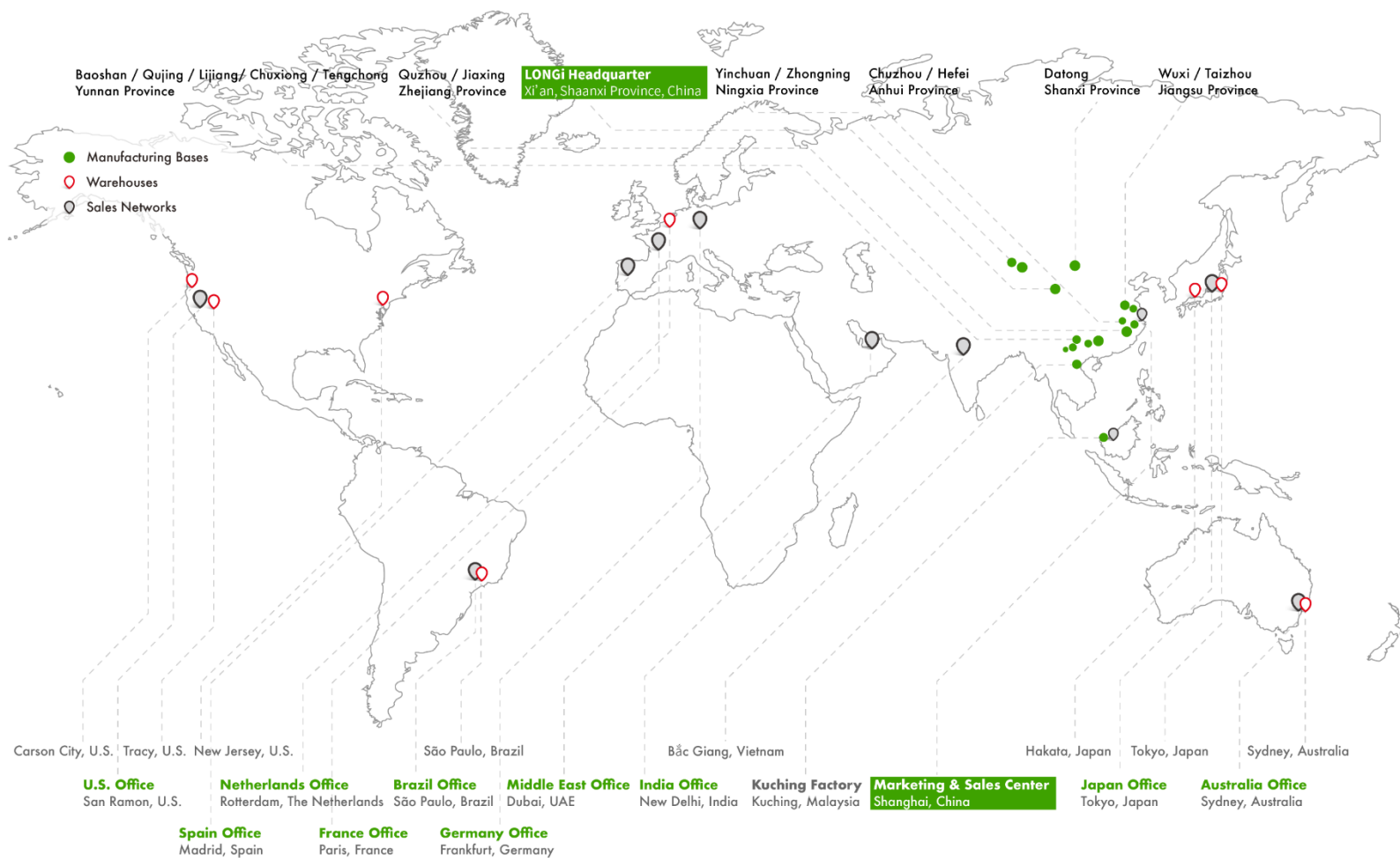


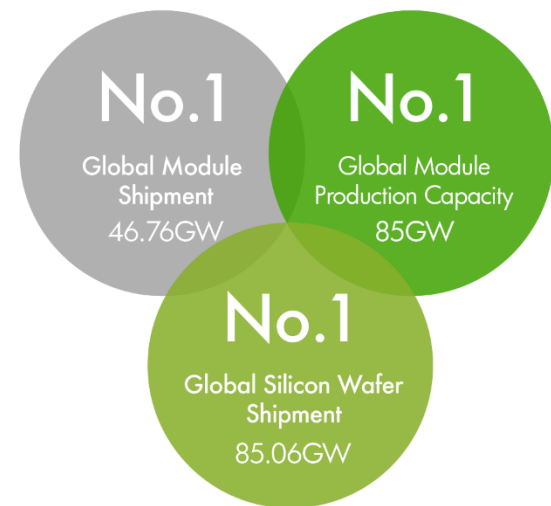
MODULE RELIABILITY CONTROL FOR HARSH ENVIRONMENTS

SHEN, PEIJUN
Product Marketing EU
LONGi Solar Technology Co., Ltd.
Email: peijunshen@longi.com

WE COMMIT OURSELVES TO GLOBAL CLEAN ENERGY DEVELOPMENT AND CONTINUE TO LEAD

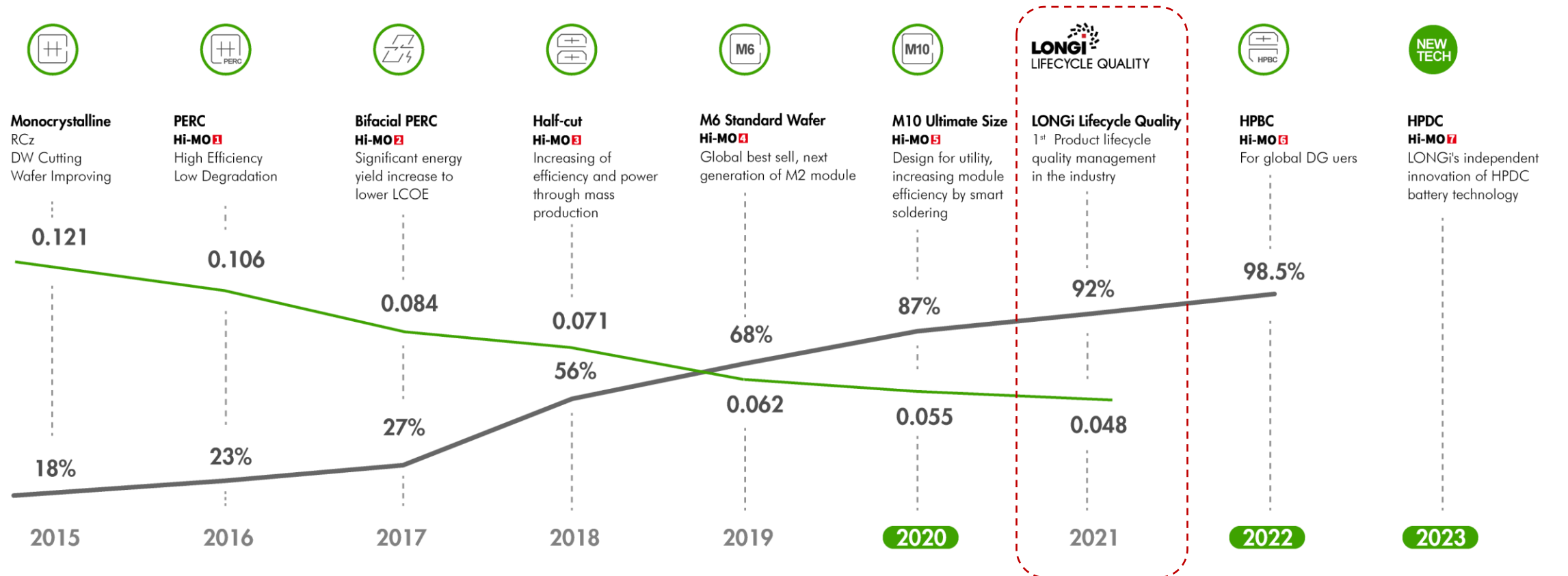


As global energy technology leader, LONGi has largest contribution in PV supply, as well as full local customer and community network



