



LONGi Propelling the transformation

PRODUCT BROCHURE 2019

LONGi Propelling the transformation

LONGi Solar Technology Co., Ltd.

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10.2019

LONGi GREEN ENERGY

THE LARGEST MANUFACTURER OF MONOCRYSTALLINE SILICON WAFERS AND MODULES IN THE WORLD

LONGi Green Energy Technology Co., Ltd. ("LONGi") was founded in 2000 and listed on Shanghai Stock Exchange in 2012 (stock code: 601012), headquartered in Xi'an, China. The company is holding a whole production chain from silicon ingot to the photovoltaic power station. Now It is the largest manufacturer of monocrystalline silicon wafers and modules in the world.

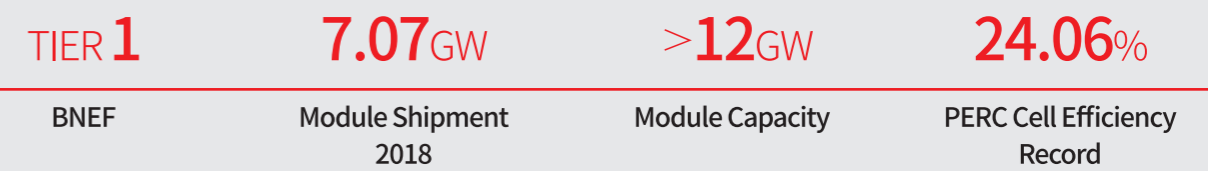
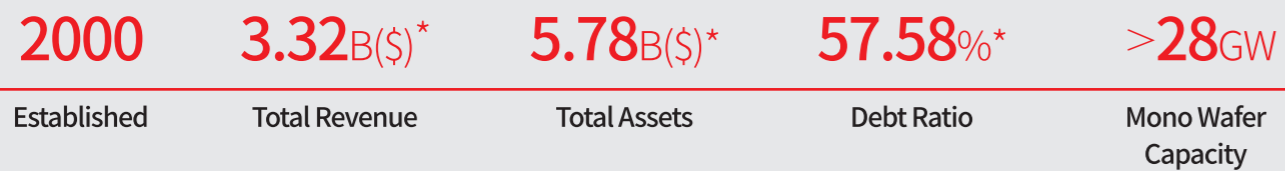
Till 2018, LONGi has 28GW monocrystalline silicon wafer capacity and plans to expand silicon wafer capacity to 65GW in 2020. LONGi has continuously invested over 5% of the revenue in R&D to promote monocrystalline technology globally. LONGi's R&D investment in 2017 reached the first place in photovoltaic industry.**

LONGi SOLAR

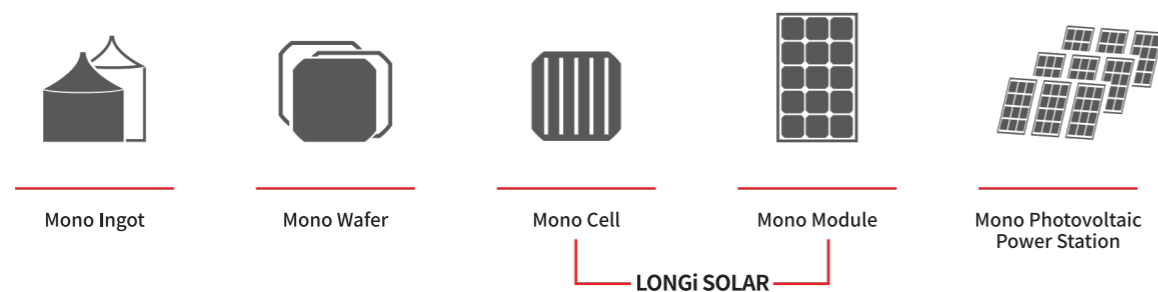
FOCUS ON PRODUCTION, SALES AND R&D OF MONO CELL AND MODULE

LONGi solar is a subsidiary of LONGi Green Energy, focus on production, sales and R&D of mono cell and module. The shipment of LONGi Solar is approximately 7GW in 2018. Factories are located in China: Taizhou, Quzhou, Chuzhou,

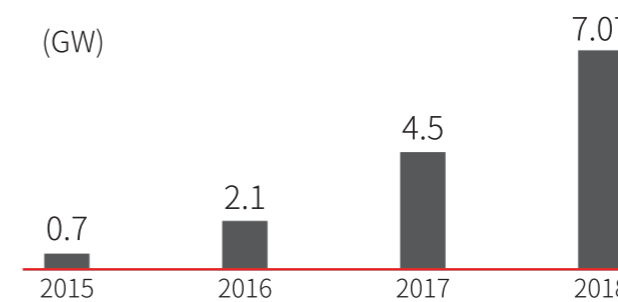
Xi'an, Datong, Yinchuan and Malaysia: Kuching. The module capacity has reached 12GW. LONGi Solar is committed to provide the best LCOE solutions as well as promote the worldwide application of monocrystalline technology.



