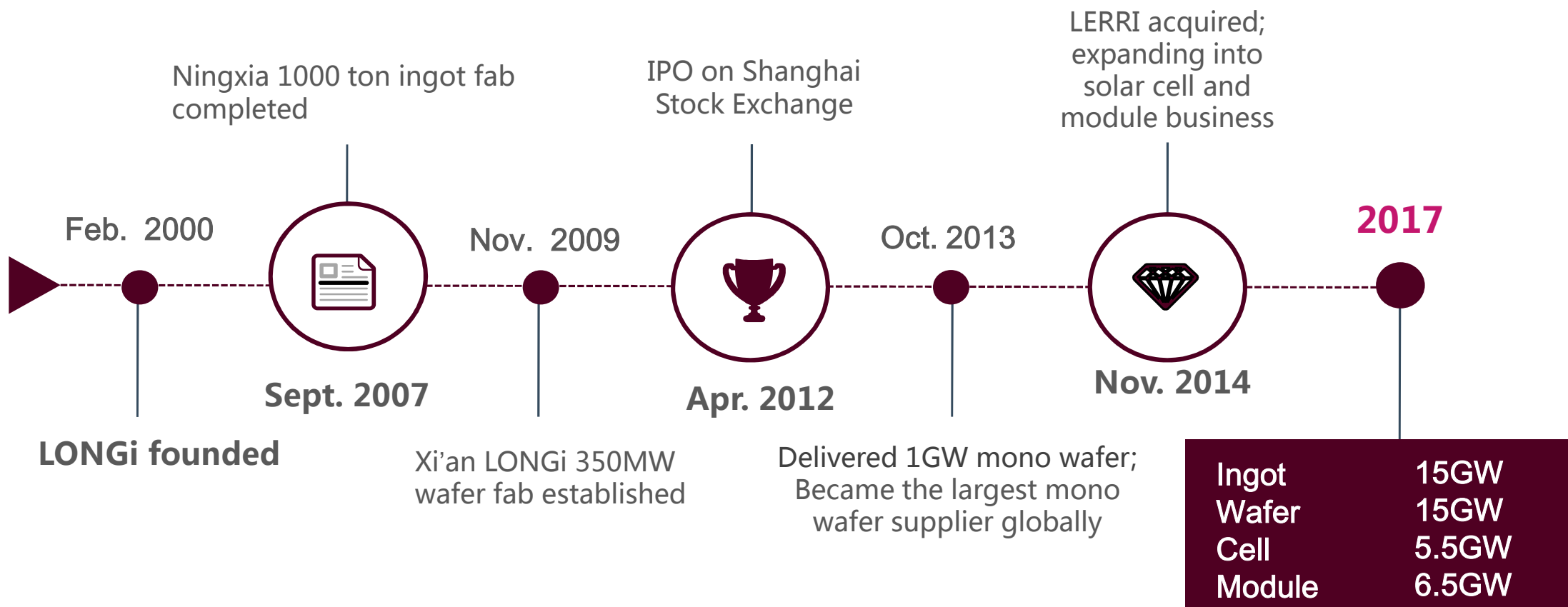




# LONGi Solar Introduction and Technology Roadmap

# LONGi Solar Milestone

**LONGi**Solar

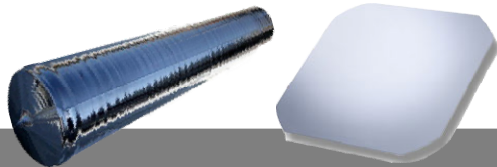


# LONGi Green Energy Technology Company

Total  
Employee  
~18000

**LONGi** Silicon

Mono Ingot Mono Wafer

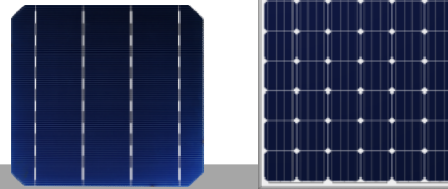


Founded in 2000, Xi'an LONGi Silicon Materials Corp. is the largest mono crystal manufacturer in the world. It provides high-quality products and services for photovoltaic and semiconductor industry; It was renamed LONGi Green Energy Technology Co. Ltd. in 2017

**LONGi** Solar

Mono Module

Mono Cell



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

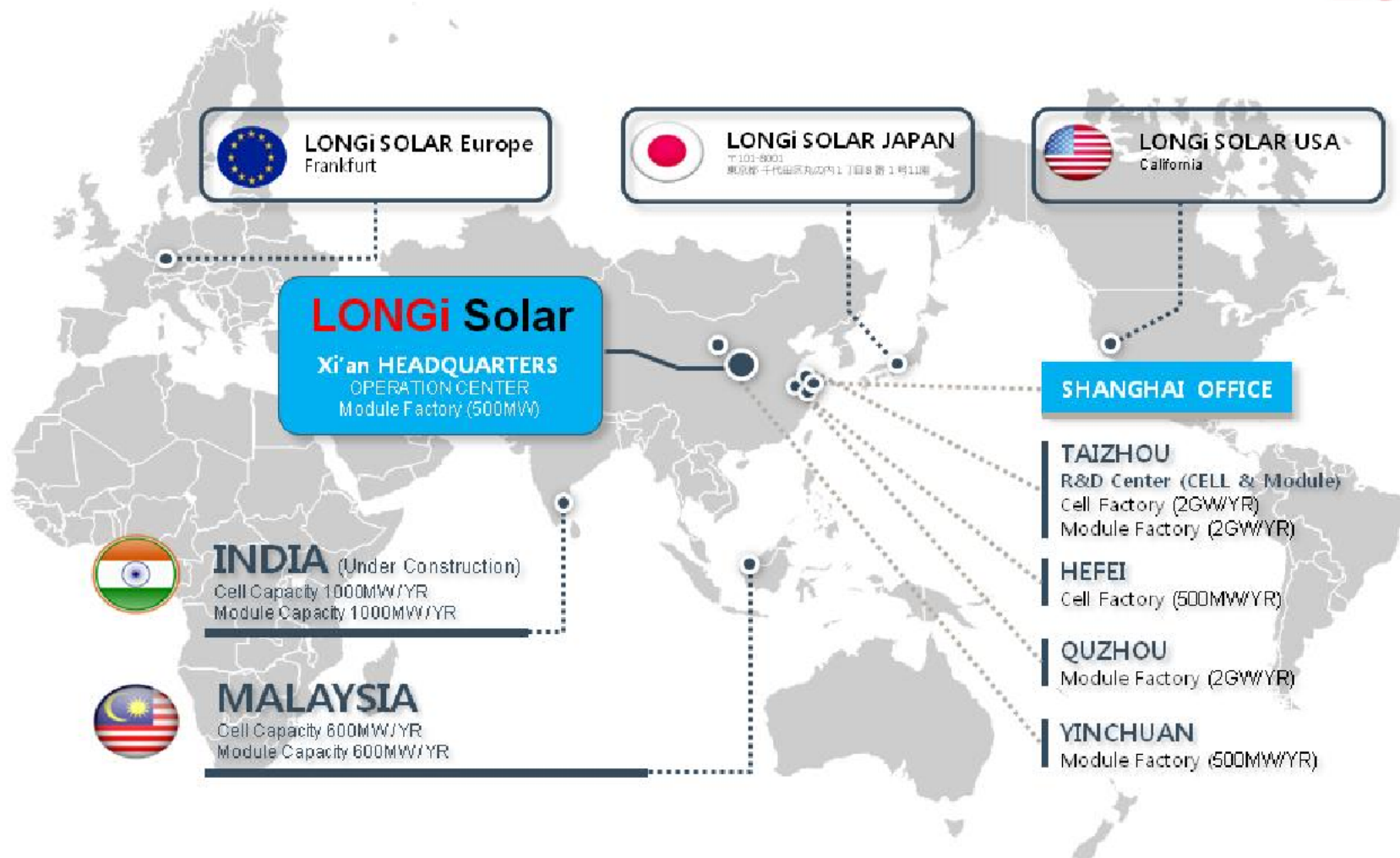
**LONGi** Energy

Mono Power Plants



# Global Presence

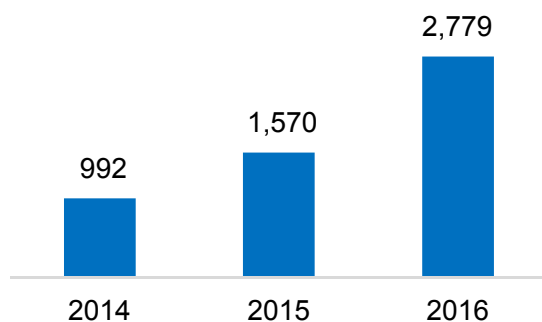
**LONGi**Solar



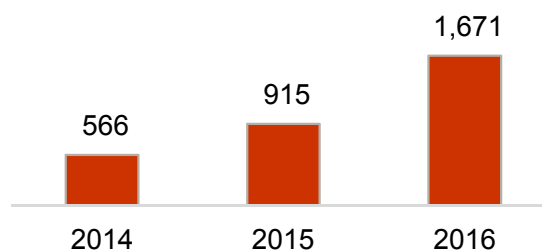
# Financial Strength

**LONGi**Solar

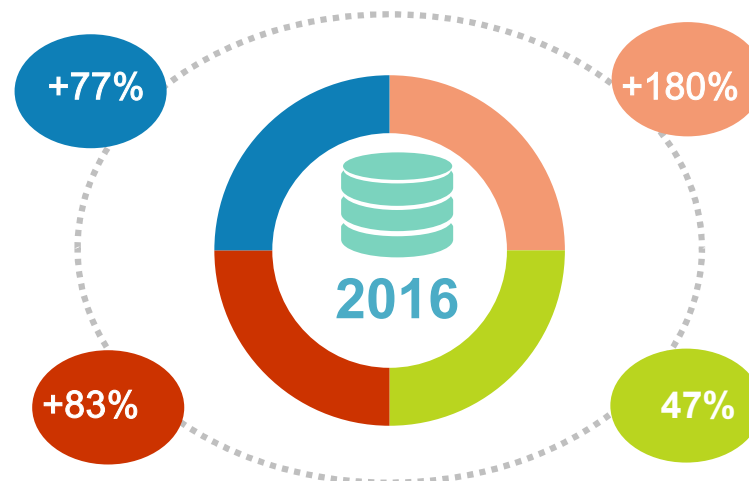
Total assets (Million USD)



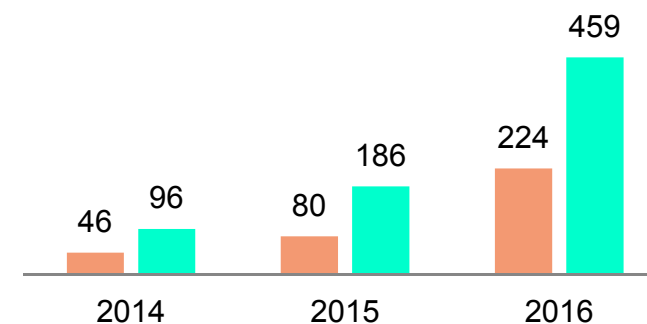
Revenue (Million USD)