NOTE During 2022.1.1-2022.12.31

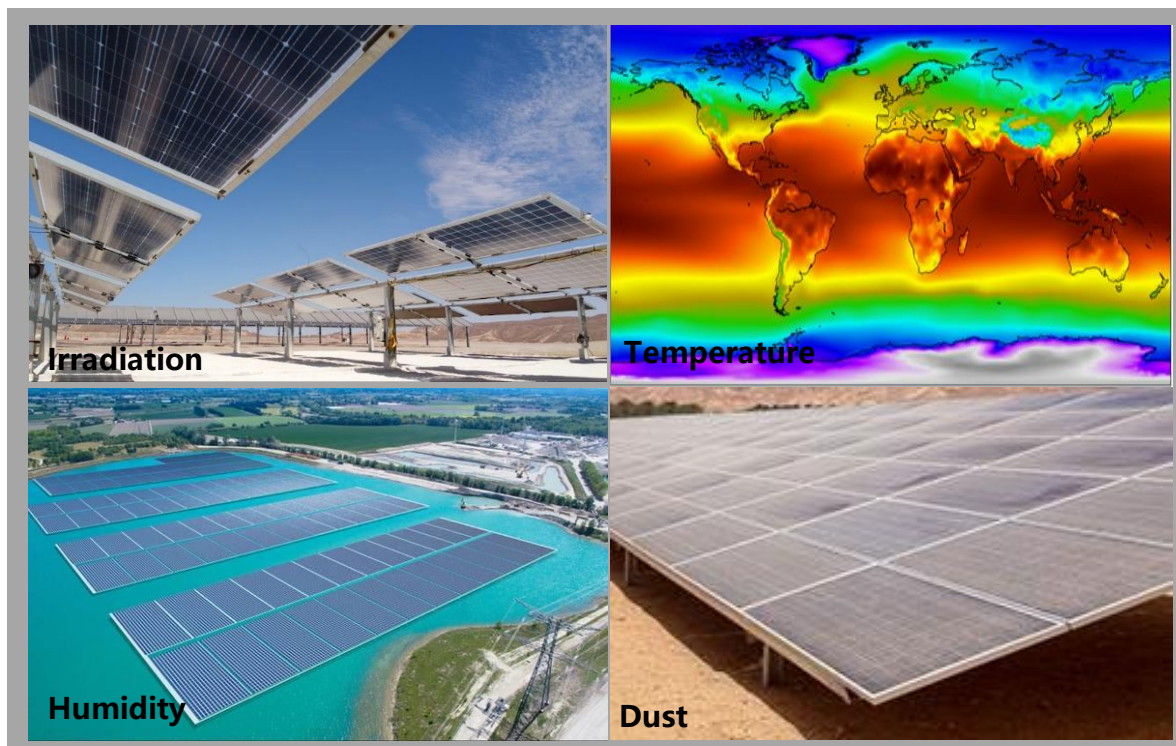
OUR INNOVATION WILL BE RAPIDLY TRANSFORMED TO THE ACCELERATOR OF THE INDUSTRY EVOLUTION



LONGi's Mono Technology Led the PV industry into monocrystalline era
M6 Wafer Standard Led the industry into the high power era
M10 Wafer Standard Led the industry into the era of the large module and standards

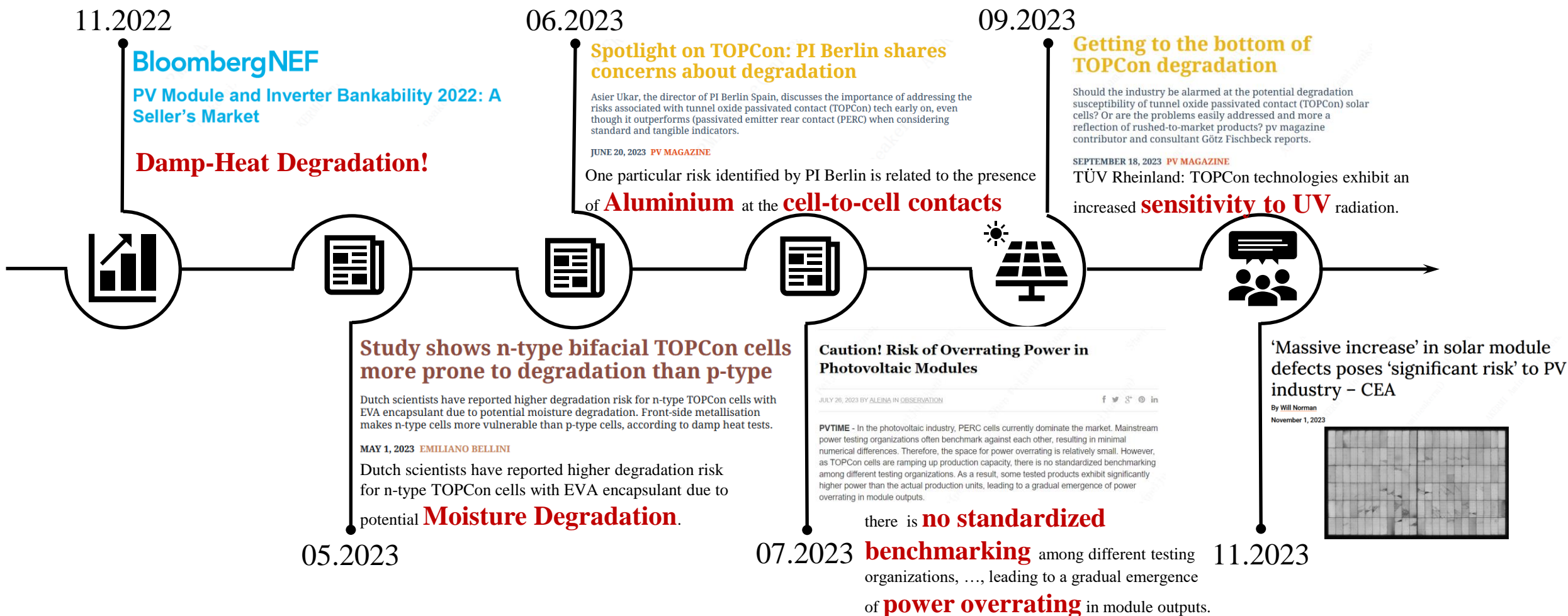
— Market share of monocrystalline products
 — Global utility-scale solar PV project LCOE(USD/KWH)¹
 1 - Source IRENA

