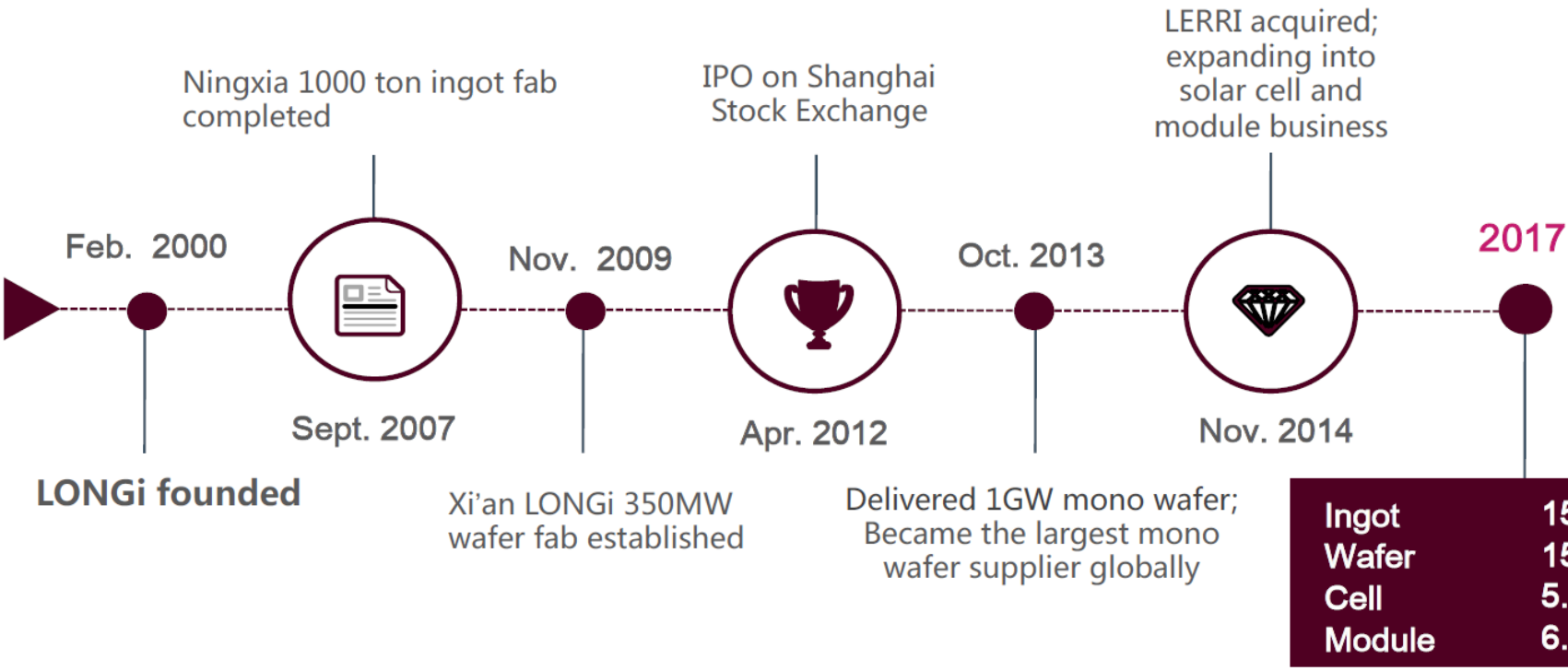
An introduction to Longi, considerations for bifacial modules

LONGi Solar Milestone



LONGi Green Energy Technology Company

LONGi Solar

LONGi Energy

LONGi Solar

LONGi Silicon

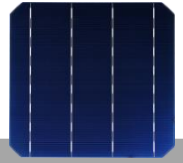
Mono Power Plants

Mono Module

Mono Cell

Mono Ingot

Mono Wafer



Founded in 2000, Xi'an LONGi Silicon Materials Corp. is the largest mono crystal manufacturer in the world. It provides high-quality products and services for photovoltaic and semiconductor industry; It was renamed LONGi Green Energy Technology Co. Ltd. in 2017

Since established in 2007, LERRI devotes itself to R&D and manufacturing of high efficiency mono solar cells and modules. LERRI Solar was renamed LONGi Solar in 2017

Technology Strength

5-7%

R&D Investment

5-7% of LONGi ‘s total revenue is invested in R&D

190

Patents

Has developed 190 patents on ingot, wafer, cell and module technology

700

Technical Team

More than 700 technical staff working on ingot, wafer, cell, and module development

