



# **Value Opportunities**

## **N-type Mono Bifacial Module**

# Introduction of Jolywood Sunwatt



- Headquarter established in March, 2008
- Located in Changshu City, Jiangsu
- Listed company in Changshu (Stock Code:SZ300393)
- Market value: RMB 10.4 Billion
- Top 1 PV back sheet manufacturer, 25% market share worldwide and 16GW back sheet revenue in 2016
- Owns “N-bifacial” technology and initiates the industrialized mass production of bifacial cell and module in 2016



# Jolywood (Taizhou) Solar Technology Introduction



- Established in February 2016
- A wholly-owned subsidiary of Jolywood Sunwatt
- Located in Taizhou, Jiangsu
- Main product: N-bifacial mono cell and module
- Current cell capacity: 2.4GW
- The largest “N” Bifacial cell manufacturers in the world
- Sales Revenue 17’ is estimated RMB3 Billion

**14  
Production  
Lines**

N-type mono bifacial solar  
cell production lines

**2.4 GW**

2.4GW production  
capacity

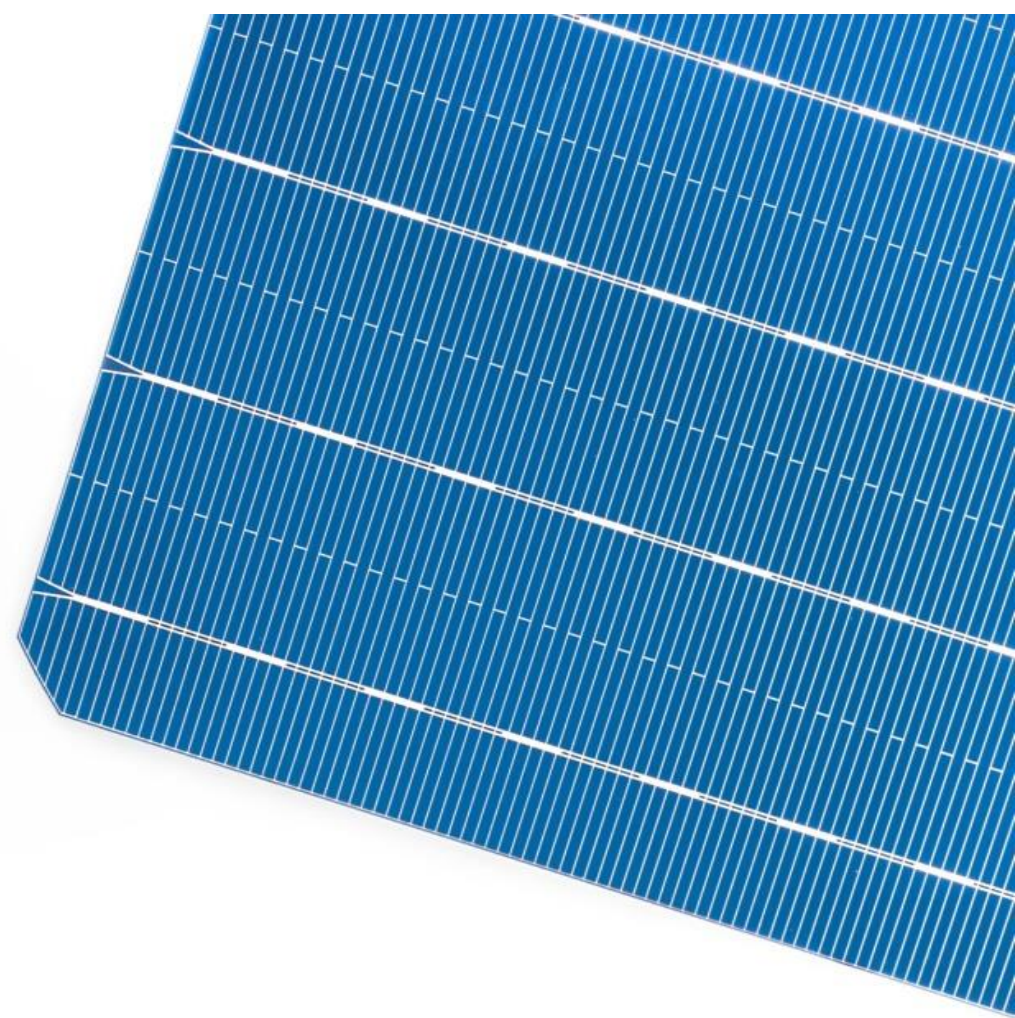
► HIGH-EFFICIENCY & BIFACIAL POWER

## N-type Bifacial Mono Cells

Average efficiency of front side > **21.3%**