Modules are Subjected To Various Environmental Impacts During Lifetime



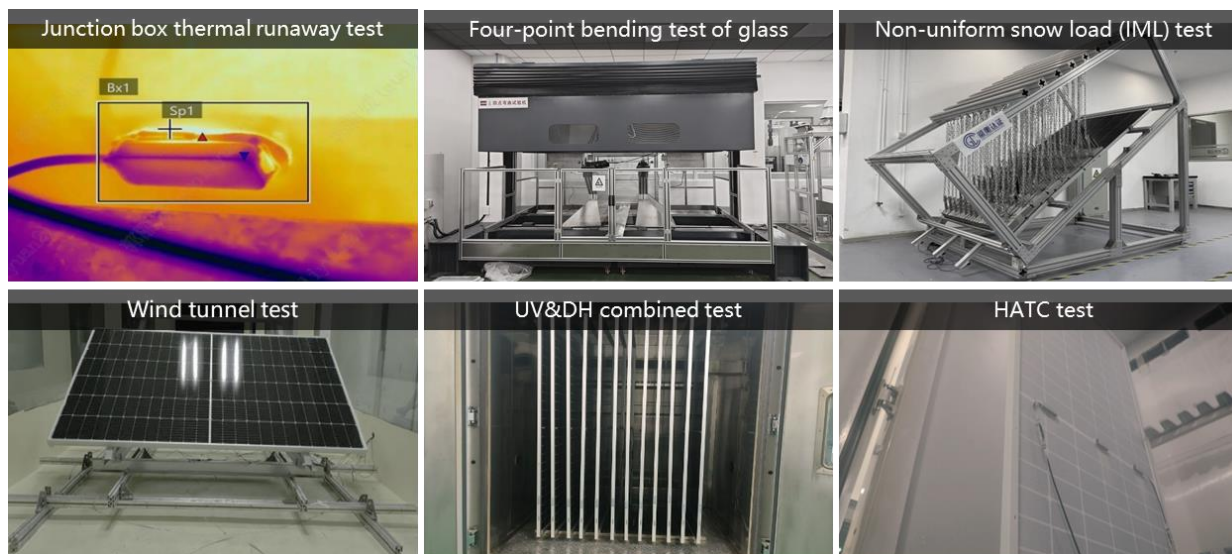
Environmental Factors	Effects on PV Module
Solar Exposure	light-induced degradation of cell efficiency
Temperature Variation	the failure of welded circuit connections, exacerbate cracks in solar cells, junction box and module connection failures
Hot Spot	localized overheating in modules, causing hot spot failure
Electrical Potential	failure of solar cells due to the system voltage
Shading	overheat of diodes, resulting in excessive voltage drop and high leakage current
UV Aging	encapsulation failure by yellowing of EVA, embrittlement of sealing compound, and aging of back sheets
Hot& Humid/ Damp & Freezing	glass fogging, encapsulation failure, corrosion, and the failure of junction boxes and module connections
Dynamic Mechanical Load	cracks in solar cells

Here is An Example for TOPCon Technology: Many Potential Risks of TOPCon Have Been Exposed In the Past Year



LONGi LIFECYCLE QUALITY Guarantees Long Term Reliability of Products

LONGi LIFECYCLE QUALITY ensures high reliability throughout the entire life cycle, covering design, materials, manufacturing, demonstration, and value-added services. It includes Threther tests and comprehensive aging tests for materials and products to ensure their reliability in extreme weather conditions. Longi products have demonstrated clear performance advantages compared to others in third-party testing and power generation demonstrations.



Award-Winning Reputation



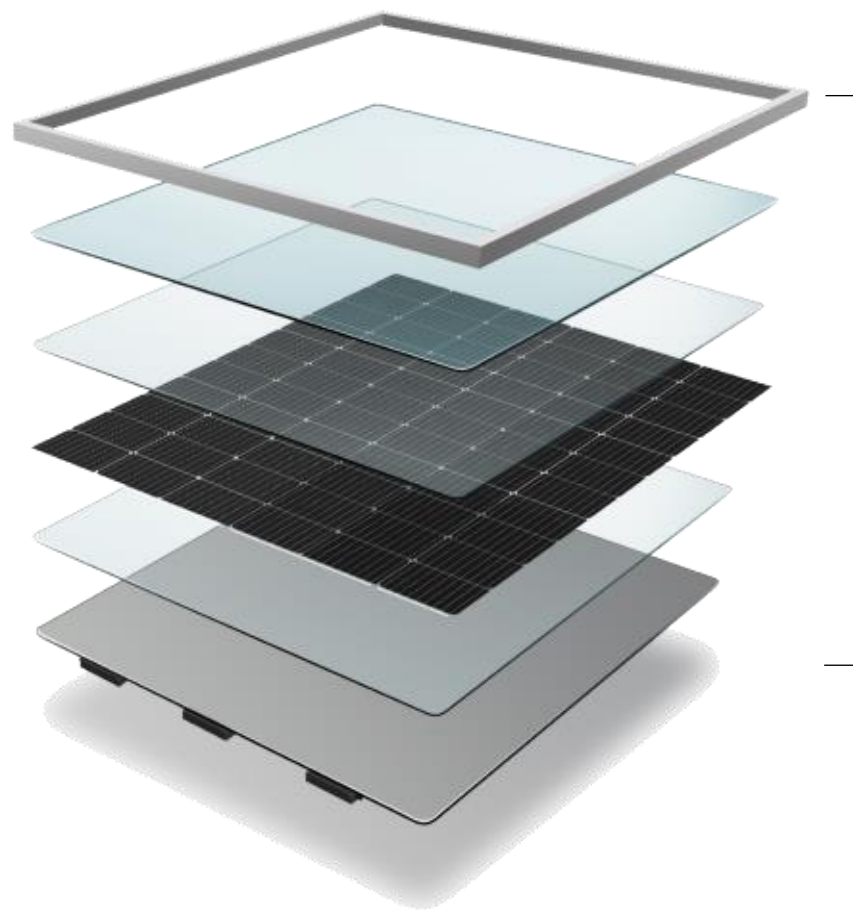
2019 - 2023

"Highest Achiever" award for five consecutive years.

