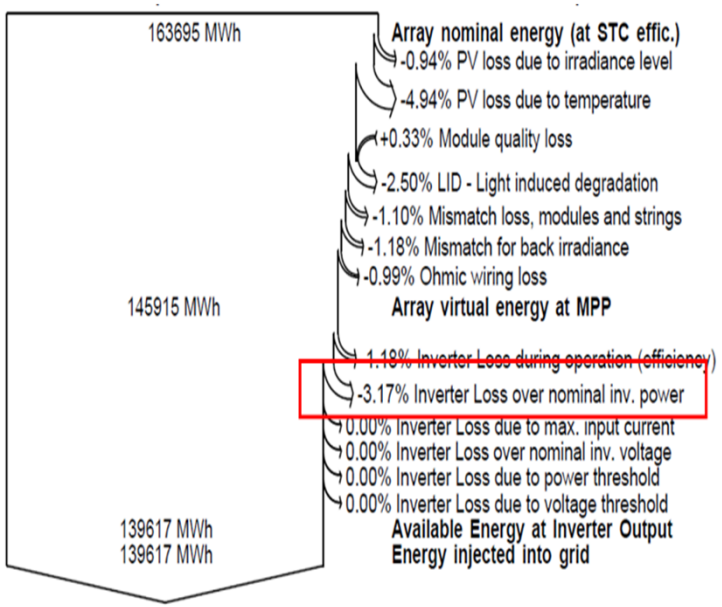


- With installation height > 1 m → Spatial nonuniformity < 5%

Installation Design: DC/AC ratio and inverter

$$\text{Bifacial DC/AC ratio} = \frac{\text{DC/AC ratio}_{monofacial}}{1 + \text{energy gain}}$$



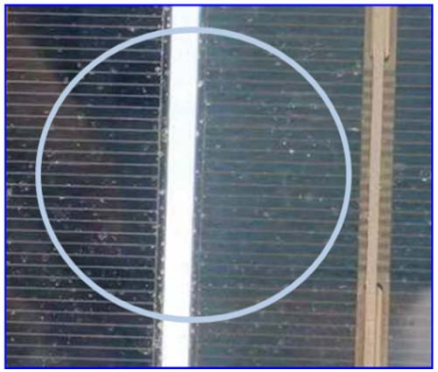


Albedo	0.25				0.52			
DC/AC ratio	1.10	1.20	1.32	1.41	1.10	1.20	1.32	1.41
Clipping loss	0	0.06%	0.65%	1.64%	0.04%	0.40%	1.67%	3.17%
Bifacial gain	10.46%	10.46%	9.89%	9.27%	20.18%	19.77%	18.30%	17.05%

Clipping loss of different bifacial DC/AC ratio (Location: Shandong China, Project size: 105MW)

O&M: Soiling and Cleaning

Bifacial with dual glass :
There are dirt and mud spots which is not easy to clean