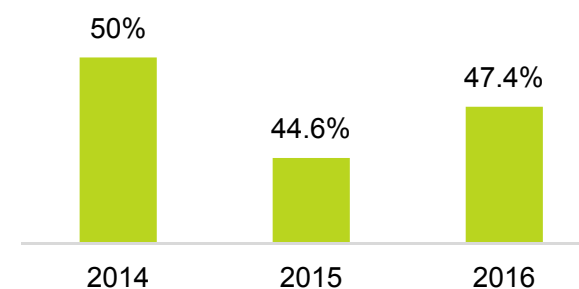
**Market Cap**  
**>US\$11B**  
as of 12/31/2017



Net Profit (Million USD)  
Gross Profit (Million USD)



Debt Ratio



# Financial Strength

## Morgan Stanley (April 18, 2017) Prefer Cost and Technology Leaders Amid Dark Times for Solar

Stock ideas	Rating	Investment thesis
China Stocks		
Longi (601012.SS)	<b>Overweight</b>	1. leading mono c-Si player; strong growth momentum gaining market share from multi c-Si products; in addition, mono c-Si product price is strong in 2017 due to supply shortage, though the overall market is in oversupply; 2. Healthy balance sheet; 3. Coming catalysts: strong 1Q17 result; new 5GW capacity to ramp up gradually from late April to year end

	Longi 601012.SS	A	B	C	D	E	F
Rating	Overweight	Overweight	Overweight	Overweight	Equal-weight	Equal-weight	Underweight
Trading Currency	CNY	USD	USD	USD	USD	USD	USD
Price Target	22.9	8	28.3	19.4	32	6	11.3
Current Price	16.2	5.23	19.1	17.0	27.42	6.52	13.1
Upside/Downside (%)	41%	53%	46%	14%	17%	-8%	-14%
Market Cap (in USD mm)	4,337	556	199	577	2853	903	790
Average Daily Traded Vol (in USD mm)	42	7	0	2	2.5	2.5	25
Bull Case Value	28.7	15	35.0	25.5	43	11	20.0
Upside (%)	77%	206%	83%	50%	57%	69%	53%
Bear Case Value	11.1	2	11.0	10.0	21	1	7.0
Downside (%)	-31%	-62%	-42%	-41%	-23%	-86%	-47%
Risk/Reward Skew	2.5	3.3	2.0	1.2	2.5	0.3	1.1
Morgan Stanley Estimates							
FY16e	CNY	USD	USD	CNY	USD	USD	USD
Sales	11,420	464	229	21,401	2,061	2,703	2,863
EBITDA	2,550	-111	96	2,252	556	164	162
COIT	2,151	-215	65	1,475	325	-11	03
EPS	0.64	0.87	4.15	30.14	5.17	-0.46	1.02
FY17e	CNY	USD	USD	CNY	USD	USD	USD
Sales	15,064	731	283	24,026	2,862	2,306	4,432
EBITDA	3,257	51	175	1,604	265	189	236
EBIT	2,573	-79	82	1,039	48	16	142
EPS	0.90	2.19	5.38	17.06	0.37	0.12	1.46

### Market

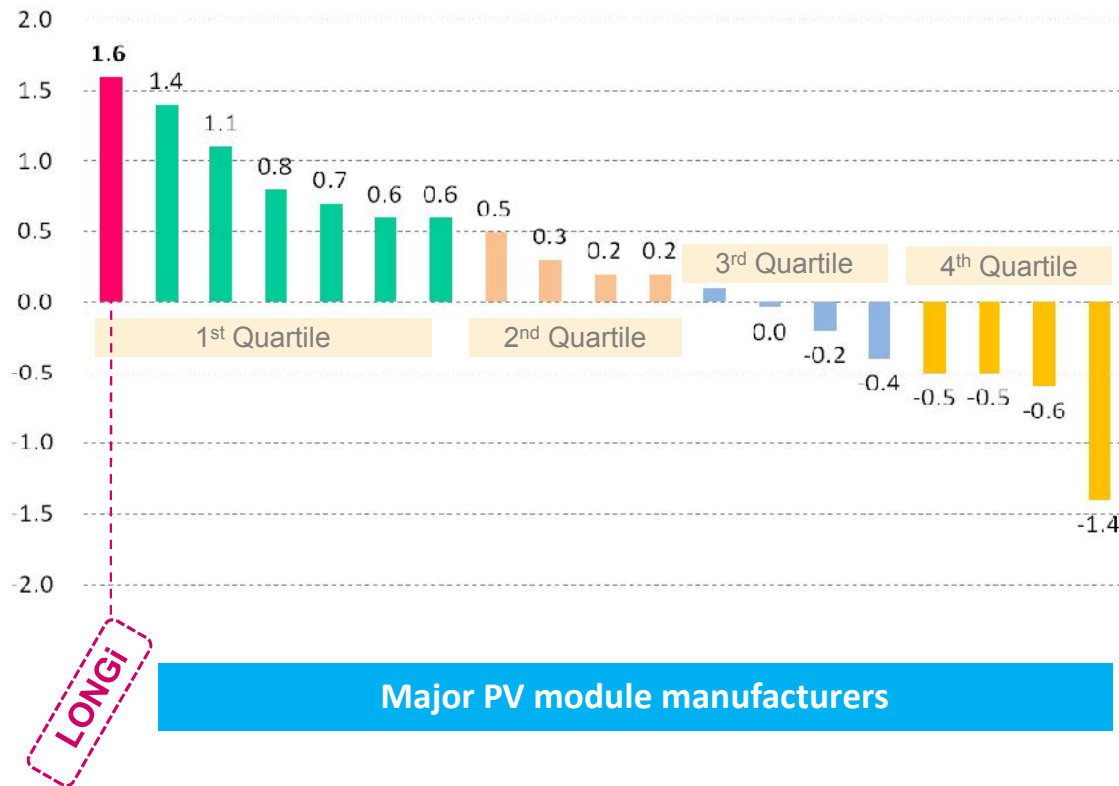
- Solar faces a strong headwind of oversupply in 2017-18
- Nevertheless, **mono c-Si** global market share to continue to grow **to 35% in 2017 and 50% in 2020**

### LONGi

- Technology-driven cost reduction is the core competitiveness, **solar conversion efficiency improvement is the most effective way to cut costs**
- Solid bottom-line growth
- Growth potential from value chain extension to module and solar project development

# Strong Financial Performance

## Financial Health No. 1 among all PV Manufacturers



Strong financial performance recognized by industry:

- Financial health No.1
- Profitability and cost leadership top 3
- Overall score top 5

PHOTON Consulting, LLC  
PV Triathlon Report in Nov, 2017

# LONGi Solar

**on Bloomberg (BNEF) PV Module Maker Tier 1 List !**



# Customers

**LONGi Solar**

LONGi Solar shipment 1GW in 2015, 2.3GW in 2016 and **4.66GW in 2017**





**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



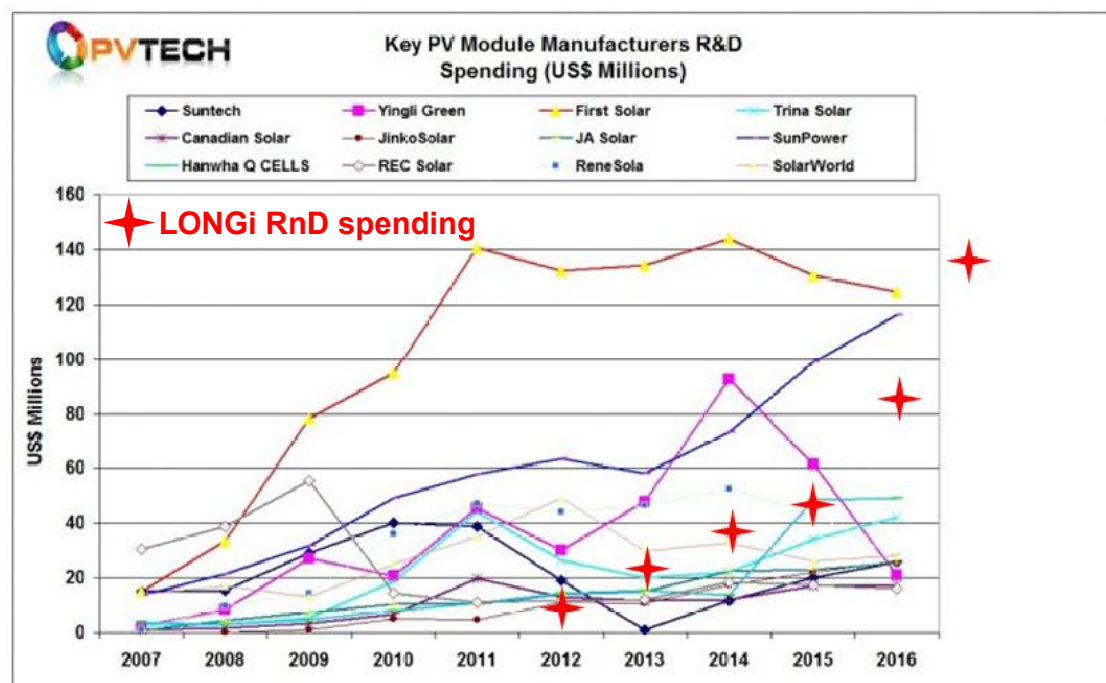
**700**

## Technical Team

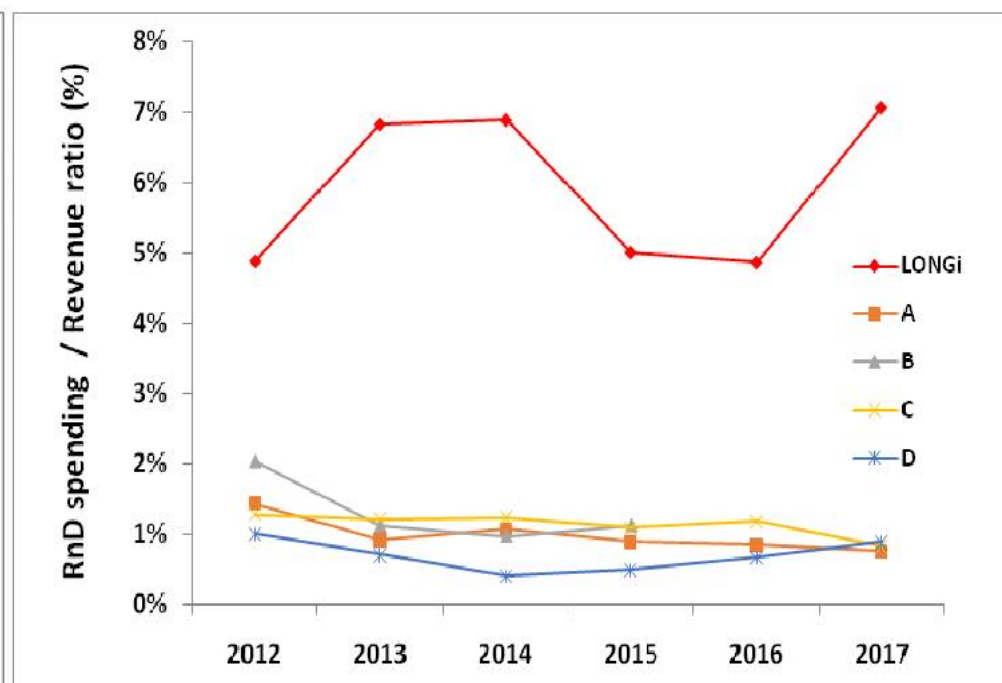
More than 700 technical staff working on ingot, wafer, cell, and module development

