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TOPCon for homes

25 April 2023

10:00 am – 11:00 am | CEST, Berlin, Paris
12:00 pm – 1:00 pm | GST, Dubai
4:00 pm – 5:00 pm | CST, Beijing

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Welcome!

Do you have any questions? ❓

Send them in via the Q&A tab. 👉 We aim to answer as many as we can today!

You can also let us know of any tech problems there.

We are recording this webinar today. 📹

We‘ll let you know by email where to find it and the slide deck, so you can re-watch it at your convenience. 👀 💡

TOPCon: The Game-Changer in Distributed Solar Markets

Johanna Bonilla
Technical Product Manager Europe

Jinko Performance

Global Leader

No.1

2016-2019

Module Shipments

150GW

Delivered

* 2023 Q1

22

World Records

90GW

Module Capacity

* 2023 Q4

15%

Market Share

* *Data as of 2023 Q2

Global Leader in Technological Innovation

Applied for 253 Patents

Authorized 1265 Patents

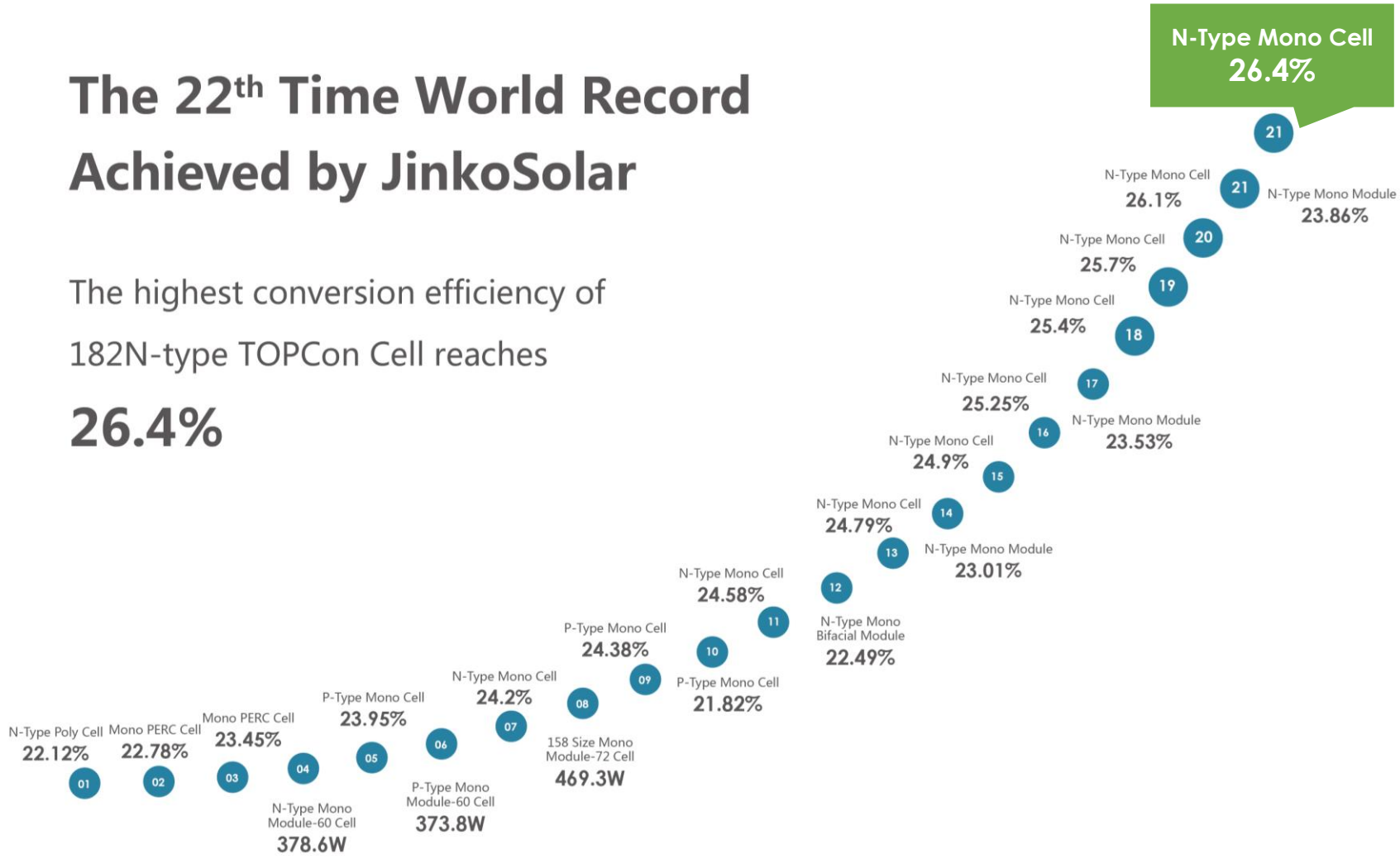
R&D Team 1395

R&D Investments 2.637 Billion (CNY)

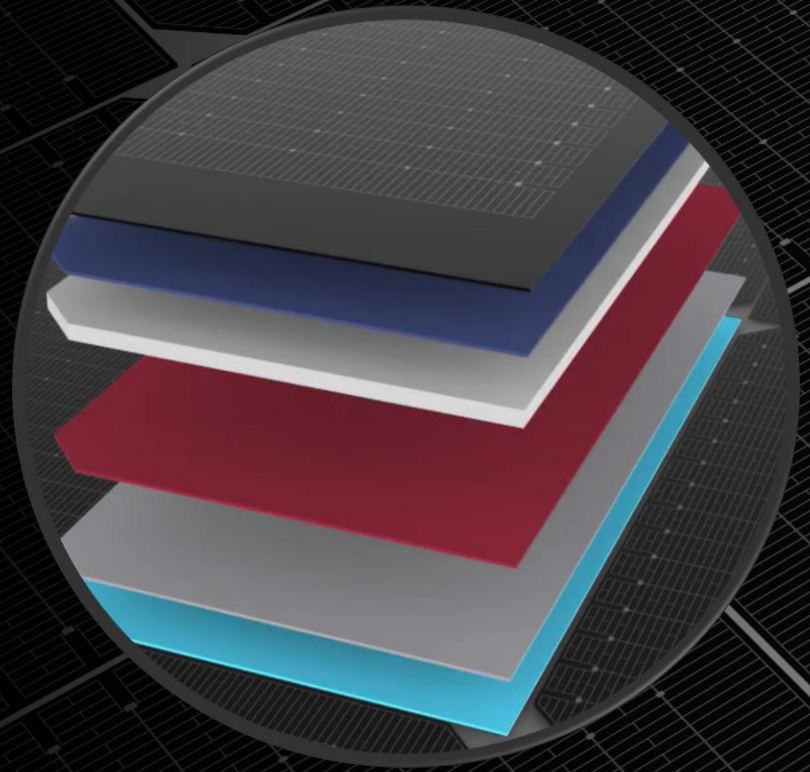
The 22th Time World Record Achieved by JinkoSolar

