

N-type in the mainstream – the future of high-efficiency PV technologies and applications

DATE

6th December 2023



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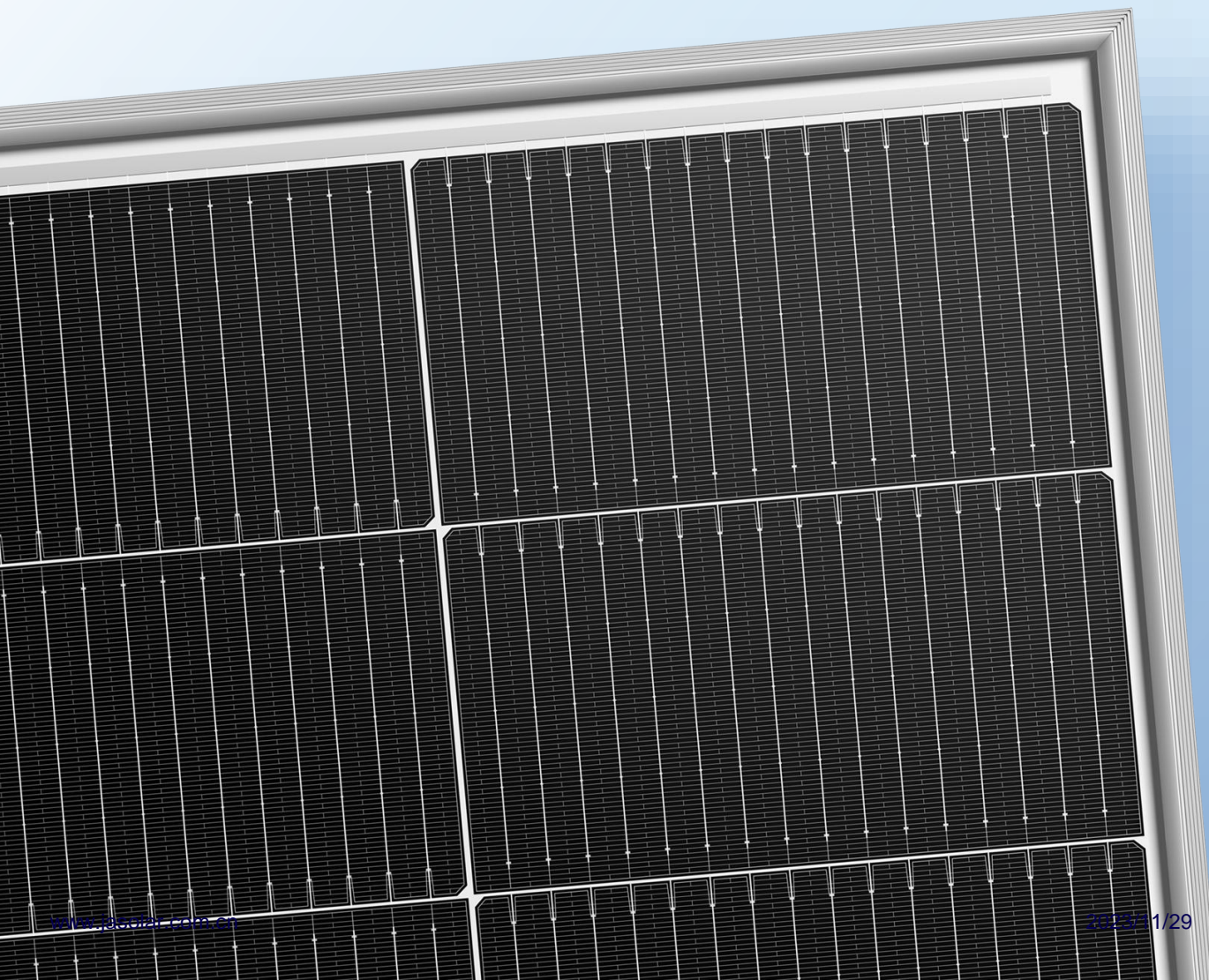


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JA SOLAR TECHNOLOGY

PV Tech Webinar

JA Solar Technology Co.Ltd.
Q4 / 2023



About JA Solar

May, 2005

Founded in

NASDAQ

Listed on Feb, 2007

Shenzhen

Stock Exchange

Listed on Nov. 2019

32591

Employees

US\$ 10.6 B

Revenue in 2022

+152 GW

Cumulative Shipments

135

Covered Countries
and Regions

13

Global factories

16%

Market Share Global
(2022, S&P Global)

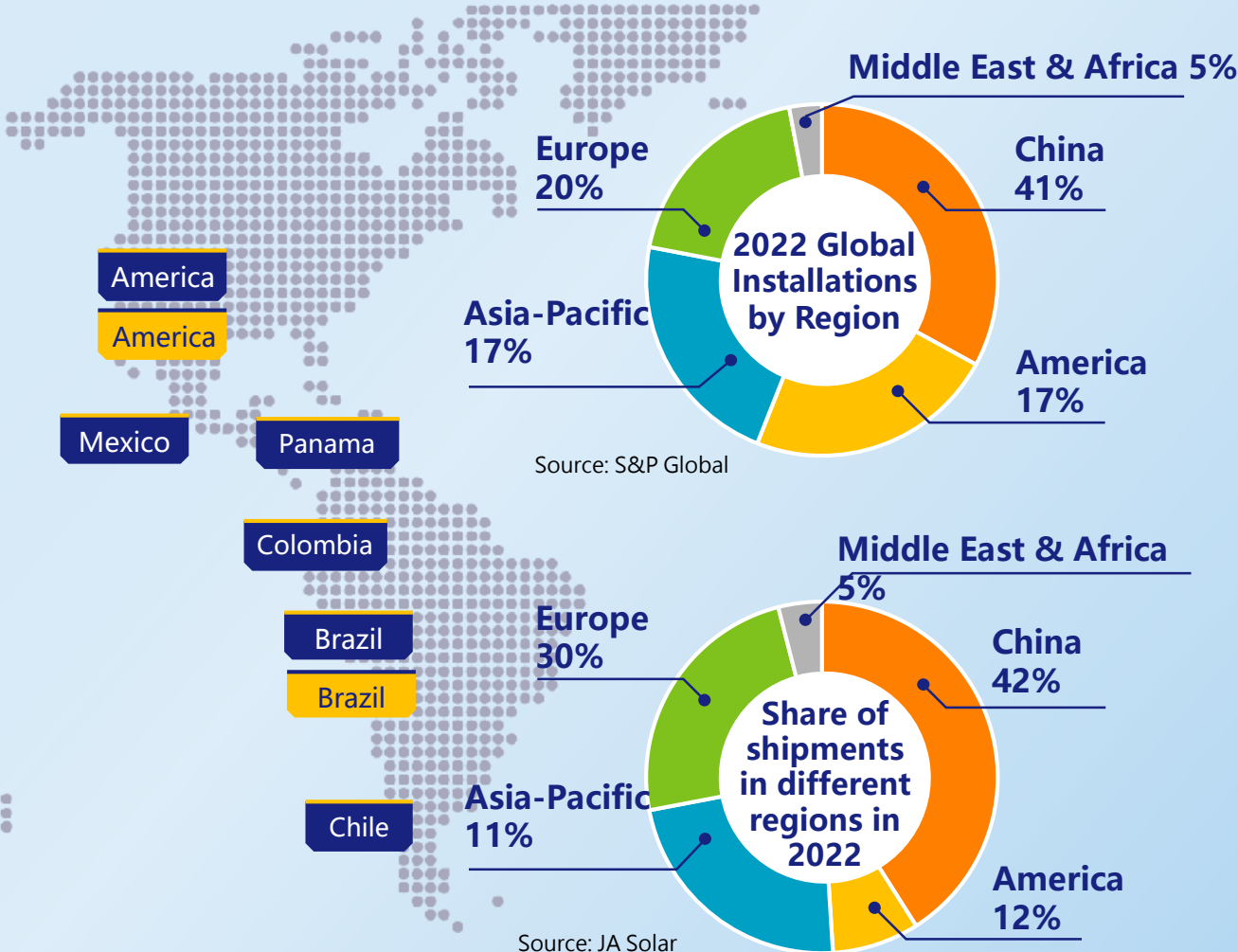
Fortune China 500

Many Consecutive Years Listed on

Top3

In modules
shipping

(2022, PV InfoLink)