# R&D Spending

## R&D Spending



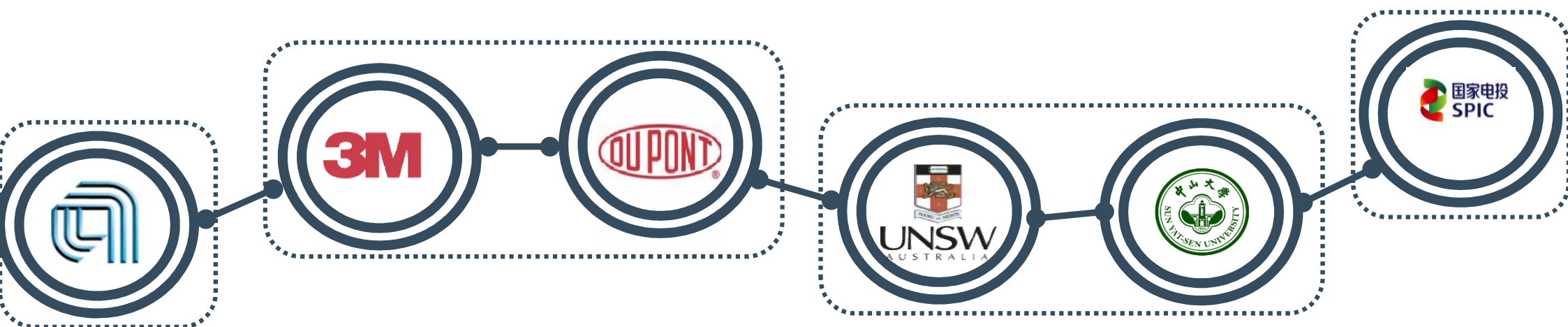
## R&D Spending as Percentage of Revenue



Technology strength is realized through consistent investment in R&D, to develop products with leading performance at lower cost

# Strategic Partners

**LONGi** Solar



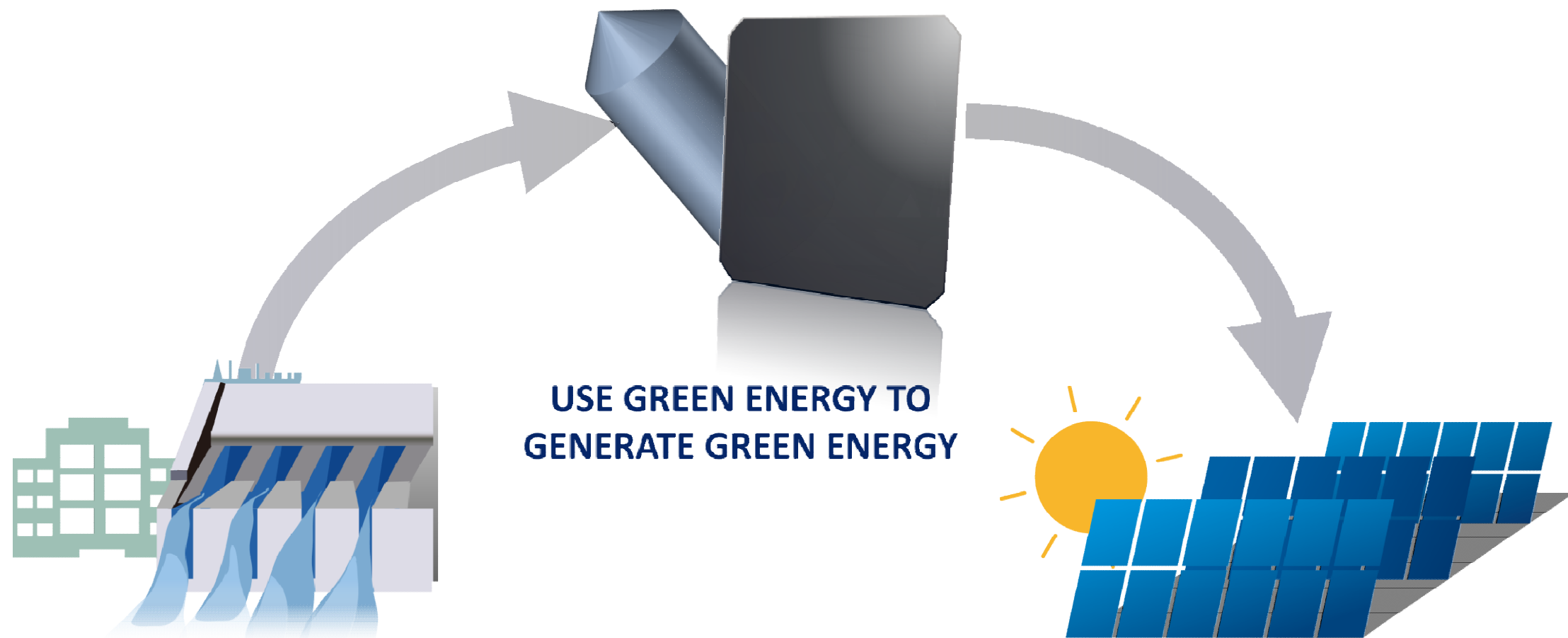
**Equipment**

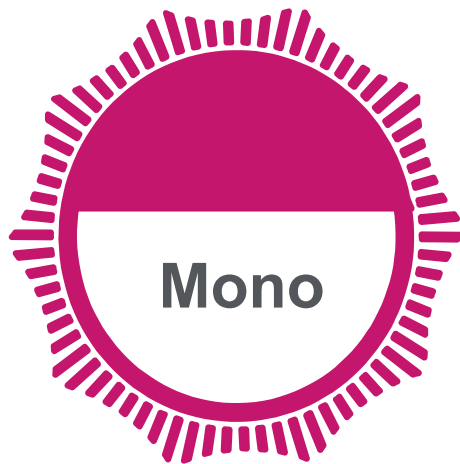
**Materials**

**University**

**Customer**

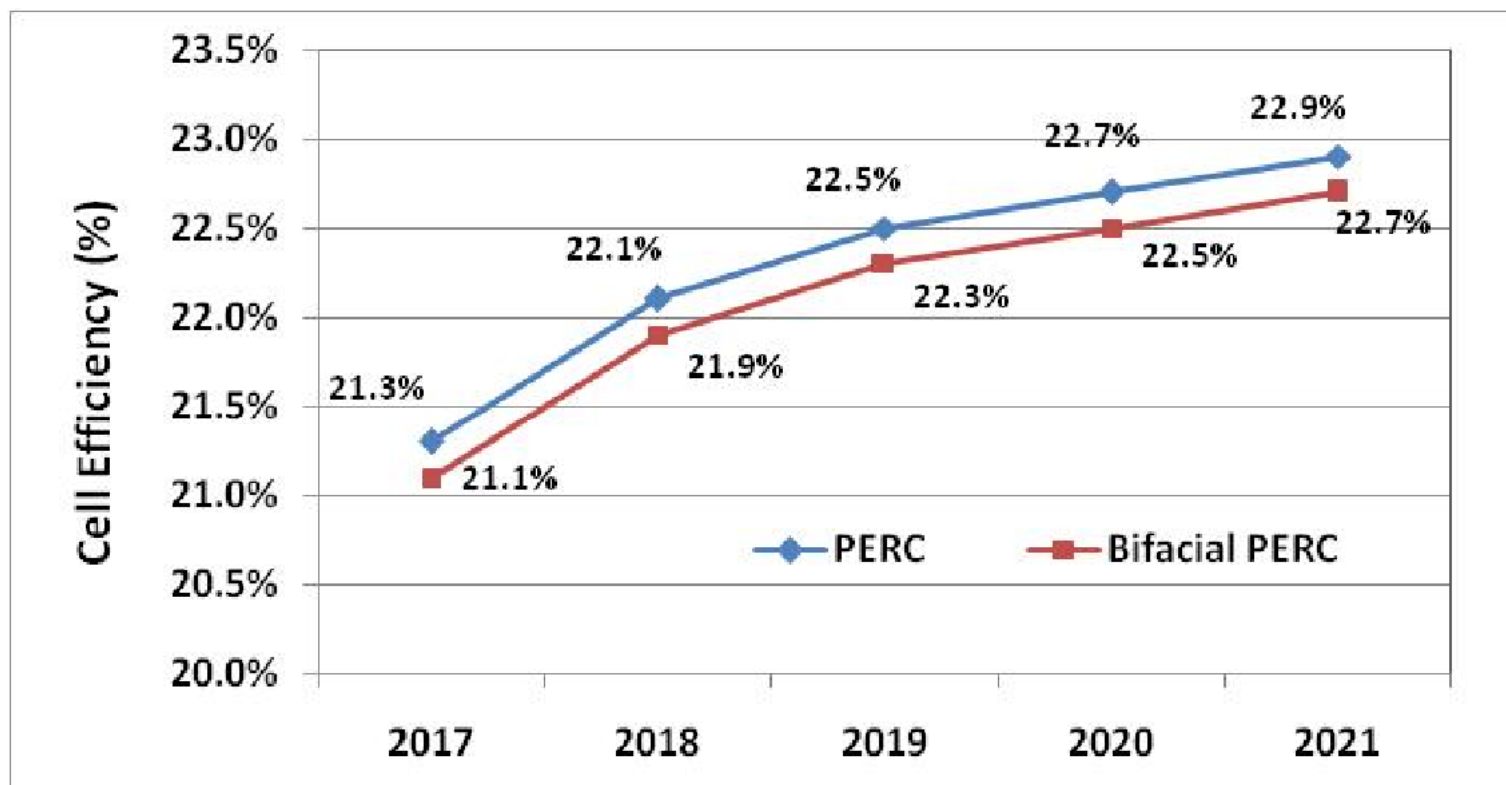
LONGi Solar has established strong strategic partnership with equipment and material suppliers, leading research institute and university, as well as customers, to advance development on ingot, wafer, cell and module technology