The highest conversion efficiency of 182N-type TOPCon Cell reaches

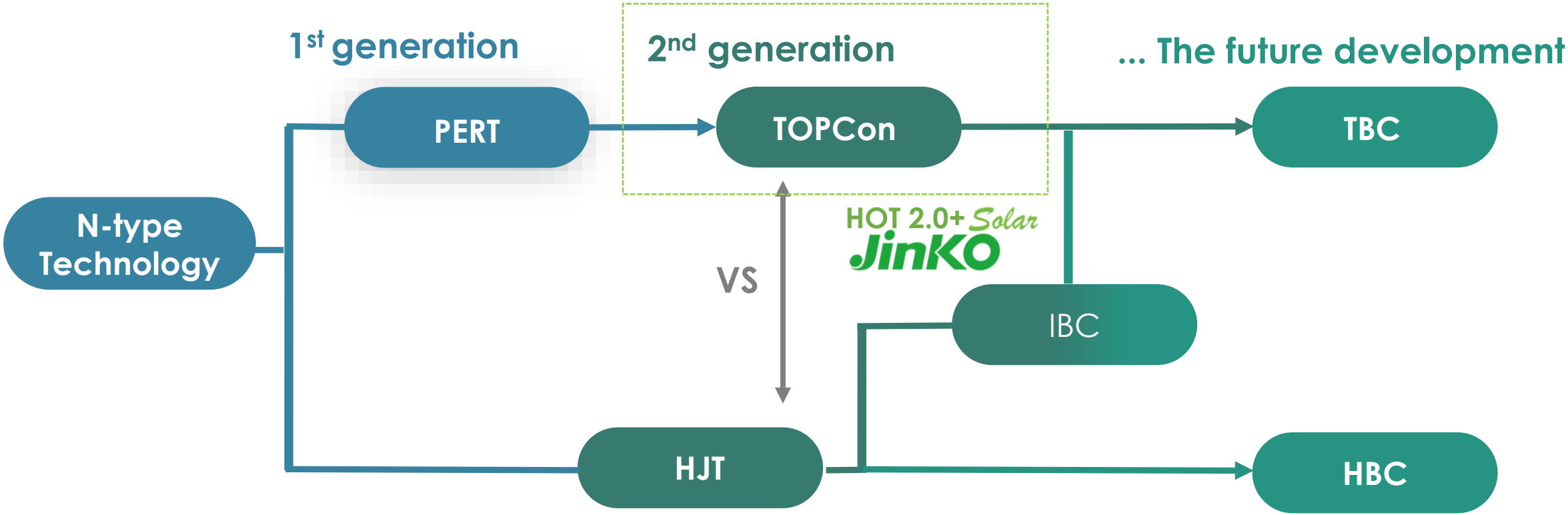
26.4%



TOPCon N-type
JKS Technology Innovation



TOPCon n-type — State of the art

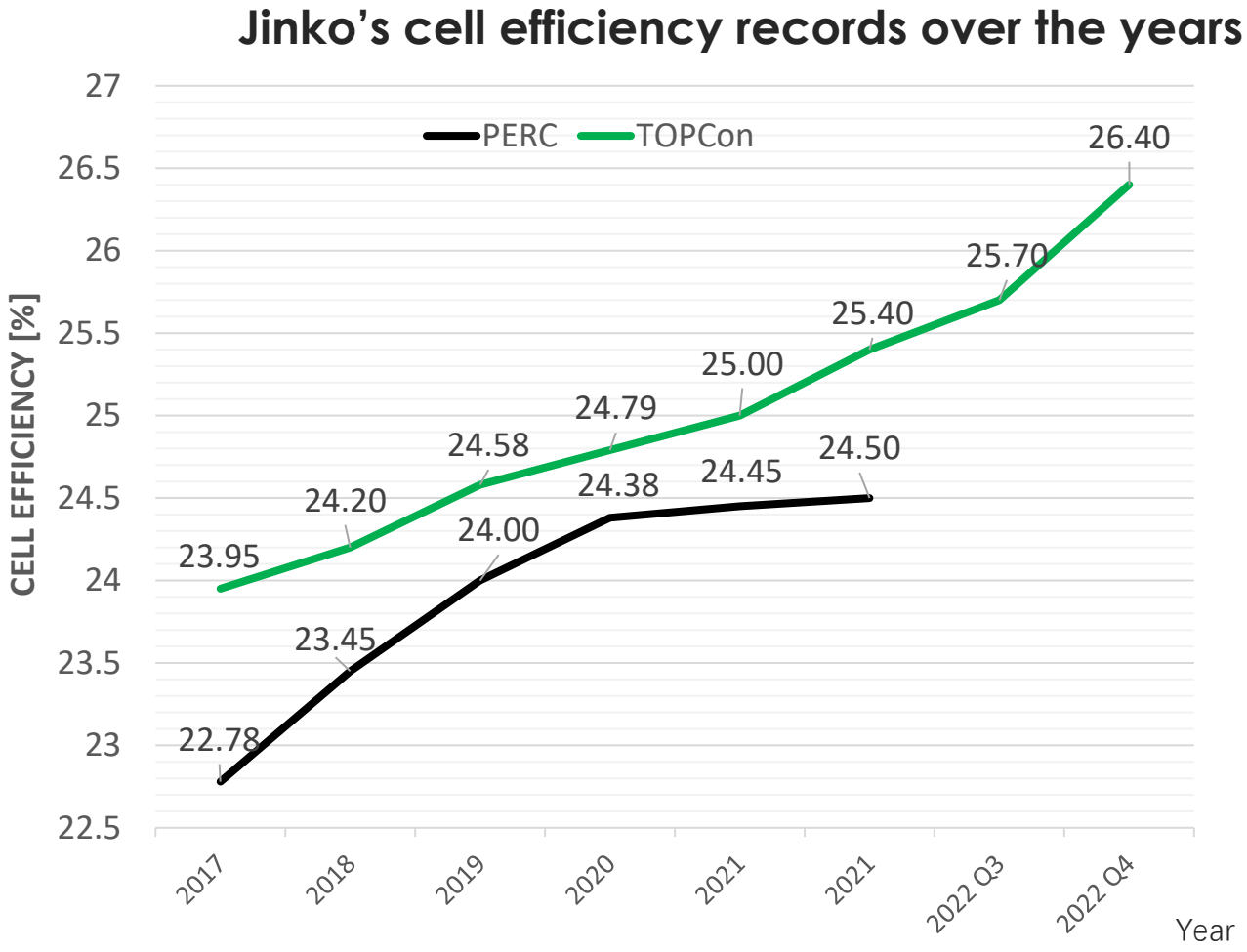


PERT: Passivated Emitter Rear Totally Diffused

*TOPCon ; Tunnel Oxide Passivated Contact
HJT : Heterojunction
IBC : Interdigitated Back Contact

TBC: Transparent Back Contact
HBC: Heterojunction back contact

TOPCon n-type — Cell Efficiency breakthrough



(Data source: Jinko's public data)

~>25% Breakthrough: mass production efficiency

28.70% Higher efficiency limits

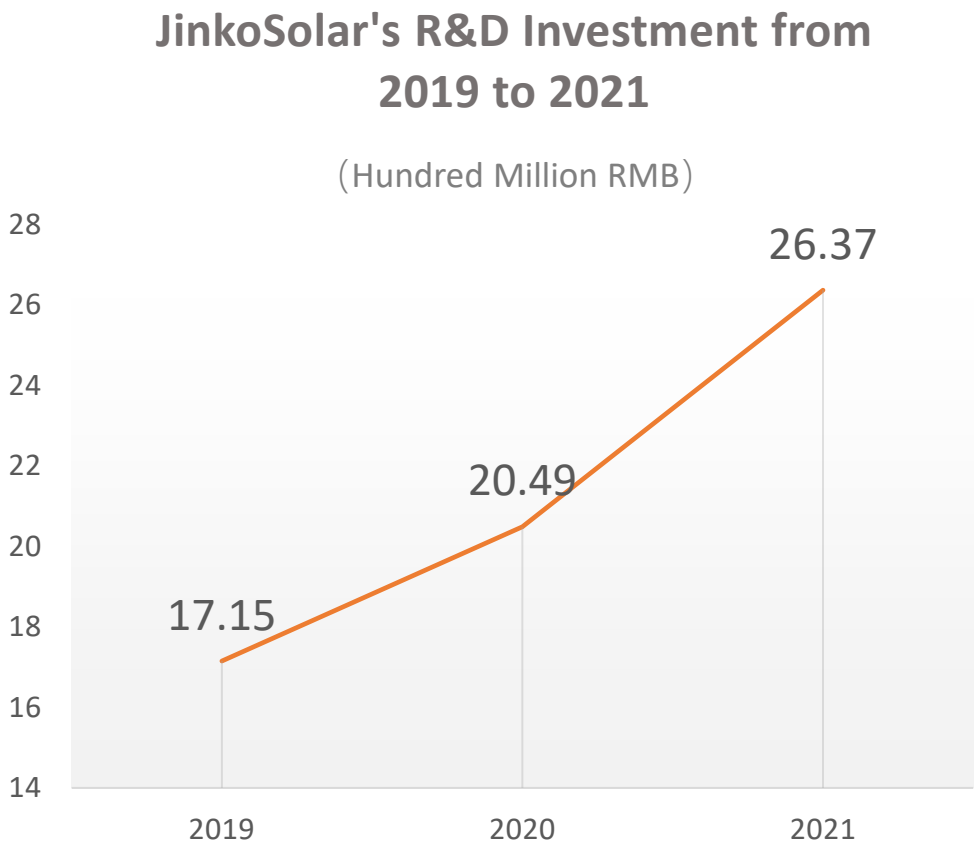
Topcon (28.2%~28.7%) vs. PERC cells (24.5%).

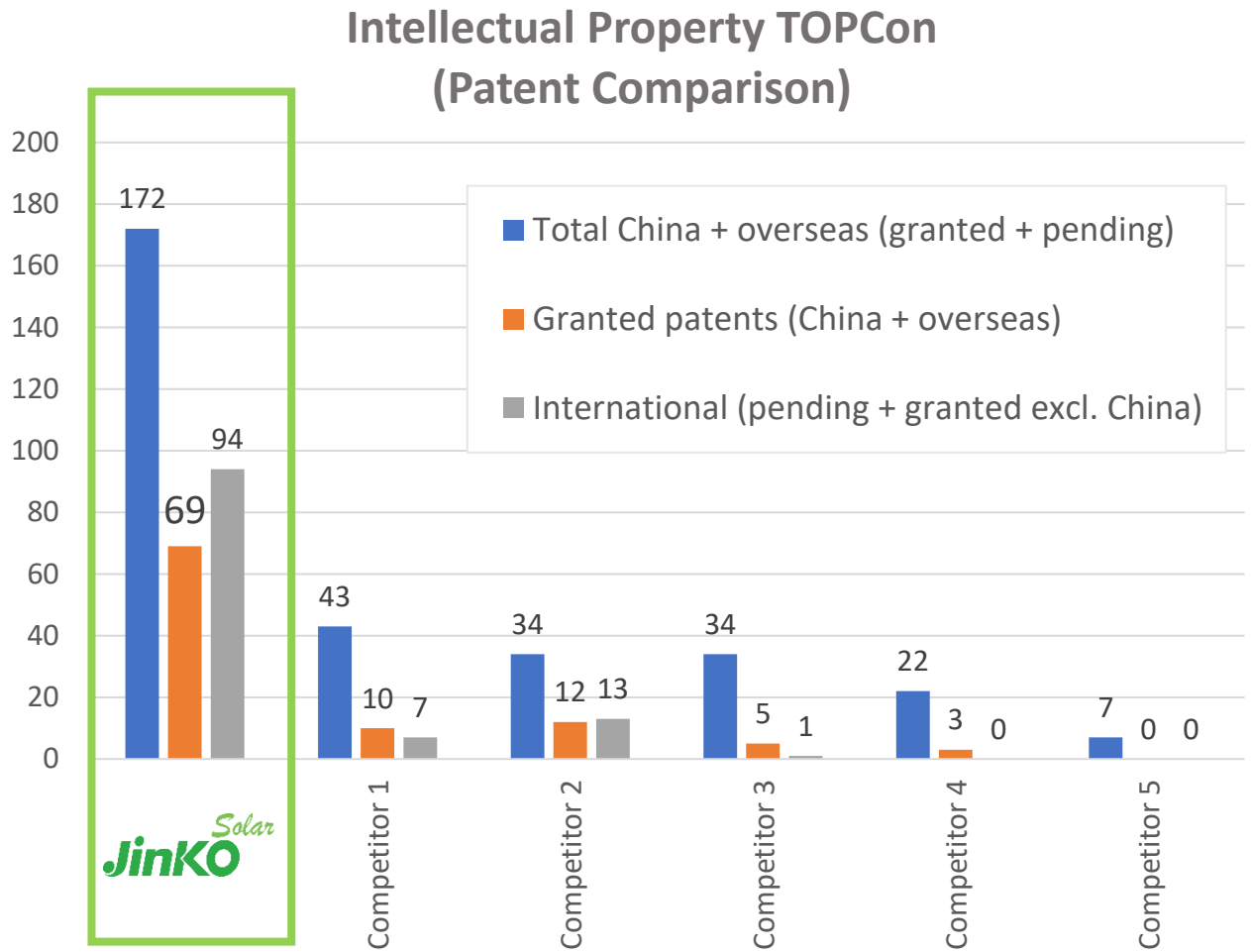
up to 3% Better power generation

Lower temperature coefficients, better operating temperatures, and **negligible** LID/LETID* degradation

*LID: Light Induced Degradation / LETID: Light-elevated temperature-induced degradation

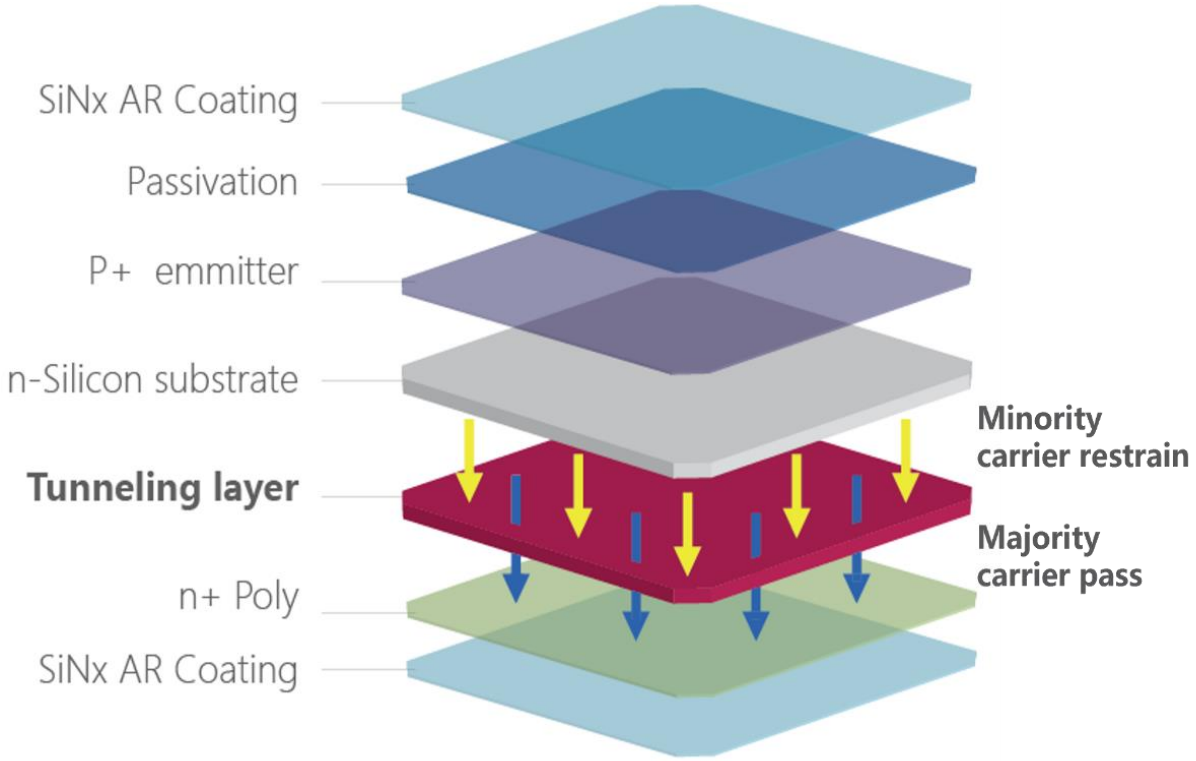
TOPCon n-type — JKS Strong IP TOPCon Portfolio