LONGi INDUSTRY CHAIN



MODULE SHIPMENT OVER THE YEARS OF LONGi SOLAR



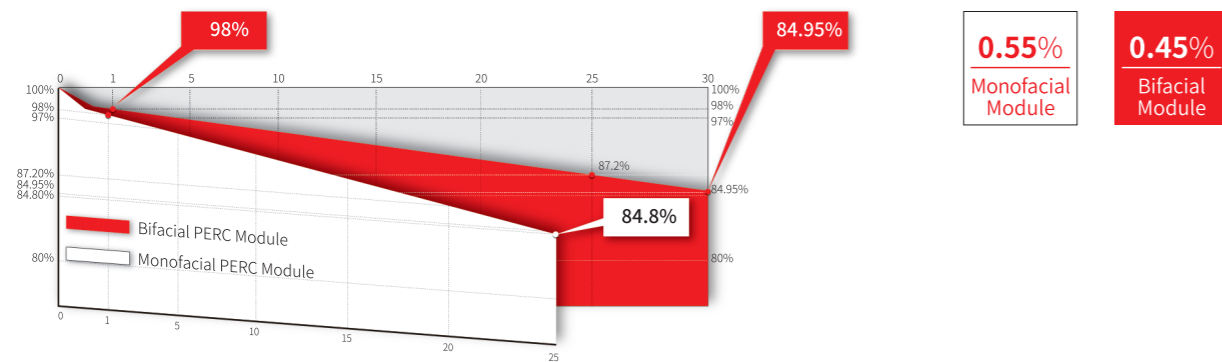
*Based on the 2018 financial report of LONGi

**<https://www.pv-tech.org/news/longi-sets-solar-industry-record-for-rd-spending>

WARRANTY

FIRST-YEAR POWER WARRANTY OF $\geq 98\%$ FOR PV MODULES

Based on the advanced mono wafer and anti-LID technology, LONGi offers a first-year power warranty of $\geq 98\%$ for PV modules.

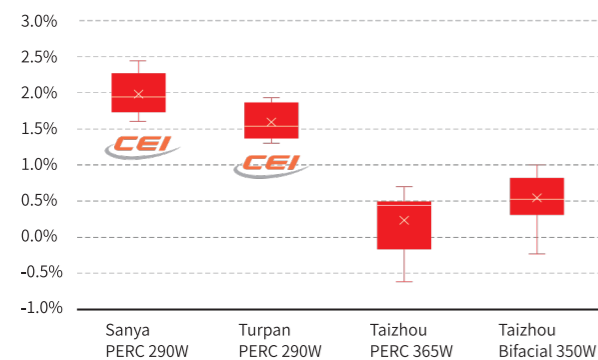


LONGi also provides a 10 years warranty for Material & Craftwork of PV modules, and a 25 years power warranty with a linear degradation inferior to 0.55% per year for monofacial module.

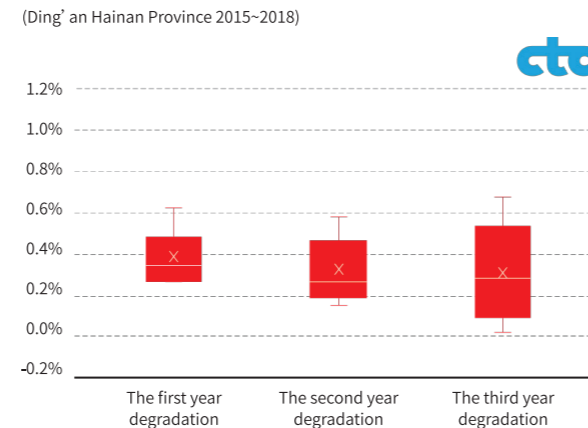
For the Bifacial module, the warranty prolongs to 30 years with a linear power degradation of 0.45% per year.

The low degradation property of LONGi's module is demonstrated by long-term outdoor test.

