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 50GW 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.

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<table>
<thead>
<tr>
<th>Year</th>
<th>Total Revenue (B$)</th>
<th>Total Assets (B$)</th>
<th>Debt Ratio (%)</th>
<th>Mono Wafer Capacity (GW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>3.32</td>
<td>5.78</td>
<td>57.58</td>
<td>&gt;28</td>
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TIER 1

<table>
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<tr>
<th>Tier 1 Description</th>
<th>Data</th>
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<tr>
<td>BNEF</td>
<td>7.07</td>
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<tr>
<td>Module Shipment 2018</td>
<td>&gt;12</td>
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<tr>
<td>Module Capacity 2018</td>
<td>24.06</td>
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LONGi INDUSTRY CHAIN

- Mono Ingot
- Mono Wafer
- Mono Cell
- Mono Module
- Mono Photovoltaic Power Station

MODULE SHIPMENT OVER THE YEARS OF LONGi SOLAR

<table>
<thead>
<tr>
<th>Year</th>
<th>GW</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>0.7</td>
</tr>
<tr>
<td>2016</td>
<td>2.1</td>
</tr>
<tr>
<td>2017</td>
<td>4.5</td>
</tr>
<tr>
<td>2018</td>
<td>7.07</td>
</tr>
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</table>

*Based on the 2018 financial report of LONGi
WARRANTY

FIRST-YEAR POWER WARRANTY OF ≥98% FOR PV MODULES

Based on the advanced mono wafer and anti-LID technology, LONGi offers a first-year power warranty of ≥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.

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

“ALL QUALITY MATTERS” AWARD

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.

LONGi’s product center will also testify energy yield and degradation of various PV modules in out-door stations.
INGOT PULLING
RENDER PERC CELLS WITH HIGH EFFICIENCY AND LOW LID

As a leading company in monocristalline 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 monocristalline wafer in the industry. The 180μm and 150μm 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.
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.

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 TGP runner project in Sheng 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 90% 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 688 have better current collection ability.
- Unique parallel connection design, more energy yield in case of shading.
- 35mm frame, front / back side maximum static loading: 5400N/2400pa.
- Cell efficiency >22%, anti-LID, anti-PID, 1st year degradation <2%.

ELECTRICAL CHARACTERISTICS AT STC

<table>
<thead>
<tr>
<th></th>
<th>Hi-MO3m</th>
<th>LR6-60HPH</th>
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<tbody>
<tr>
<td>Pmp (W)</td>
<td>315</td>
<td>320</td>
</tr>
<tr>
<td>Voc (V)</td>
<td>49.6</td>
<td>49.9</td>
</tr>
<tr>
<td>Imp (A)</td>
<td>9.36</td>
<td>9.43</td>
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<td>Eff (%)</td>
<td>19.0</td>
<td>19.3</td>
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<tr>
<td>Size / Weight</td>
<td>1672x911x35mm / 16.8kg</td>
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<tr>
<td>Cell Arrangement</td>
<td>10x6*2</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>Hi-MO4m</th>
<th>LR4-60HPH</th>
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<tbody>
<tr>
<td>Pmp (W)</td>
<td>350</td>
<td>355</td>
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<tr>
<td>Voc (V)</td>
<td>46.5</td>
<td>46.7</td>
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<tr>
<td>Imp (A)</td>
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<td>10.60</td>
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<tr>
<td>Eff (%)</td>
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<td>19.0</td>
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<tr>
<td>Size / Weight</td>
<td>1776x1052x35mm / 20.5kg</td>
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<tr>
<td>Cell Arrangement</td>
<td>10x6*2</td>
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Technical data above mentioned may be subject to modifications, please refer to the latest database.
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 EBB 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 HEXTracker) can reduce the shading.

Split junction box, Cabkik 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

<table>
<thead>
<tr>
<th></th>
<th>Hi-MO3</th>
<th>LR6-72HBD</th>
<th>Hi-MO4</th>
<th>LR4-72HBD</th>
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<td>Pmp (W)</td>
<td>370</td>
<td>375</td>
<td>380</td>
<td>415</td>
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<tr>
<td>Voc (V)</td>
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<td>48.3</td>
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<td>Imp (A)</td>
<td>9.30</td>
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<td>Cell Arrangement</td>
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Technical data above mentioned may be of modification, please refer to the latest datasheet.
# BIFACIAL CASE STUDY

## BIFACIAL GAINS IN VARIOUS PLACES AND ENVIRONMENTS

<table>
<thead>
<tr>
<th>Project Location</th>
<th>Ground</th>
<th>Gain</th>
<th>Capacity</th>
<th>Baseline</th>
<th>Mounting</th>
<th>Statistical Period</th>
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<tbody>
<tr>
<td>KUBUQI, ORDOS, INNER MONGOLIA, CHINA</td>
<td>White Gravel</td>
<td>20%</td>
<td>600Wp</td>
<td>Mono PERC</td>
<td>Fixed</td>
<td>Sept. 2018</td>
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<td>TAIZHOU, JIANGSU, CHINA</td>
<td>Sand</td>
<td>9%</td>
<td>600Wp</td>
<td>Mono PERC</td>
<td>Fixed</td>
<td>Sept. 2018</td>
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<tr>
<td>DINGAN COUNTY, HAINAN PROVINCE, CHINA</td>
<td>Light Asphalt</td>
<td>5.8%</td>
<td>1.8kWp</td>
<td>Mono PERC</td>
<td>Fixed</td>
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<td>LIVERMORE, USA</td>
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<td>7.4%</td>
<td>2.1kWp</td>
<td>Mono PERC</td>
<td>Single axis tracker</td>
<td>Sep. 2018–Oct. 2018</td>
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<tr>
<td>PAHRUMP, USA</td>
<td>Gravel</td>
<td>8.0%</td>
<td>2.8kWp</td>
<td>Mono PERC</td>
<td>Fixed</td>
<td>Oct. 2018-Jan. 2019</td>
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</table>
**REFERENCE PROJECTS**

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

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

**VICTORIA, AUSTRALIA**
30 kW
Module Type: LR6-60FP 200Wp
Completion Date: Apr. 2018

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

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

**THE THIRD TOP RUNNER PROJECT IN SIHONG, JIANGSU, CHINA**
275 MWp
Module Type: LR6-60HBD 335Wp
Completion Date: Oct. 2018

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**“SOLAR FOR SOLAR”**

LONGi has selected Yunnan, China and Kuching, Malaysia as new facilities, to be powered by 100% hydro energy. The company believes 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.