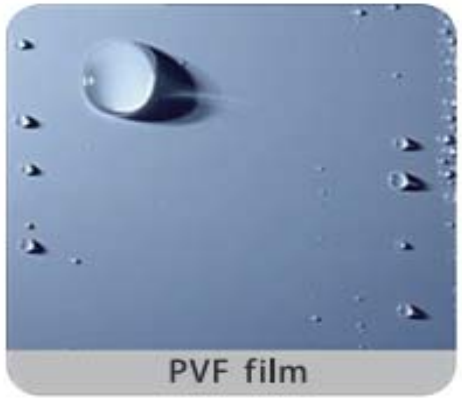


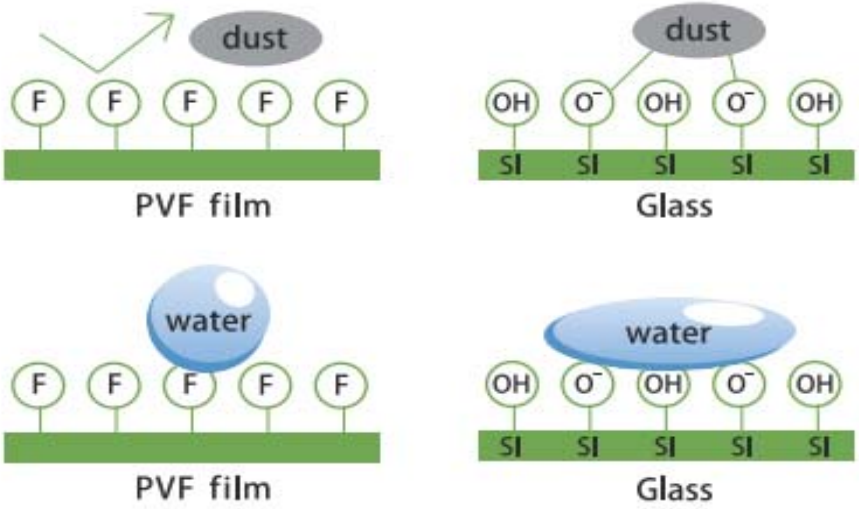
Bifacial with transparent backsheet :
There is no obvious dirt, and very little dust in the middle area

Soiling rate of the rear side is only 11.3% of the front side
(Field test result in Chile)

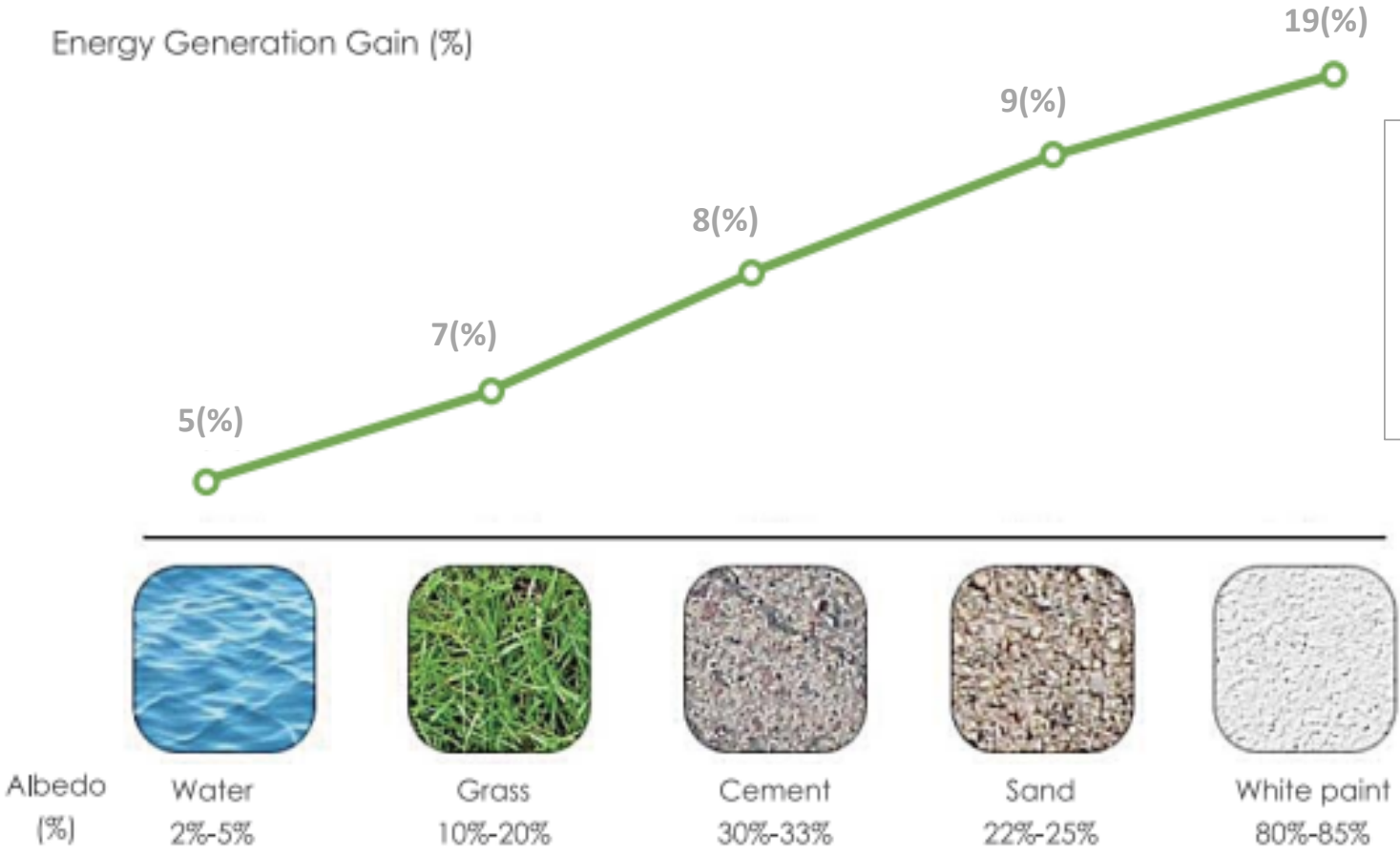
The frequency of bifacial rear-side cleaning is much lower than the front side