1ST YEAR DEGRADATION IN DIFFERENT CITY IN CHINA



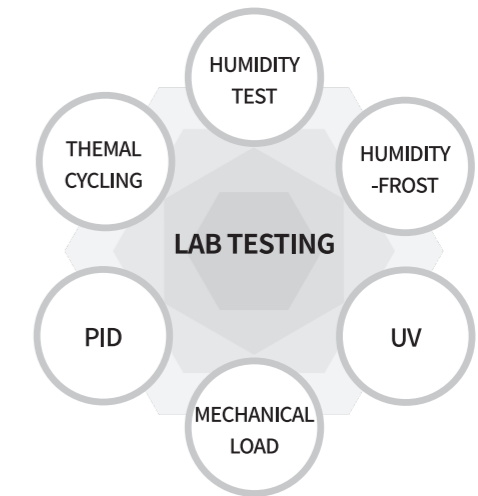
LONGi SOLAR MODULE TESTED BY CTC



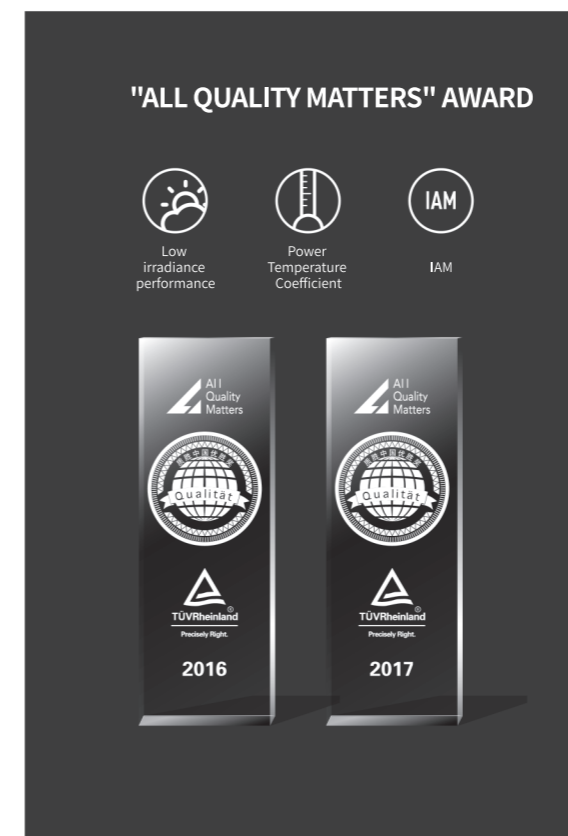
QUALITY

RELIABILITY TEST

LONGi's modules have passed routine test of IEC and UL, and have an excellent performance in rigorous third-party test.



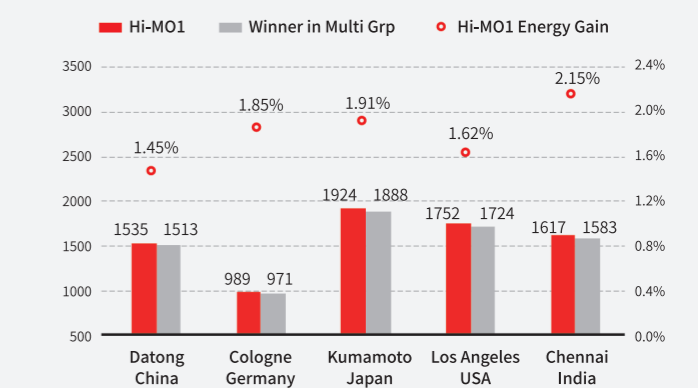
PERFORMANCE TEST



LONGi's PERC module won the first prize in energy yield simulation in 2017 and 2018, and the first prize in outdoor energy yield of monofacial module in 2019 conducted by TÜVRheinland.



SIMULATED POWER GENERATION IN 2017 (kWh/kWp/year)



LONGi's product center will also testify energy yield and degradation of various PV modules in out-door stations.

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INGOT PULLING

RENDER PERC CELLS WITH HIGH EFFICIENCY AND LOW LID

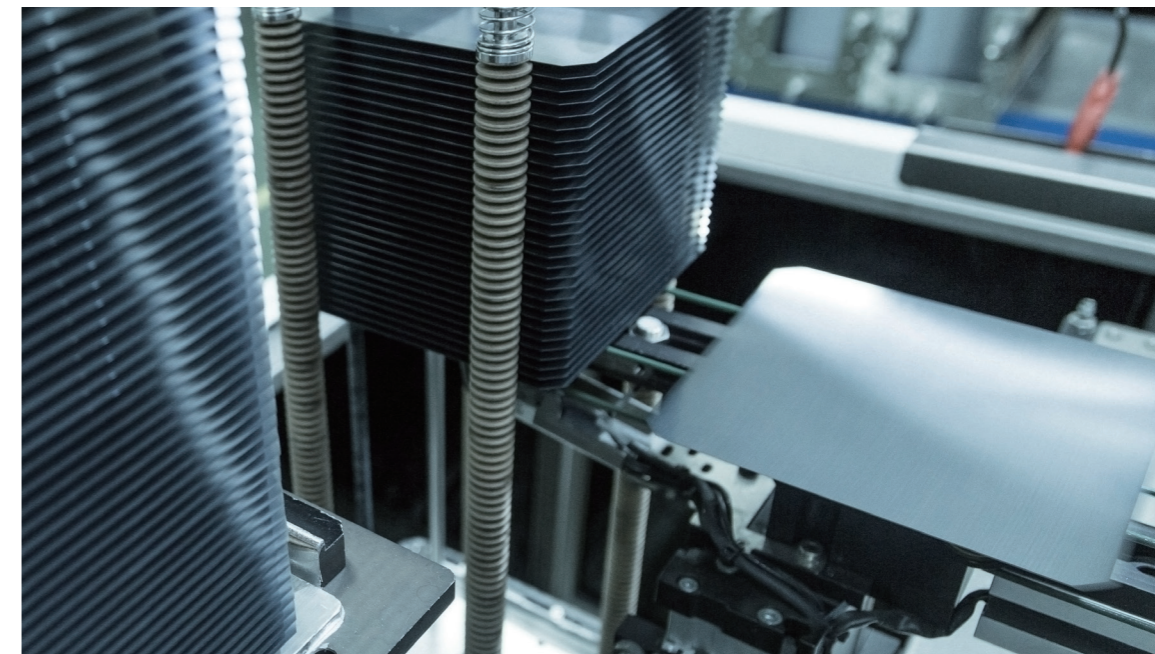
As a leading company in monocrystalline industry, LONGi focus on reducing production cost by larger silicon loading, higher pulling speed. The RCZ technology was first successfully commercialized by LONGi. Also LONGi has improved the quality of silicon wafers by reducing oxygen content, carbon content and metal impurity, which render PERC cells with high efficiency and low LID.