From: Jan 2023- based on PATSnap Database

TOPCon n-type — JKS Technology innovation



TOPCon

HOT 2.0+ Technology

Better activation rate

Less impurities

Better thickness uniformity

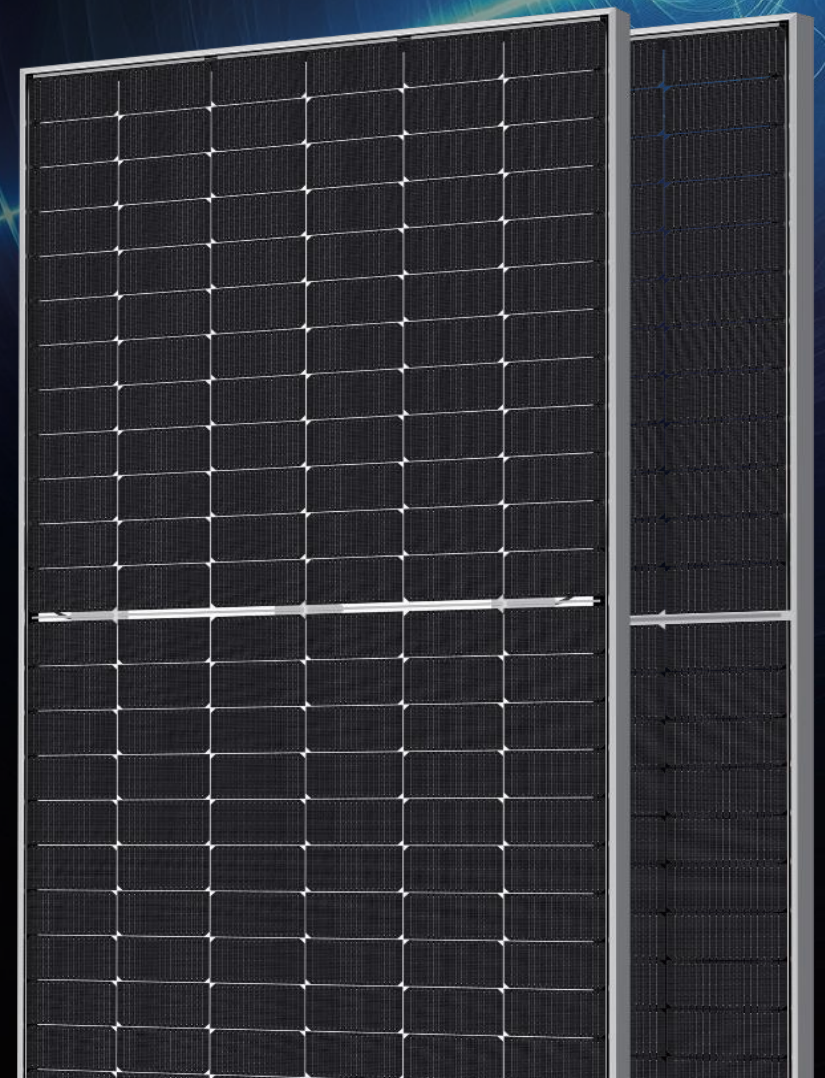
Better carrier conductivity

Tiger Neo Series

n-type TOPCon

TIGER Neo

N-Type TOPCon- A Notch Above



Tiger Neo Series — Application Scenarios

Utility

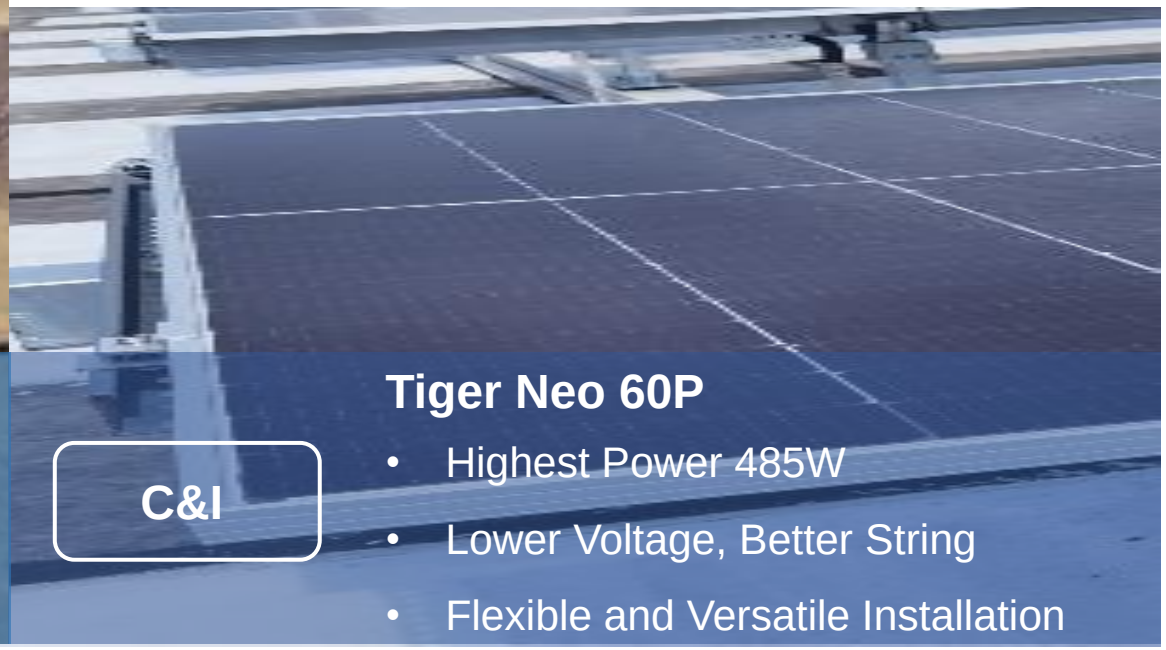
Tiger Neo 72P/78P

- Highest Power 590W/630W
- Lowest LCOE

Tiger Neo 54P

- Highest Power 450W
- Smaller size

Residential



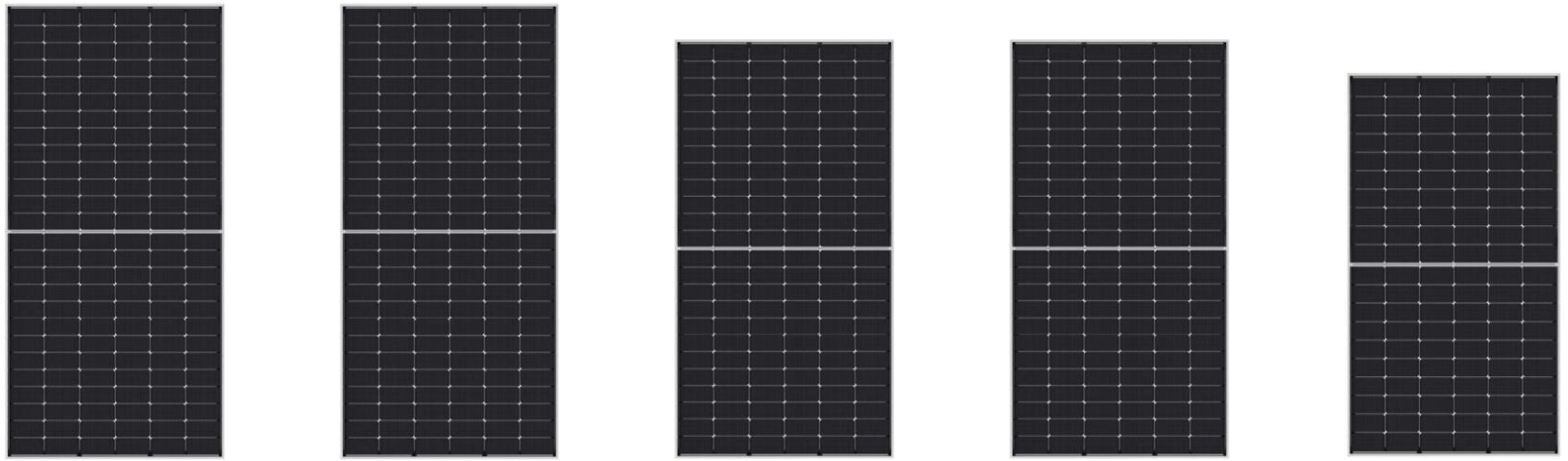
C&I

Tiger Neo 60P

- Highest Power 485W
- Lower Voltage, Better String
- Flexible and Versatile Installation

Tiger Neo Series

Tiger Neo



- N-type M10/182mm wafer
- TOPCon technology
- Higher efficiency
- Lower degradation
- Higher bifaciality

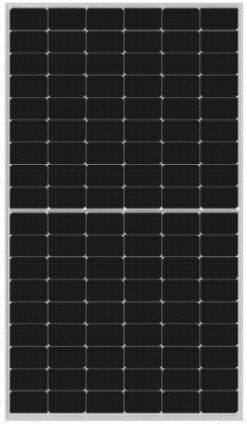
JKMxxxN-78HL4-(V)*	JKMxxxN-78HL4-BDV	JKMxxxN-72HL4-(V)	JKMxxxN-72HL4-BDV	JKMxxxN-60HL4-(V)
615-630 W	615-630 W	575-590 W	570-585 W	475-485W
2465*1134 mm	2465*1134 mm	2278*1134 mm	2278*1134 mm	1903*1134mm
22.00~22.54%	22.00~22.54%	22.26%~22.84%	22.07%~22.65%	22.01%~22.47%
78P	78P	72P	72P	60P
Mono-facial	Bifacial	Mono-facial	Bifacial	Mono-facial

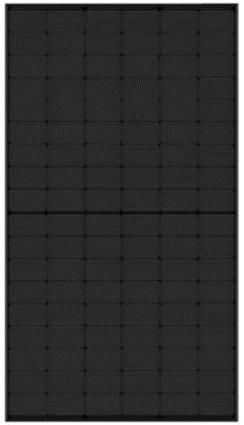
Minimum power is based on mass production starts from 2023 Q2. Maximum power is based on the highest efficiency BOM of 2023 Q4 Forecast
*Non-mainstream product

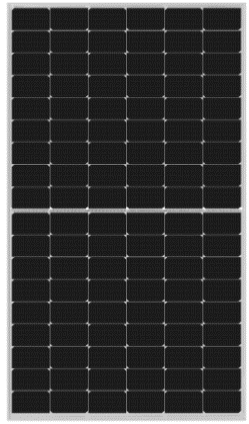
2023 New Products

Tiger Neo

- TOPCon technology
- Higher power
- Higher efficiency
- Lower degradation
- Higher bifaciality







JKMxxxN-54HL4R-(V)	JKMxxxN-54HL4R-B	JKMxxxN-54HL4R-BDV*
435-450W	430-445W	425-440W
21.77-22.52%	21.52-22.27%	21.27-22.02%
1762*1134mm	1762*1134mm	1762*1134mm
54P	54P	54P
Mono-facial	Mono-facial All Black	Bifacial Dual-glass

Minimum power is based on mass production starts from 2023 Q2.Maximum power is based on the highest efficiency BOM of 2023 Q4 Forecast
*Non-mainstream product

Solar
JinKO

Tiger Neo Series

Advantages

Higher Energy Generation
& Enhanced Reliability

Advantage Ⅰ

Optimized Performance

Leading Warranty

N-type module: 30 years

vs.

