WEBINAR:
PERC, monofacial and bifacial
Which PV modules offer you the best LCOE

LONGi

www.longi-solar.com

LONGi Green Energy Technology Co., Ltd

LONGi Silicon

LONGi Solar

Mono Power Plants

LONGi Energy

LONGi Milestones

Dedicated in Mono since 20 years

Feb. 2000
LONGi founded

Sept. 2007
Ningxia 1000T mono ingot fab completed

Apr. 2012
IPO on Shanghai Stock Exchange

Oct. 2013
Delivered 1GW mono wafer; Became the largest mono wafer supplier globally

Nov. 2014
LONGi Solar acquired; expanding into solar cell/module business

2019(est.)
Ingot / Wafer **36GW**
Module **16GW**

2021(est.)
Ingot / Wafer **65GW**

Largest Mono Wafer and Module Manufacturer

Accounts for 40% of mono wafer capacity in the world in 2019.

(Source: PV-infoLink 2018 global PV manufacturers capacity, production statistics)

Technology projections. Mono p-type

Trend: share of c-Si material types

- Mono P-Type being the mainstream technology for the coming years
- Poly becoming residual due to the limitations in technology
- Mono N-Type being more competitive in cost and grabbing market share along the time

- LONGi continues to develop and evaluate advanced technologies and will introduce the right Technology into production at the right time

Source: ITRPV 2019

Technology projections. Mono p-type

Efficiency and Power Evolution

LCOE Levelized Cost of Energy

INCURRED COST ALONG THE ENTIRE LIFE OF THE INSTALLATION AND THE ENERGY PRODUCED
Module as a reference

LCOE Levelized Cost of Energy. YIELD

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LCOE Levelized Cost of Energy

YIELD – Technology

CTM & Module design

Optical gain

- White EVA
- LRF
- Round ribbon
- Glazed glass
- ARC
- Cell to cell gap (Tiling & shingle)
- Bifacial

Electrical gain

- Half cutted cells +5W
- Tiling
- Shingle +15W
- Cell to cell gap (Tiling & shingle)
- MBB
- Bifacial up to 70%
- Splitted JB +1 to 2W

Degradation

- Low LID (Gallium)
- LIR
- WVTR Mono and bifacial
- Half cutted cells
- Materials: Backsheet

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LONGi spends 5-7% of its revenue on R&D. Total investments in the past 8 years reached $792M. We cooperate with research institutes on advanced PV Technology and product reliability and industrial partners

LCOE Levelized Cost of Energy YIELD – Reliability & Efficiency

R&D - Materials

Industrial Partner

HUAWEI 3M Heraeus DUPONT NEXTracker SUNGROW Soltec

Research Institutions

UNSW EPFL SERIS 中国电研 南京大学 IEECAS

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LCOE Levelized Cost of Energy YIELD – Reliability & Efficiency

Company financial health

Source: BloombergNEF

- LONGi obtained AAA rating of PV tech Financing in Q1/Q2 2020
- Ranked the NO. 1 in Bloomberg's financial health ranking of photovoltaic manufacturers

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LCOE Levelized Cost of Energy YIELD – Reliability & Efficiency

Yield and reliability tests

TOP PERFORMER
In PV Module Reliability Scorecard
2017~2019

DNV·GL
PVEL

HIGHEST POWER GENERATION
In PV Magazine Test
2019.6 to present

pv magazine test

ALL QUALITY MATTERS AWARD
Energy Yield Simulation 2017, 2018
Energy Yield Test 2019

All Quality Matters
TÜVRheinland

HIGH ACHIEVER
In PV Module Index
2019 (only two)

2019 PV Module Index HIGH ACHIEVER
LONGi Solar
RETC

PV Magazine Test

In **PV Magazine Test** power generation of LONGi's modules were significantly higher than the others

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LCOE Levelized Cost of Energy - SITE

Design

ELECTRICAL PARAMETERS

- Voc (72 vs 78) & String lenght
- High current & bigger wafer

Bifacial

- Albedo
- Clearance
- Pitch
- Electrical mismatching
- Bifacial gain
- Inverter de-rating

Degradation & losses

- Shade & Half cutted cells
- Leap frog connection
- Wiring protecction against humidity and UV