Average efficiency of rear side > **19.2%**

Bifaciality > **90%**



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JOLYWOOD  
SOLAR TECHNOLOGY



# N-TYPE BIFACIAL GLASS-GLASS MODULE

## Higher Conversion Efficiency

- Increase the amount of power generation by 30% at most

## Excellent Performance in Weak Light

- More power output in low irradiance conditions, such as mist and cloudy days

## Positive Tolerance Guarantee

- 0~+5W positive tolerance of maximal power guaranteed

## Better Reliability

- More than 30 internal tests, anti-PID, no snail tracks

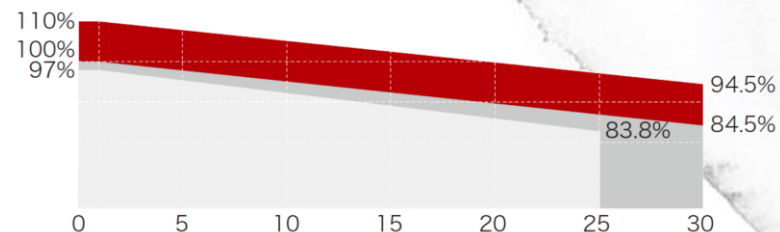
## Ultra-low Light Induced Degradation

- LID<1%, further increase power generation

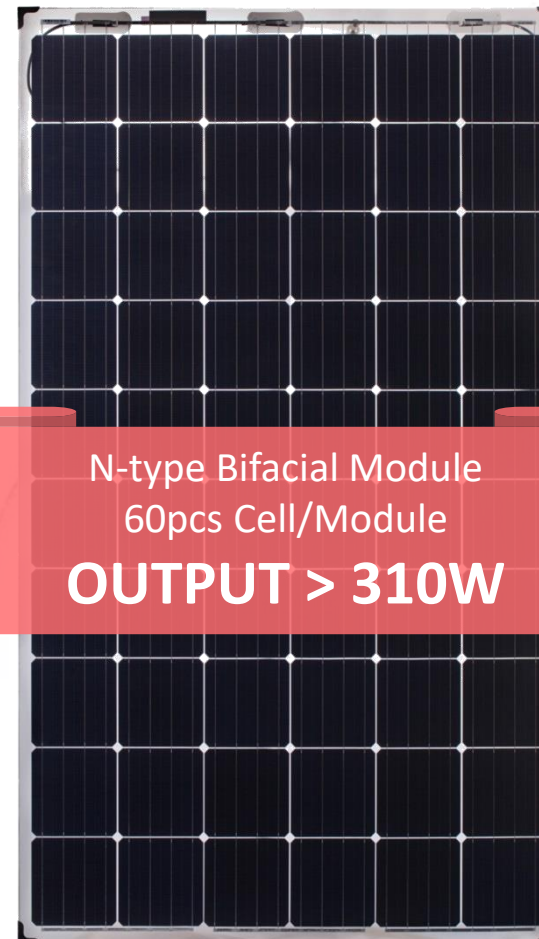
## Better Customer Benefits

- Product material and process quality assurance for 15 years, linear warranty for 30 years

组件标准线性功率保证  
中来 N 型组件正面线性功率保证  
中来 N 型组件正面 + 背面线性功率保证



- 1st year degradation **1%**
- Annual average degradation **0.5%**
- Gain of front side increases **24%**
- Gain of front + rear sides increases over **36%**