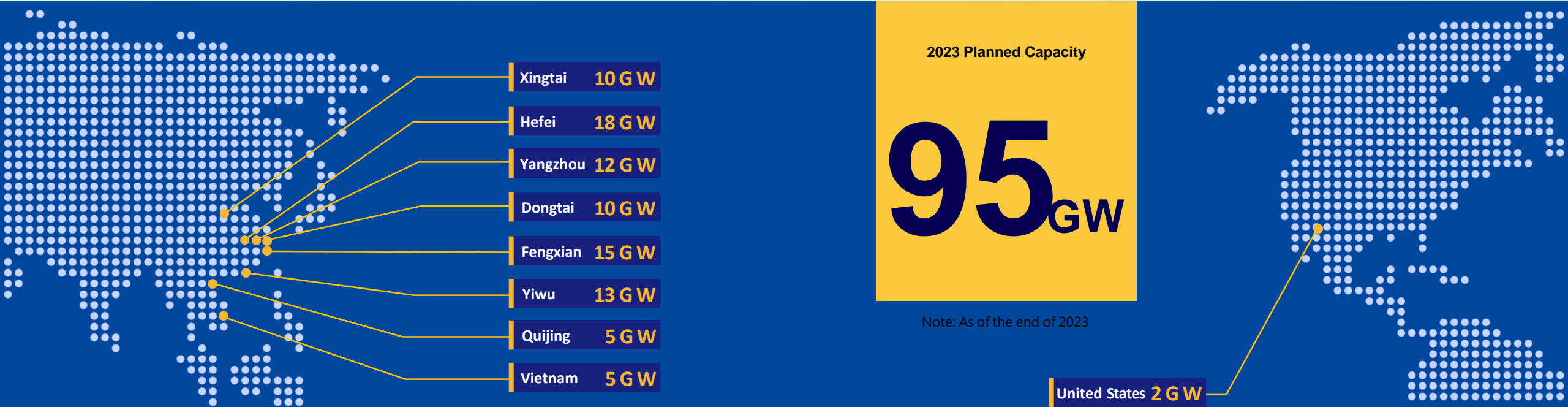
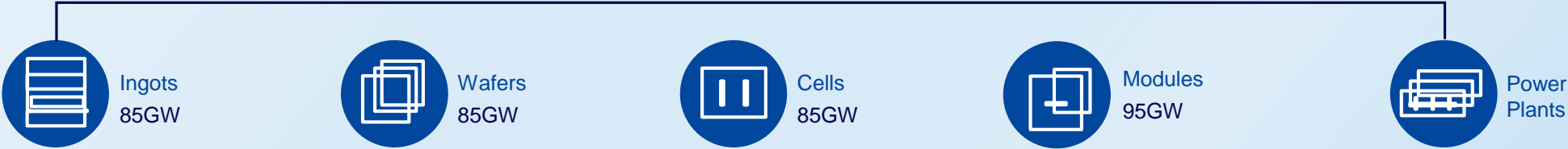
**Location of Sales Subsidiaries**

**Location of Warehouses**

■ Verticalization and Production Capacity

Deep empowerment of vertical integration, capacity planning of 95GW

Control of the entire production chain





This report is an annual report covering the period from January 1, 2022, to December 31, 2022.

JA Solar has a zero-tolerance position towards modern slavery and human trafficking and is a signatory to the UN Global Compact Act

JA Solar undergoes regular third-party audits to ensure compliance with international standards and transparency. (Achilles, Sedex, Ecovadis, CEA, STS)

Environmental (E)	<ul style="list-style-type: none"> Environmental Management System Effluents and Waste Management Clean Technology Opportunities 	<ul style="list-style-type: none"> Energy Management Addressing Climate Change 	<ul style="list-style-type: none"> Water Resources Use and Management Biodiversity
Social (S)	<ul style="list-style-type: none"> R&D Innovation and Intellectual Property Protection Customer Protection Driving Industry Development Employee Training and Development 	<ul style="list-style-type: none"> Product Quality and Safety Supply Chain Management Public Welfare Occupational Health and Safety 	<ul style="list-style-type: none"> Product Life Cycle Management Responsible Procurement Protection of Employee Rights and Interests Occupational Health and Safety Diversity And Equality of Opportunity
Governance (G)	<ul style="list-style-type: none"> Anti-Corruption and Business Ethics Information Security and Privacy Protection 	<ul style="list-style-type: none"> Corporate Governance Improper Competition Behavior 	<ul style="list-style-type: none"> Compliance and Risk Management Market Performance



Comprehensive traceability system

Complete Integrated Traceability System

Total JA Group level ERP/MES system in place alongside physical labelling and indicators

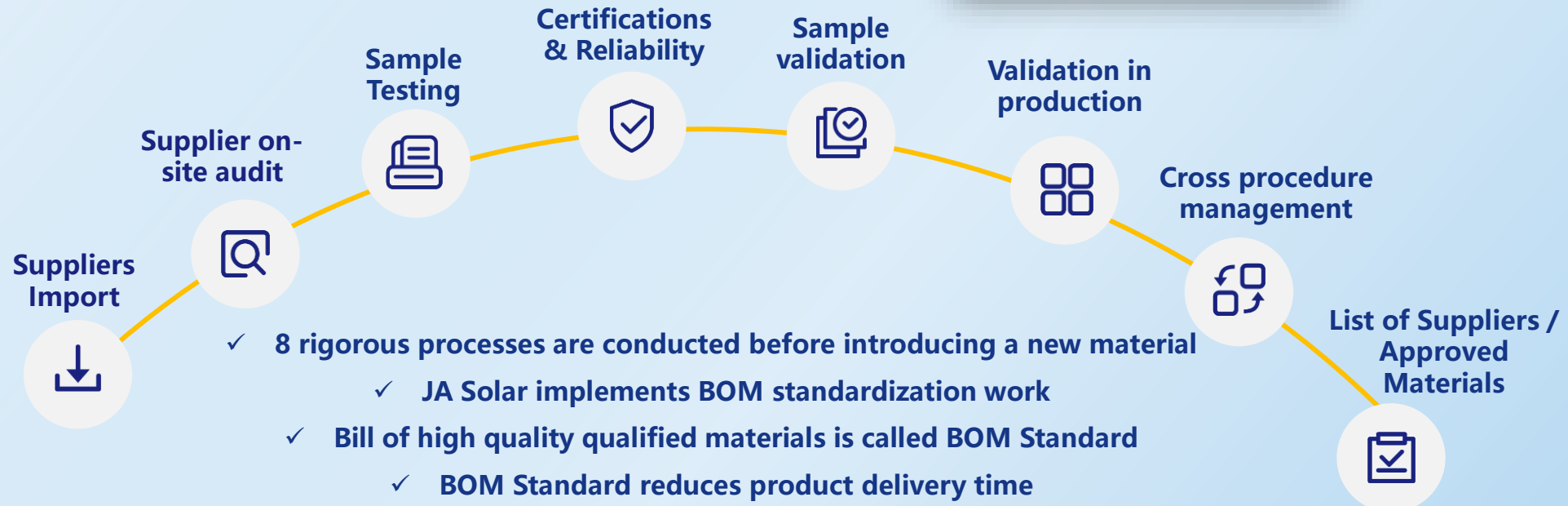
Exact production sites and supplier can be traced completely from serial number