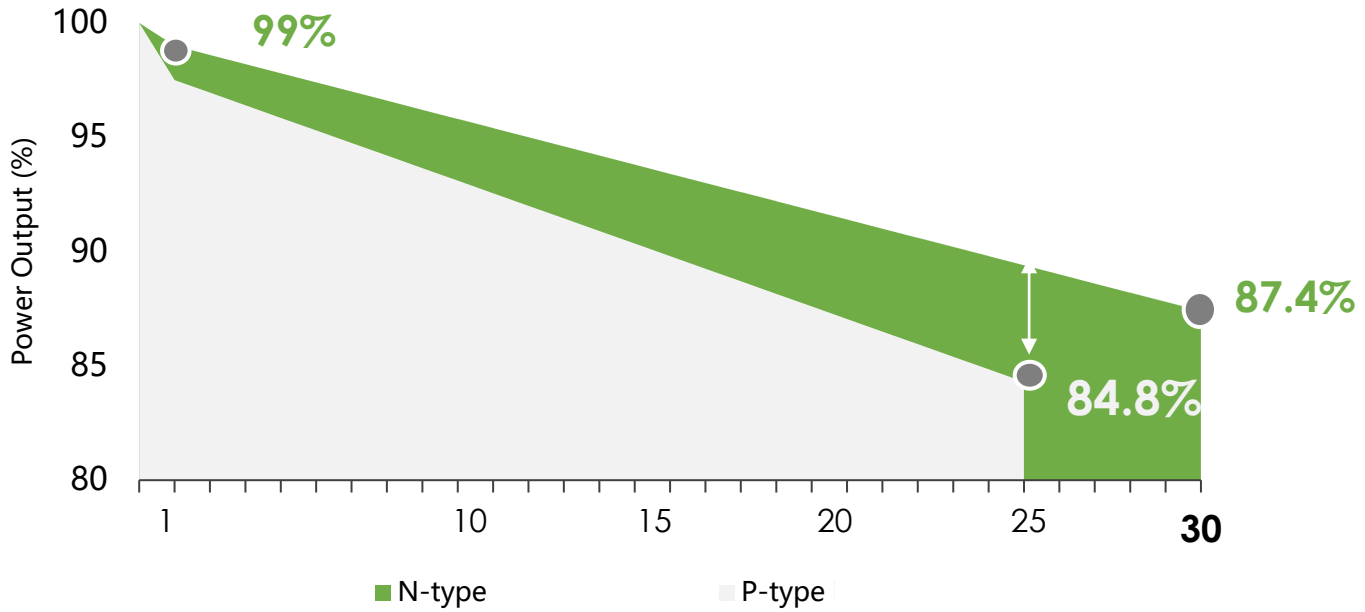
P-type module: 25 years.

With 1st year degradation ≤ 1%, the power after 30 year will remind over 87.4%

30 years Power Warranty

≤ 1%
First year degradation

0.4%
Linear degradation



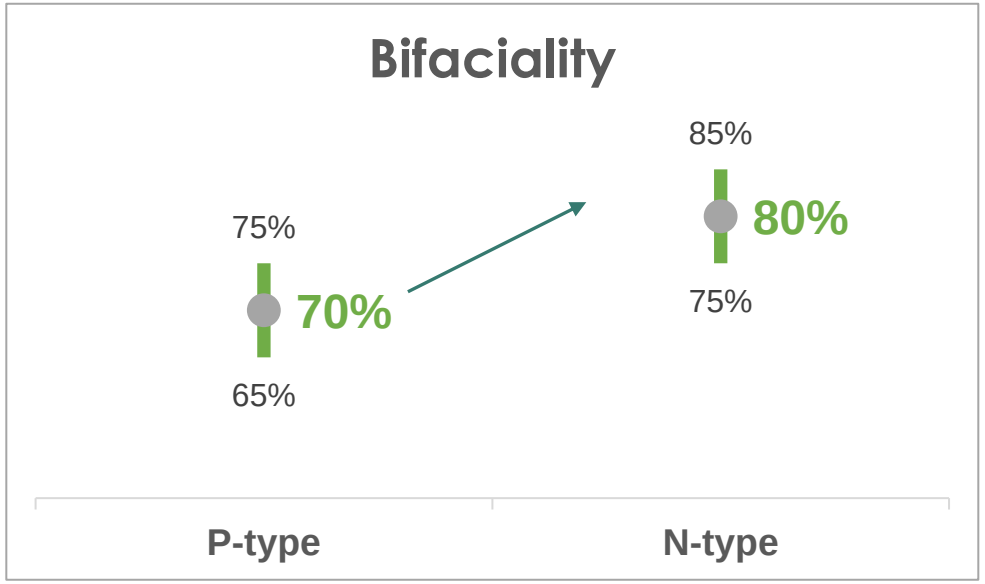
Advantage II

Bifaciality Factor

~80%

N-type's higher bifaciality will contribute to obtain a

Higher Bifacial gain



$$P_{\text{Integrated power}} = P_{\text{front}} * (1 + BSI * Bifi)$$

*Bifi: Module bifacial factor
*BSI: Bifacial stress irradiance coefficient (depend on real irradiance & ground reflectivity)

Power gain contrast

PERC	BSI*Bifi(70%)≈**9.45%**
TOPCon	BSI*Bifi(80%)≈ **10.80%**
	BSI*Bifi(85%)≈ **11.48%**

Simulation results for location Haining

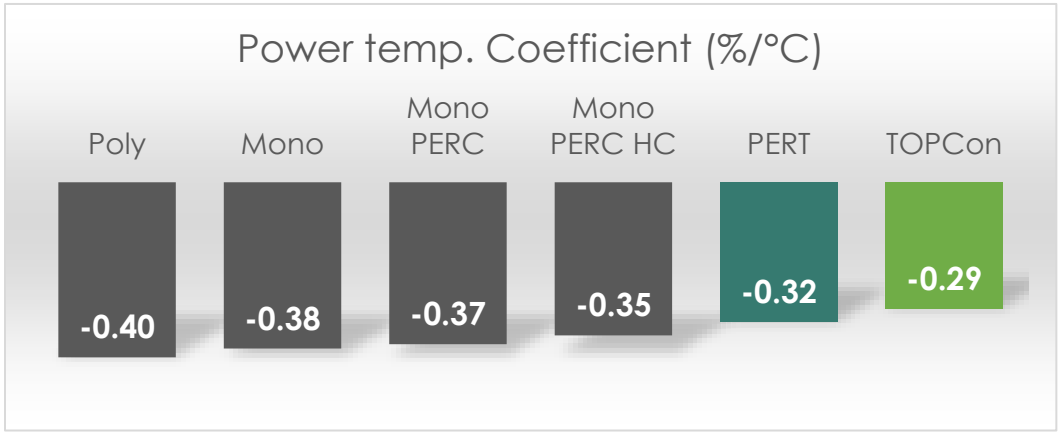
Advantage Ⅲ

Optimized Temperature Coefficients

-0.29%/ ℃

P-type -0.35%

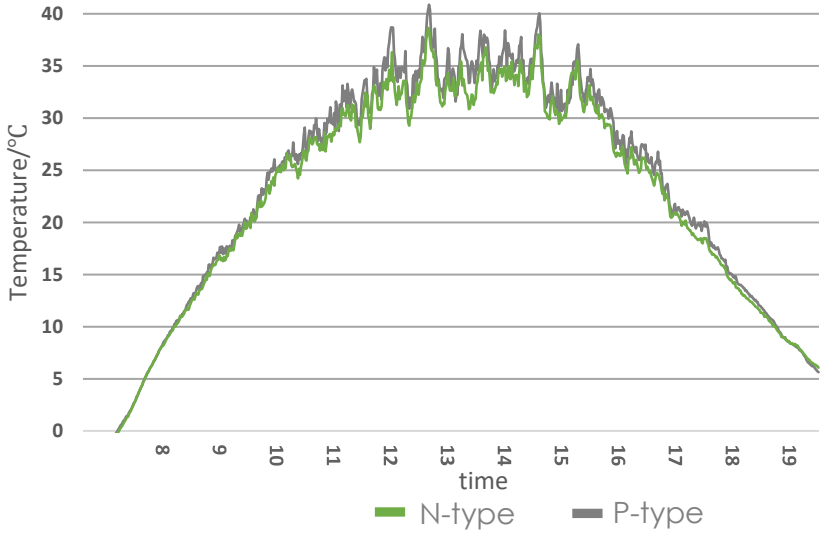
N-type -0.29%



The power temperature coefficient has improved with every generation of PV technology, but the switch from PERC to TOPCon will further improve it by +15%.

- Tiger Neo's power output will increase with the better **temperature coefficient** (**0.9% higher yield** compared to p-type)
- Under the same environment, Tiger Neo's **operating temperature will be lower** (**1 ℃ lower** compared to p- type)
- Under higher temperature conditions, the advantage will further expand (**~2%** higher)