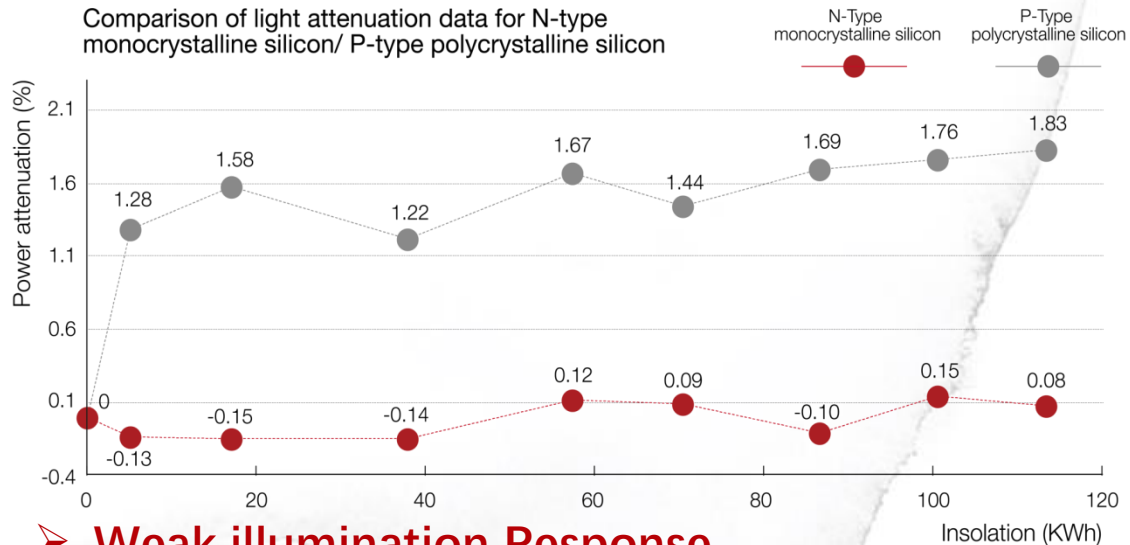
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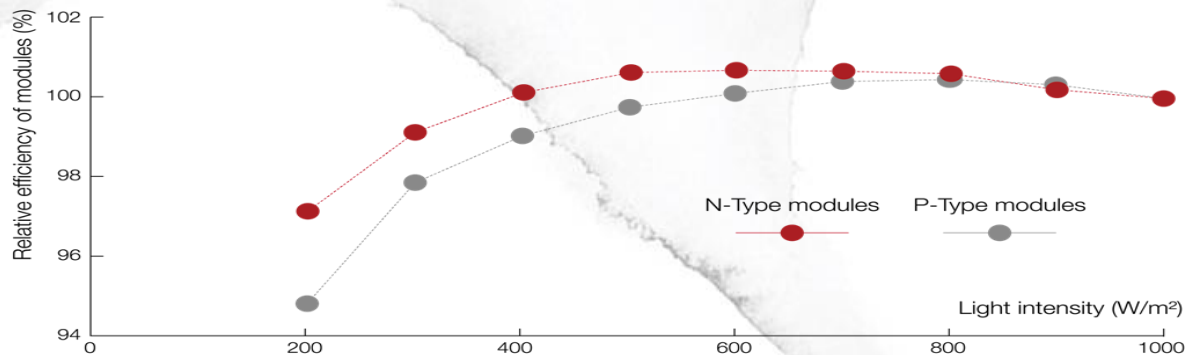
# Key Features of N Type Module

## LID

Comparison of light attenuation data for N-type monocrystalline silicon/ P-type polycrystalline silicon