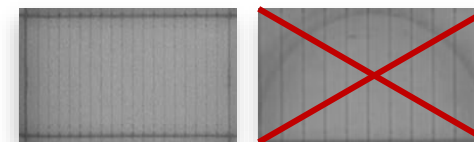


Standards	61215	63209-1	PVEL	RETC
Test Protocol	TC200	TC200*3	TC200*3	TC200*4
	DH1000	DH2000	DH2000	DH2000
	UV15 +TC50 +HF10	DH200 +(UV60+TC50+HF10)*3 +UV6.5	DH1000 +(UV65+TC50+HF10)*3 +UV6.5	UV45 +UV45
	SML +TC50 +HF10	SML +DML +TC50 +HF10	SML +DML +TC50 +HF10	SML +DML +TC50 +HF30
	PID96	PID96*2	PID96*2	PID96*3
	/	/	LeTID 162*3 (75°C)	LeTID 162*2+500+162*2 (75°C)
Comments	Standard	Guarantees Long Term Reliability		

Cases Study of Enhance Reliability Performance of Hi-MO7 as an Example

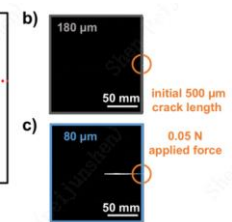
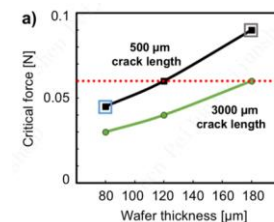


Wafer ✓ Grade A+ silicon wafer quality



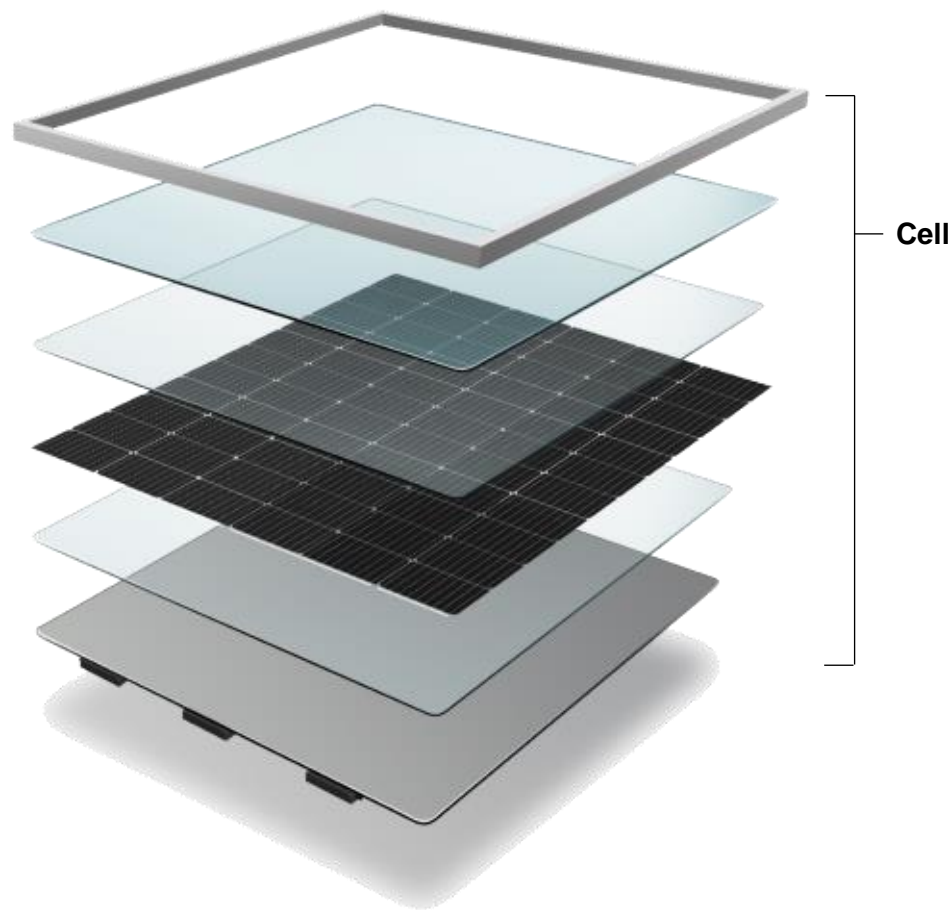
reduces oxygen content resulting in no 'Striation Ring' and low LID performance

✓ 140um wafer thickness

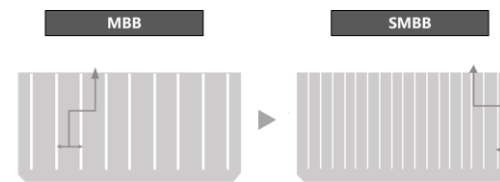


Avoiding Crack Propagation Risk from Aggressive Thin Wafer

Cases Study of Enhance Reliability Performance of Hi-MO7 as an Example

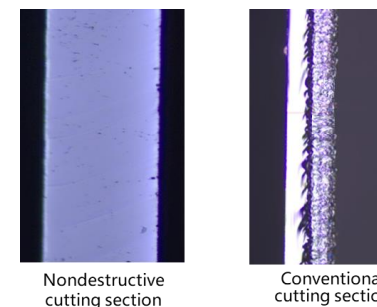


✓ SMBB technology



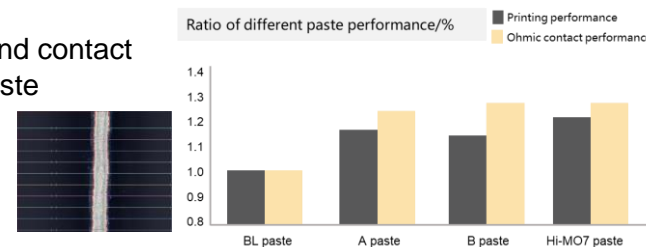
18BB grid line, 19 zones, to decrease the **cracked sensitivity** 5.3% and improve the reliability of the module **ML/TC200**

✓ Nondestructive cutting technology



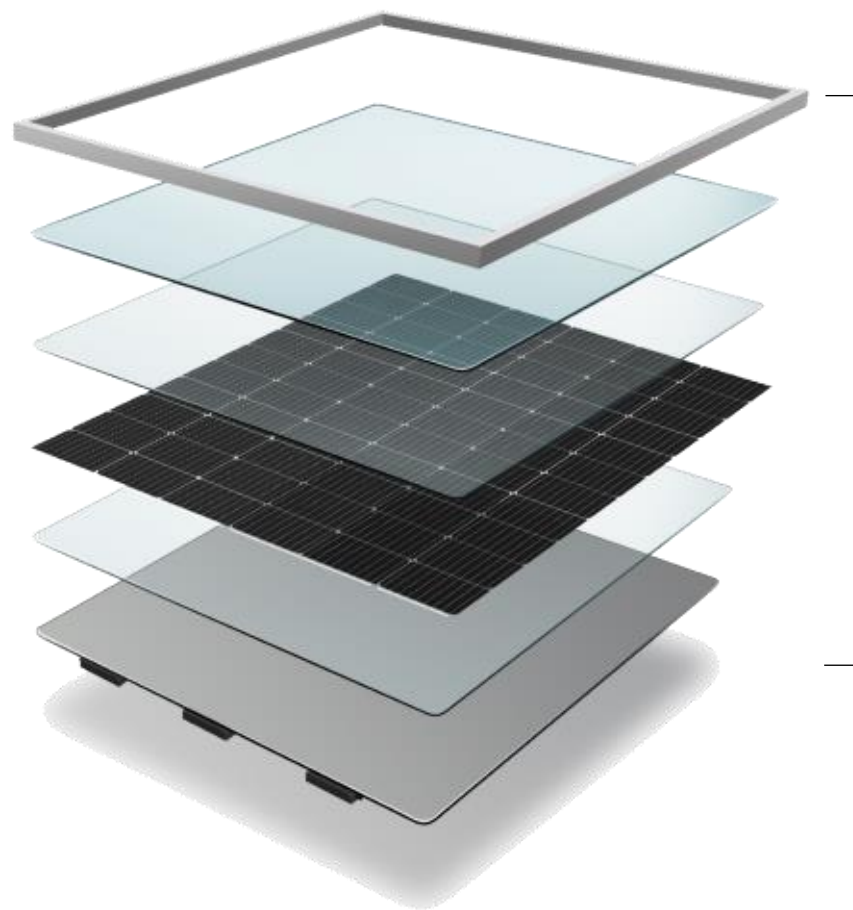
The section is smooth, which significantly reduces **micro cracks** risk