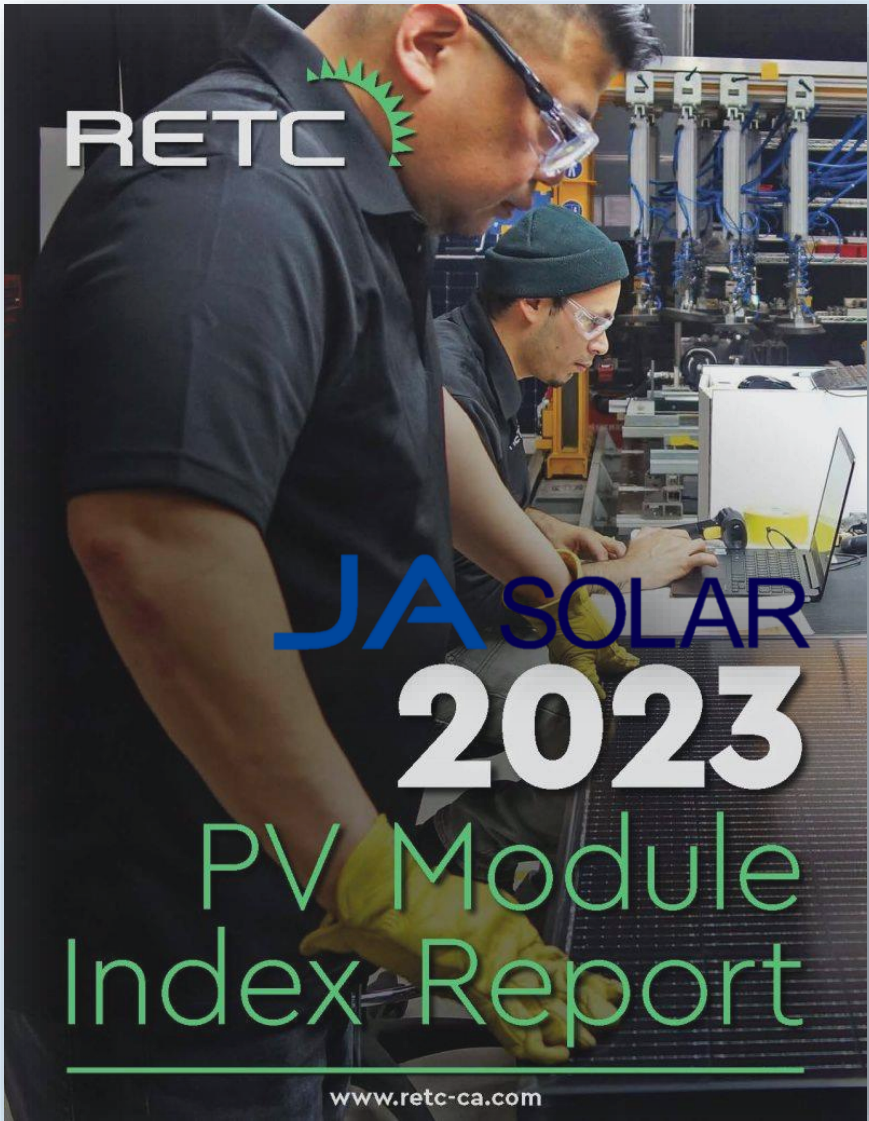
All products are supplied to the downstream production base of JA Group.

Full information on all parts of BOM (glass/frame etc) provenance available on request

certisolis	
TEST - CERTIFICATION PHOTOVOLTAÏQUE	
Evaluation Carbone simplifiée	
ECS CRE4 N°022-2022_001	
Titulaire du certificat :	Sites de production soustraits :
JA SOLAR Technology Co., Ltd	Xingtai Jinglong Electronic Material Co., Ltd.
10/18 First Mining Export	Xingtai Street, South Park, Xingtai Development Zone, Hebei
Processing Zone - Feng Jian	Province, P.R. China
201401 Shanghai République de Chine	Identification unique du site : 1-4
Sites de production soustraits :	
JA Solar (Xingtai) PV Technology Co., Ltd	JA Solar (Hefei) PV Technology Co., Ltd
No. 1688, Chang'an Road, Development Zone, Xingtai City, Hebei Province, China	No. 999, Changning Avenue, Gasen District, Hefei City, Anhui Province, China
Identification unique du site : 1-1	Identification unique du site : 1-2
Sites de production soustraits :	
JA SOLAR Malaysia Sdn. Bhd	JA Solar Technology Yiwu Co., Ltd.
Lot 17001 Medan Bayan Lepas, Kawasan Perindustrian Bayan Lepas, 12010 D.I. 13000 Pulau Pinang, Malaysia.	165 Tongge Road, Yiwu City, Zhejiang Province, China
Identification unique du site : 1-4	Identification unique du site : 1-1
Produits concernés (produits de la production soustraits) :	
Modules monocrystallins demi cellules PERC :	
JAM72530/MR, 525W à 550W	
JAM54530/MR et JAM54531/MR (Backsheet noir) : 390W à 415W	
Méthodologie :	
Cahier des charges (CDC) de l'après d'offres CRE4 portant sur la réalisation et l'exploitation d'installations de production d'électricité à partir :	
De l'énergie solaire « Centrales au sol » (CDC modifié du 12/02/2021) Valable à partir de la deuxième période.	
De l'énergie solaire « Centrales sur bâtiments, terres et hangars agricoles et ombrières de parking de puissance comprise entre 100 kW et 10 MW » (CDC modifié du 03/02/2021) Valable à partir de la septième période.	
D'énergies renouvelables en autoconsommation et études en métropole continentale (CDC modifié du 04/06/2020) Valable à partir de la cinquième période.	
D'énergies renouvelables en autoconsommation et études dans les zones non interconnectées (CDC modifié du 06/06/2020) Valable pour la période.	
De l'énergie solaire « Transition énergétique du territoire de l'Essenheim » (CDC modifié du 27/05/2020) Valable à partir de la deuxième période.	
De l'énergie solaire et études dans les zones non interconnectées (CDC modifié du 12/02/2020) Valable pour toutes les périodes.	
Cahier des charges de l'après d'offres PER2 portant sur la réalisation et l'exploitation d'installations de production d'électricité à partir :	
De l'énergie solaire « Centrales au sol » (CDC modifié du 06/06/2021) Valable pour la première et deuxième période.	

des sites de production :	
	Coefficients répartition / Sites fabrication / Pays fabrication
	JAM54530/MR - JAM54531/MR - JAM72530/MR
	37% Burghausen - Allemagne ou Michigan - Etats-Unis
	30% Xuzhou - Chine
Polysilicium	33% Recyclé Xingtai, Hebei - Chine
Lingots	100% Xingtai, Hebei - Chine
Wafers	100% Xingtai, Hebei - Chine
Cellules	100% Chine & Malaisie (1)
Modules	100% Chine (1)
Verre et Trempe	100% Hefei - Chine
EVA	100% Chine (1)
PET	100% Chine (1)





<https://retc-ca.com/pvmi-high-achiever>

Top Brand PV
EUPD Research

TUV SUD
IEC61215 & 61730

Environmental Product Declaration (EPD)