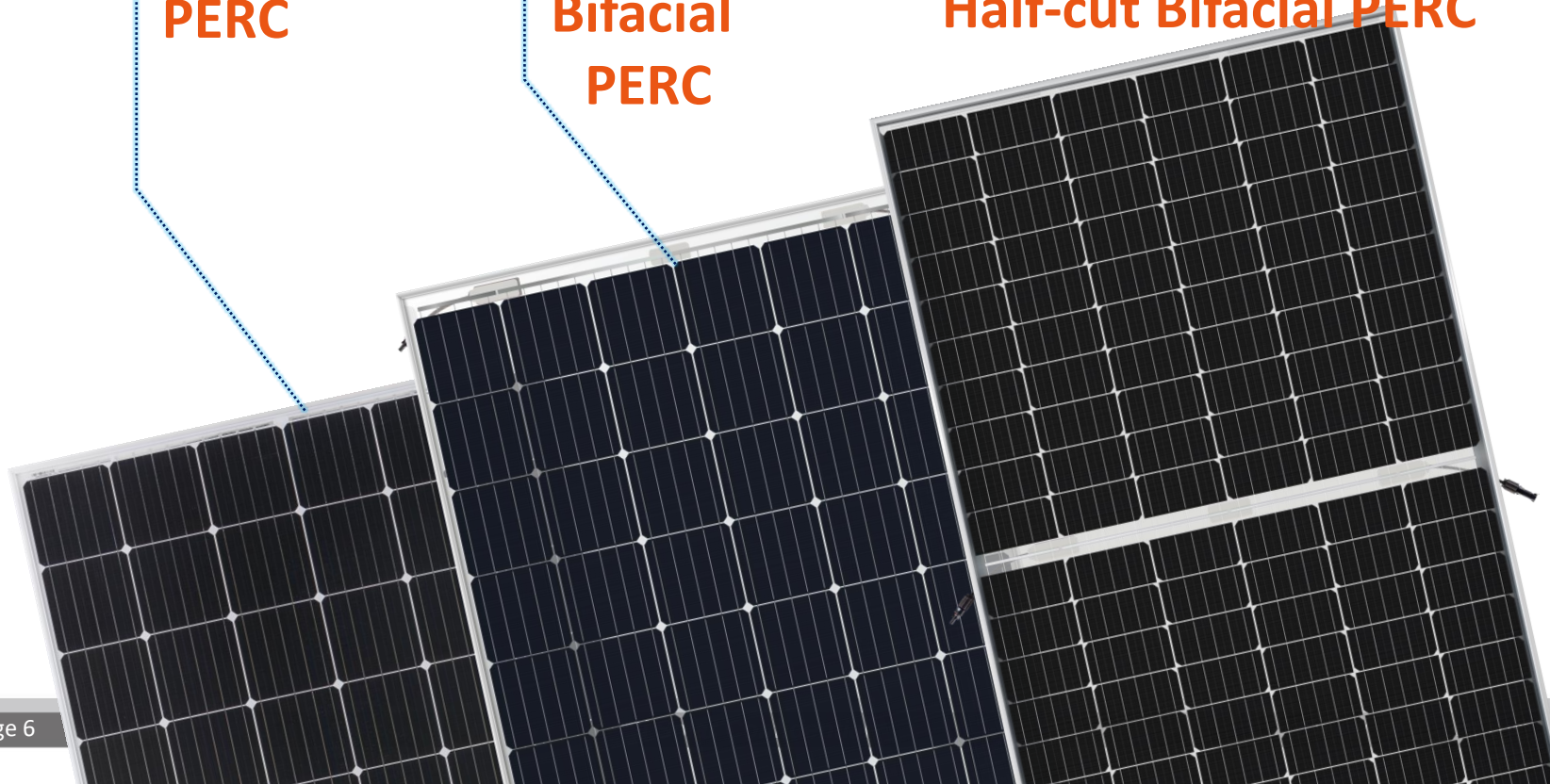
Product Offering

LONGi Solar

Hi-MO 1
PERC

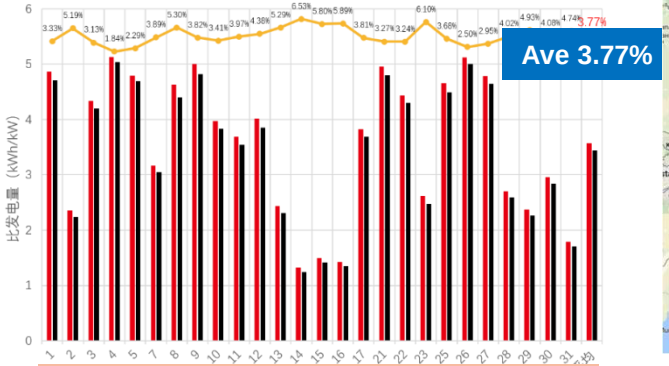
Hi-MO 2
Bifacial PERC

Hi-MO 3
Half-cut Bifacial PERC



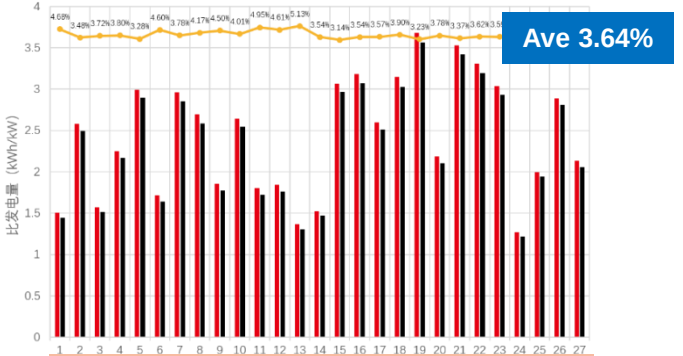
Better Energy Yield with PERC Modules

Power generation comparison in Sanya



South China, hot and humid

Power generation comparison in Tulufan



North West China, hot and dry

Contributions:

1. Better performance at low irradiance
2. Lower operation temp
3. Better TempCo with PERC
4. Voltage stays within MPPT range longer, Longer inverter operating time

System setup: 8pcs 290W Hi-MO1 module and 260W Multi modules (Tier1 supplier), 3kw inverter

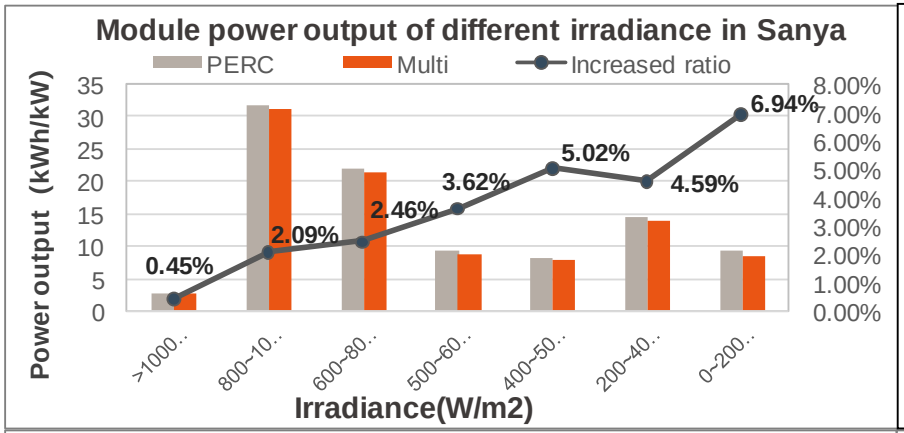
Data source: China Electric Institute

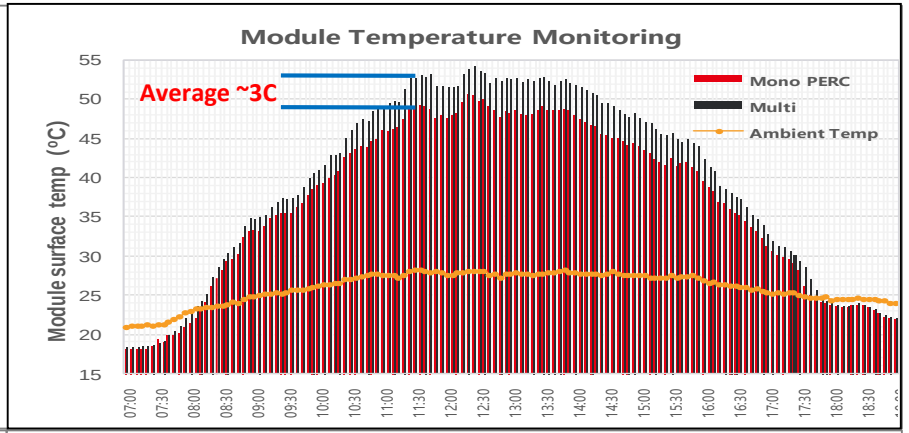
国机集团 | CEI 中国电器院

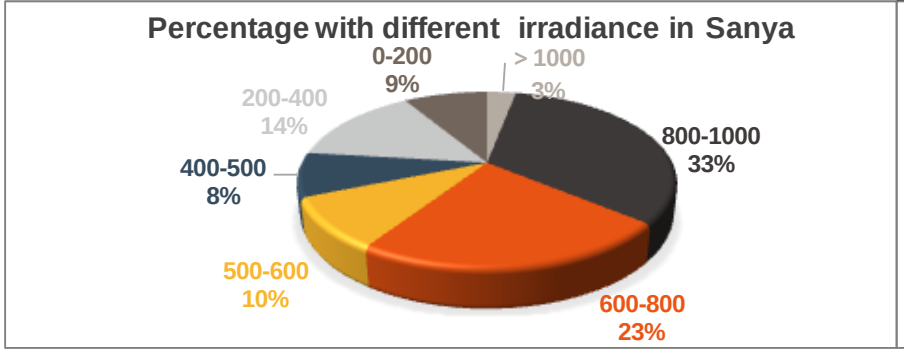
China Electric Institute

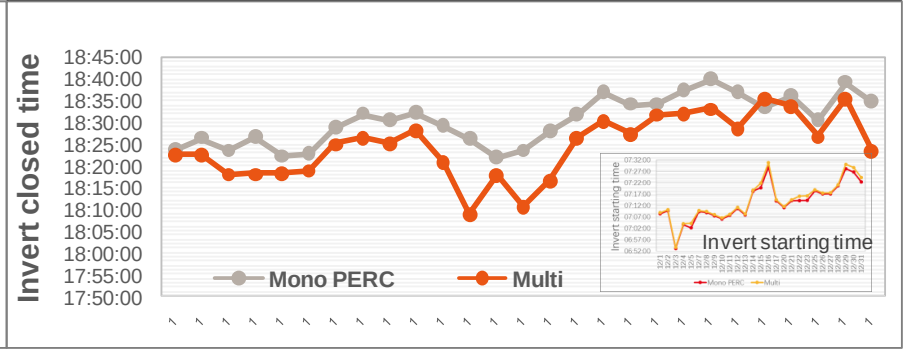
Hi-MO1 (PERC) module power generation is >3% higher than Multi module

Better Energy Yield: Contributing Factors









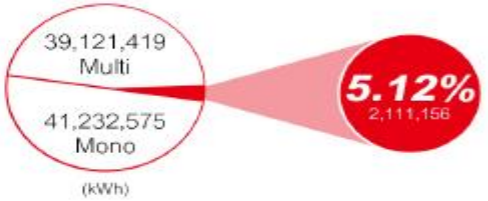
Benefit #2: Better Energy Yield

Power Yield of 10MW Mono Solar Farm is 5.12% higher than 10MW Multi Solar Farm

(Both projects located at the same location in Golmud, Qinghai, China)