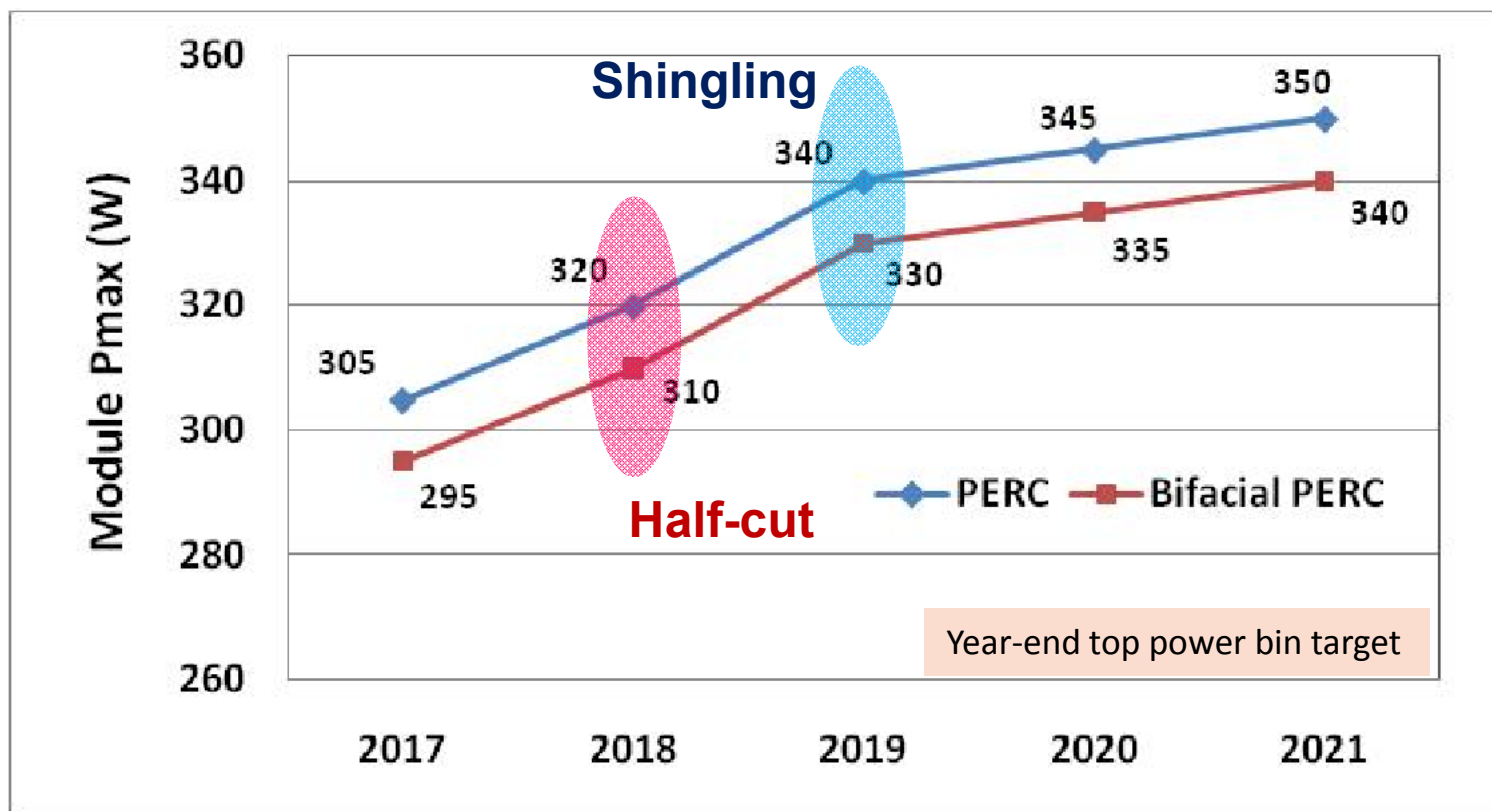


- Focus on MONO Products only

# Technology Roadmap: Cell

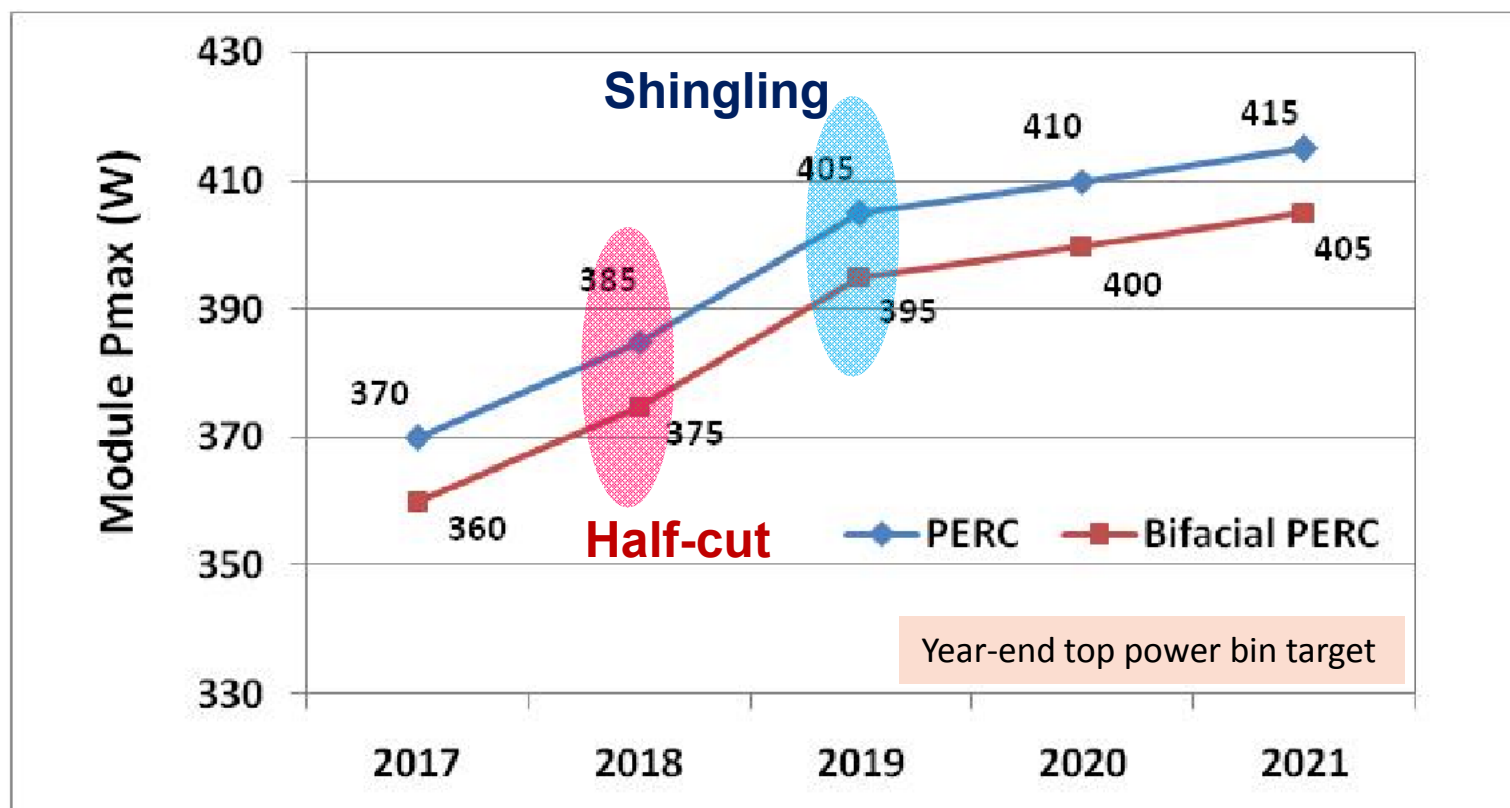


# Technology Roadmap: 60C Module



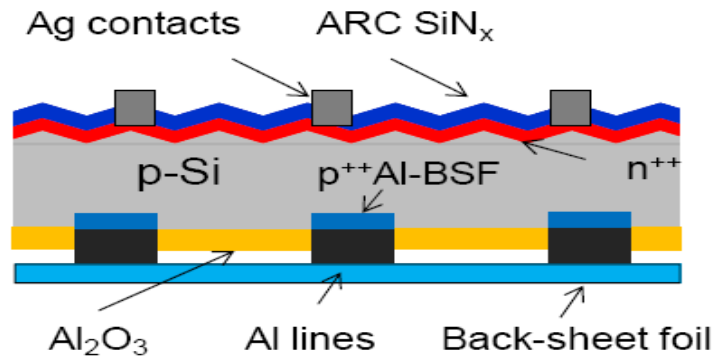


# Technology Roadmap: 72C Module



## Mono PERC

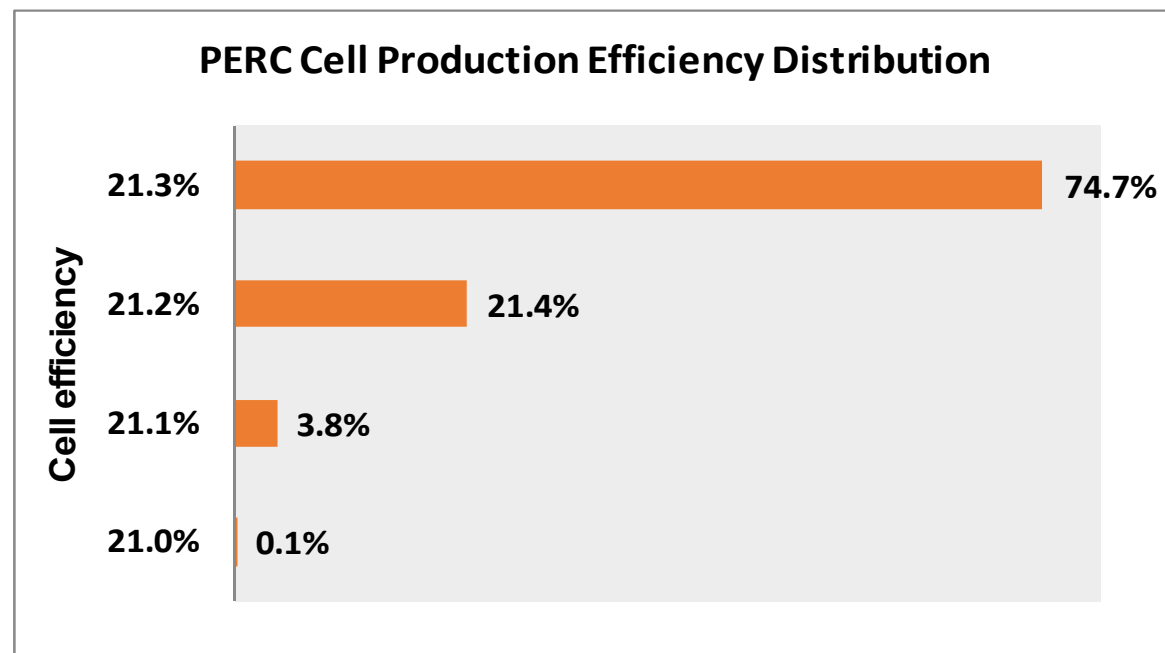
# LONGi Solar's Low LID PERC: Hi-MO1



- ◆ 21%+ average cell efficiency, 60C module power at 300W+ and 72C module at 360W+
- ◆ Outstanding low-light performance, which produces more energy than normal AlBSF mono module at system level
- ◆ Outstanding temperature coefficient
- ◆ Excellent LID performance
- ◆ Suitable for utility, as well as commercial and residential rooftop applications

# PERC Cell Efficiency Performance

**LONGi**Solar



**22.17%** 2017.4

**22.43%** 2017.8

**22.71%** 2017.10

**23.26%** 2017.10

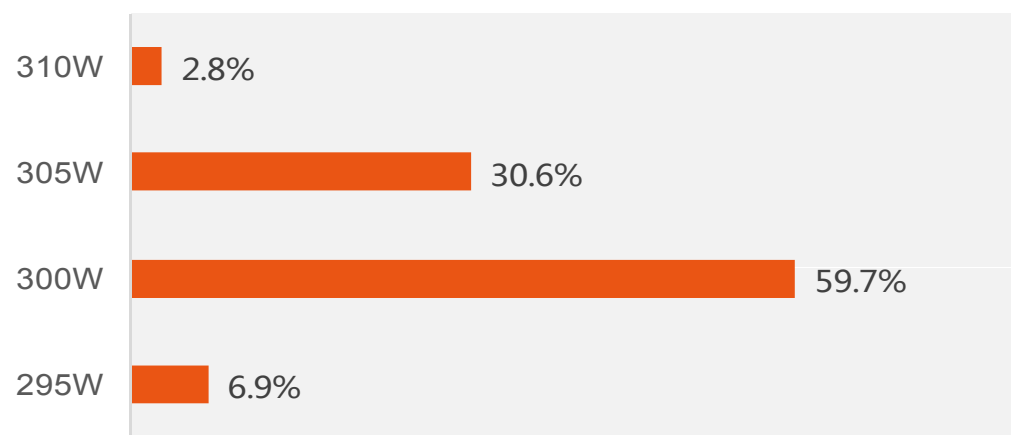
PERC Cell efficiency record

PERC production cell efficiency average >21.2%;  
Record 23.26% PERC cell efficiency demonstrated through next Gen development