The hydrophobic surface offers excellent **anti-staining features**, making cleaning of the modules easier





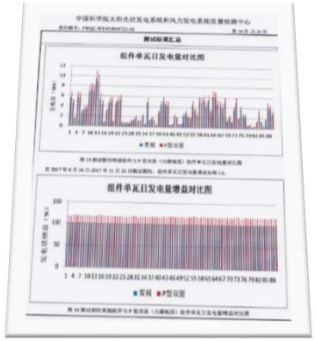
Real Energy Generation Gain

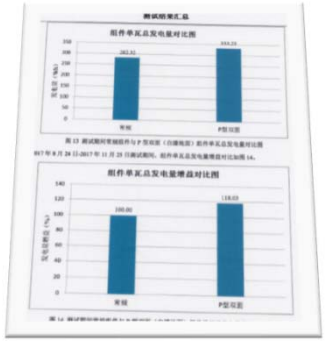


✓**The electric characteristics** : same as bifacial modules with dual glass

✓**Energy generation gain:** Consistent with bifacial modules with dual glass

3rd Testing Report





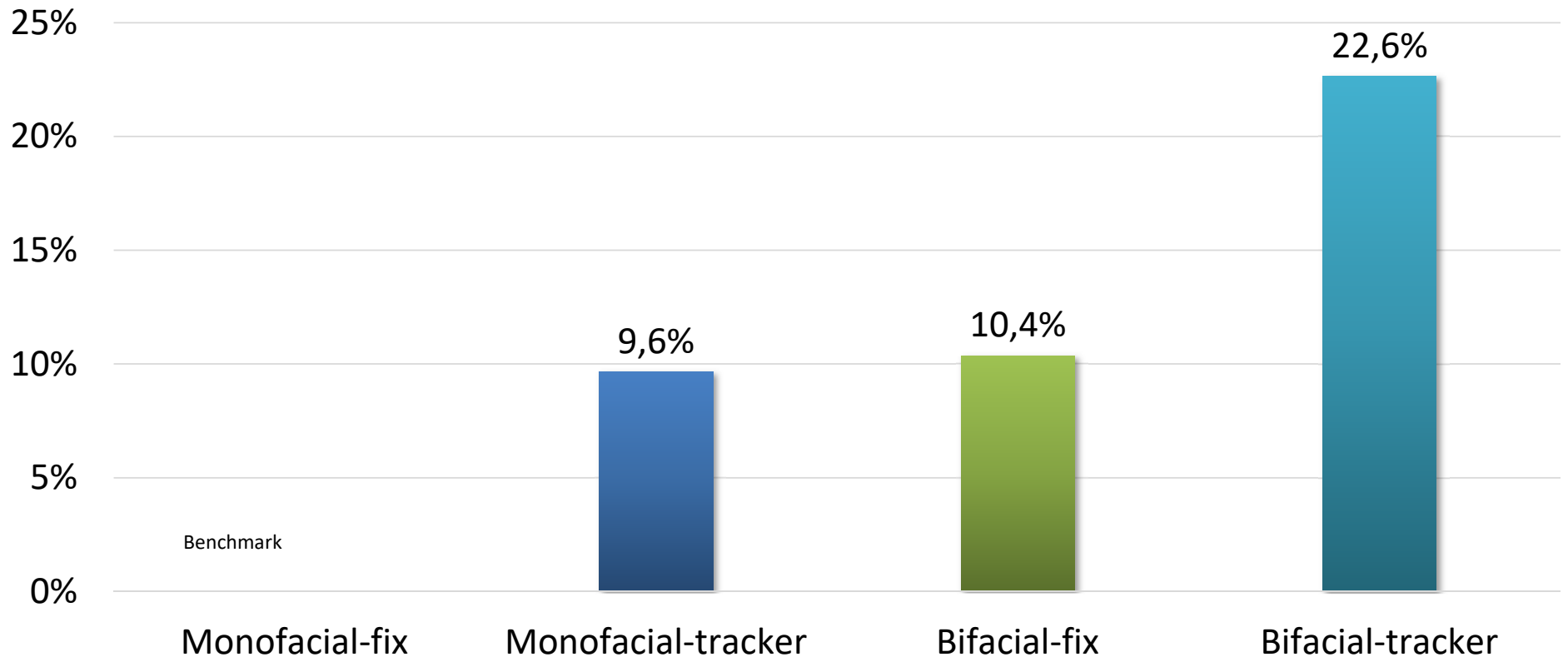
CAS Test Center confirmed that bifacial Module gained **18%** in white-painted ground，keeping same with JINKO internal test result.