✓ Improve printing and contact performance of paste



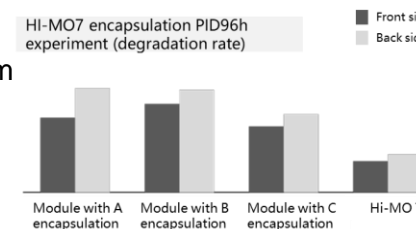
Improve **DH1000** performance

Cases Study of Enhance Reliability Performance of Hi-MO7 as an Example



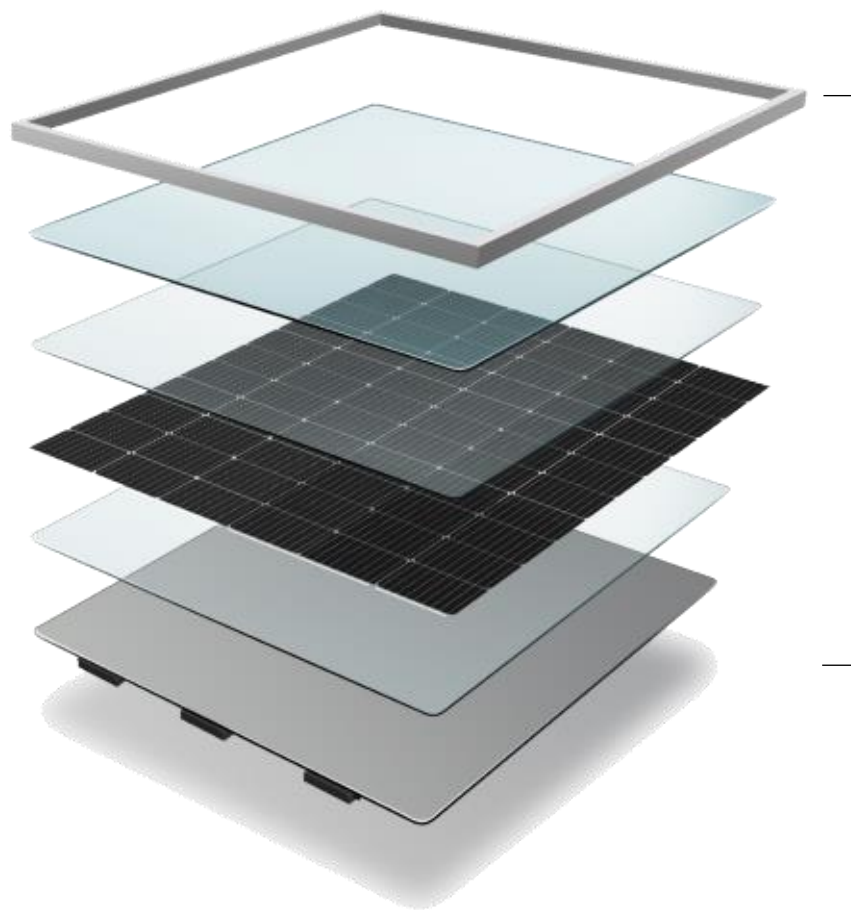
✓ Optimization of encapsulation system

Encapsulation



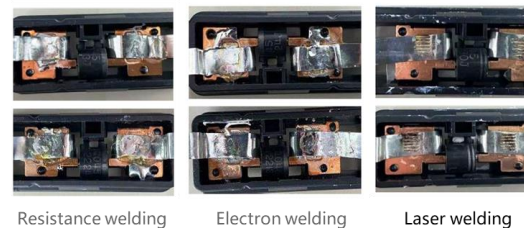
The gram weight of adhesive film increased by 5%
the UV aging resistance increased by 5%
the PID resistance increased by 8%

Cases Study of Enhance Reliability Performance of Hi-MO7 as an Example

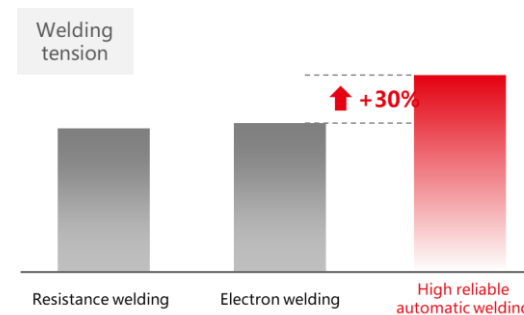


Junction Box

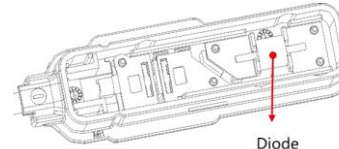
✓ automatic welding



Highly reliable automatic welding & full AI visual quality inspection ensures that the welding is robust. After PCT48 × 3, TC200 × 3, the welding line is clear



✓ Safe Margin for Diode



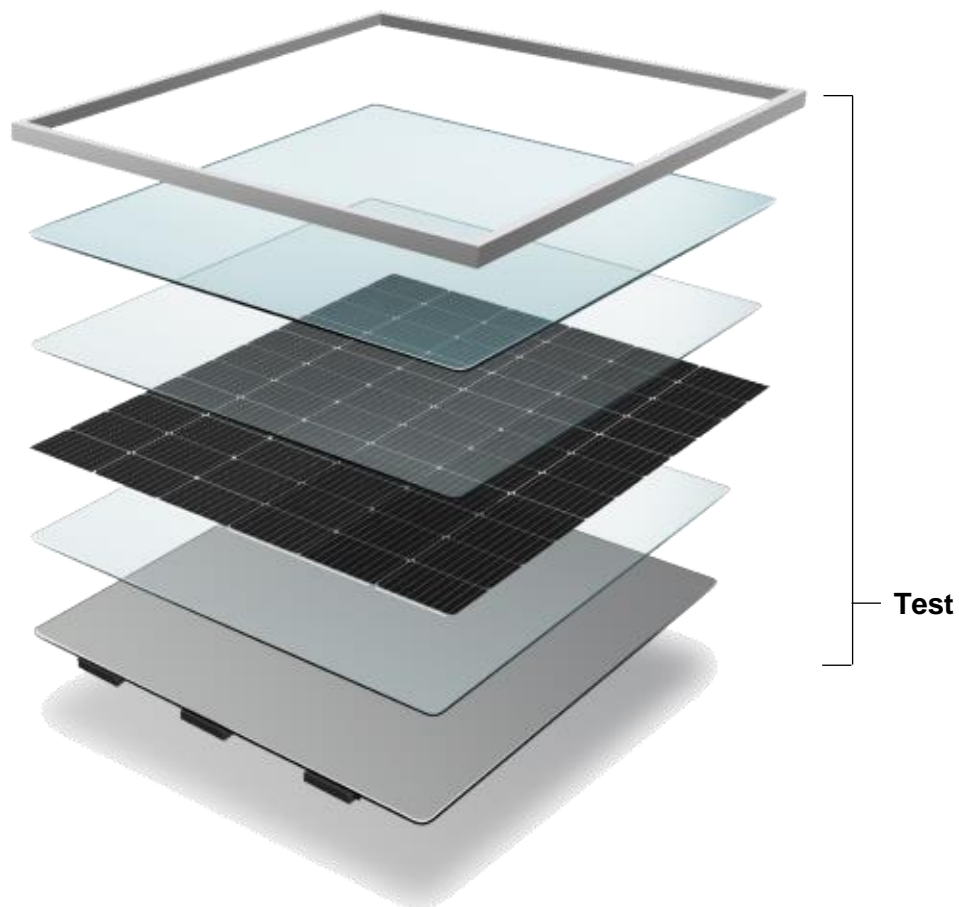
Module Type	Wafer Size	Isc(A)	(1 + 30%*80%)*1.25*Isc	Junction box current(A)	Safety margin
LONGi LR5-72HGD	182*183.75	14.30	22.17	25	12.8%
LONGi LR7-72HGD	182*191.6	14.70	22.79	25	9.7%
A Company	182*210	15.90	24.65	25	1.4%
B Company	210*210	18.18	28.18	30	6.5%