# PERC Module Performance

**LONGi** Solar

60C PERC Module Power Distribution



## Module Power Record

**316.6W**

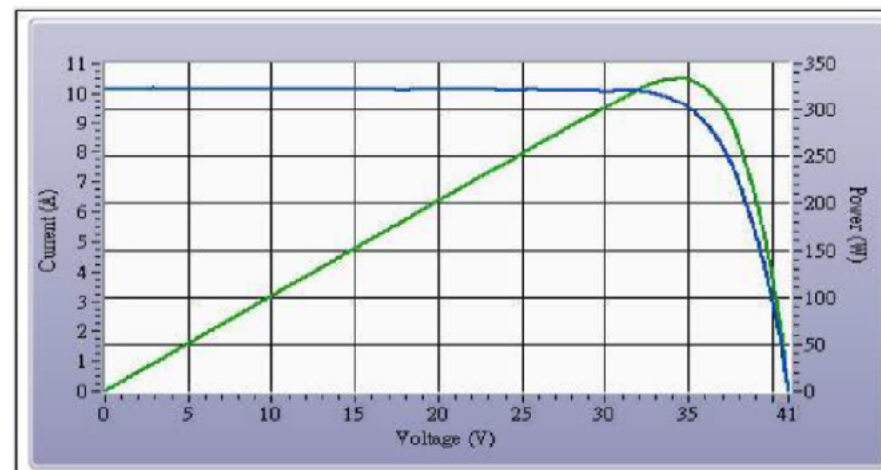
Dec. 2016

**325.6W**

Apr. 2017

**333.7W (20.41%)**

Jan. 2018

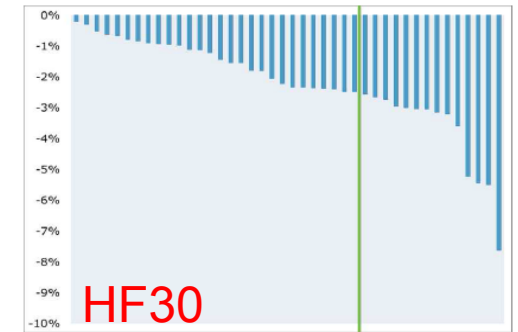
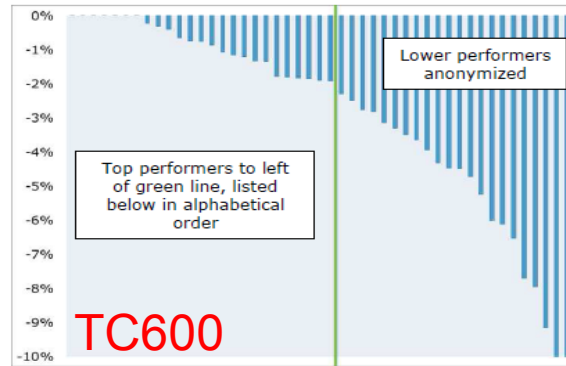
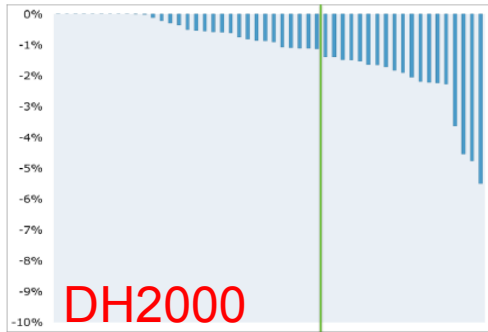


60C module production Pmax >90% at 300W or above;

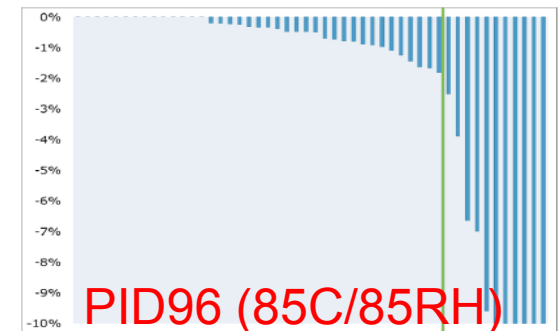
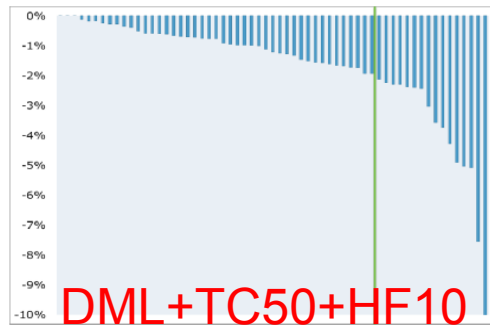
Record 333.7W (60C) module power demonstrated through next Gen development

# High Reliability: 2017 DNV-GL Reliability Scorecard

**LONGi**Solar



LONGi Solar modules are among **Top Performers** (to the left of each green line) for **All** extended reliability tests

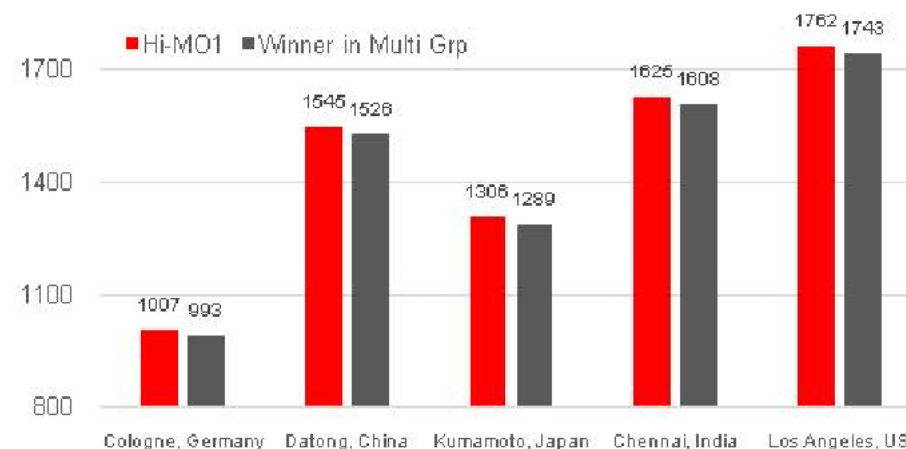


# Better Energy Yield with PERC Modules

**LONGi** Solar



Simulated power generation (kWh/kWp/year)



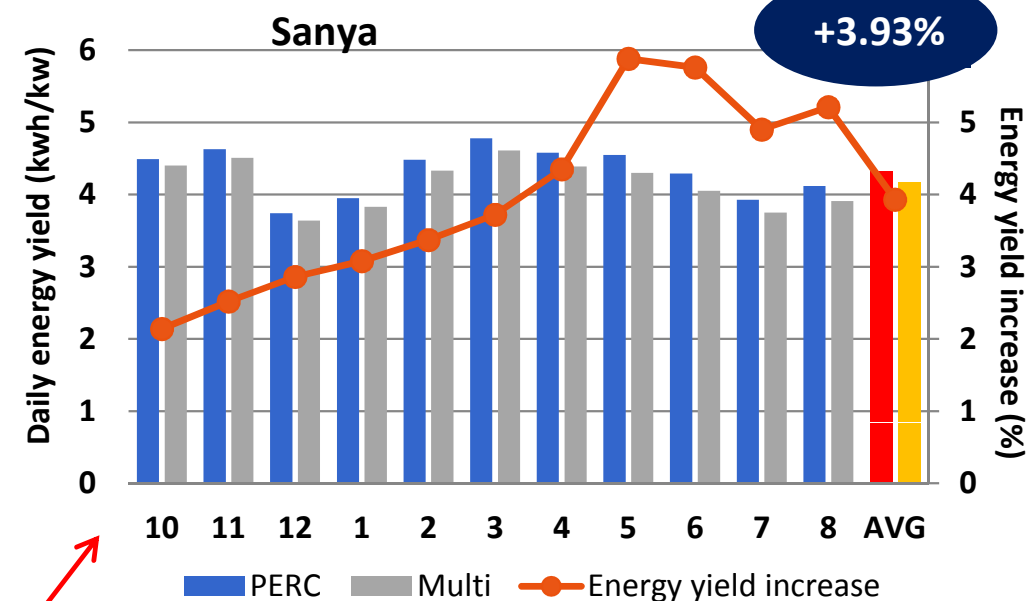
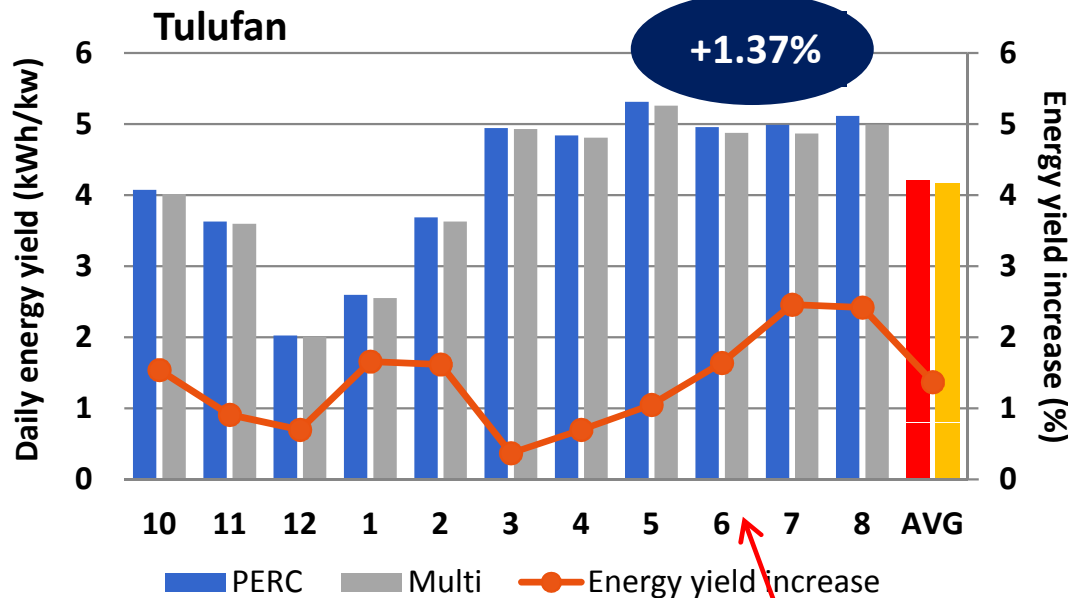
- TUV Rheinland established module PAN file with performance measurement under different irradiance, temperature and incident angle using randomly selected module samples from production shipment
- Simulated energy yield in five different cities globally
- Not intended as performance guarantee

**Hi-MO1 ranked No. 1 in TUV Rheinland energy yield simulation for all modules**

# Better Energy Yield with PERC Modules

**LONGi** Solar

Energy Yield Comparison (Oct '16 – Aug '17)