Real-time operating temperature



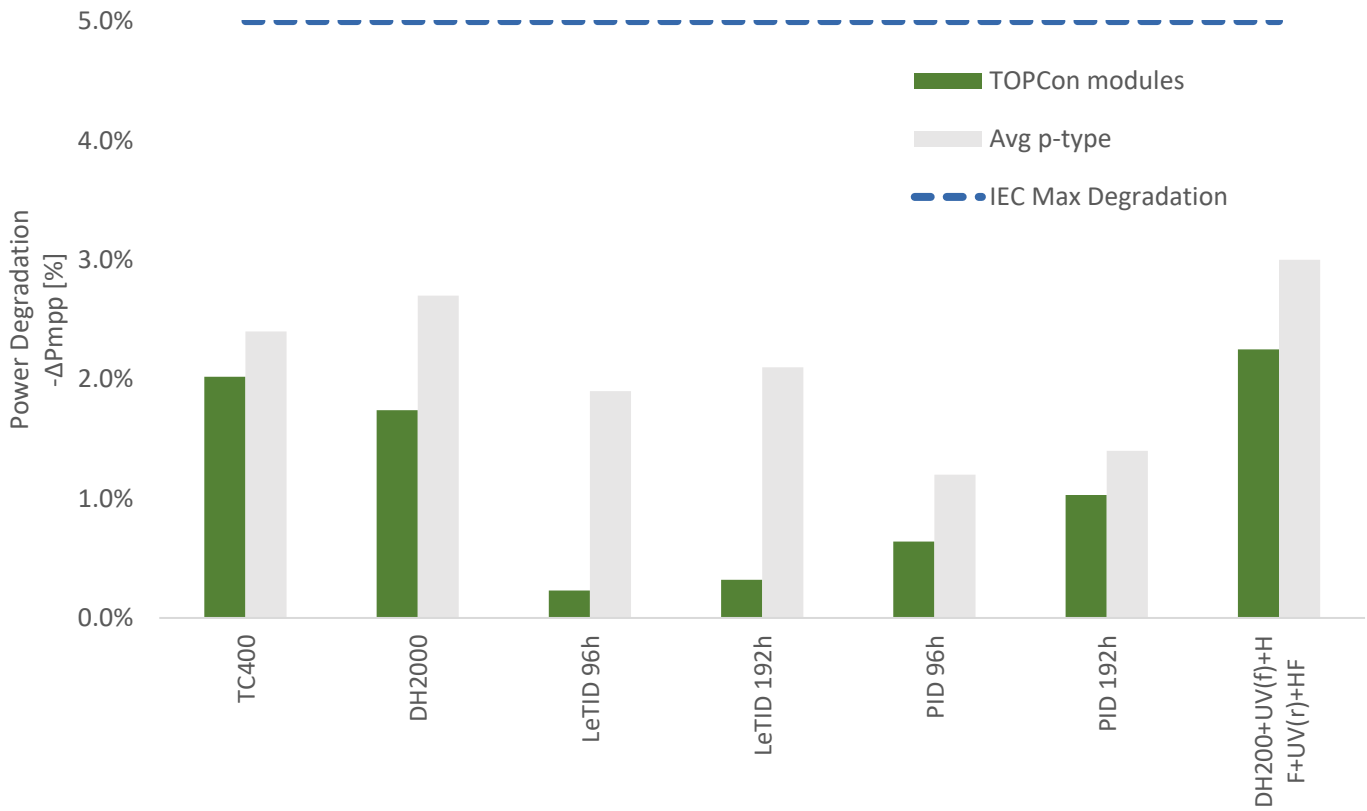
Location: Haining, Date: 4/12/2020

Advantage IV

Enhanced Reliability

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

Enhance Realiability testing

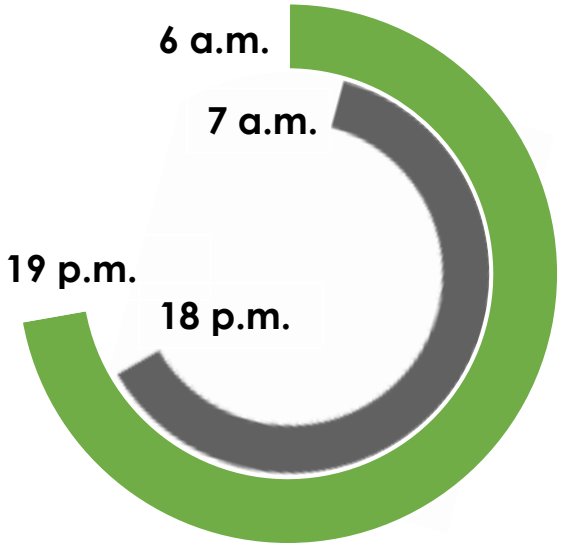


Results for TOPCon : Avg. values of Tiger Neo 78 Dual glass JKMxxxN-78HL4-BDV, TÜV Nord

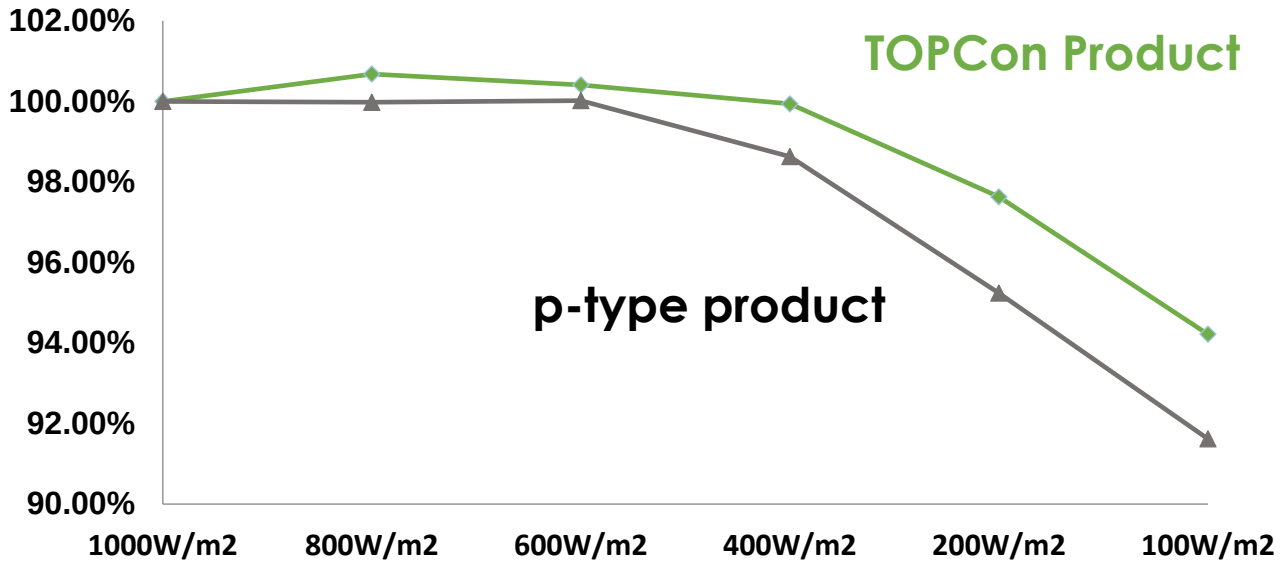
Advantage V

Better low light performance

N-type cell: higher internal resistance, restrain minority carriers recombination, naturally better low light response



- Compared with traditional PERC modules, n-type TOPCon modules have a better response at low light (below 600W/m^2)
- This reflects on extended power generation period by about 1h in the morning and evening.



Improved Energy Generation

over 3%

1 Optimized Temperature Coefficients

The advanced n-type TOPCon technology brings better temperature coefficients from -0.35% (p-type) to -0.29% (n-type)

2 Higher Bifacial Gain

n-type modules have higher bifacial factor: 70% (n-type) vs. 80% (n-type), significantly optimizing power generation capacity.

3 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 negligible LID < 0.5%)

Improved Long-term

Performance & Reliability

4 Advance Power Warranty

n-type TOPCon offers 30 yrs. power warranty compared to 25 yrs. p-type. Besides of a 1st year degradation of only 1% and annual 0.4% only.

5 Enhanced Reliability

n-type modules have better reliability indicators than the requirement of the IEC standards and show improved results than p-type.

6 Improved light efficiency & appearance

Tiger Neo series uses circular ribbon to optimize light absorption and advance wiring technology, improving the overall electrical performance and module appearance

Tiger Neo TOPCon for Residential

Tiger Neo Residential — 2023 New Products

Multiple application scenarios for roofs

15 Year
Product warranty

STANDARD MONOFACIAL

Highest Power **450**W

Efficiency **22.52**%

25 Year
Product warranty

ALL BLACK MONOFACIAL

Highest Power **445**W

Efficiency **22.27**%

15 Year
Product warranty

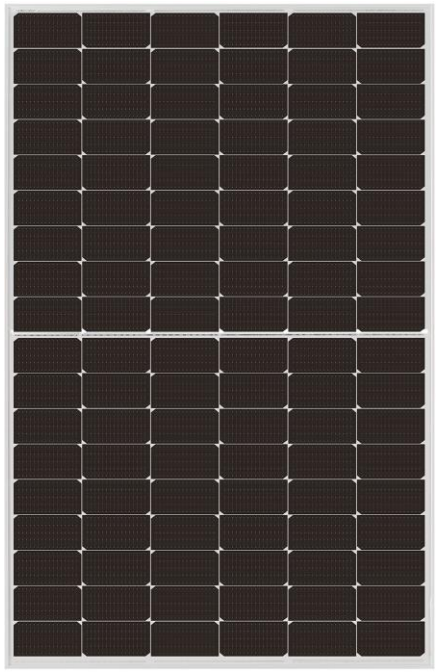
BIFACIAL DUAL GLAS

Highest Power **440**W

Efficiency **22.02**%

Tiger Neo Residential — Monofacial Products

Tiger NEO 54R

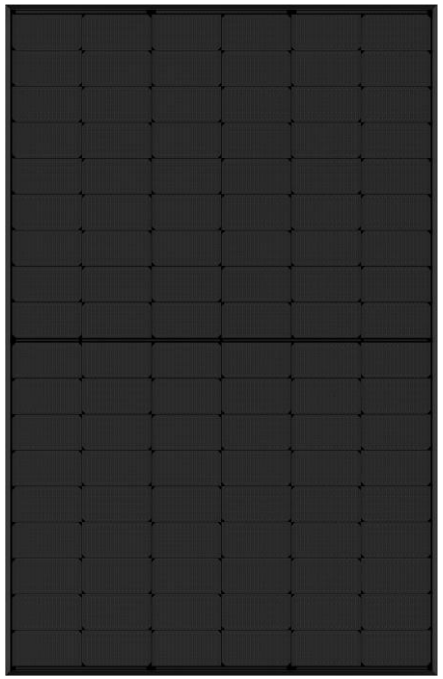


15 Year Product warranty

Max Power: **450Wp**

Highest Efficiency: **22.52%**

Tiger NEO 54R ALL Black



25 Year Product warranty

Max Power: **445Wp**

Highest Efficiency: **22.27%**

Smart size, higher power

1762*1134*30mm

22.0 kg

Perfect to handle

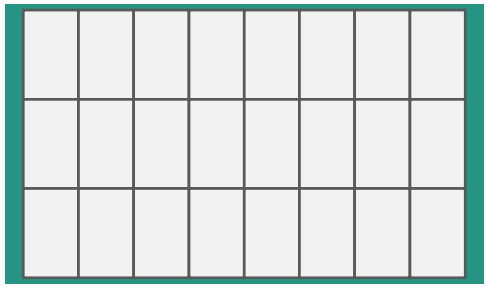
*Max power available by 23Q4

More power, more energy, same roof size

Location: Wangersen (Stade), Germany (53.37°N, 9.42°E)

Tilt angle: 30°, no near shadings, 54m^2 available area

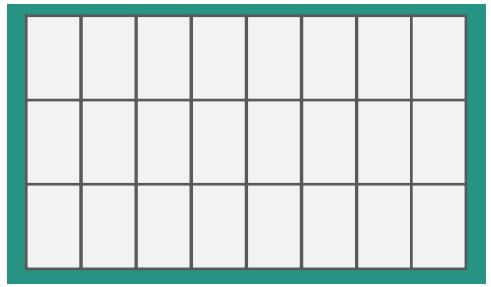
Tiger PRO 54 –p-type



Tiger Pro 420W*
26pcs, 51m^2
Total **10.92kW**

Produced Energy:
11.70 MWh/year

Tiger NEO 54R- TOPCon



Tiger Neo 445W**
26pcs-52m^2
Total **12kW**

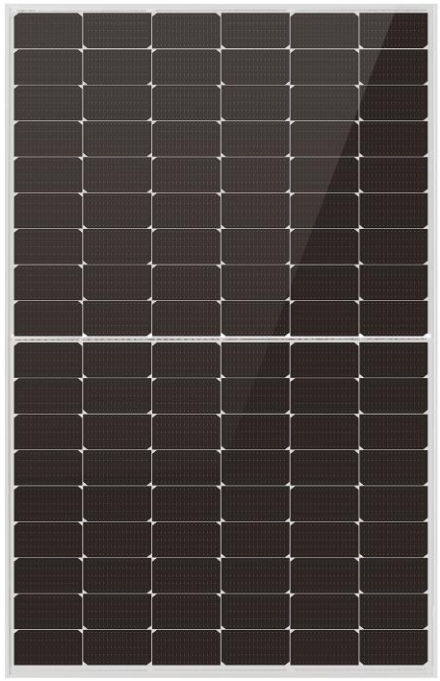
Produced Energy:
12.23 MWh/year

With a change of technology from perc to TOPCon:

2.6% more installed capacity with less modules **& 4.5% more energy production**.