Cases Study of Enhance Reliability Performance of Hi-MO7 as an Example

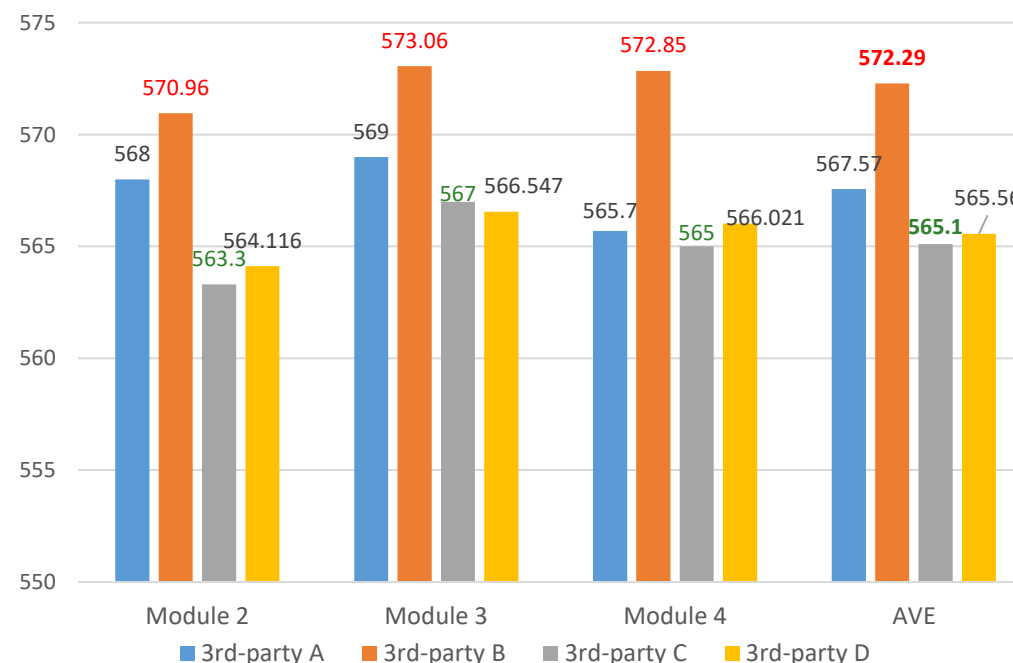
✓ Strict Golden Modules

No.	Module Type	Serial Number	3 rd -party A	3 rd -party B	3 rd -party C	3 rd -party D
1	LR5-72N-type Bifacial-555M	LRRI04*****0028	555.9	562.76	553.7	557.586
2	LR5-72N-type Bifacial-565M	LRRI04*****0012	568	570.96	563.3	564.116
3	LR5-72N-type Bifacial-565M	LRRI04*****0039	569	573.06	567	566.547
4	LR5-72N-type Bifacial-565M	LRRI04*****0037	565.7	572.85	565	566.021
AVE Difference			2.15	7.41	-0.25	1.09

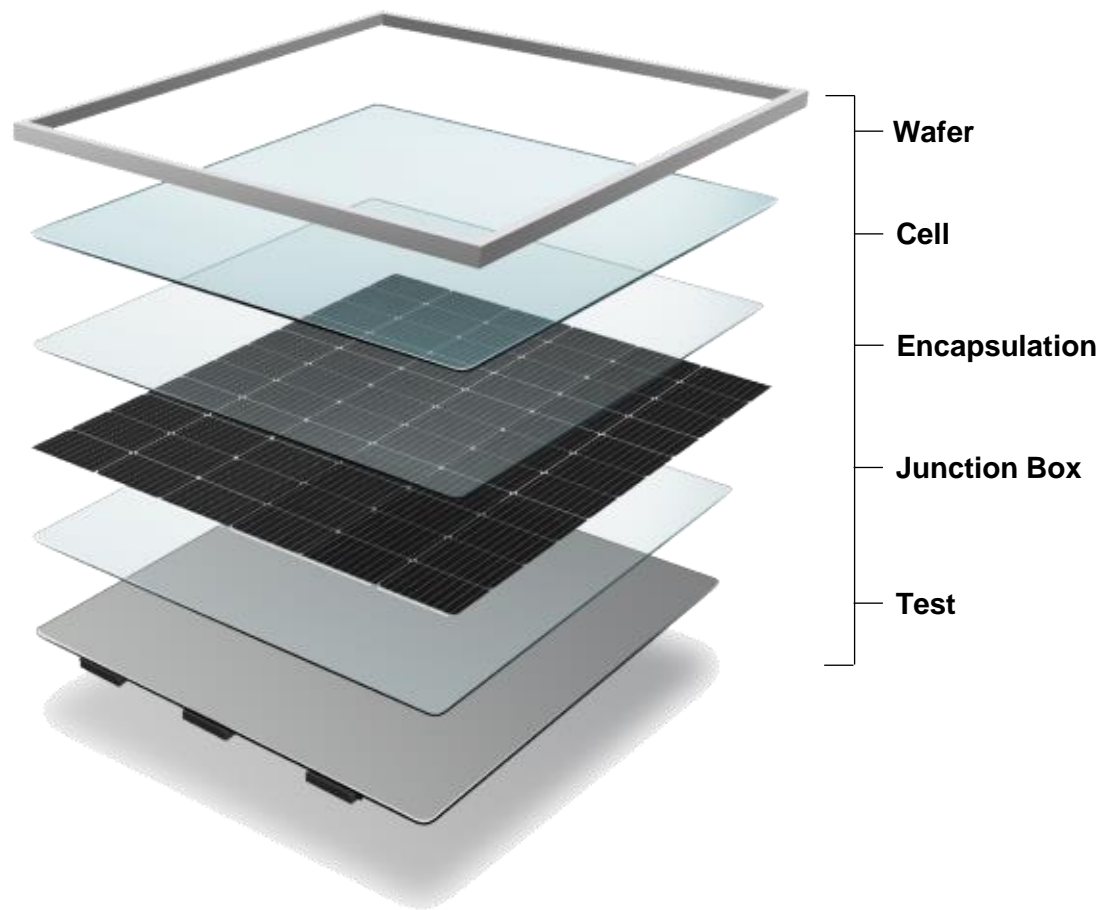
LONGi chooses the strictest 3rd-party C golden module for Avoiding the Risk of 'Overrate'