DIAMOND WIRE SLICING

SIGNIFICANTLY INCREASES WAFER OUTPUT PER UNIT MASS

LONGi took the lead in diamond wire slicing technology, which significantly increases wafer output per unit mass. LONGi promoted the M2 (156.75 mm/210 mm) standardization of monocrystalline wafer in the industry. The 180 μ m and 150 μ m wafer with diamond wire slicing technology by LONGi are widely used in the industry. In the future, LONGi will launch thinner mono silicon wafer which can bring more value for customers.



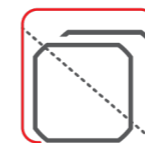
RCZ Technology



Low LID



High Minority Carrier
Lifetime & Low
Resistivity



Diamond Wire
Slicing



M2 Standardize
Wafer



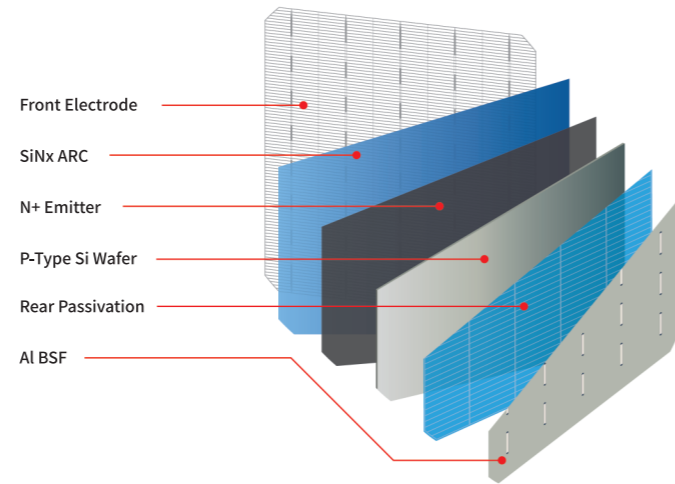
Thinner Wafer
Less Price

PERC TECHNOLOGY

HIGH EFFICIENCY & MORE ENERGY YIELD

The PERC cell has a passivated rear side and a laser grooving process, which significantly improves the cell efficiency.

In 2016, LONGi released the Hi-MO1 module with PERC and Anti-LID technologies. At present, the cell efficiency has been increased from 21% to over 22%.

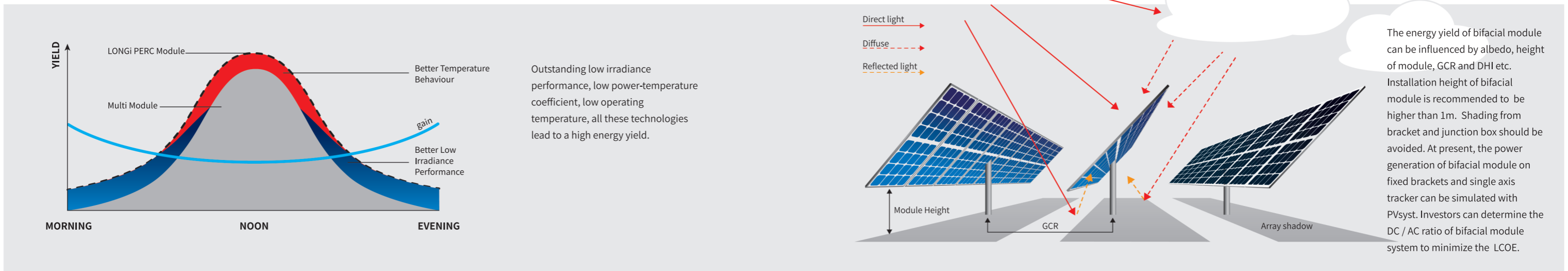
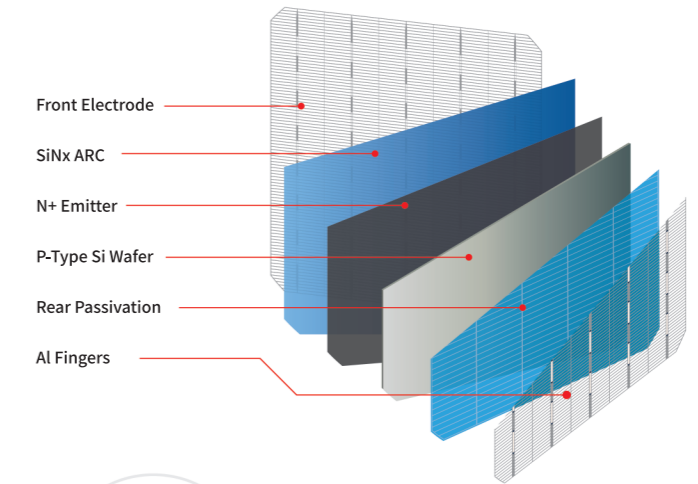


BIFACIAL PERC TECHNOLOGY

CELL BIFACIALITY OF 75%-80%: HARVEST MORE LIGHT

For a bifacial PERC cell, the Al back surface field is replaced by Al grid, hence render the majority of rear side transparent and attain a bifaciality of 75%-80%.