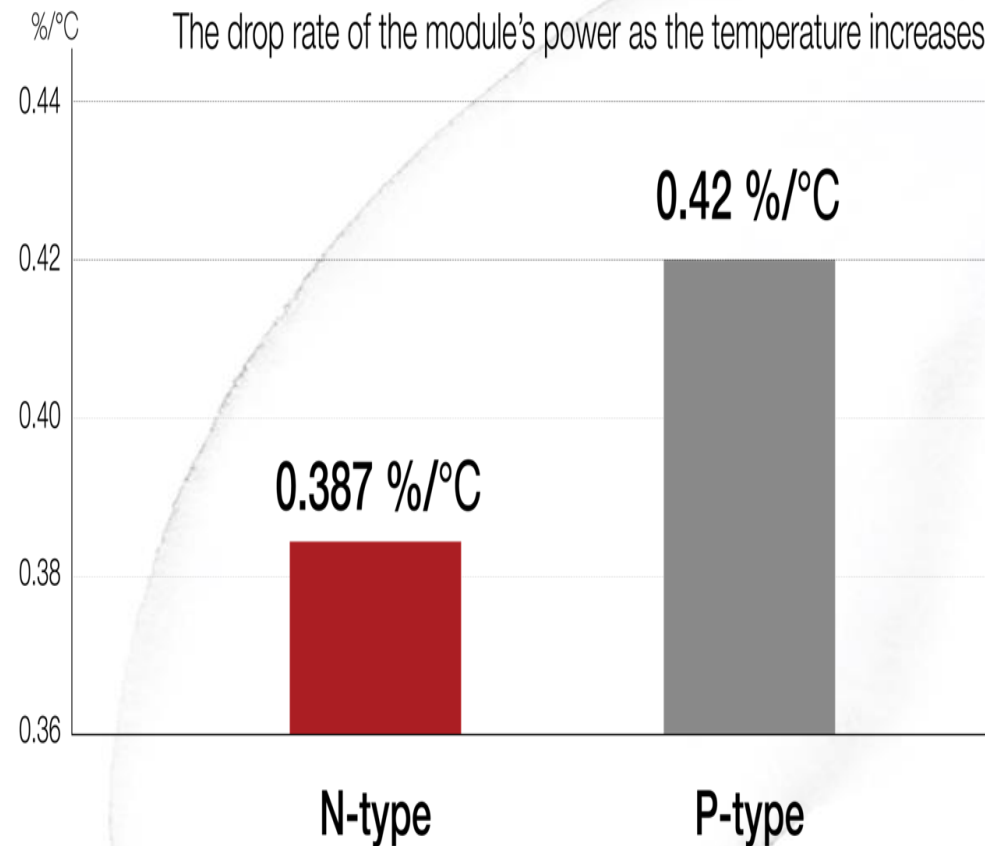
## Weak illumination Response



Source: D. Song et al., Photovoltaic Specialists Conference (PVSC), 2012 38th IEEE, Austin, TX, 2012, pp. 003004-003008

## Temperature Coefficient

The drop rate of the module's power as the temperature increases.