2023 PV Module Reliability Scorecard
EXECUTIVE SUMMARY

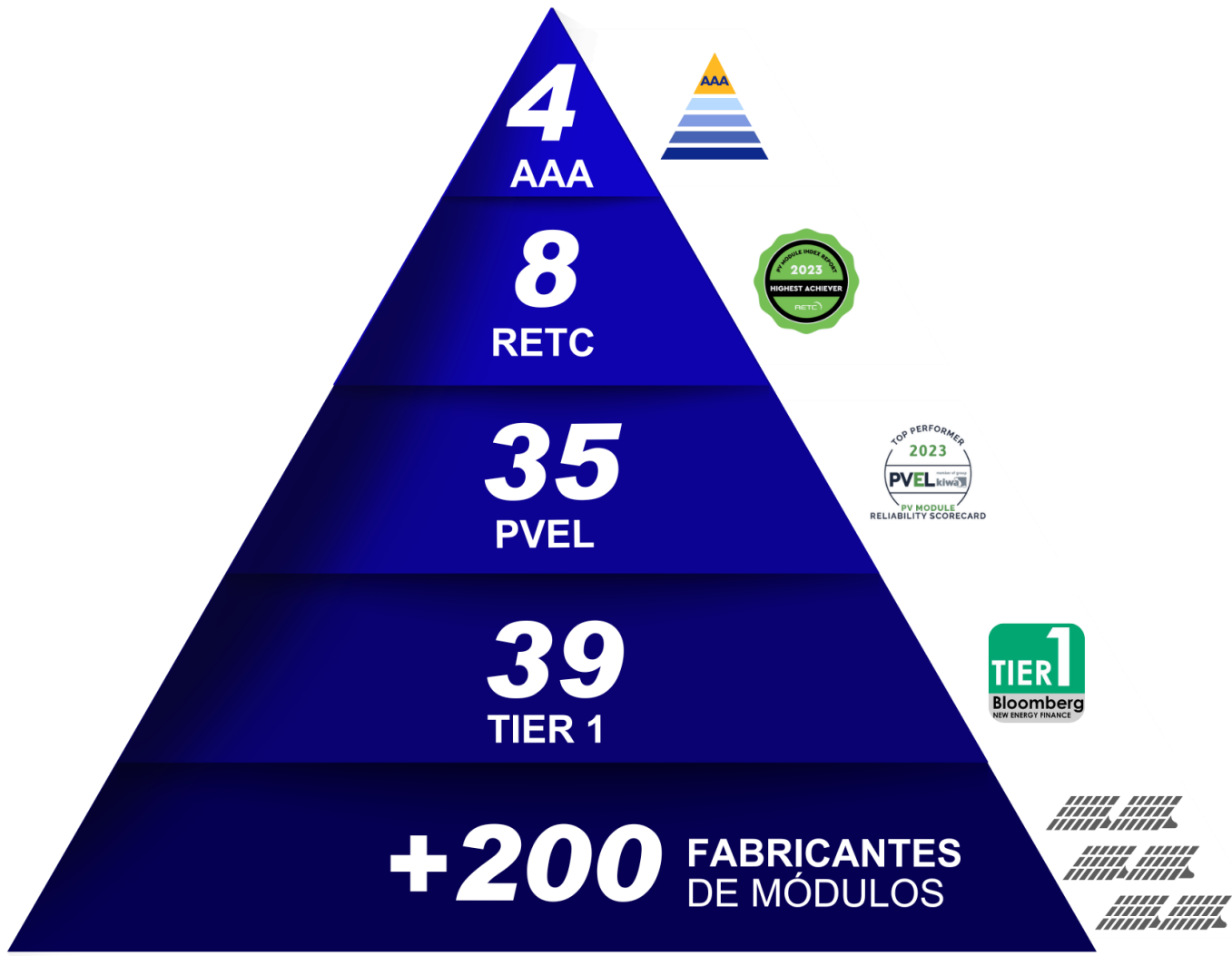
JA SOLAR

The 9th Edition of PVEL's PV Module Reliability Scorecard features Top Performers from 35 manufacturers and is the solar industry's essential resource for PV module reliability and performance insights.

TOP PERFORMER
2023
PVEL
PV MODULE RELIABILITY SCORECARD

https://scorecard.pvel.com/manufacture_name/jasolar/

Quality pyramid





Contacts

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much more!

Social media



@jasolar



JA Solar





JA SOLAR

Harvest the Sunshine

Solar Synergy: A Journey into DeepBlue 4.0 Pro's Design and Performance Analysis

Lida Guo

Product Technology Department

2023/12



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02 New-generation N-type Products by JA

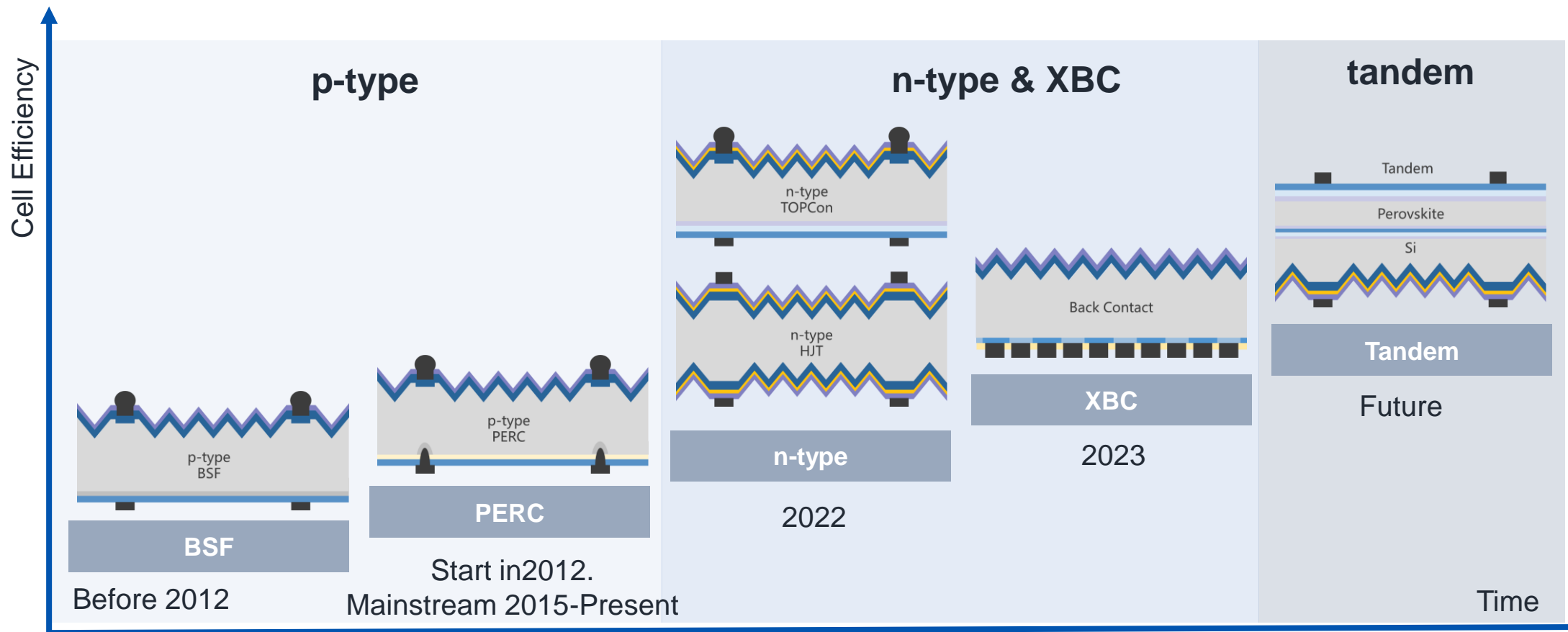
03 Product Value of DeepBlue 4.0 Pro

The background of the slide features a close-up, low-angle shot of solar panels. The panels are dark blue with a grid of thin, lighter blue lines. The perspective is from below, looking up at the panels, which creates a sense of depth and scale. The lighting is bright, suggesting a sunny day, and the overall color palette is dominated by the blue of the panels and the white of the text.