10MW Mono

10MW Multi

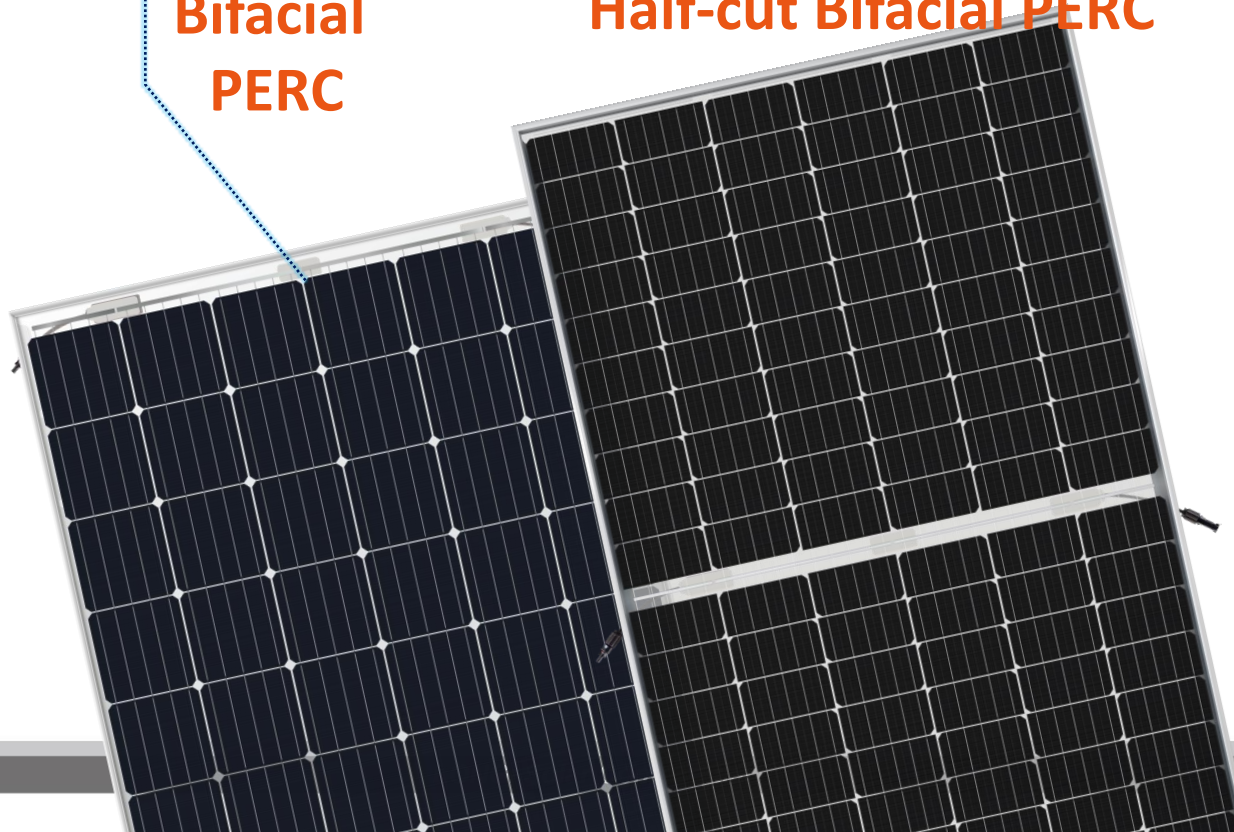


Hi-MO 2

Bifacial PERC

Hi-MO 3

Half-cut Bifacial PERC



Hi-MO2 : Bifacial Mono PERC

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High Power

72C Module power

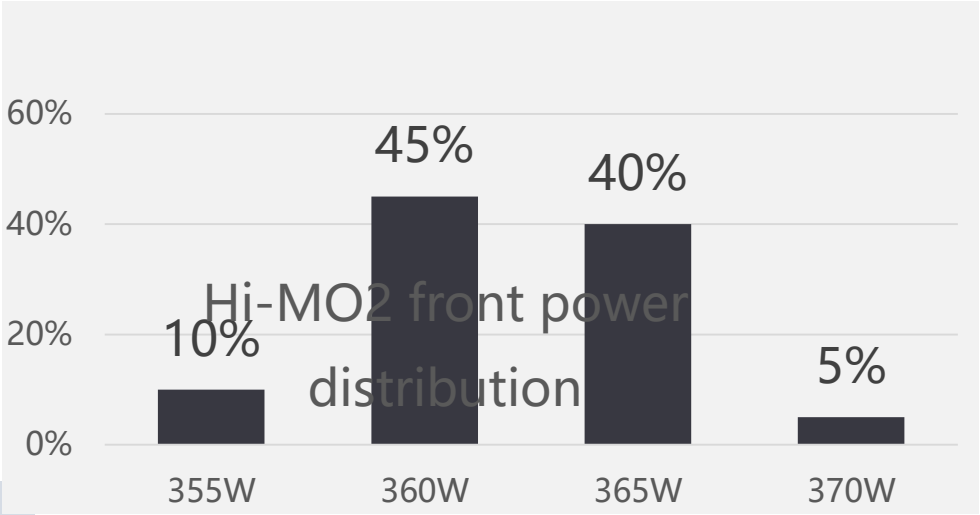
360/365W

60C Module power

300/305W

Rear/front power ratio

> 75%



Rear power contribution	+5%	+10%	+15%	+25%
360W	378W	396W	414W	450W
300W	315W	330W	345W	375W