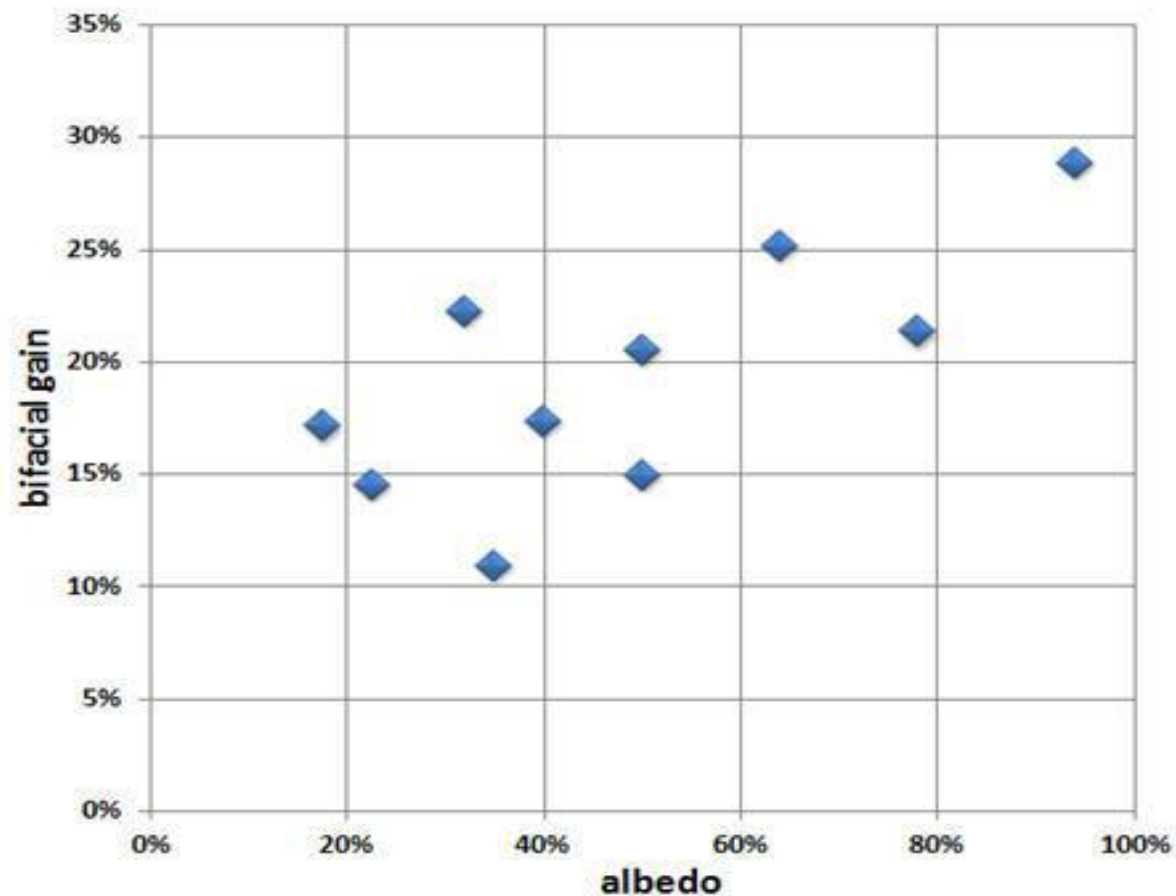


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# Albedo and Bifacial Gain



surface	albedo [%]
water	8
dry dark soil	13
grass	17-28
dry sand	35
dune sand	37
old snow	40-70
reflective roof coatings	80-90
fresh snow	75-95



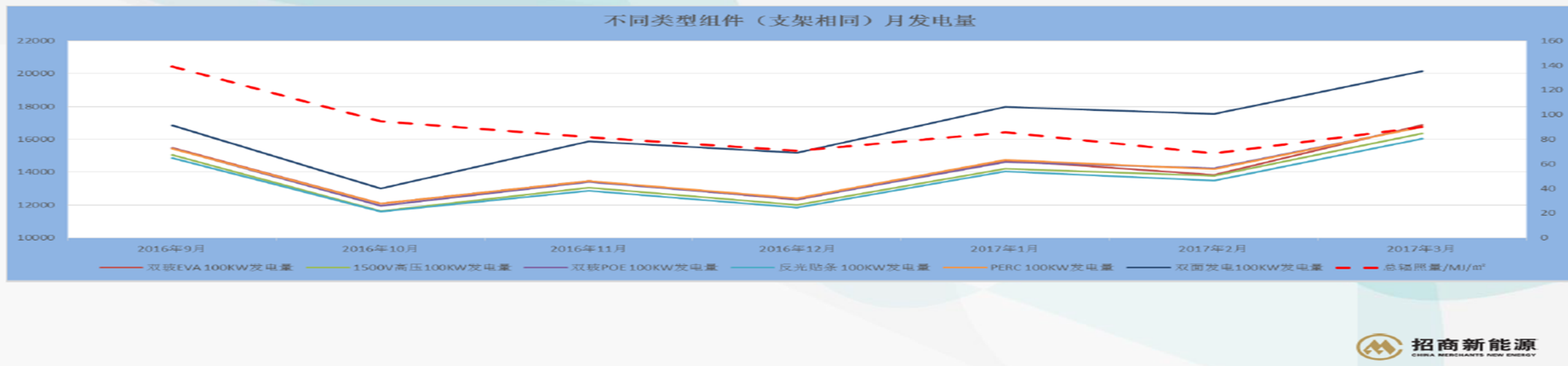
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# Real Generations Data Comparison from Different Technologies

