

## **N-type Promotion Report**

Presenter | Global PM



## The Breakthrough of Cell Efficiency



### **24. 5%** Mass Production Efficiency

The application of Hot 2.0 technology has contributed to a new breakthrough in N-type cells, and the efficiency of mass-produced cells can reach 24.50%.

## 28.70%

#### **Higher Efficiency Limits**

Topcon cells have higher efficiency limit (28.2%~28.7%), much better than PERC cells .



## N-type Cell—The Technical Classification

Nowdays, the N-type cells studied are mainly divided into: PERT, Topcon, HJT and IBC.

Among them, Topcon and HJT are the focus of attention of the current N-type technology and the focus of high-end products' competition.



## N-type Cell—Topcon & HJT





Both Topcon and HJT achieve power improvement through passivation. The former one uses tunneling oxide layer while HJT uses intrinsic amorphous silicon film. The differences in the methods lead to the differences in their respective processes, resulting in the difference in the commercial cost between the two (about  $0.3 \neq /W$ ).

### Technology Innovation — Selective Passivation Contact



Passivation—The key technology determines the maximum efficiency



## Outstanding applicability to multiple application scenarios



Utility

#### Tiger Neo 78P

- Maximum power 610W
- Lowest LCOE in certain senario

Tiger Neo 60P/54P

- Maximum power 475W/425W
- Compatible with residential
- Roofing and C&I
- High eff. module for DG market

C&I

Tiger Neo 72P
Maximum power 565W
Low voltage, flexible string setting
Moderate size, widely applicable to different power stations

Solar

JinKO

DG

## **Tiger-Neo Module Series**



7

Tiger-Neo 78P Max 610/605W mono/bifacial module



Tiger-Neo 72P Max 565/560W mono/bifacial module



Tiger-Pro 60P/54P Max 475/425W mono module





## **Product Advantage I Optimized Degradation Advanced Warranty**

The power warranty could achieve 30 years compared with traditional P-type module. The first year degradation is lower than 1% which means the power output could remain over 87.4% compare with the 1<sup>st</sup> year

30 years Power Warranty

 $\leq 1\%$ 





**Product Advantage II** Optimized **Temperature Coefficients** -0.30%/ °C P-type -0.35%

N-type -0.30%

- Tiger Neo's power output will increase with the better temperature coefficient (0.75% higher compared with PERC)
- Under the same external environment, Tiger Neo's operating temperature is lower ( >1 % compared with the same specification P type )
- Under high temperature condition, the advantage will further expanded (~2% higher )



Power Loss influenced by

#### Real-time operating temperature





## Product Advantage III **Bifacial Factor** 85% N-type's higher bifacial factor will bring significant power gain around **2.03%**





## Product Advantage IV Enhanced Reliability

5.00%

4.50%

4.00%

3.50%

3.00%

2.50%

2.00%

1.50%

1.00%

0.50%

0.00%

### $\bigcirc$

The N-type modules have better indicators than normal IEC standard and performs excellent during test process.

#### **Tiger Pro N Reliability Test IEC 5%** 3.12% 2.92% 2.8... 2.68% 2.69% 2.43% 2.50% 2.37% 2.26% 2.16% 1.93% 1.75% 1.49% 1.34% 0.82% 0.76% UN30+TC100+HF20 TCHOO WAST CSONHFLO WSO 0H1000 0++2000 xc200 61D 00 610795

N-type

#### P-type \*Jinko R&D Data Testing Sample: Jinko N-type mono Module Jinko P-type mono Module

## Product Advantage V Better low light performance



N-type cell, higher internal resistance, longer minority carriers life, naturally better low light response



- Compared with traditional PERC modules, N-type TOPCon modules have a better response to low light, extend the power generation period by about 1H in the morning and evening.
- Low light coefficient, especially the performance below 600W/m2, N-type products > P-type products



## Product Advantage VI High efficient use of

light

(J)

The use of circular ribbon effectively increases the total reflection of oblique light and the absorption of rear reflected light further improvement of bifacial factor



Tilt irradiation	Triangular ribbon	Circular ribbon	
Integrated light utilization	43. 33%	54. 44%	

Rear Reflected light Triangular ribbon		Circular ribbon P-type	Circular ribbon N-type
Bifacial factor	67.8%	70%	85%

## Product Advantage VI Better busbar matching



Jinko SMBB technology, effectively improves current collection capability, reduces the risk of hidden cell cracks and improves power performance



Electrical Analysis : Busbar increases by 1, internal resistance decreases by ~ 4%, corresponding power increases by 0.18%.