Hi-MO2 – Hi-MO3: Hi-reliability Module Design

Al-frame design

- avoid damage in transportation and installation
- Avoid damage caused by uneven stress in mounting points of dual-glass module after long-term use.
- Silicon gel on fringe of dual glass can avoid moisture
- 1500V

60cell 1664×997×40mm 21.8kg

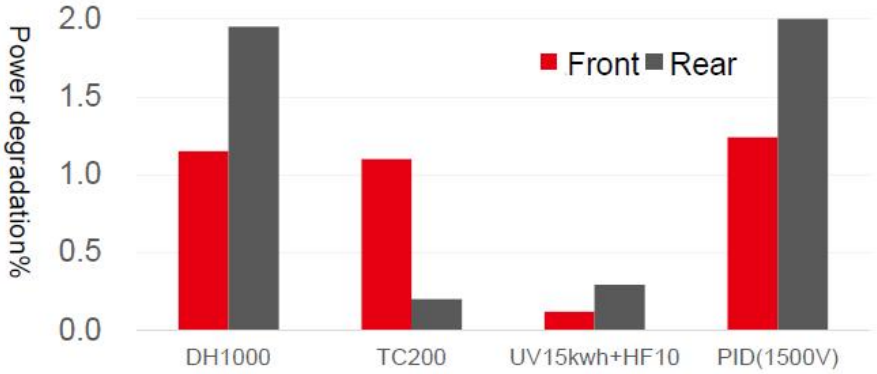
72cell 1978×997×40mm 25.8kg

- Proper size to avoid shading caused by J-box and Al-frame
- 2mm+2mm half-tempered glass to reduce weight.