## Contributions:

1. Better performance at low irradiance
2. Lower operation temp
3. Better TempCo with PERC

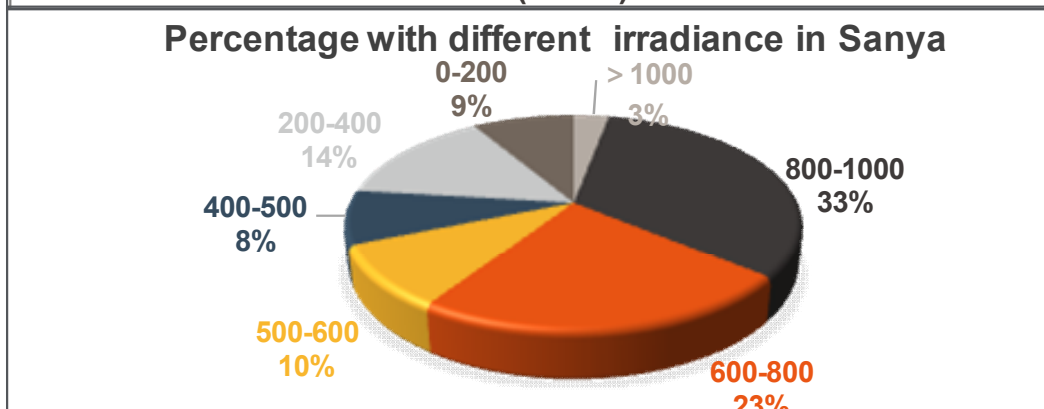
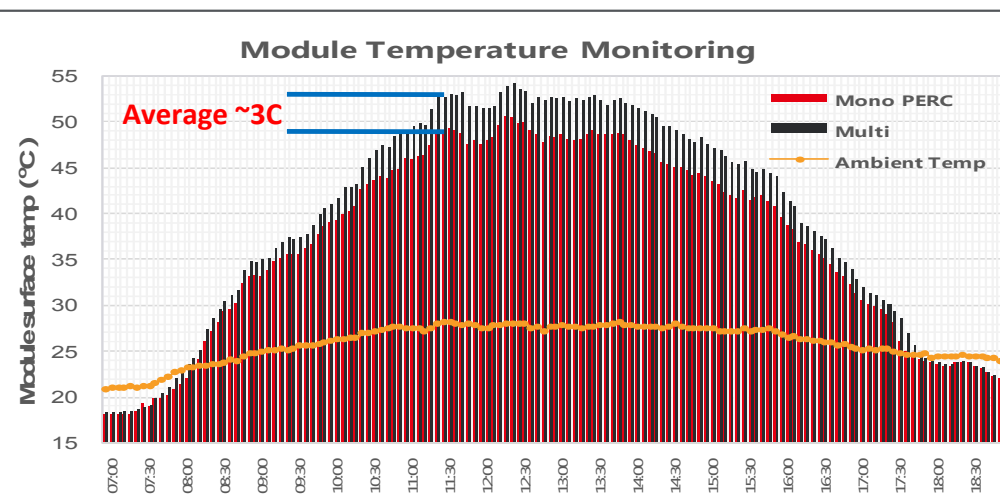
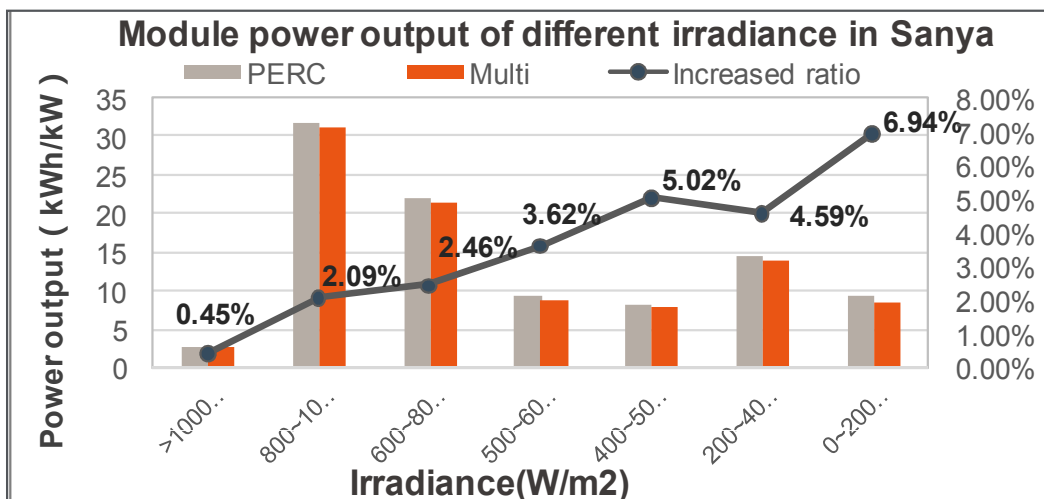


**System setup:** 8pcs 290W Hi-MO1 module and 260W Multi modules (Tier1 supplier), 3kw inverter  
 Data source: China Electric Institute





# Better Energy Yield with PERC Modules

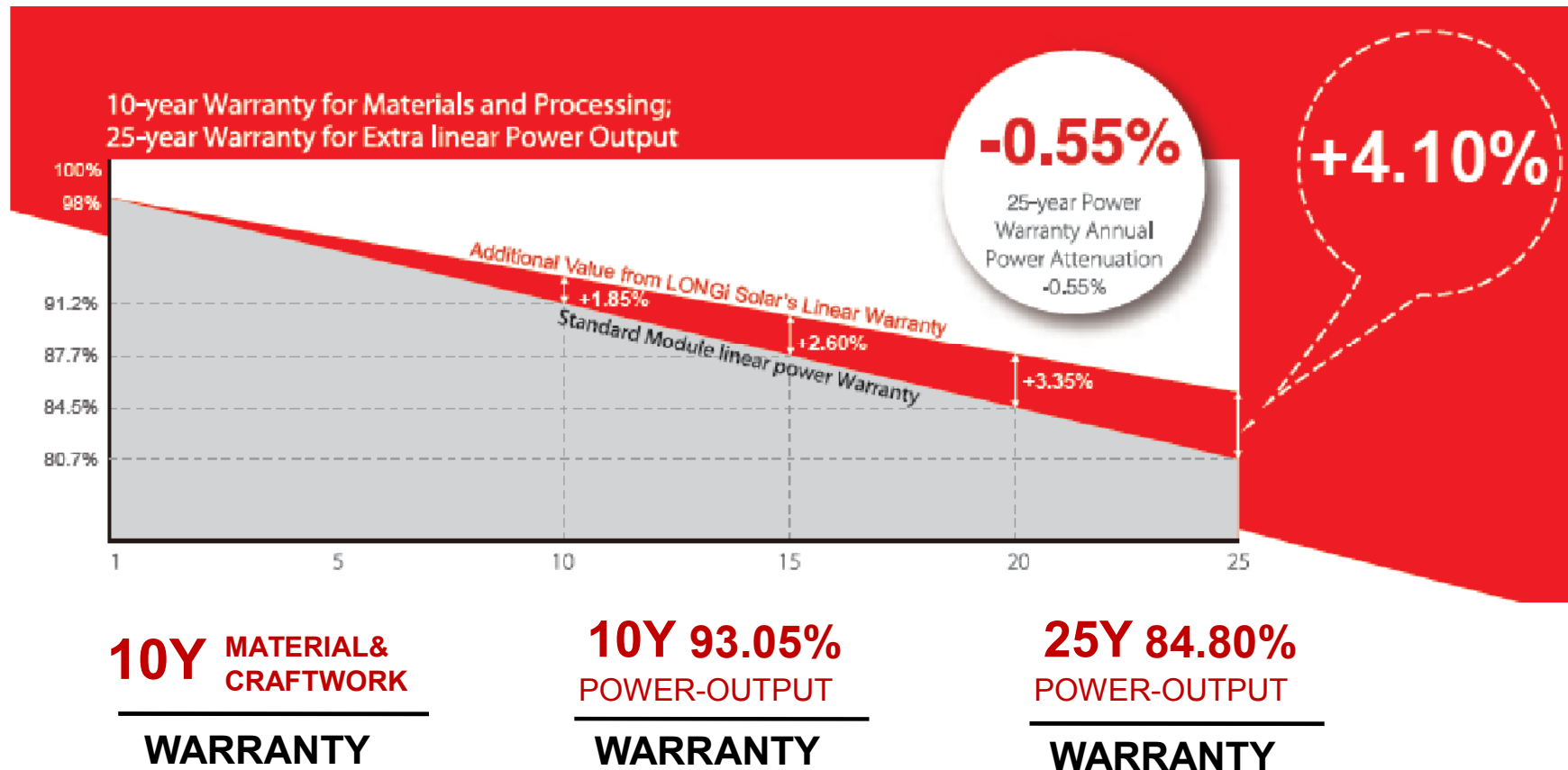


$P_{max} \text{ TempCo (Multi)} = -0.42\%/^{\circ}\text{C}$   
 $P_{max} \text{ TempCo (Mono PERC)} = -0.38\%/^{\circ}\text{C}$

# PERC Module Linear Power Performance Warranty

**LONGi**Solar

Low LID and slower power degradation enabled better warranty term

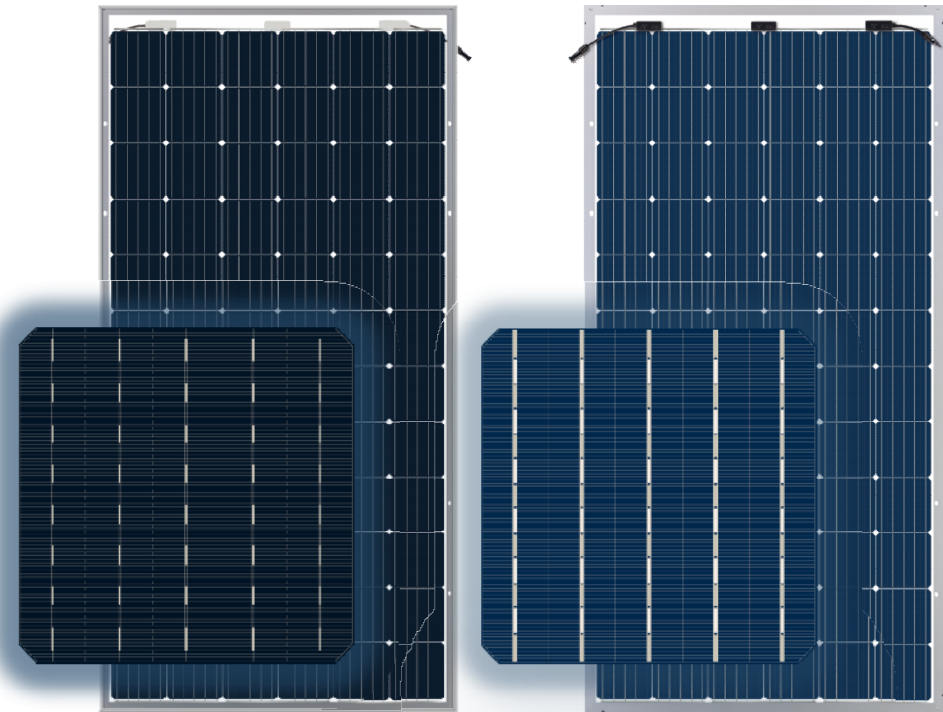


## Bifacial PERC

# Bifacial Technology

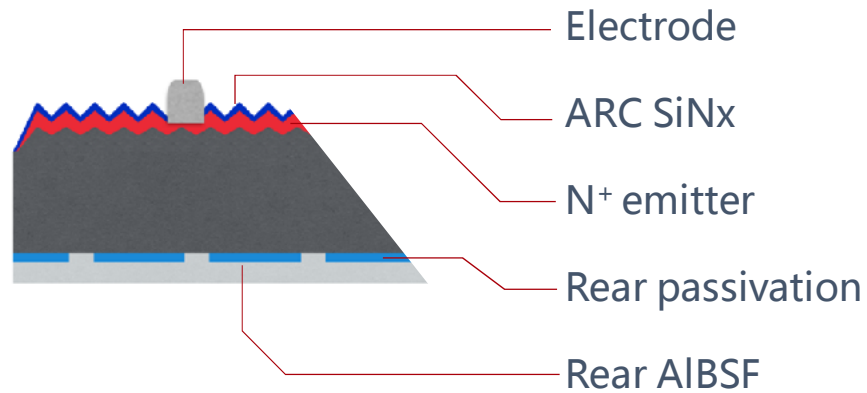
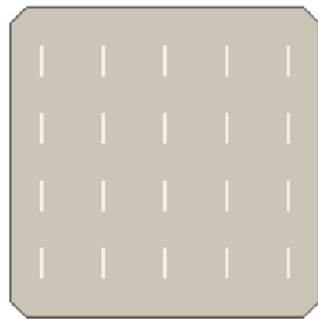
Mono-facial to Bifacial power generation