Ground		Water	Grass	Cement	Sand	White-paint
Albedo		~3%	~15%	~32%	~24%	~80%
Actual Data	JINKO	4-5%	6-7%	6-7%	7-9%	17-19%
	Third-Party(CAS)					**18%**
System PR	Baseline=80%	83-84%	84-86%	84-86%	85-90%	93%-96%

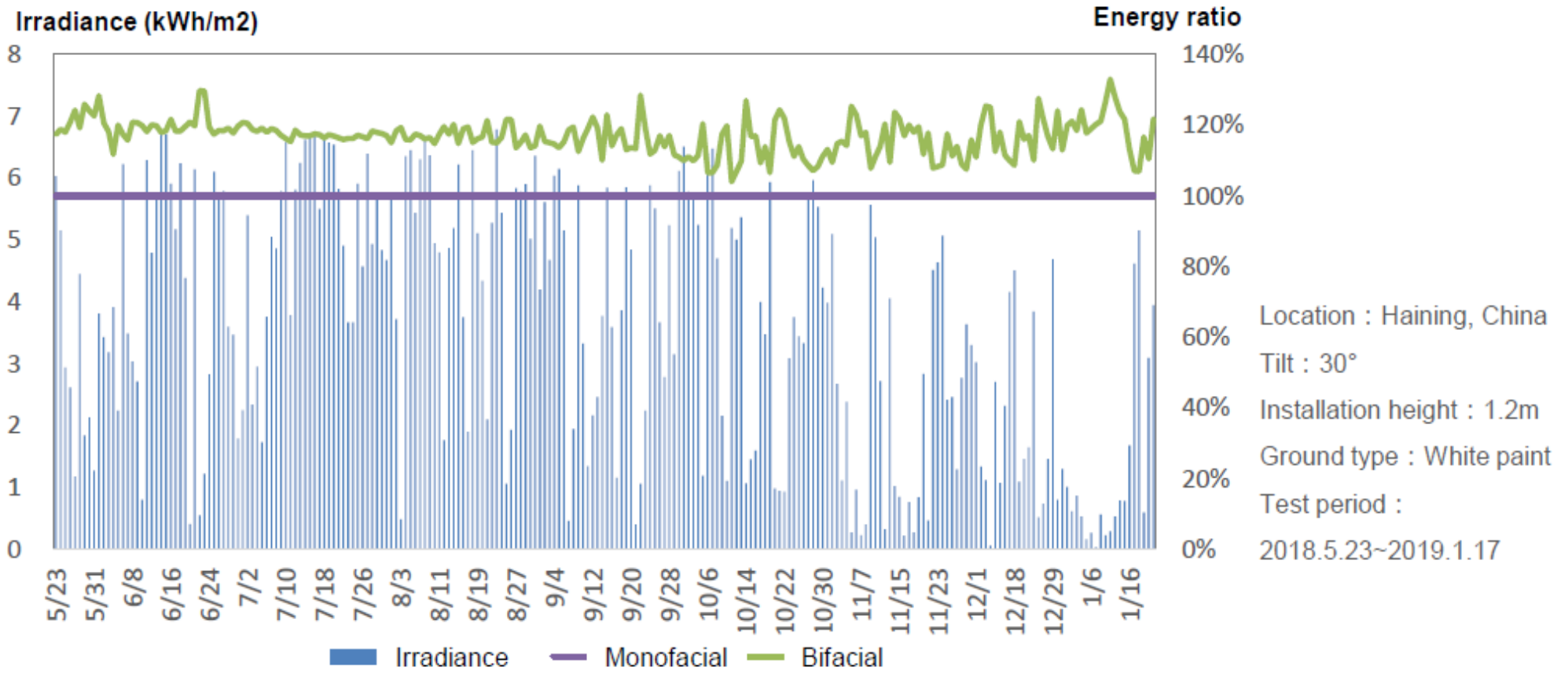
Notes: Chinese Academy of Sciences(CAS) is the highest academic institution of natural sciences, the highest scientific and technological advisory body, and the comprehensive research and development center of natural sciences and high technology in China.