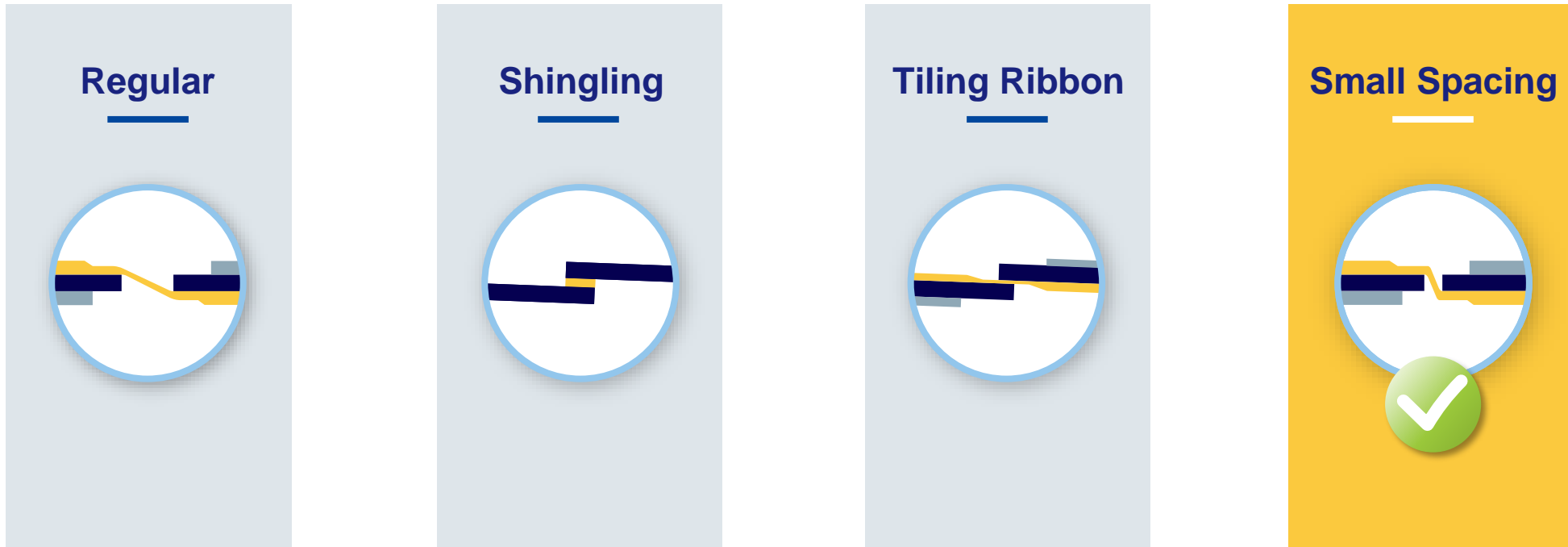
Part 1

PV Technologies and Development Trend

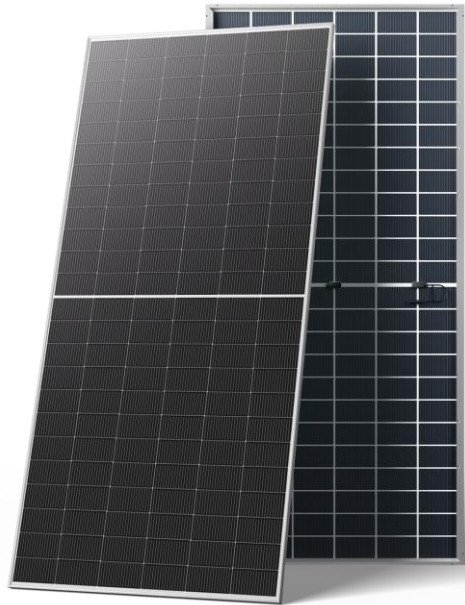
Silicon Solar Cell Technology Development Route



- PERC efficiency in mass production ~ 24%, limited space for further efficiency improvement and cost reduction.
- After PERC, the new technology still needs to have mass production characteristics, including high efficiency, low cost, good product yield and so on.
- TOPCon is this kind of technology, so it will gradually become the mainstream technology in the market.



Considering the power improvement, product yield, reliability and other factors, **small spacing** gradually become the mainstream of high-density encapsulation technology.



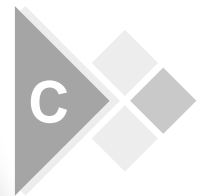
Module cost (price)

Lower module cost,
lower initial cost



Module efficiency (power)

High efficiency (power)
modules can reduce
system BOS



Power Generation Performance

Modules with excellent
power generation
performance can reduce
the LCOE.



Long-term reliability

High reliability ensures
stable power generation
throughout the entire life
cycle

Optimal LCOE (core)



considering 4 aspects above



Optimal Solution

The background of the slide features a close-up, low-angle shot of solar panels. The panels are arranged in rows, with the perspective creating strong diagonal lines that recede into the distance. The top half of the image is in soft focus, while the middle section, containing the text, is sharp. The bottom half returns to a soft focus. The overall color palette is dominated by the blue of the solar panels and the white of the text.

Part 2

New-generation N-type Products by JA

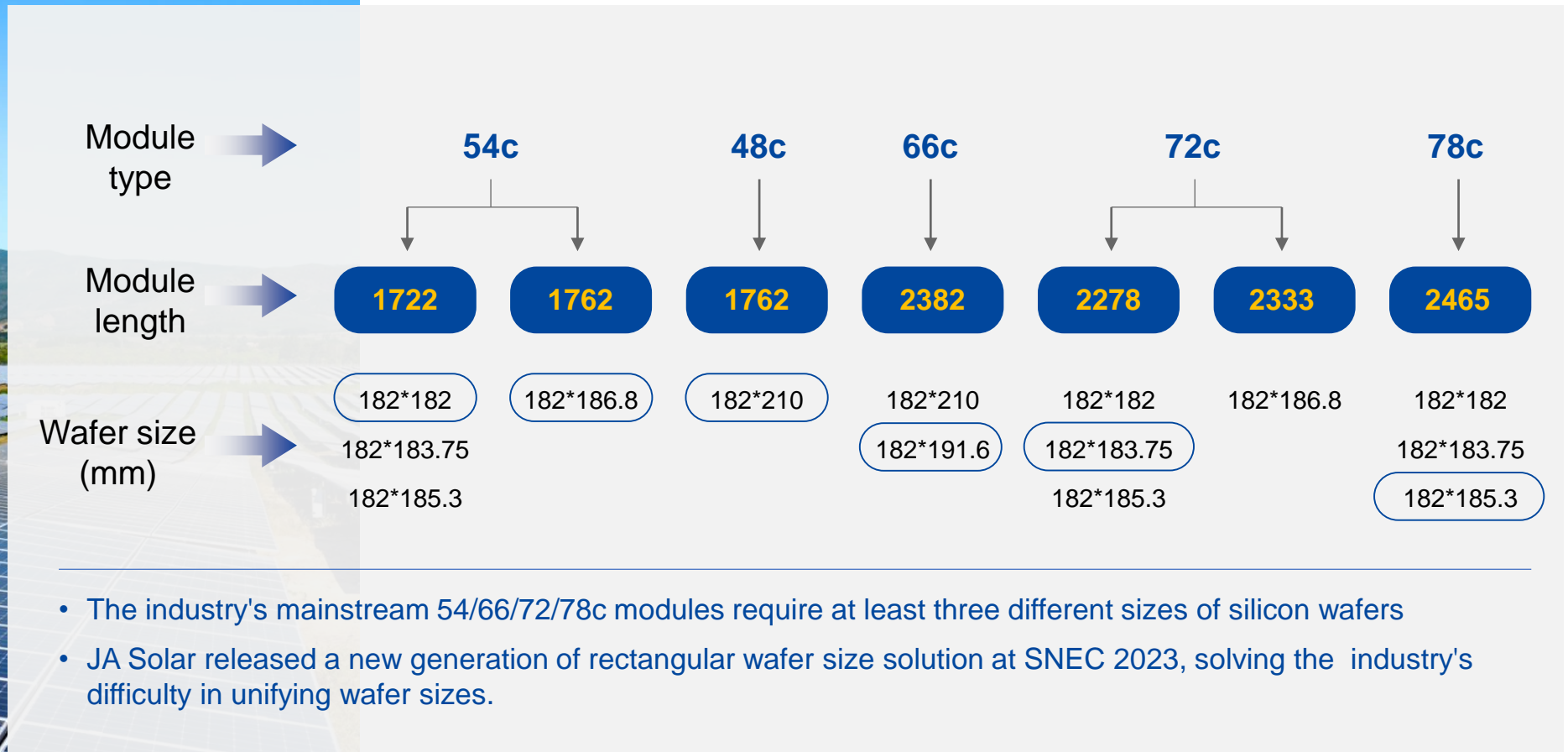
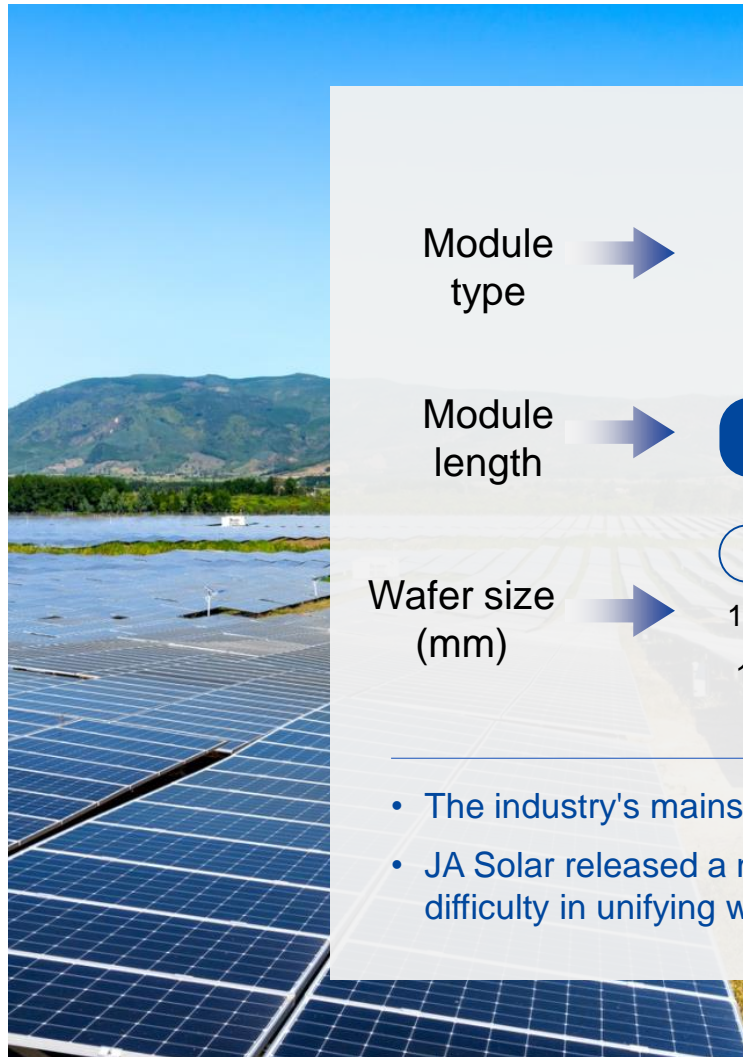