- LONGi Solar Bifacial PERC Hi-MO2 cell and module bifaciality >75%
- Significant increase on energy yield
- Double glass lamination, 30 year power degradation warranty

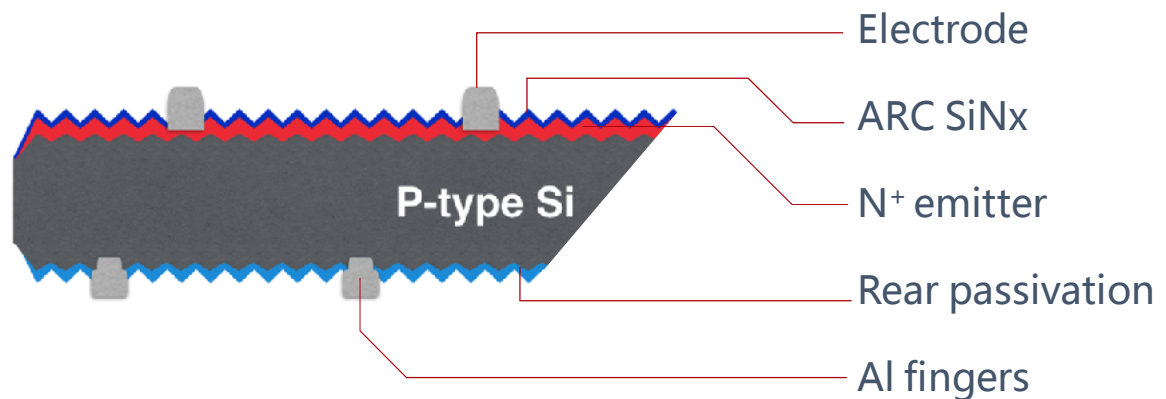
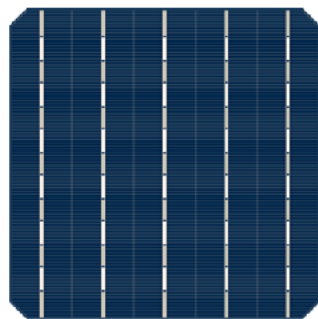


# Mono PERC and Bifacial PERC

PERC



Bifacial PERC



# LONGi New Product — Bifacial PERC



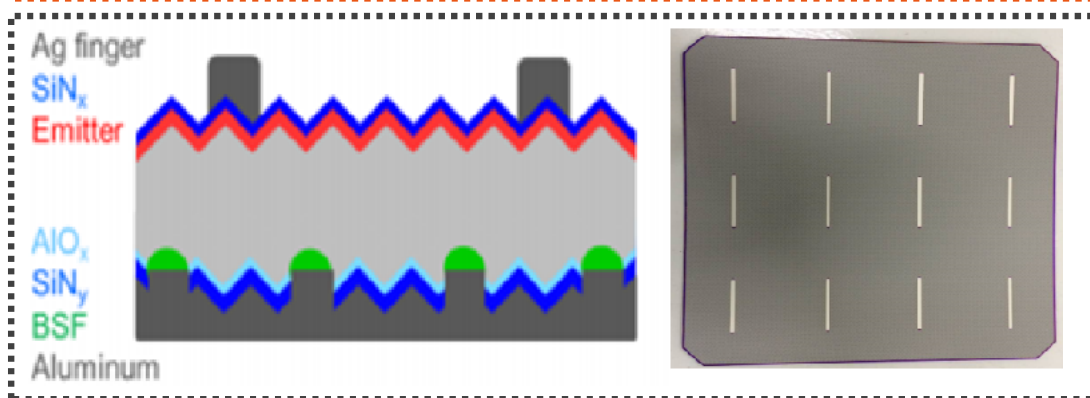
## 1. Product features

### 1.1 Product performance and cost

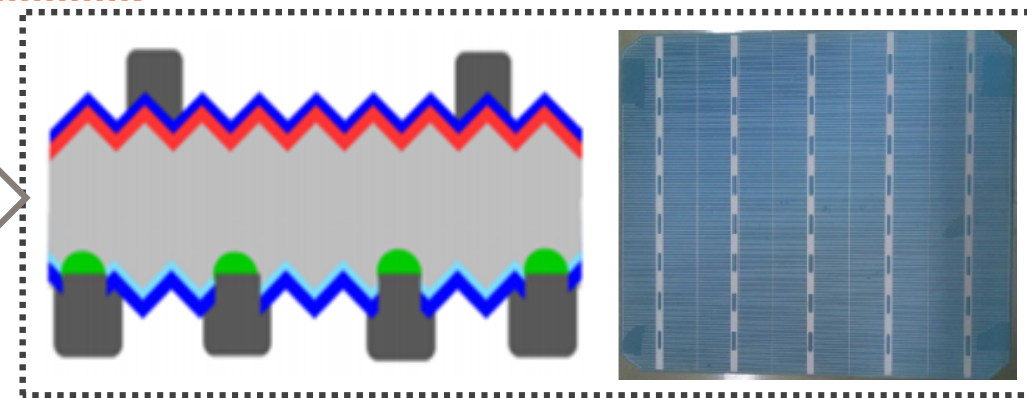
- Front side efficiency equivalent to conventional PERC
- Manufacturing cost comparable to conventional PERC
- Bifacial light harvesting, 8%-25% power gain from rear side
- Symmetric design to reduce mechanical stress

### 1.2 Application

- Commercial rooftop and carport
- BIPV and BAPV
- Water floating PV systems
- Utility



Conventional PERC cell structure

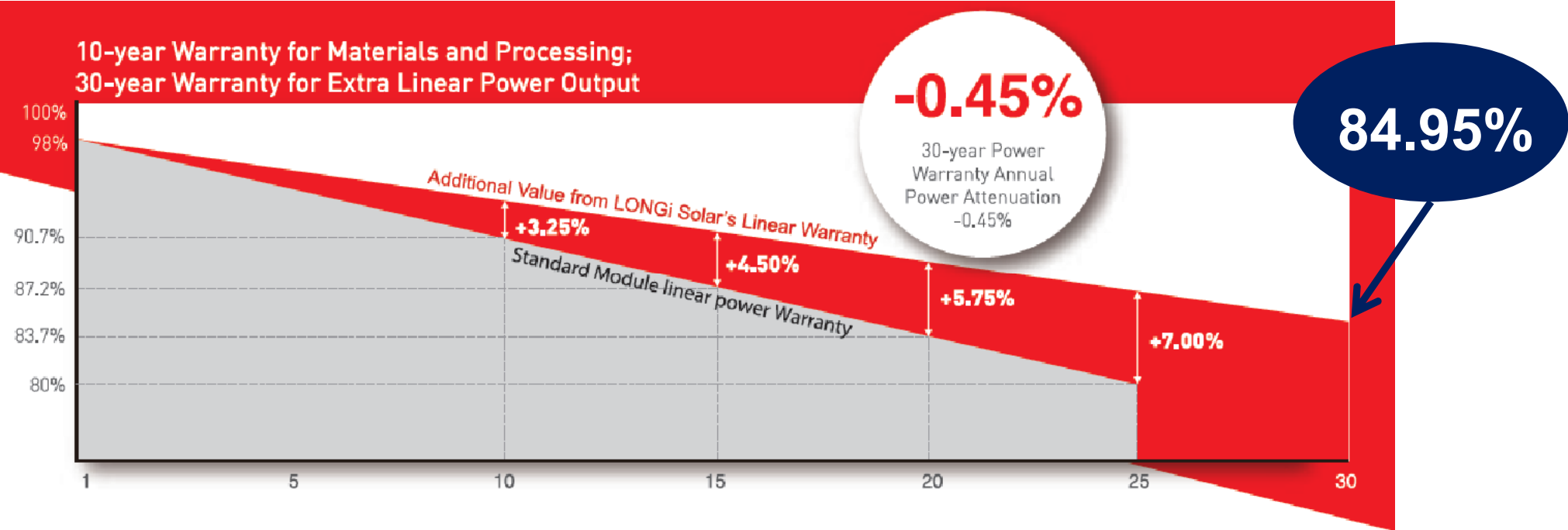


Bifacial PERC cell structure

2.4 Module datasheet

Electrical Properties(STC*)—P-PERC Bifacial—predicted data						
Item	Units	Bifacial Gain—72 Type				
		0%	5%	10%	20%	30%
Maximum Power(Pmax)	[W]	360	378	396	432	468
MPP Voltage(Vmpp)	[V]	38.7	38.9	39.1	39.4	39.6
MPP Current(Impp)	[A]	9.30	9.72	10.13	10.96	11.82
Open Circuit Voltage(Voc)	[V]	47.9	48.1	48.3	48.6	48.8
Short Circuit Current(Isc)	[A]	9.76	10.32	10.70	11.60	12.52
Module Efficiency	[%]	18.30	19.32	20.18	22.02	23.85