Installation Design: Fixed tilt or Tracking

Energy Gain (%)
Simulated, albedo 0.35
Location: Haining, China



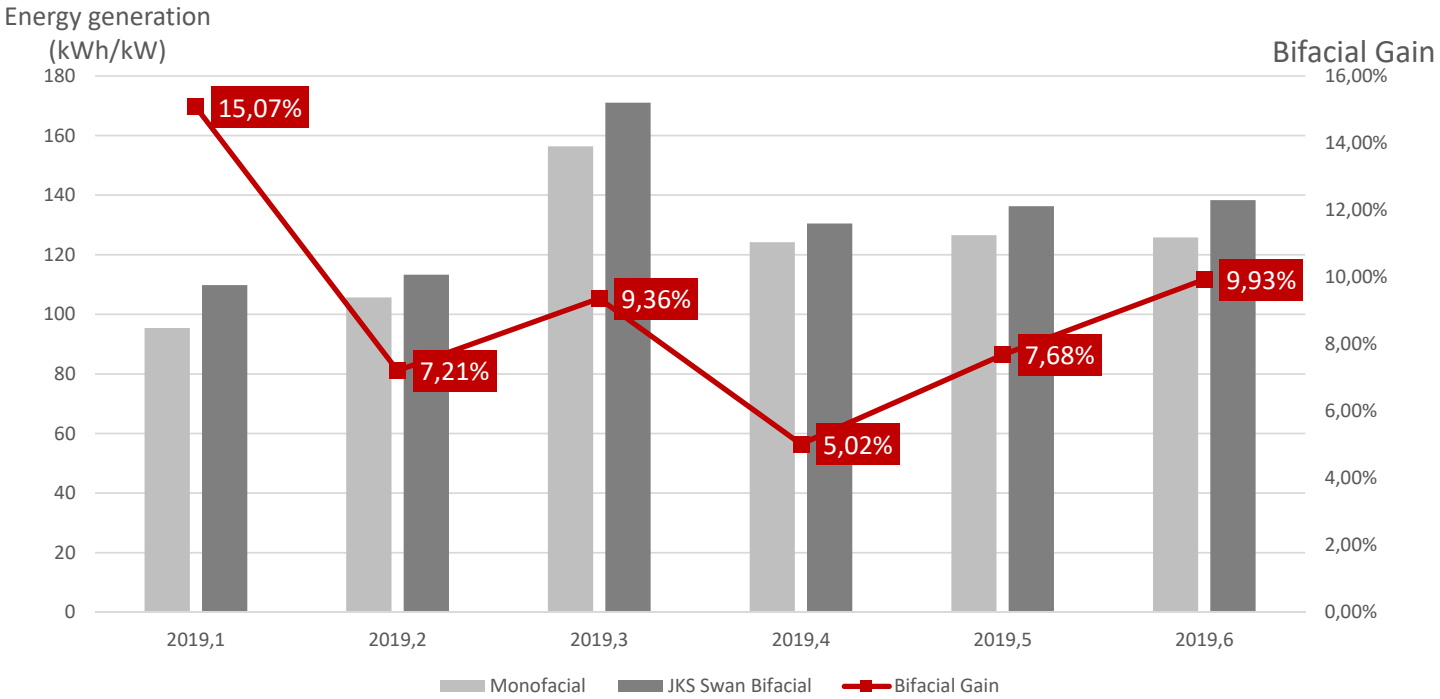
Case Study 1: White paint Fixed installation



Location：Haining, China
Tilt：30°
Installation height：1.2m
Ground type：White paint
Test period：
2018.5.23~2019.1.17

Swan bifacial reached average **16%** bifacial gain compared with monofacial modules, and in summer energy gain was up to 20%.