Ultra-fine soldering wire improves product quality, 0 hidden crack rate increases by 5%~10%.



## Improved Energy Generation Over 3%



# 1

#### **Optimized Temperature Coefficients**

The advanced N-type HOT2.0 technology brings better temperature coefficients from -0.35% (P-type) to -0.30% (N-type)



#### **Higher Bifacial Gain**

N-type modules have higher bifacial factor : 70% (P-type) up to 85% (N-type), significantly optimizing power generation capacity.



#### Lower LID / LETID

Low B content in N-type c-Si doped with P (significantly lower LETID from 0.9~1.2% (P-type) to 0.4% (N-type) and improved LID < 0.5%)

### Outdoor Project Data Support—Topcon VS PERC





### LCOE Analysis for Utility — Jinko N 605W VS XXP 660W



\* 200MW AC power station in Inner Mongolia N: 39.74°, E: 99.21°

#### 1. Initial- 1.18% lower than P-type

The table below shows the design of the project (tracker)

Cell	Jinko-N-605W	210-P-660W	
Power	605W	660W	
Efficiency	21.64%	21.25%	
Length (mm)	2465	2384	
Width (mm)	1134	1303	
Voc (V)	54.76	45.90	
1500V single series/pcs	25	30	
Tracker installation fee	76.21%	80.19%	
String/ tracker	4	3	
No. of tracker	Base	101.9%	
Power/ tracker (W)	60500	59400	
Tracker length (m)	Base	Base+4m	
No. of column	Base	Base+1	
Percentage (All column)	74%	80%	
Tracker-theroy (/W)	Base	104.2%	
BOS cost	Base	101.18%	

#### 2. Power Gain-Around 12096 MWh/Y than P-type



### Utility LCOE Analysis — Jinko N 605W VS XXP 660W



#### Saudi Arabia 2P tracker

	182N-72	210P-60	210P-66
Power (W)	565	600	660
∆BOS (US Cent/W)	-	▲2.80%	▲0.40%
∆LCOE (US Cent/W)	-	▲6.20%	▲4.94%

#### Spain 2P tracker

	182N-78	210P-60	210P-66
Power (W)	605	600	660
∆BOS (US Cent/W)	-	▲2.65%	▲0.37%
△LCOE (US Cent/W)	-	▲4.78%	▲3.84%



### **System Design—the combination of inverters**



Scenario	Module	Impp	Supplier	Imax / string	Imax (expected)	Deadline (expected)
Residential	60N-mono	13.49A	Growatt	13.5A	-	-
			Solis	16A	-	-
			SMA	Compatible	-	-
			Goodwe	13A	15A	2021 Q4
C&I	72N-mono 13.65A	13.65A	Huawei	13A	16A	2022 Q4
			Sungrow	13A	15A	2022 Q3
			SMA	Compatible	-	-
Utility	78N-bifacial 15.34A(15%bifacial gain)	Huawei	15A	16A	2022 Q3	
		Sungrow	20A	-	-	
		94,	Solis	16A	-	-

\* The maximum operating current is calculated with the irradiance of 1000 in the standard working condition. The actual working condition is lower than this value, and the compatibility is easier to meet

Satisfiability unsatisfiability

### System Design—the combination of inverters



#### String inverter



## Isc 14.18A Voc 55.40V

 Inverter upgrades for high-current modules continue, and as of Q2 2022, the vast majority of inverters are compatible with existing Tiger Neo high-current modules Central inverter

















## System Design—the combination of mounting system



### High mechanical strength design

Enhanced frame design

- Thicker material
- Thicker cavity



# Multiple installation modes Bolts installation

Clamp installation

2400Pa 5400Pa



## **Tiger Neo Global Capacity**

Tiger Neo will be ready for mass production in 2022 and the capacity will reach 10GW





# Thanks !