Hi-MO2 – Hi-MO3: Hi-reliability Bill Of Material

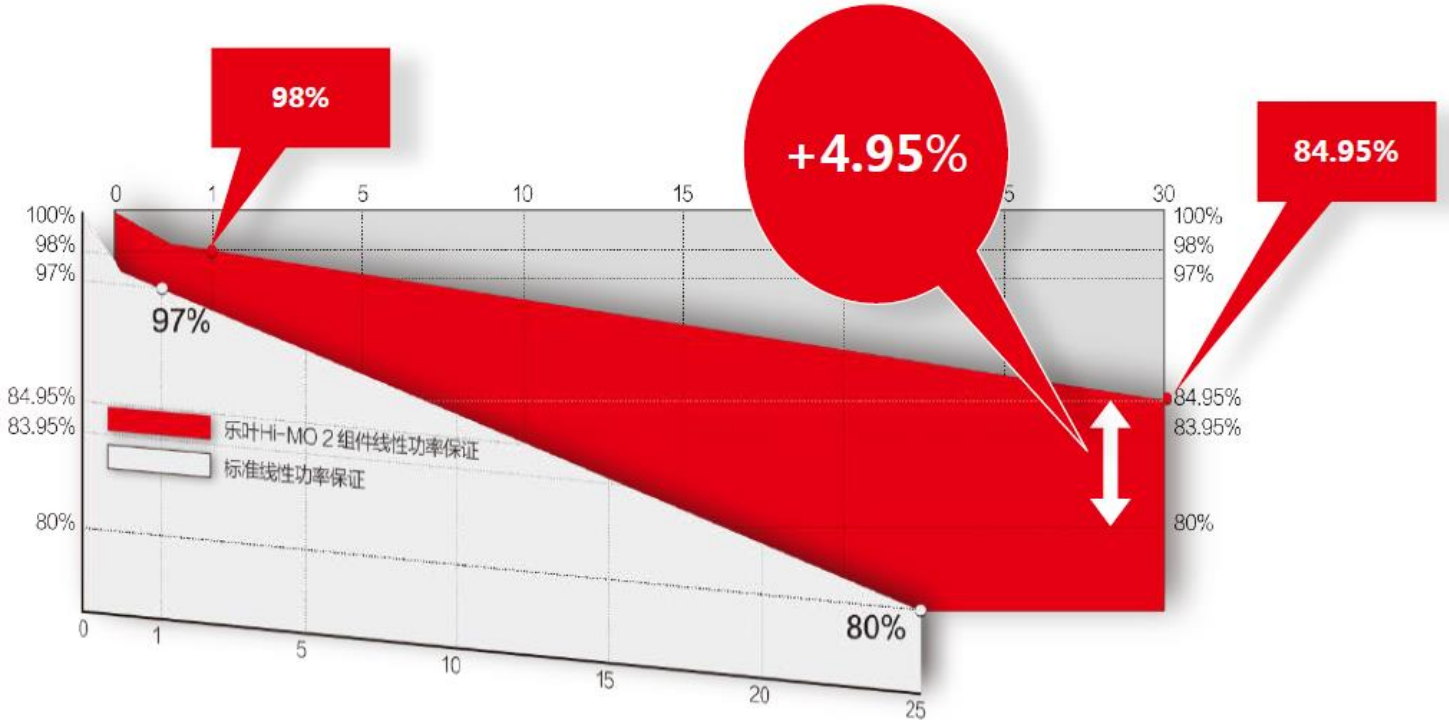
POE encapsulation

- Better material stability than EVA
- High body resistivity, low moisture transmission rate
- High long-term reliability, especially improve rear anti-PID performance



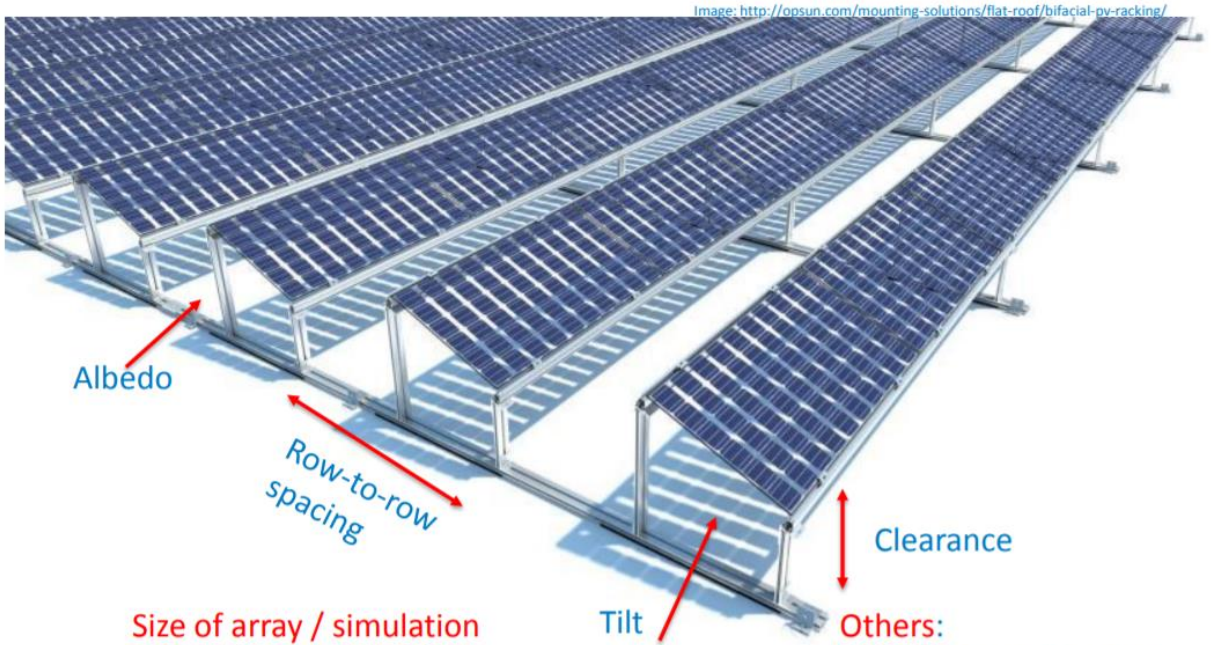
Hi-MO2 – Hi-MO3 PERC Module Linear Power Performance Warranty