PERC Module Linear Power Performance Warranty

WARRANTY

12Y	MATERIAL& CRAFTWORK
10Y	POWER-OUTPUT >93.05%
25Y	POWER-OUTPUT >84.80%

Lower LID and slower power degradation enabled better warranty term: 1st year degradation <2%, 0.55% annually through 25 years

Bifacial Module Power Degradation Warranty

WARRANTY

12Y	MATERIAL& CRAFTWORK
10Y	POWER-OUTPUT >93.95%
30Y	POWER-OUTPUT >84.95%

1st year degradation <2%, 0.45% annually through 30 years

LCOE Levelized Cost of Energy. CAPEX

LCOE Levelized Cost of Energy. OPEX

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LCOE Levelized Cost of Energy YIELD – CAPEX & OPEX

Module design

392W	404.3W	414.3W	440.0W
72 half-cell power	+3.14%	+5.70%	+12.21%

- With using M6 wafer and mainstream PERC cell，440W+ module can be achieved
- The efficiency of 440W+ bifacial module --19.9%.

Excellent Power Generation Based on Low LID PERC Technology

Based on wafer-cell-module technology and quality control of industrial chain， Hi-MO series PERC module have excellent power generation and anti-LID performance.

Good performance at low irradiance

Low Power temperature coefficient

Low LID (includes LeTID)

Efficiency up to 21%, capacity over 30GWp

Increase String Capacity without Changing String Length

- Since the voltage of Hi-MO4 module remain same, the number of modules in one string will remain same, thus improve the power of one string greatly.
- Reduce the string number in same capacity, Meanwhile: 1.fixed mounting number, 2.pile foundation numer, 3.cable, 4.string inverter decrease significantly, which reduce the BOS cost for power station

Schematic figure: number of one sting 28, fixed mounting type 14×2.
The string length is typically 26-28 in 1500V system.

Compatible with Tracker and Save Cost

- Fixed mounting
- Single-axis tracker
- Floating
- Roof short side

Take 1P single-axis tracker for example:

[redacted]

Cell spec(mm)	Cell number	Tracker plan	Height(m)	String number	Pile number	Tracker+foundation cost
M2 156.75	72	A	1.5	28	12	Baseline
G1 158.75		B	1.5		12	-0.2 ¢ /W
163		C	1.6		13	-0.4 ¢ /W
M6 166		D	1.6		13	-0.6 ¢ /W

The BOS of 78 module is 0.1 cents/W higher than 72 module
The calculation is from NEXTracker

Compatible with String Inverter & Increase DC/AC Ratio

- Currently the maximum input current for string inverter is 13A, Hi-MO4 bifacial module can match with string inverter well considering the front irradiance a little bigger than 1000W/m2
- Hi-MO4 compared with modules using G1 wafer (158.75mm) , can reduce the cost of AC side equipment.

LR4-72HBD	Pmax(W)	440W	445W	450W
STC	Voc (V)	49.2	49.4	49.6
	Isc (A)	11.45	11.52	11.58
	Vmp (V)	41.0	41.2	41.4
	Imp (A)	10.73	10.80	10.87
10% Bifacial gain	Imp (A)	11.80	11.88	11.96

Module type	Hi-MO4	G1 72C	G1 78C
Power	440W	405W	440W
String Length (1500V)	28	28	26
Inverter Capacity / Input	225kW / 24		
DC Capacity	295.68	272.16	274.56
DC/AC ratio	1.31	1.21	1.22

Comparison of Main Products in Market (Bifacial Module)

- The upgraded Hi-MO4 has advantage in BOS cost 0.69 cents/W compared with the 72C-G1 module
- The calculation is based on fixed mounting and centralized inverter, if using tracker or string inverter the advantage of Hi-MO4 will be more obvious

Module type	G1 72C	G1 78C	Hi-MO4
Module Power	405W	440W	440W
1_{st} Year Degradation	2.5%	2.5%	2%
LID	0.5%	0.5%	0.45%
Voc	49.2V	53.3V	49.2V
String Number	28	26	28
Landscape Installation	14×4	13×4	14×4
BOS cost	Baseline	-0.14 ¢/W	-0.69 ¢/W

Calculation location: Shaoguan, Guangdong, China

New Product Outlook

Hi-MO5

Stay tuned

Schematic diagram

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Technology Strength
is the best warranty for Financial Health, Green Product and Green Manufacturing

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The World Leading Solar Technology Company