Case Study 2: Grass Fixed Mounting System



Location: Lv Liang, ShanXi Province

Tilt Angle:30°

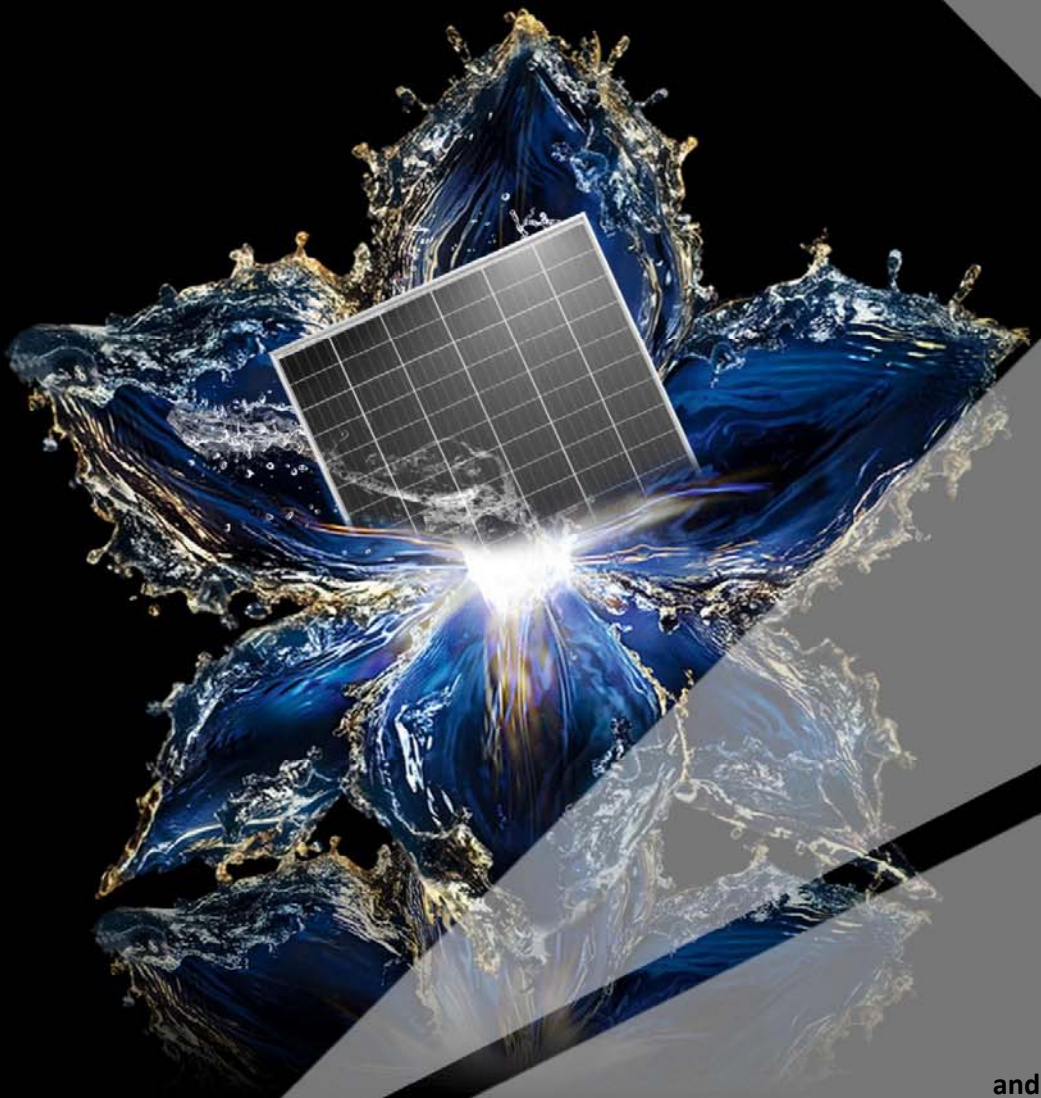
Installation Height: 0.3m-1.2m above from the ground

Ground Type: Grass/Soil

Testing Date:2019.1~2019.6

- Gain of bifacial modules is **9.05%** compared with monofacial modules
- Bifacial modules gain is proportionally higher in low-irradiance environments
- Energy gain reached **15.07%** in January with many overcast days

Thank you!



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