*Max power available. **Max power available until 23Q4

Tiger Neo Residential — Bifacial Dual Glass 54R



Tailored for innovative Application Scenarios

15 Year
Product warranty

Smart size, higher power

1762*1134*30mm

22.0 kg

Perfect to handle

Max Power: **440Wp**

Highest Efficiency: **22.02%**

Bifacial Factor: **80±5%**

*Max power available by 23Q4

Carport

Sun room

More power, more energy, same roof size

Location: Wangersen (Stade), Germany (53.37°N, 9.42°E)

Tilt angle: 30°, no near shadings

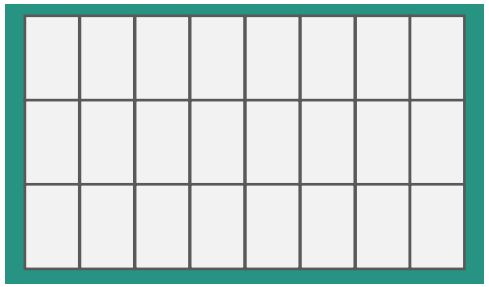
280 m^2 available roof area

Albedo: 0.25

Height: 0.80m

Pitch: 3.0

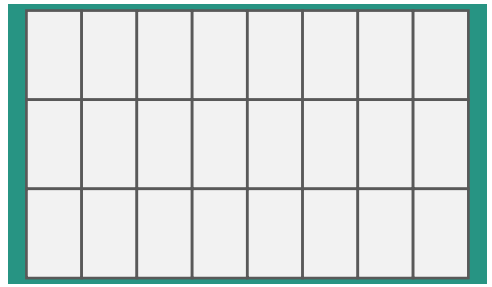
Tiger PRO 54 p-type mono



Tiger Pro 420W*
140 pcs
Total **58.8 kW**

Produced Energy:
60.07 MWh/year

Tiger 54R TOPCon bifacial DG



Tiger Neo 440W**
140pcs
Total **61.6kW (front)**

Produced Energy:
65.27 MWh/year

With a change of technology from perc to TOPCon:

4.8% more installed capacity (only front Pmax) **& 8.7% more energy production** for the same number of modules.

*Max power available. **Max power available until 23Q4

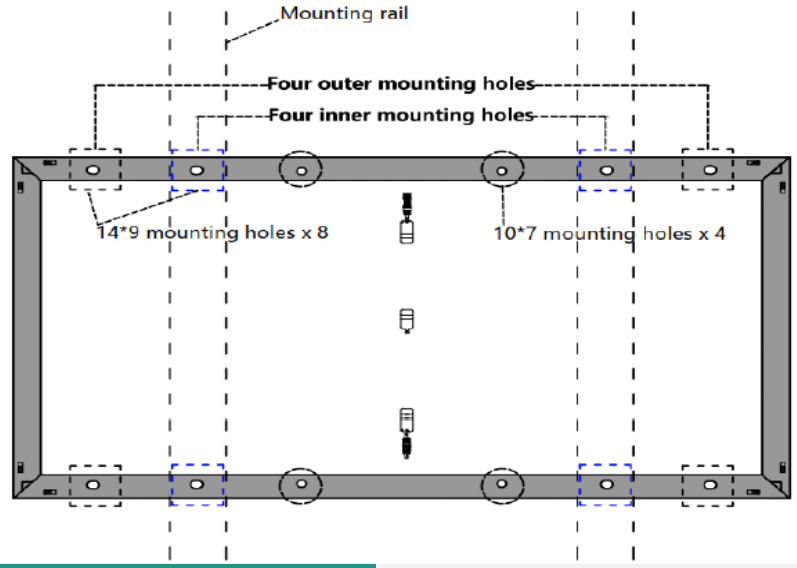
Tiger Neo 54R Series – Higher Mechanical Load

JinKO Solar

Easy installation- Tiger Neo 54R

Installation with bolts (four inner mounting holes)

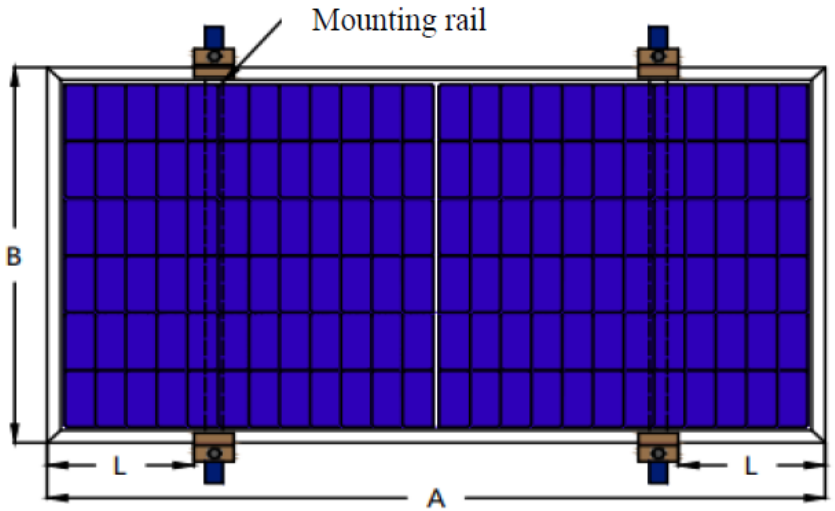
1762*1134*30
A/5±50mm



Max. Design Loads:	4000 Pa (positve) 2666 Pa (negative)
Max. Test Loads:	6000 Pa (positve) 4000 Pa (negative)

Clamps on Long Sides of the Frames

1762*1134*30
A/5±50mm



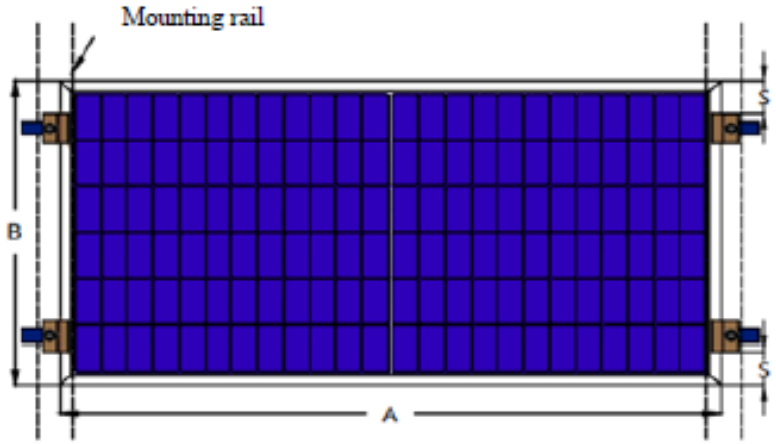
Max. Design Loads:	4000 Pa (positve) 2666 Pa (negative)
Max. Test Loads:	6000 Pa (positve) 4000 Pa (negative)

Refer to Installation Manual for details and more installation methods

Easy installation- Tiger Neo 54R

Clamps on Short Sides + Rail behind short side

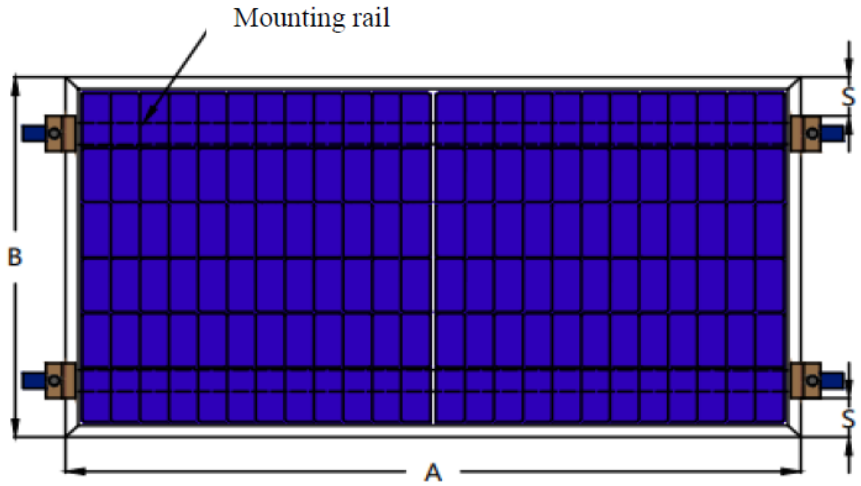
1762*1134*30
S= 100 -250



Max. Design Loads:	1067 Pa (positve) 1067 Pa (negative)
Max. Test Loads:	1600 Pa (positve) 1600 Pa (negative)

Clamps on Short Sides + Rail Perpendicular to short side

1762*1134*30
A/5±50mm ; S=100-240mm



Max. Design Loads:	1200 Pa (positve) 1200 Pa (negative)
Max. Test Loads:	1800 Pa (positve) 1800 Pa (negative)

Refer to Installation Manual for details and more installation methods


JinKO Solar
THANK YOU!