LONGi New Product — Bifacial PERC



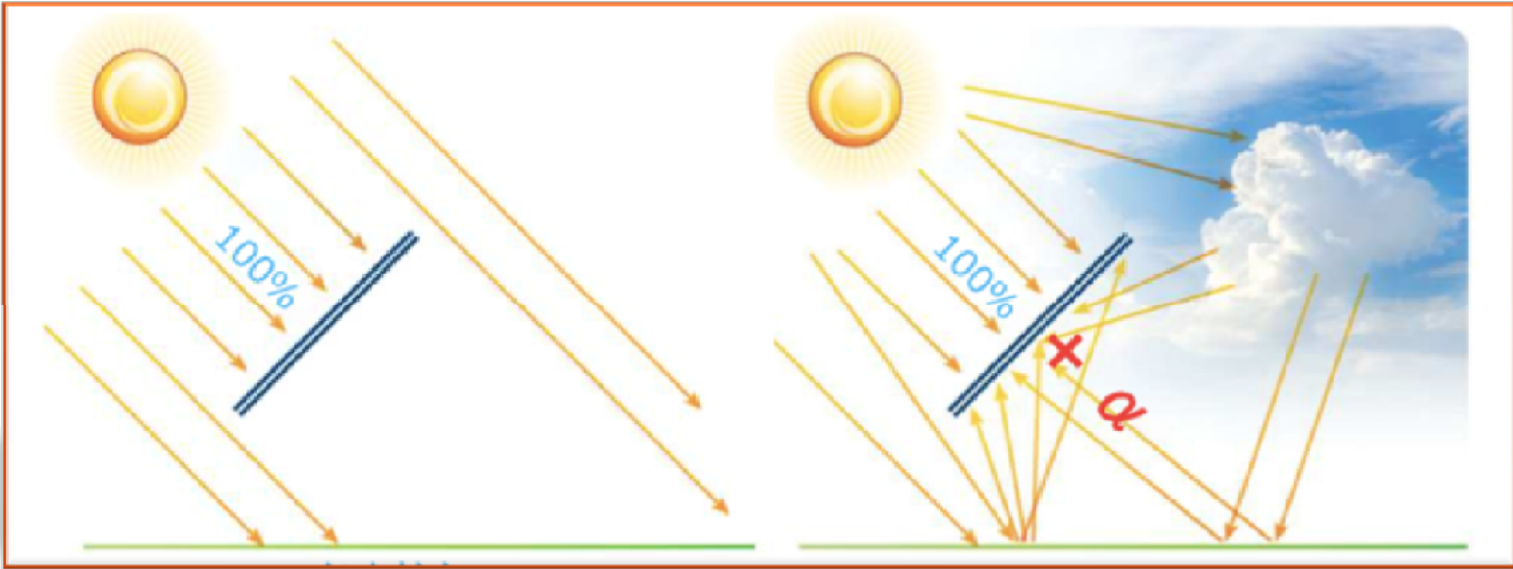


**LONGi New Product — Bifacial PERC**



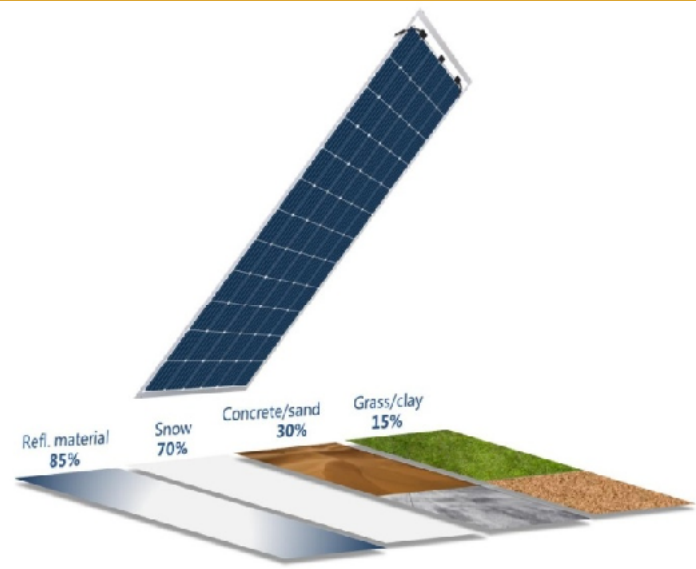
Mono facial module

Bifacial module



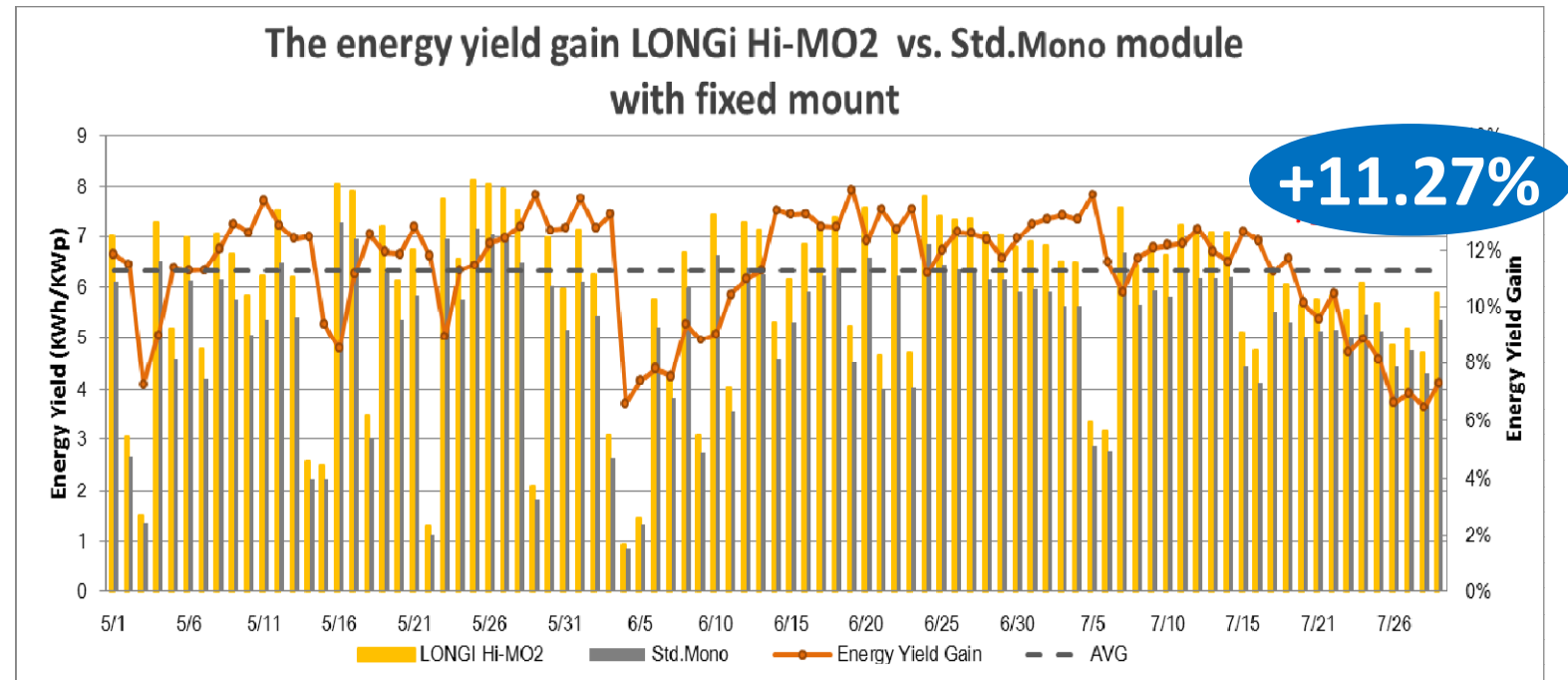
Direct sunlight

Direct sunlight + Reflection + Scattered light



# Bifacial PERC Module Field Monitoring Data

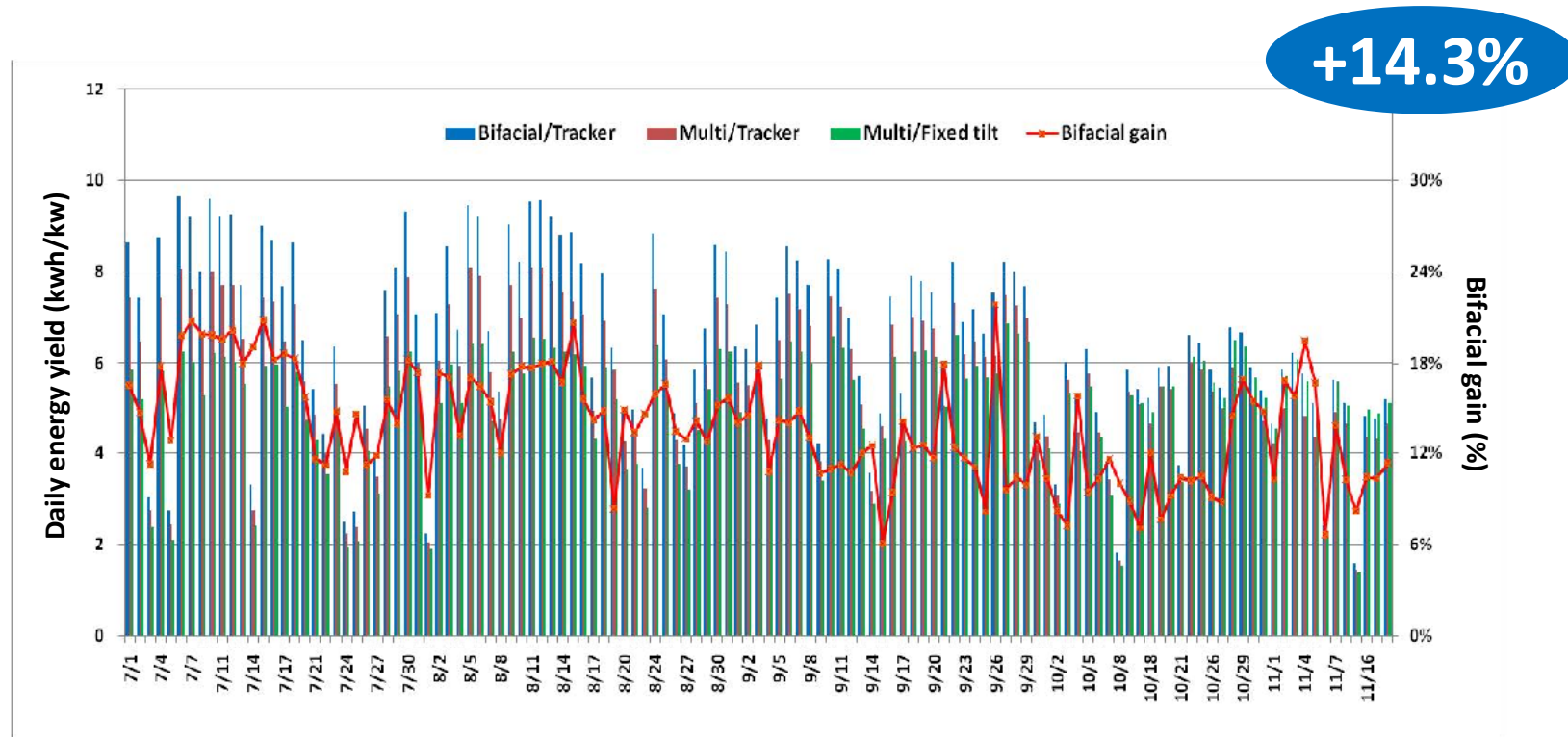
**LONGi**Solar



- Bifacial PERC Capacity 18.9kw, std. mono capacity 18.25kw, project located in Pucheng, Shaanxi, China
- Fixed tilt configuration (15 degree), distance to ground 1.6m
- Three month monitoring data showed 11.27% energy yield from backside

# Bifacial PERC Module Field Monitoring Data

**LONGi** Solar



**+14.3%**

- Hi-MO2 Bifacial PERC Demo project (336kw on single axis tracker) in Kubuchi, Inner Mongolia, China
- Power generation in July- Nov by bifacial module + tracker is 27.3% higher than Multi module + fixed tilt and 14.3% higher than Multi + tracker



# *Thank You for Your Attention*

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