Design Logic

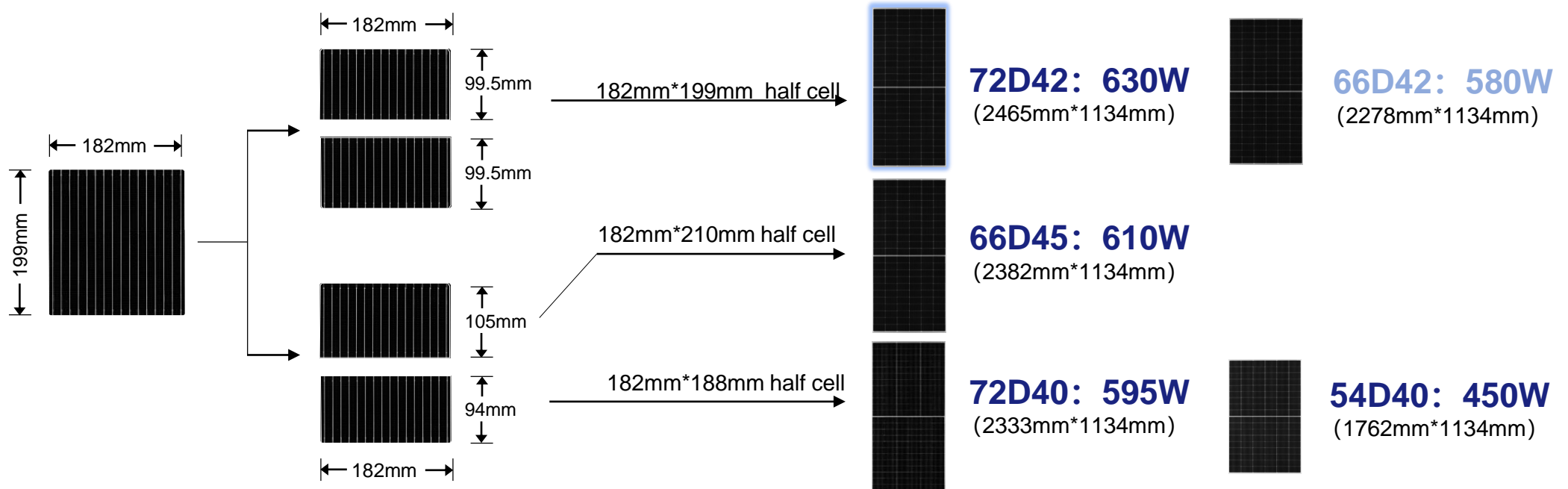
- In September 2021, JA Solar, Jinko and LONGi jointly announced the standard size of M10 series modules
 - 54c: 1722mm*1134mm
 - 72c: 2278mm*1134mm
 - **78c: 2465mm*1134mm**
 - one of the important product specifications in the industry
 - widely used in various application scenarios
 - has been tested by the market
 - showing considerable customer value.



- Adopting **182mm*199mm** rectangular wafers. **2465mm*1134mm** module size with **72 cells**.
- Same dimensions as the original 182-n-78 version, with a power of up to **630W** and a module efficiency of **22.5%**. The power is the highest among all 182 series products.
- Voc is reduced by **7.6%** compared to 78c module. Lower hot spot risk; the number of modules per string is increased; lower BOS costs.



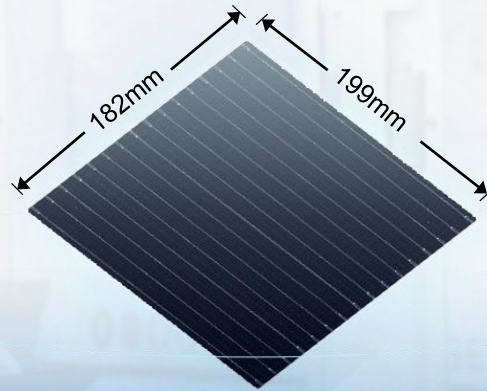
The new generation rectangular wafer size 182mm*199mm



- **182*199 rectangular wafer + optimized cell design**
 - ➔ increased module power
 - ➔ produce 4 high-efficiency modules + 1 regular module using only 1 wafer type.
- Better production advantages, performance advantages and customer value.
- Achieve win-win situation for the whole industry.