In 2017 LONGi released the Hi-MO2 module with bifacial PERC and double-glass packaging. Hi-MO2 module can absorb light on rear side, thus reduce the LCOE of power plant significantly.



PERC Cell Efficiency in Mass Production



1st Year Degradation, Anti-LID



Outstanding Low Irradiance Performance



low Power Temperature Coefficient



Albedo
It has considerable gains on grass land, dry sand, especially in snowfield



Module Height
High module height will reduce the shading impact on rear side. A minimum of 1m is recommended



GCR
A low GCR will increase radiance on the rear side



DHI
Diffuse light can be absorbed by the rear side of the module. the higher proportion of Diffuse light, the higher is the bifacial gain.

In the outdoor test by PV magazine, LONGi ranks first among all the mono module,
LINK: <https://www.pv-magazine.com/features/pv-magazine-test/>

HALF-CUT TECHNOLOGY

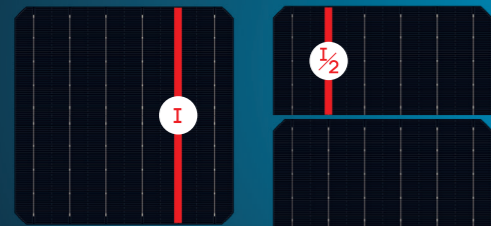
HIGHER POWER & MORE RELIABLE

Half-cut cell technology is to cut the cell into two separate parts by mature infrared laser, hence halve the working current. The thermal loss on the ribbon will be remarkably reduced and the module's power increases by 2%. The reliability of module is also enhanced.

The combination of half-cut cell technology and bifacial module can amplify the gain over the effect of current-reduction.

LONGi released Hi-MO3, a bifacial half-cell module, at the SNEC exhibition in 2018.

Nearly 275MWp Hi-MO3 were supplied to the Chinese TOP runner project in Sihong County. The total signed order of Hi-MO3 was up to 500MWp throughout 2018.



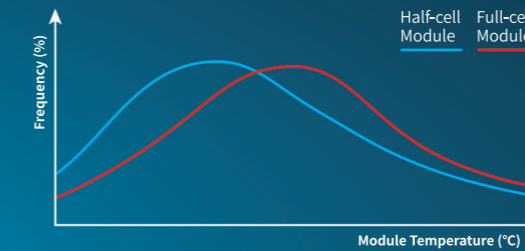
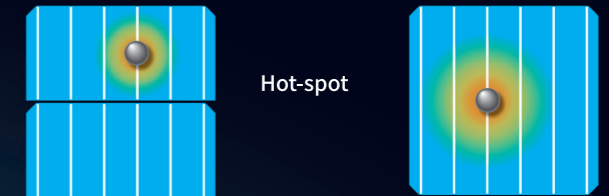
Monofacial or bifacial PERC cell module with half-cut technology has high power, the property of anti-PID, anti-LID (including LeTID), low hot spot temperature, excellent low irradiance performance and low power temperature coefficient.

PROPERTIES

A Lower Hot Spot Temperature

In field applications, small area shadings can cause the temperature of those parts extremely high. This phenomena is called hot spot. The long duration of hot spot could bring irreversible degradation of modules.

Because the string current of half-cell modules is half of full-cell modules, the hot spot temperature can be obviously reduced. LONGi's experiments show that this reduction could be 10-20°C, which increases the module reliability.



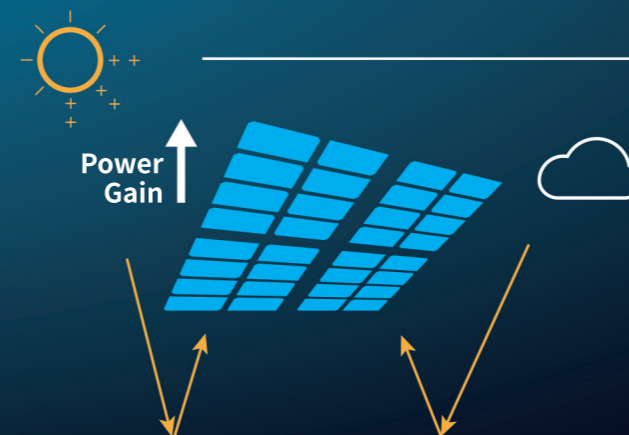
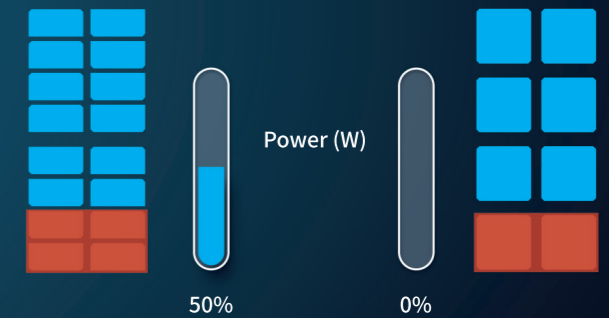
B Lower Operating Temperature

Half-cut cells have half of the working current, thereby the thermal loss is remarkably reduced. Operating temperature correspondingly decreases, and the reliability of module is improved as well as power gain.