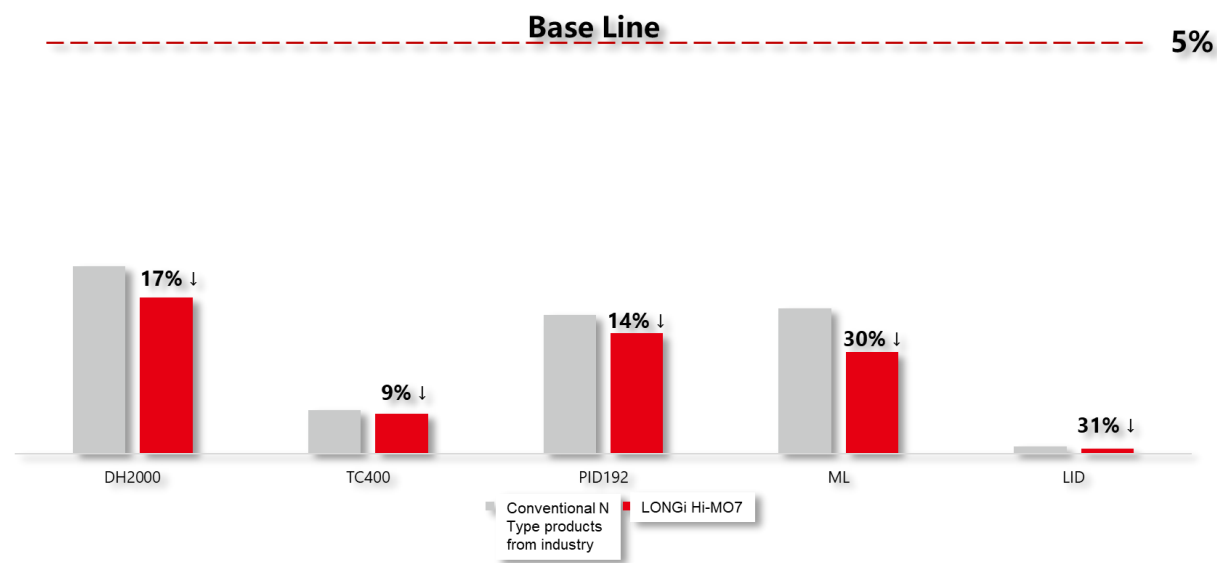
The power results given by 4 3rd-parties of the same one module



Cases Study of Enhance Reliability Performance of Hi-MO7 as an Example

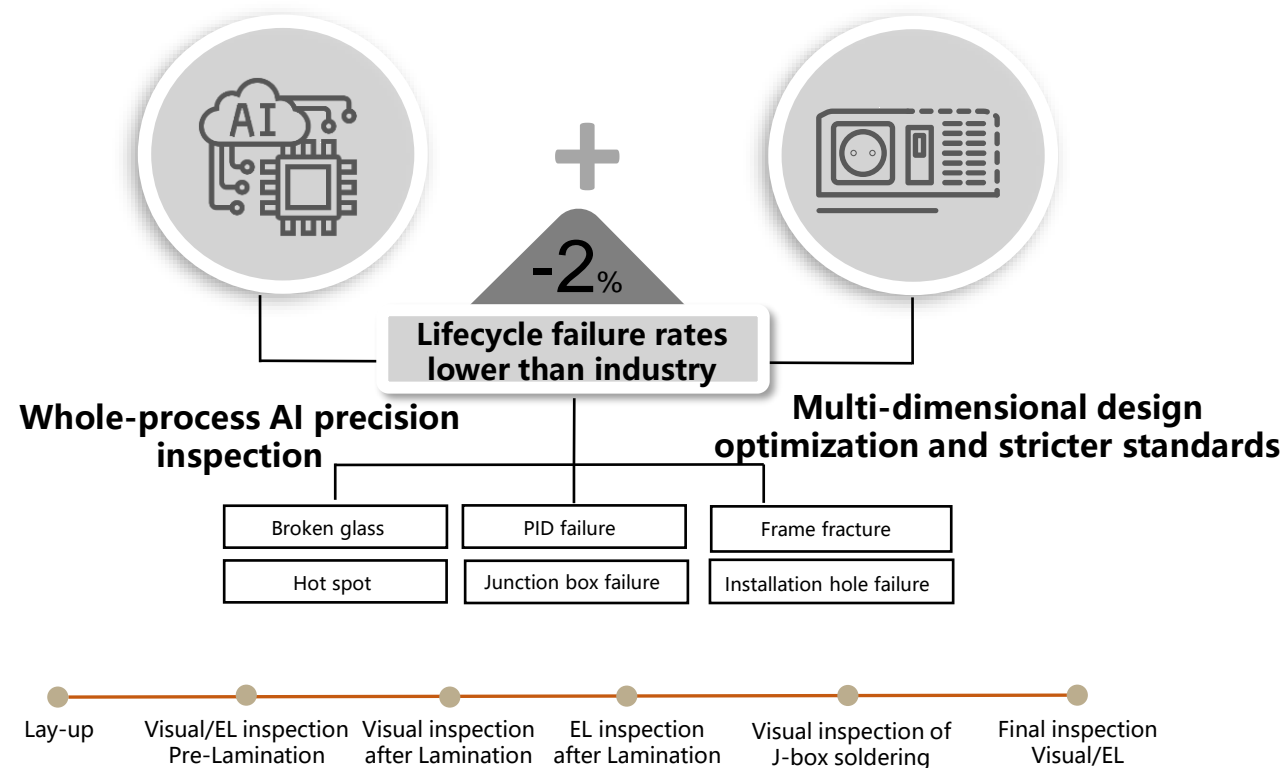
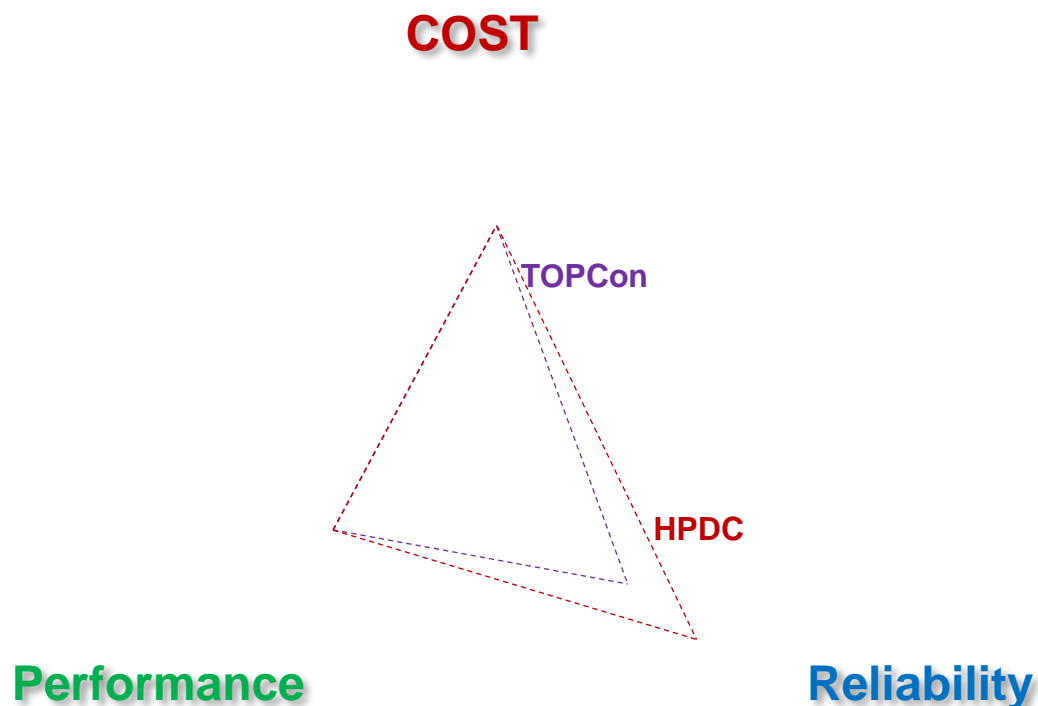