Industry significance of new generation wafer size

Stronger chain and industry inclusiveness



Excellent equipment compatibility



Uniform material specification



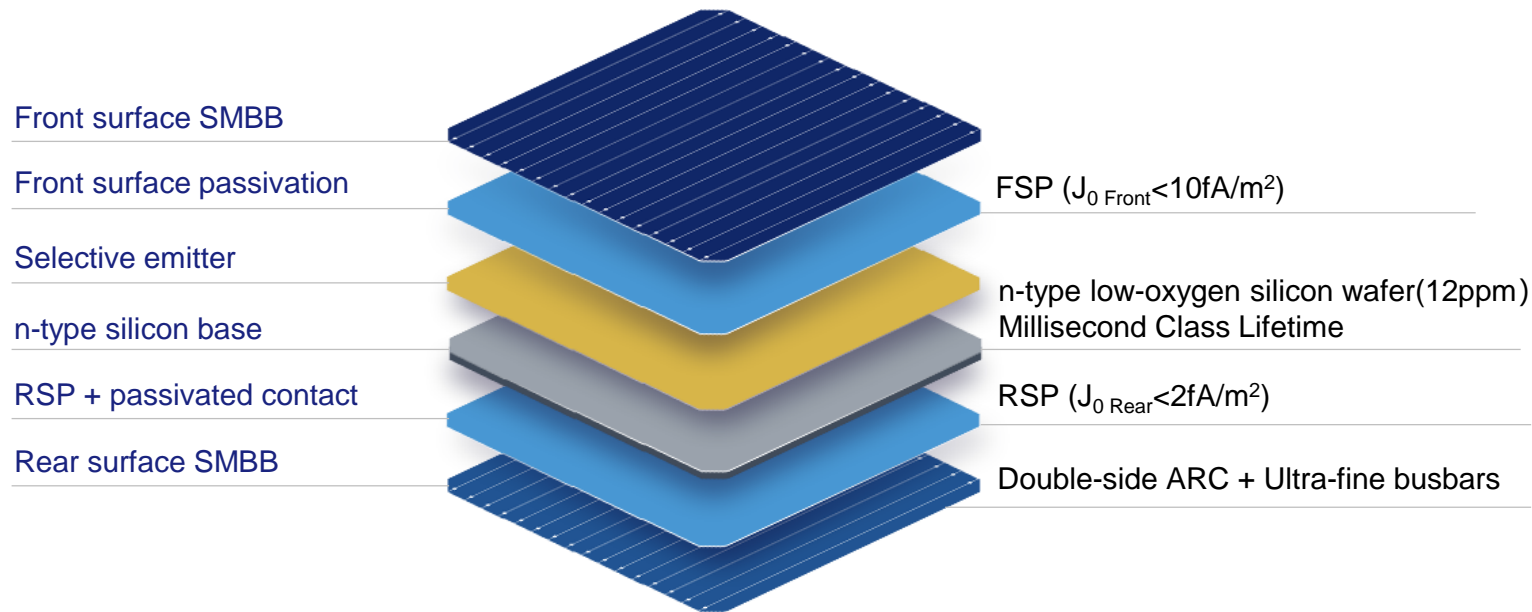
Standard module size



Lower integration cost

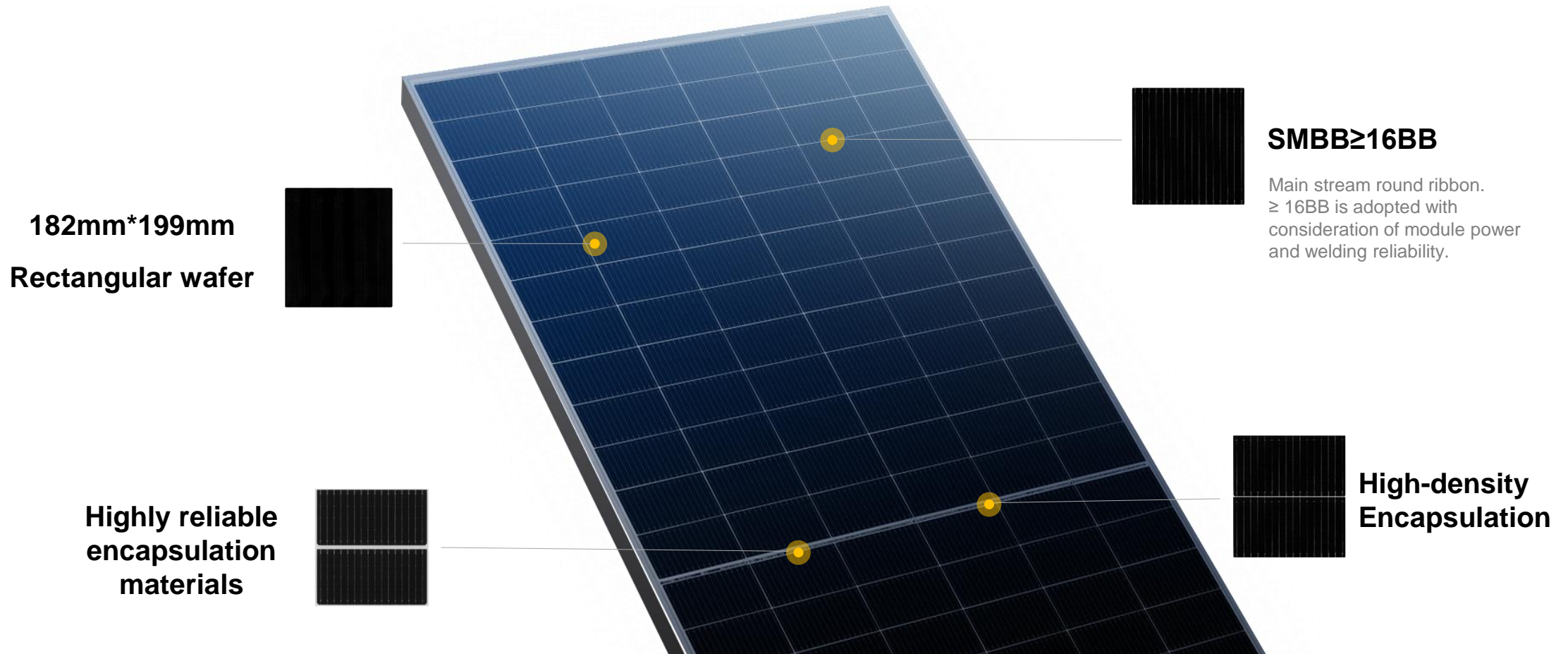