First year degradation is less than 2%.From second year, degradation is less than 0.45%. Output power after 30 years is more than 84.95%



System design with PERC Bifacial Modules

Hi-MO2 – Hi-MO3: Influence on bifacial gain



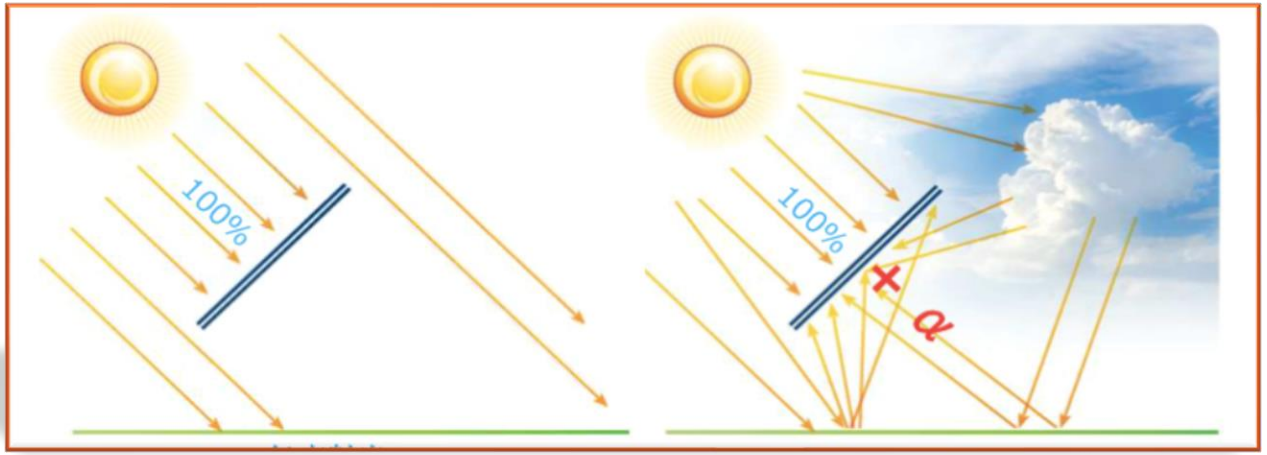
Size of array / simulation
Location
Weather
Sky Diffuse Model

Others:
Spacing between cells
Shade obstructions

Hi-MO2 – Hi-MO3 : Bifacial Mono PERC. Albedo

Mono facial module

Bifacial module



Direct sunlight

Direct sunlight + Reflection + Scattered light

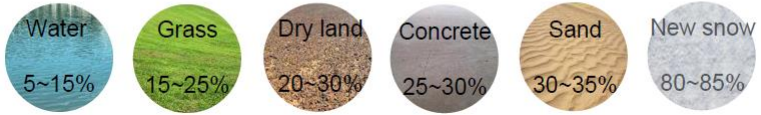
Albedo

Fraction of the solar energy reflected from the Earth back into space

$GCR = \frac{Module\ area}{Ground\ area}$ Vs Pitch

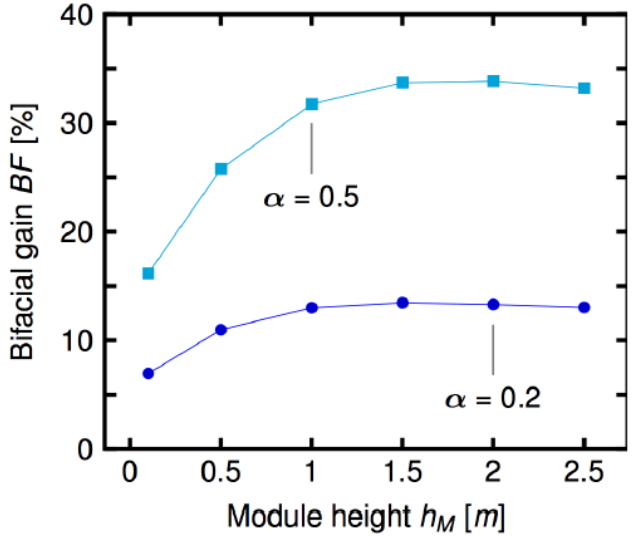
Higher GCR implies closer rows

Typical ground albedo



$$albedo = \frac{reflected\ light}{incident\ light} = \frac{Isc\ ground}{Isc\ sky}$$

Hi-MO2 – Hi-MO3 : Bifacial Mono PERC. Module elevation



$h_{M,opt}$ = 1.5 m

- BF = 13 % — α = 0.2
- BF = 34 % — α = 0.5

- Is the distance between the ground and the bottom side of the module
- Key parameter to guarantee more sunlight reflectance
- Elevation impacts in irradiance uniformity in the rear side
- Over 1m elevation there is a saturation
- Impact on mounting structure cost