Power Degradation of HiMO7 after IEC x2 Tests



LONGi Lifecycle Quality Improve the Resistance of Product from Environmental Attack

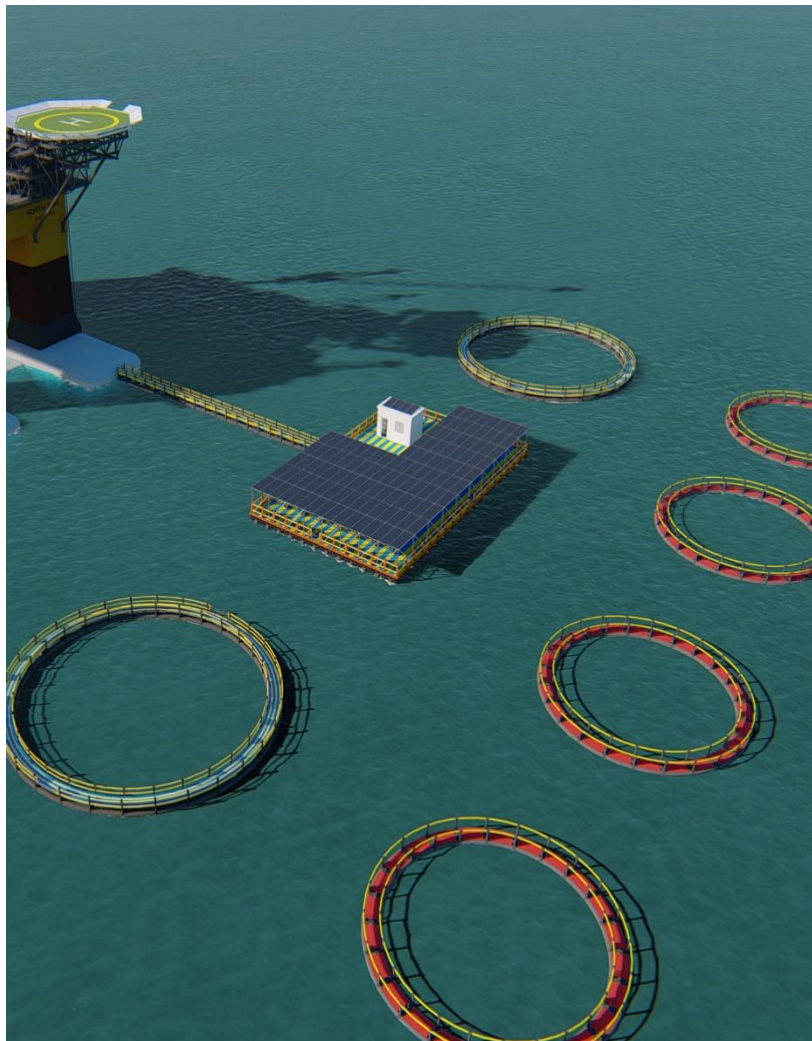
Nearly 200 pieces of high-quality data are automatically analyzed and evaluated intelligently, the detection efficiency has increased by 25%. The implementation of this measure effectively reduces the industry's NG missed detection rate by approximately 4%, thereby ensuring lower failure rates for Hi-MO7 at PV power plants.



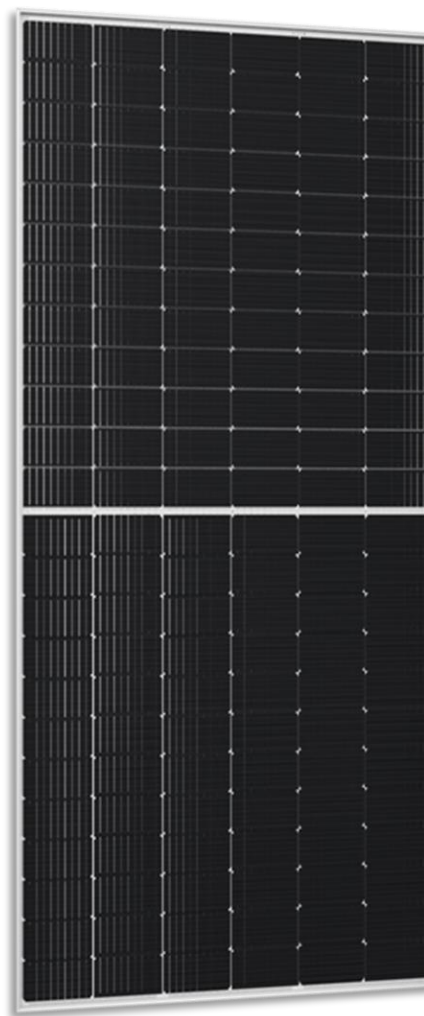
Special Case in Offshore Environment

Areas	<50m Range of the Coastline	Intertidal Zone	Nearshore	Deep-Sea
Mounting structure	Pile-mounted	Pile-mounted	Pile-mounted/Floating	Floating
Area for setting modules	Atmosphere	Atmosphere	Atmosphere /Sea Spray zone	Sea Spray zone
Humidity	High humidity	High humidity	High humidity	High humidity
Salt spray Level	High	High	High	High
Corrosion Level	Very high (C5)	Very high (C5)	Extreme High (CX)	Extreme High (CX)
Impact of extreme weather	Small	Large	Large	Large
Probability of being struck by waves	N/A	N/A	N/A/Large	Large
Probability of being submerged	N/A	N/A	N/A/Large	Large

Longi Offshore PV Modules Solution



Hi-MO 7



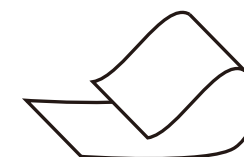
Update



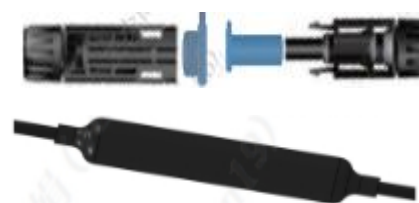

Composite frames



Specialized Coated Glass



Waterproof Film materials



IP68 Junction box
+ Dust Cap
+ Water-Proof Jacket



High performance
waterproof sealant

LONGI