## PGO发电量指数——不同组件发电量指数

◆ 以下发电量指数为不同组件类型，每种组件都以100kW为基数统计分析。



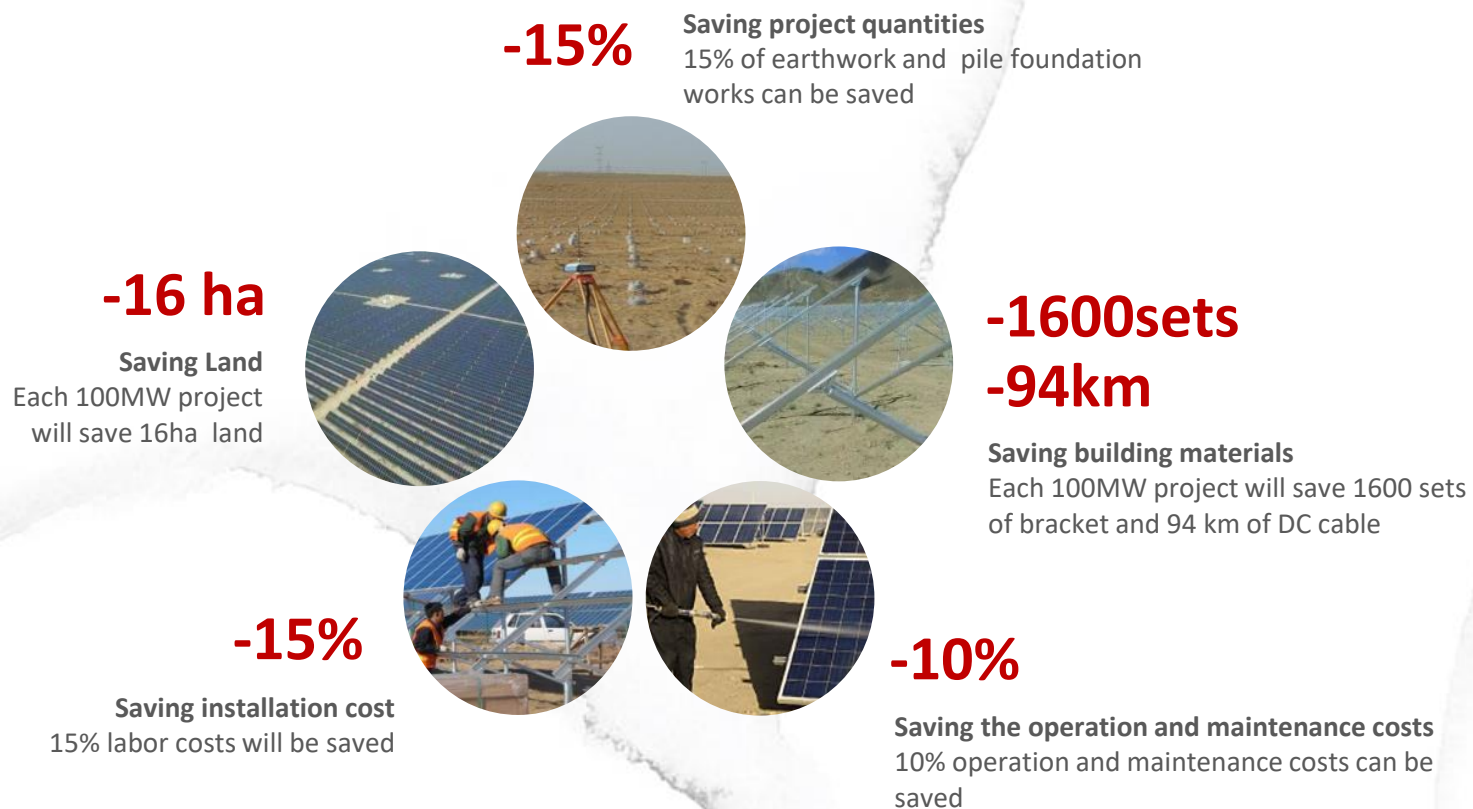
### Key Notes :

- ✓ Module types to compare including P Perc, Double glass with POE, and EVA, 1500V Module and N Bifacial Modules
- ✓ The same installation conditions ( same location and tracker)
- ✓ N bifacial module can achieve average **25%** power gain from this chart.
- ✓ Data resources from demo projects in Shanxi.
- ✓ Another 50MW project with N type Bifacial modules in Shanxi, average **15.8%** power gain during past 12 months.

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# SAVING BoS COST



## POWER PLANT COST SAVING

Remarks : Investment differences between N-type bifacial(back-side is calculated by 10% gain) 100MW conventional ground power station and P-type monocrystalline silicon power station

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# Investment Costs and Simulated LcoE

Analysis on economic  
Benefits and levelized cost of Electricity (LCOE)

✓ N-type bifacial double-glass module installed in plants which  
grantees 30 years liner power performance, achieves 10%-30% gain  
from rear side.

Items	Module Power	Module Price	BOS cost	EPC Cost	LCOE( Contribution of N-type Cell's Rear Side)				
					0% contribution	5% contribution	10% contribution	20% contribution	30% contribution
		¥/W	¥/W	¥/W	¥/W	¥/W	¥/W	¥/W	¥/W
N-type bifacial double-glass module	295W	3.600	3.439	7.039	0.567	0.540	0.516	0.473	0.436
P-type mono silicon module	280W	3.200	3.630	6.830	0.605				
P-type poly silicon module	265W	3.100	3.718	6.818	0.616				



# THANK YOU.

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