LINK THE VALUE FOR YOU

Global PV market and TOPCon trend outlook

2023.4.25

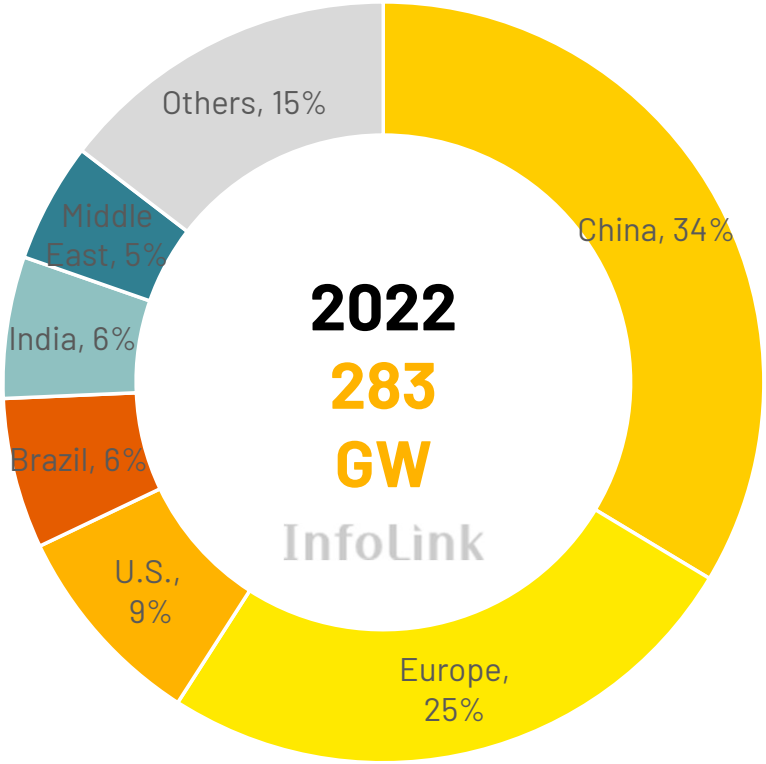
Derek 赵祥

InfoLink
CONSULTING
PHOTOVOLTAICS

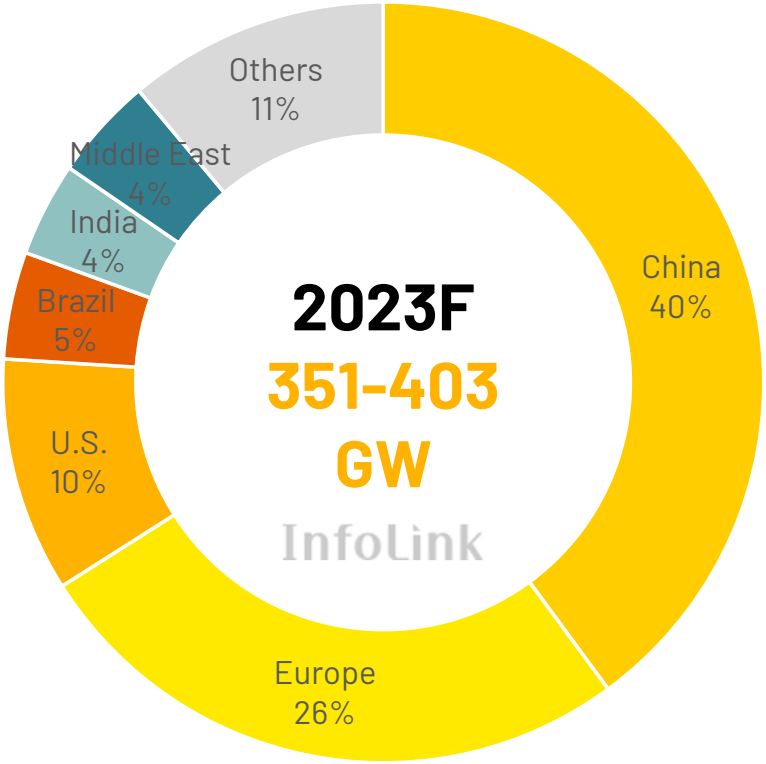
CONTENTS

01 Supply-demand overview

PV market outlook 2023



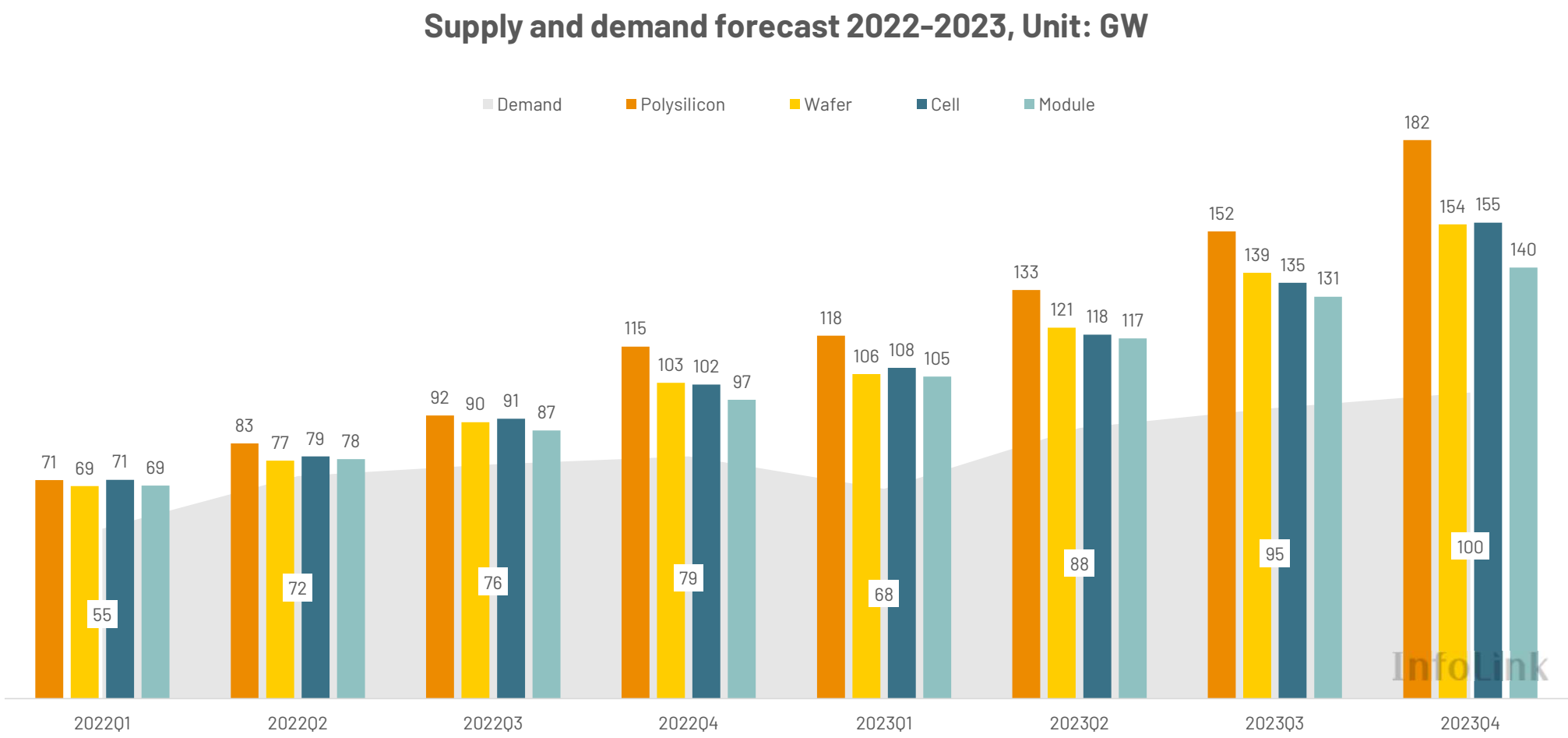
YoY **59%+**



YoY **24%+**

*InfoLink assesses demand based on module demand on DC generation side, factoring in DC/AC ratio of each market.

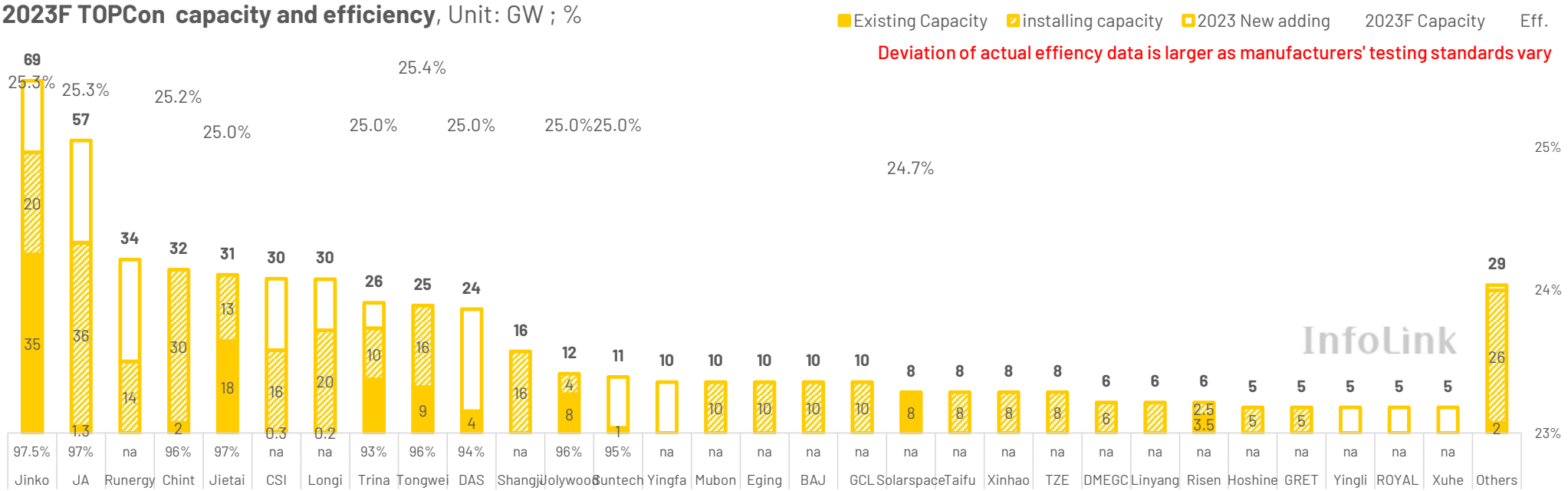
Global PV supply and demand



02 TOPCon on the rise

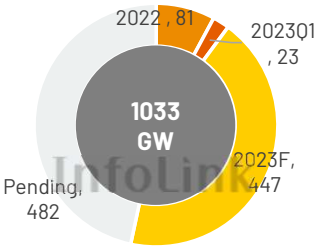
TOPCon development

2023F TOPCon capacity and efficiency, Unit: GW ; %

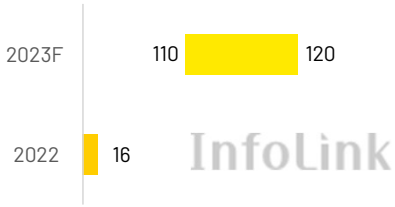


Source: InfoLink Technology Market Report_Apr-23

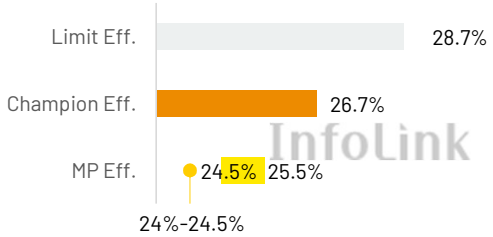
Capacity plan (GW)



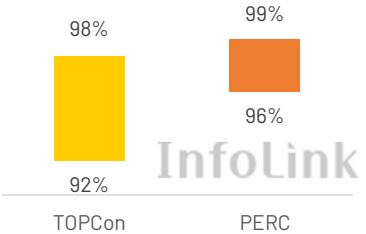
Module shipment (GW)