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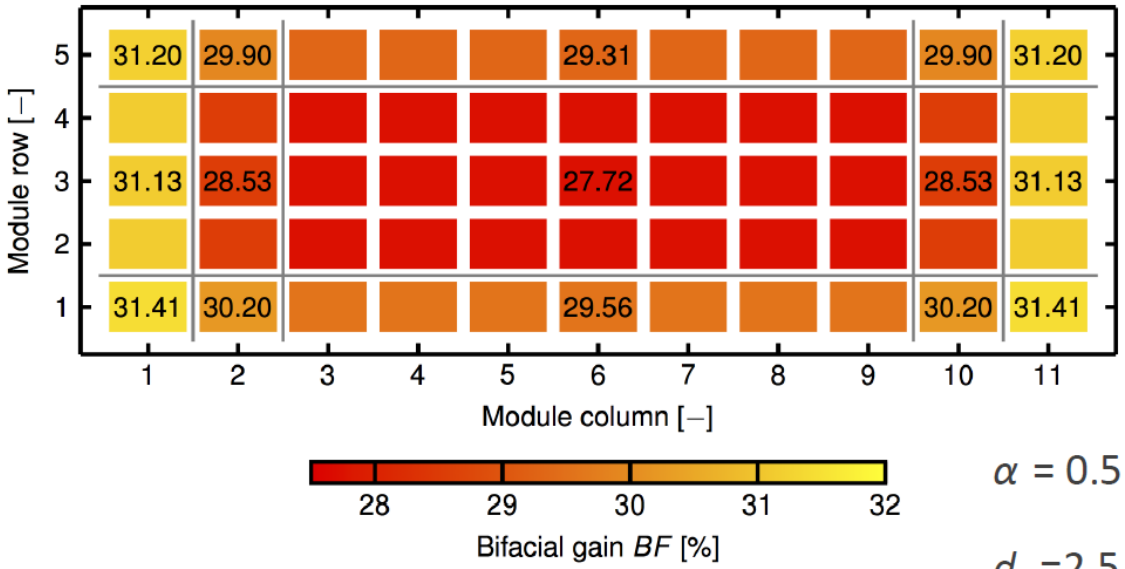
Hi-MO2 – Hi-MO3 : Bifacial Mono PERC. Irradiance uniformity, rear side



Single Module: $BF = 34\ \%$

Module field: $BF = 27.72\ \%$ (worst)

$BF = 31.41\ \%$ (best)

$\alpha = 0.5$

$d_R = 2.5$ m

$h_M = 1.5$ m

- Bifacial gain depending on the module with lowest performance = lowest irradiation
- Modules in the Edge of the array can “see” more light = higher irradiation
- Electrical connection is key to obtain the máximum Benefit = losses reduction

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Hi-MO2 – Hi-MO3 : Bifacial Mono PERC. Electrical design

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Electrical Characteristics										
Model Number	LR6-72BP-350M		LR6-72BP-355M		LR6-72BP-360M		LR6-72BP-365M		LR6-72BP-370M	
Testing Condition	Front	Back	Front	Back	Front	Back	Front	Back	Front	Back
Maximum Power (Pmax/W)	350	263	355	267	360	271	365	274	370	278
Open Circuit Voltage (Voc/V)	47.2	46.8	47.4	47.0	47.6	47.2	47.8	47.4	47.9	47.5
Short Circuit Current (Isc/A)	9.39	7.19	9.48	7.26	9.58	7.34	9.66	7.40	9.77	7.49
Voltage at Maximum Power (Vmp/V)	39.2	40.2	39.4	40.4	39.5	40.5	39.7	40.7	39.8	40.8
Current at Maximum Power (Imp/A)	8.93	6.54	9.02	6.62	9.11	6.69	9.19	6.73	9.30	6.82
Module Efficiency(%)	17.8	13.3	18.0	13.5	18.3	13.7	18.5	13.9	18.8	14.1
STC (Standard Testing Conditions): Irradiance 1000W/m², Cell Temperature 25℃, Spectra at AM1.5										

Electrical characteristics with different rear side power gain (reference to 360W front)

Pmax /W	Voc/V	Isc /A	Vmp/V	Imp /A	Pmax gain
378	47.6	9.98	39.5	9.57	5%
396	47.6	10.45	39.5	10.03	10%
432	47.7	11.39	39.4	10.97	20%
450	47.7	11.87	39.4	11.43	25%

- Size the electrical components taking into account the rear gain
- i.e. For a 360W with a rear side power gain of 10%
- Consider inverter clipping or derating due to the extra power

HIGH POWER – BOS SAVINGS and LCOE Improvement

Use of high efficiency mono/PERC module,
BOS COST SAVINGS can be realized with reduced use of

Land

Racking

Cables

Earth/concrete work

Labor

Thank You for Your Attention

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