C Lower Shading Loss

Because of the unique parallel connection design, half-cell modules still have 50% power output under the circumstance of array shading in sunrise or sunset when portrait installation.

In addition, half-cut technology can improve the output of bifacial module under non-uniform incident illumination on the backside.



D Higher Energy Yield Under High Irradiation Condition

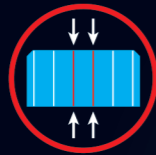
Under high irradiation conditions, half-cell module, especially bifacial half-cell module, will have a higher energy yield compared with conventional module. Bifacial half-cell module will help to achieve the lowest LCOE in regions which is rich in sun radiation resources.

60 / 72 HPH

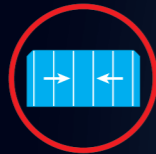
HALF-CELL MODULE (Hi-MO3m, Hi-MO4m)



Suitable for Residential and Commercial Installation



The power of half-cell module increases, and the hot spot temperature reduces because of lower working current



Cells with 6BB have better current collection ability



Unique parallel connection design, more energy yield in case of shading



35mm frame, front / back side maximum static loading: 5400Pa/2400pa



Cell efficiency >22%, anti-LID, anti-PID, 1st year degradation <=2%



Option: full Black module with Black frame and black Backsheet (60HPB)



Two grounding holes and one leakage hole at each corner



8 mounting holes, adaptable to various mounting approaches



Split junction box, Cable Length 300mm (can be Customized)



Backsheet and junction box supporting 1500V system



Backsheet with Fluoride on both sides, resistant to ultraviolet radiation

ELECTRICAL CHARACTERISTICS AT STC

	Hi-MO3m			Hi-MO4m		
	LR6-60HPH	LR6-60HPH	LR6-60HPH	LR4-60HPH	LR4-60HPH	LR4-60HPH
P_{mp} (W)	315	320	325	360	365	370
V_{oc} (V)	40.6	40.9	41.2	40.9	41.1	41.3
I_{mp} (A)	9.36	9.43	9.52	10.69	10.77	10.86
Eff (%)	19.0	19.3	19.6	19.3	19.5	19.8
Size / Weight	1672×991×35mm / 16.8kg			1776×1052×35mm / 20.0kg		
Cell Arrangement	10×6×2			10×6×2		

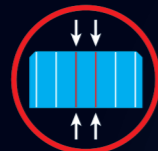
Technical data above mentioned may be of modification, please request for the latest datasheet.

60 / 72 HBD

BIFACIAL HALF-CELL MODULE (Hi-MO3, Hi-MO4)



Suitable for Utility Station and Distributed Flat Roof Station with High Albedo



The power output of bifacial half-cell module increases and energy yield is higher under high irradiance condition because of Low working current



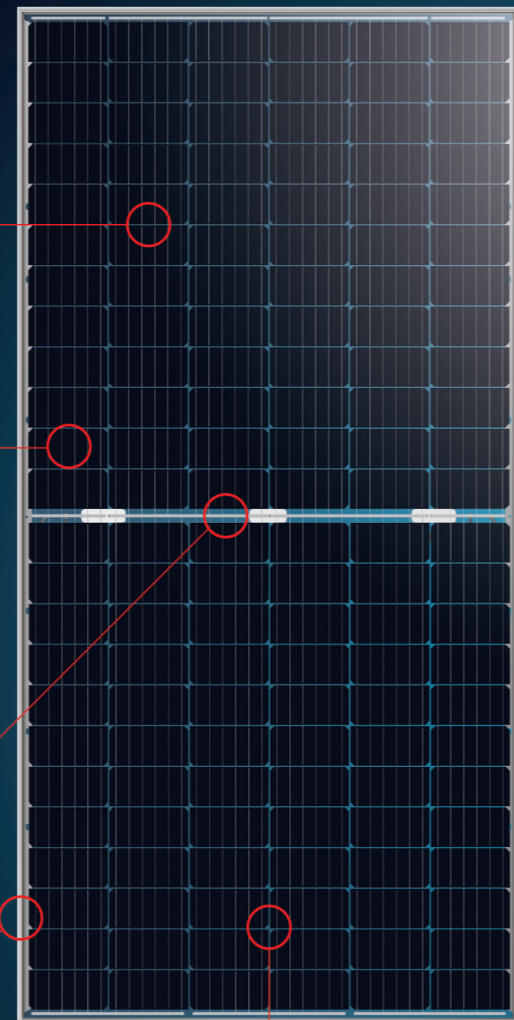
Cells with 6BB have better current collection ability