Efficiency

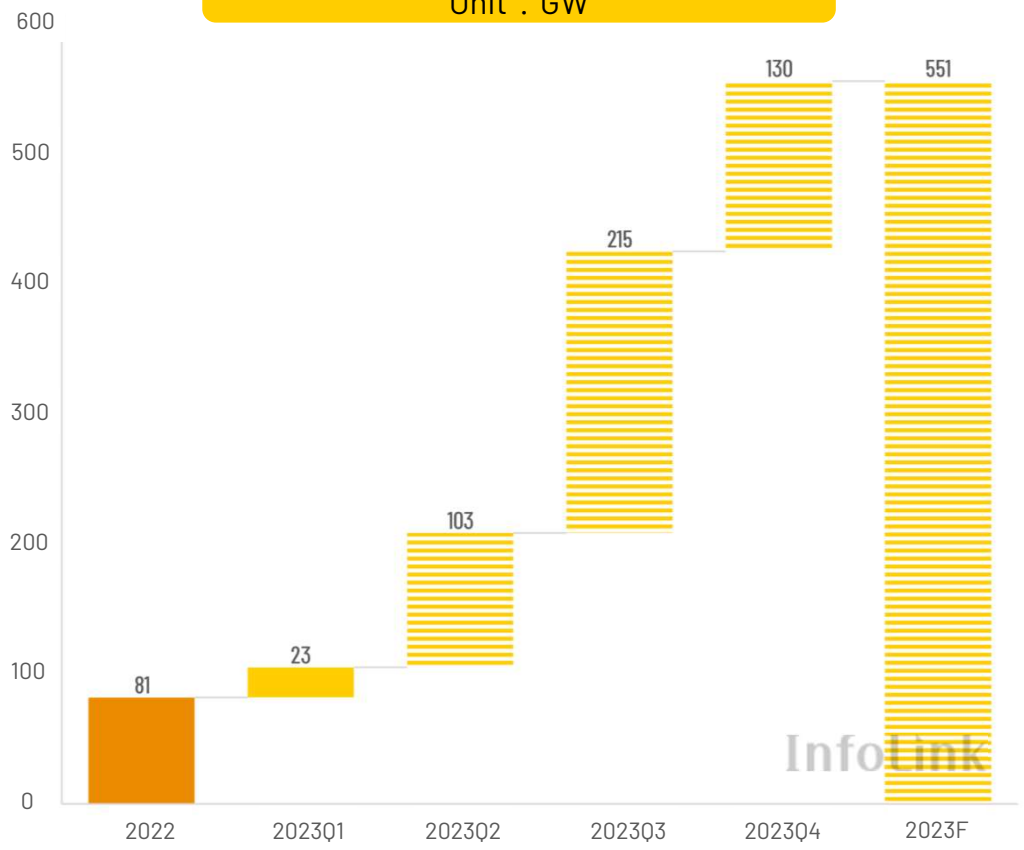


Yield rate

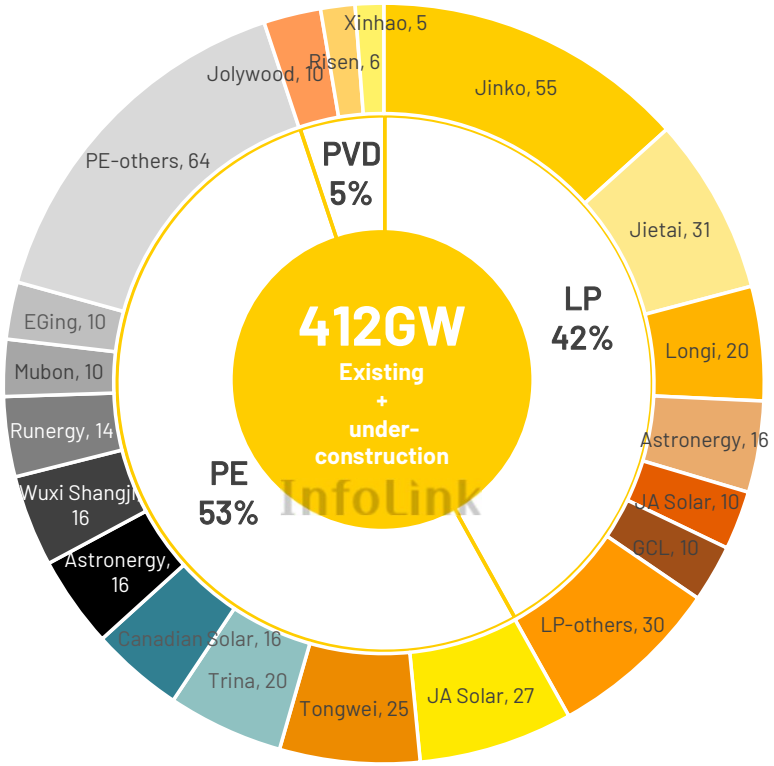


TOPCon production expansion and technology roadmap

TOPCon production expansion forecast, Unit：GW



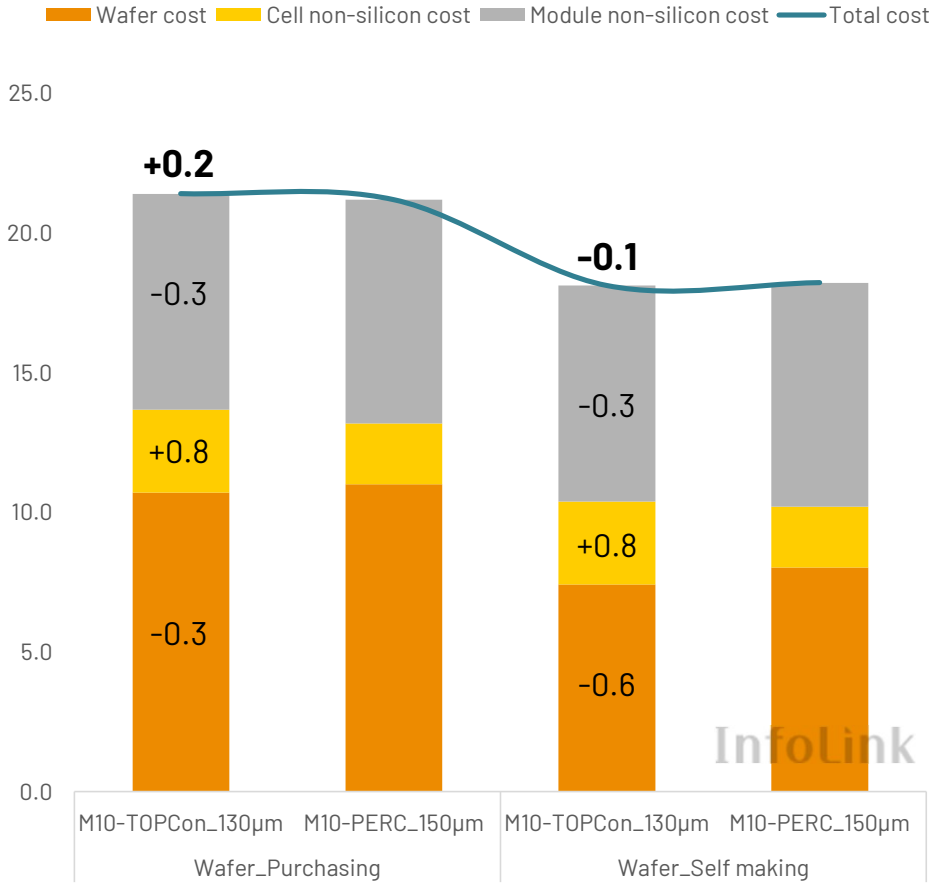
Share of rear side poly layers deposition capacity, Unit: GW/%



Source: InfoLink Technology Market Report_Apr-23

TOPCon has better profitability

TOPCon vs PERC costs, Unit: cents/W

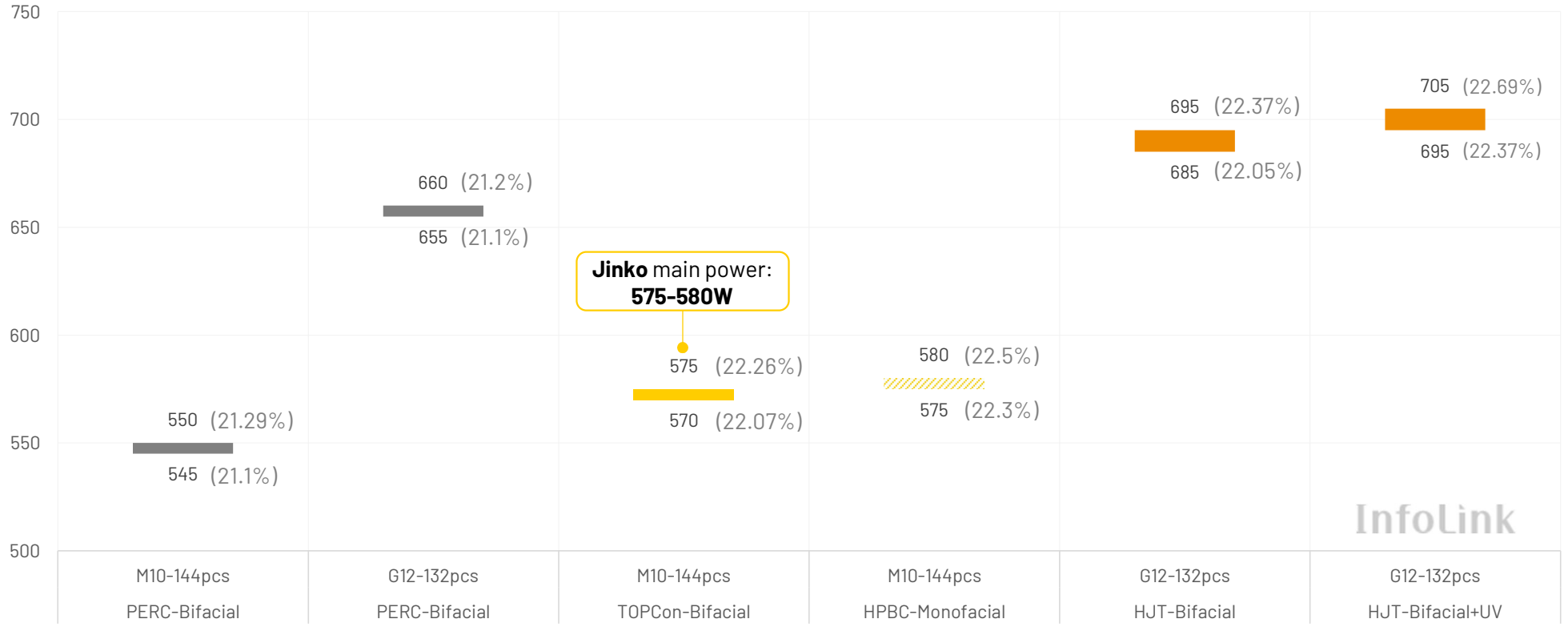


Profits of all sectors, Unit: cents/W

Updated: 2023/04/10

Module power by technology

Module power by Technology, Unit: W

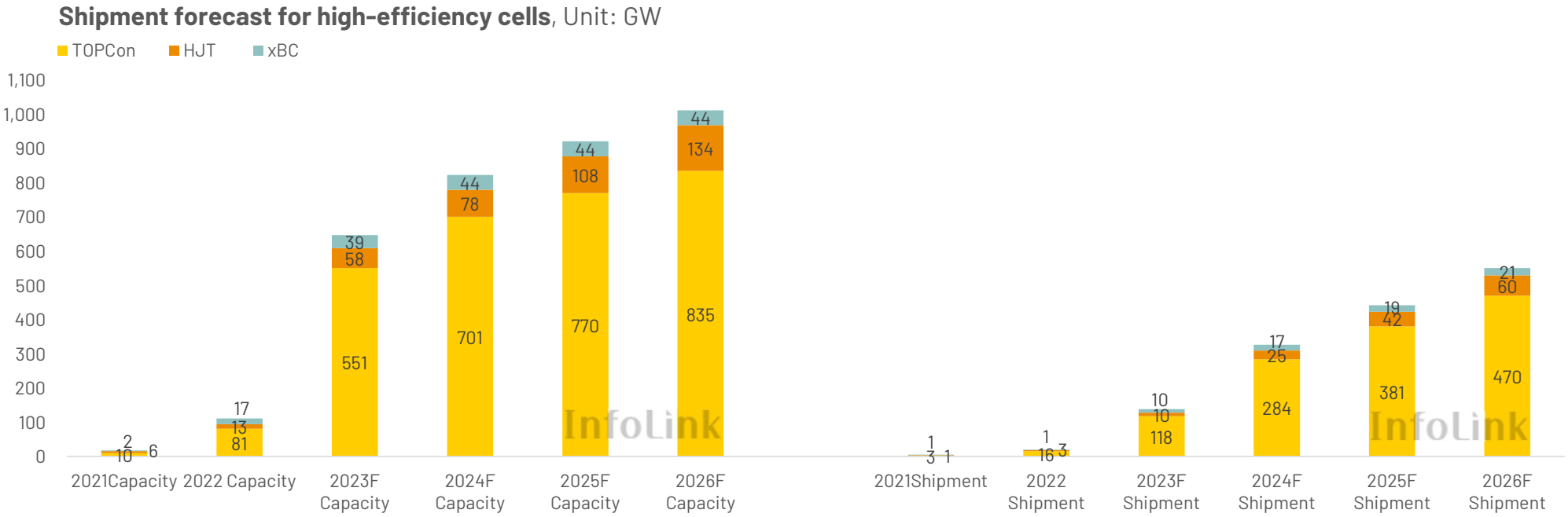


Updated: 2023/04/20

03 Market share forecast for TOPCon

Market share forecast for TOPCon

- TOPCon modules accounted for 6% of total module shipments in 2022. The market share is expected to increase to 30% in 2023 and 60% in 2024.
- In the short term, HJT and XBC have limited market share growth due to cost and yield issues.
- With a better-than-expected growth, high-efficiency cells will overtake PERC faster. In 2024, M/S of PERC modules is expected to drop to around 30%, and less than 15% in 2025.



Source: InfoLink Technology Market Report_Apr-23

About InfoLink CONSULTING

InfoLink Consulting is a global authoritative research and advisory firm focusing on renewable energy and technology. Since our establishment in 2017, we've been dedicated to helping clients navigate a rapidly changing industry by providing in-depth research data, market analysis, and tailored-made advisory service. Today, we have helped more than 130 clients across the globe plot strategies and make pivotal decisions. After deepening our presence in the renewables, we expanded into the technology field to provide comprehensive services, helping more businesses gain competitive edges.

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