Unique parallel connection design, more energy output under non-uniform Incident illumination on the backside



Framed module, front / back side maximum static loading 5400 / 2400Pa, suitable for tracker
Cost can be reduced using 60 cells frameless module in low load condition



Cell efficiency >22%, anti-LID, anti-PID, 1st year degradation <=2%



Design of short frame without C side can reduce the shading caused by frame



The 33mm gap width coordinate with single axis tracker (such as NEXTracker) can reduce the shading



Split junction box, Cable Length 300mm (can be Customized)



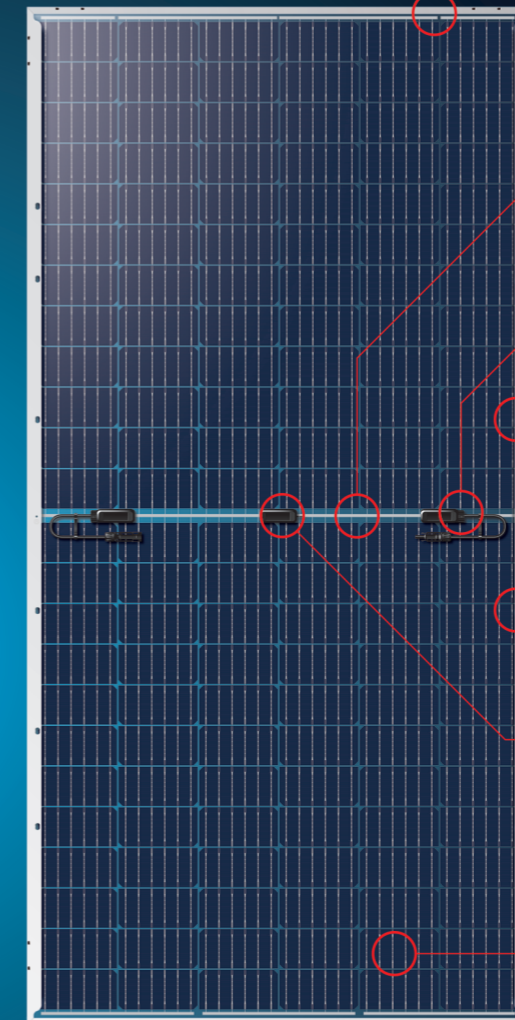
Mounting holes with 400mm distance are added to match the horizontal single axis tracker



Glass and junction box supporting 1500V system



The bifaciality is 80% when transparent glass is used on the back side. While the bifaciality is 75% and power of the front side is increased when white ceramic glass is used on the back side



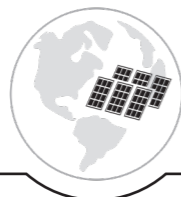
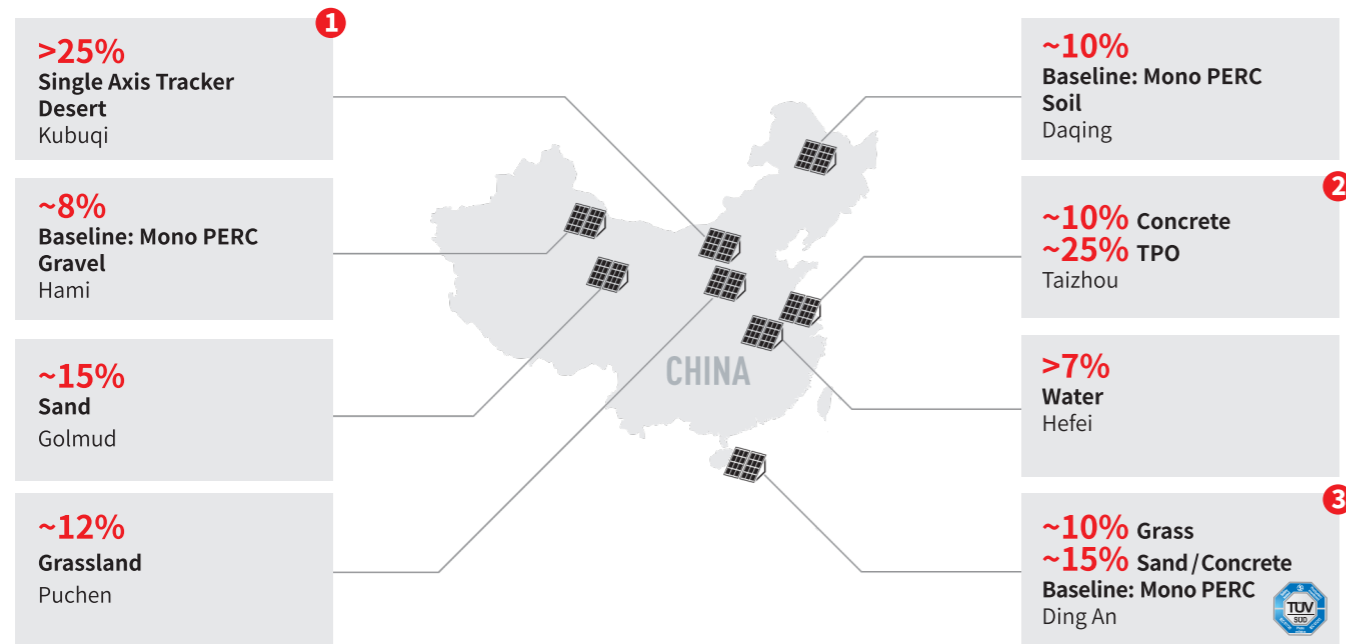
ELECTRICAL CHARACTERISTICS AT STC






Hi-MO3	LR6-72HBD			Hi-MO4	LR4-72HBD		
P_{mp} (W)	375	380	385	P_{mp} (W)	430	435	440
V_{oc} (V)	48.3	48.5	48.7	V_{oc} (V)	49.6	49.8	49.9
I_{mp} (A)	9.38	9.47	9.53	I_{mp} (A)	10.44	10.51	10.61
Eff (%)	18.6	18.9	19.1	Eff (%)	19.2	19.4	19.6
Size / Weight	2020×996×30mm / 26.3kg			Size / Weight	2131×1052×35mm / 29.5kg		
Cell Arrangement	12×6×2			Cell Arrangement	12×6×2		

Technical data above mentioned may be of modification, please request for the latest datasheet.

BIFACIAL CASE STUDY

BIFACIAL GAINS IN VARIOUS PLACES AND ENVIRONMENTS



Project location	Ground	Gain	Capacity	Baseline	Mounting	Statistical Period
Chennai, India 4 	White Gravel	20%	600Wp	Mono PERC	Fixed	Sept.2018
Thuwal, Saudi Arabia 	Sand	9%	600Wp	Mono PERC	Fixed	Sept.2018
Fremont, USA 	Light Asphalt	5.8%	1.8kWp	Mono PERC	Fixed	Aug. 2018~Oct. 2018
Livermore, USA 	Gravel	7.4%	2.1kWp	Mono PERC	Single axis tracker	Sep. 2018~Oct. 2018
Pahrump, USA 	Gravel	8.0%	2.8kWp	Mono PERC	Fixed	Oct. 2018~Jan. 2019



1 KUBUQI , ORDOS, INNER MONGOLIA, CHINA

Bifacial Module Type: 350Wp*960
Baseline: Poly module 310Wp, 80MWp
Installation: Bifacial module on tracker with 12 degree,
Poly module on fixed bracket
Completion Date: May.2017
Ground Condition: Desert
Module Height: The center height of oblique uniaxle is 2.9m
Energy Yeild: ~25%



2 TAIZHOU, JIANGSU, CHINA

Bifacial Module Type: 350Wp*8
Baseline: Poly module 270Wp*10
Installation: Fixed Bracket
Completion Date: Aug. 2017
Ground Condition: Concrete / TPO
Module Height: 1m / 2m
Energy Yeild: ~10 / 25%



3 DINGAN COUNTY, HAINAN PROVINCE, CHINA

Bifacial Module: 300Wp*10
Baseline: Mono PERC 300Wp*9
Installation: Fixed Bracket
Completion Date: Sep. 2018
Ground Condition: Grass / Concrete / Sand
Module Height: 1.5m
Energy Yeild: ~10% / ~15% / ~15%



4 CHENNAI, INDIA

Bifacial Module: 300Wp*2
Baseline: Mono PERC 310Wp*2
Installation: Fixed Bracket
Completion Date: Aug. 2018
Ground Condition: White gravel
Module Height: 1m
Energy Yeild: ~20%

REFERENCE PROJECTS



CALIFORNIA, USA
7.5MWp
 Module Type: LR6-72HV 340Wp
 Completion Date: Nov. 2017



MEXICO CITY, MEXICO
1MWp
 Module Type: LR6-72 340Wp
 Completion Date: Mar. 2018



VICTORIA, AUSTRALIA
30kW
 Module Type: LR6-60 290Wp
 Completion Date: Apr. 2018



TERNOPIL, UKRAINE
32.5kW
 Module Type: LR6-60PE 300Wp
 Completion Date: Jan. 2018



GOLMUD, QINGHAI, CHINA
20MWp
 Module Type: LR6-72BP 350Wp
 Completion Date: Dec. 2017



THE THIRD TOP RUNNER PROJECT IN SIHONG, JIANGSU, CHINA **275MWp**
 Module Type: LR6-60HBD 315Wp
 Completion Date: Oct. 2018

“SOLAR FOR SOLAR”

LONGi has selected Yunnan, China and Kuching, Malaysia as new facilities, to be powered by 100% hydro energy. The company believe in producing clean energy by using clean energy. In the near future, LONGi will combine solar power and energy storage to build Solar for Solar fabs, using solar power to produce solar products.

Solar for Solar is a perfect way to fully leverage the whole industry chain. Carbon emissions are zero throughout the entire process. Through the “Solar for Solar” model, we can continue to develop the solar industry and create more green energy.