Better system value

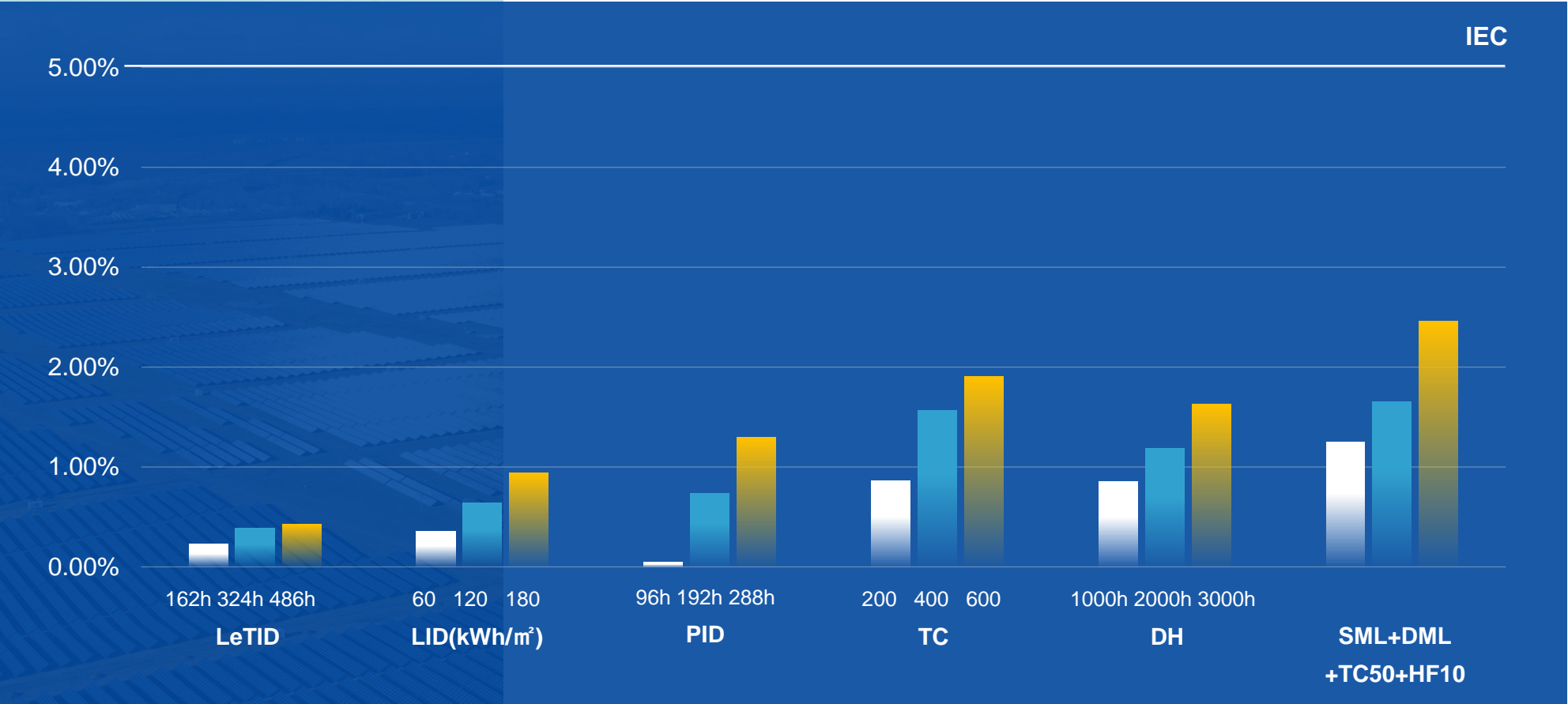
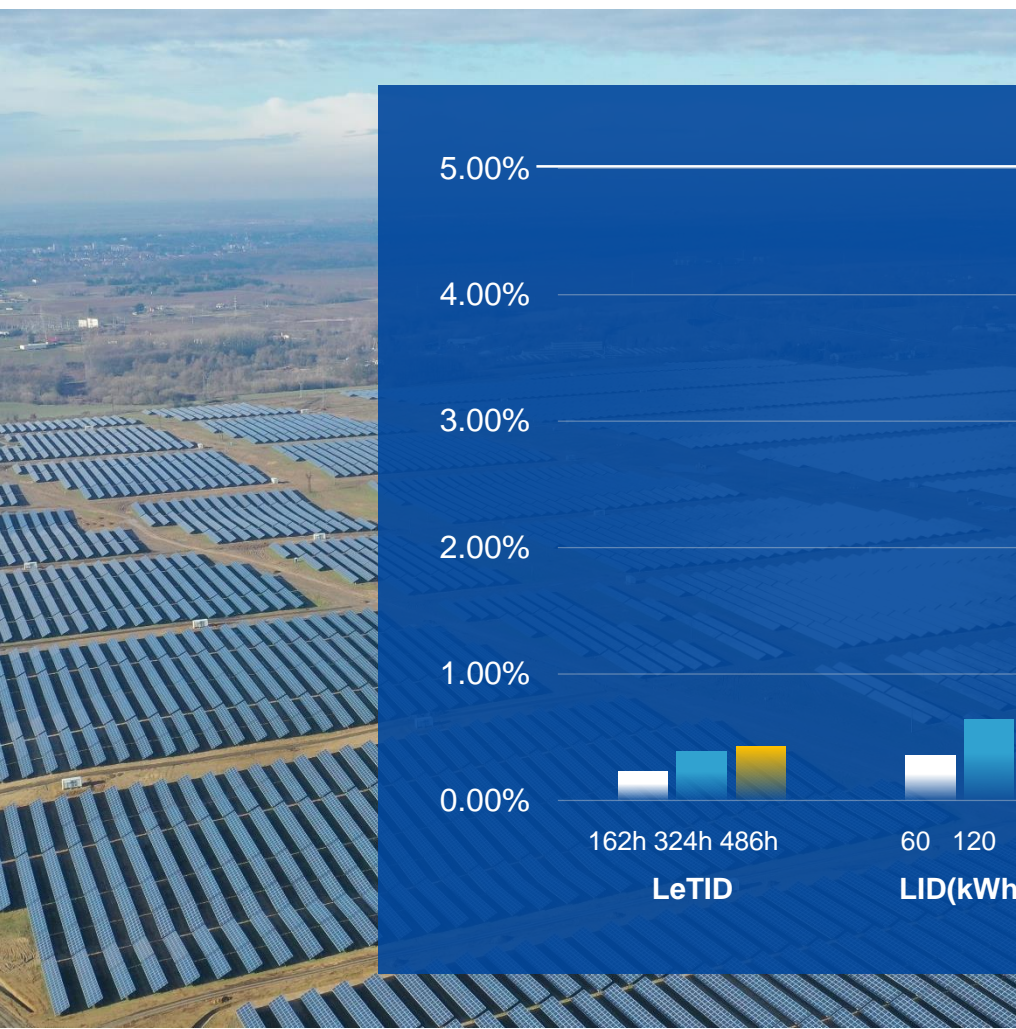


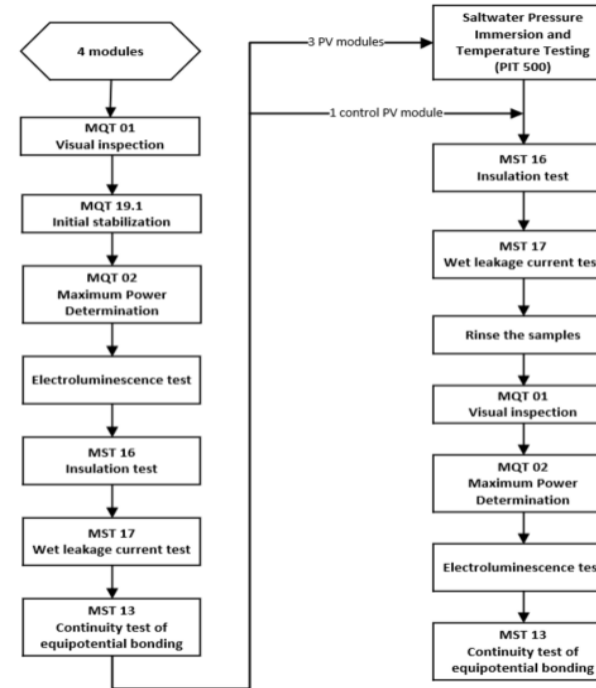
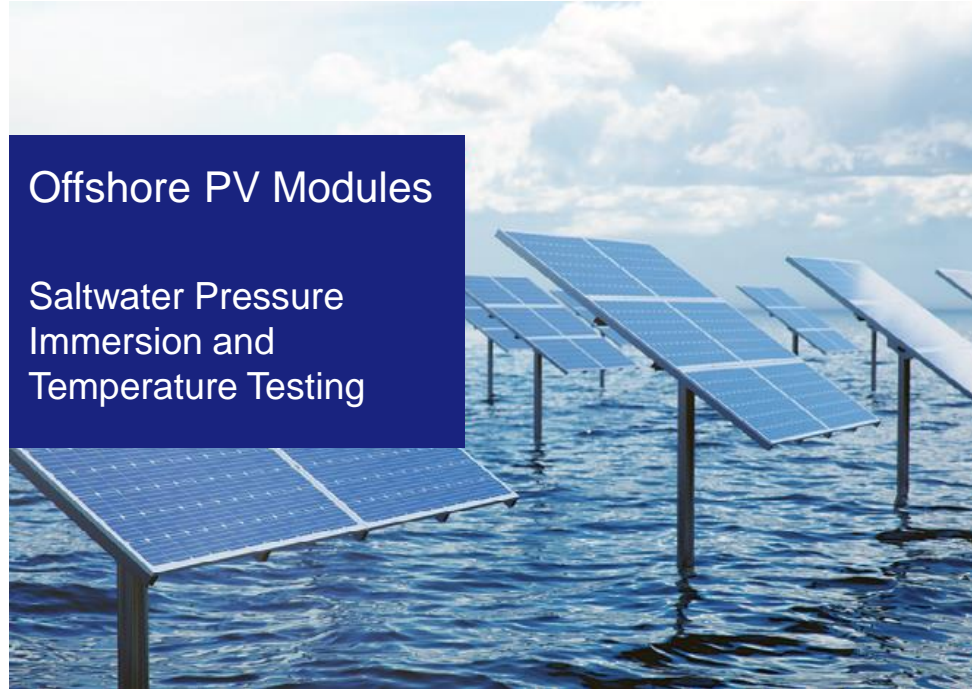
25.6%
Efficiency
in Mass Production

728mV
Voc



Module with High Power & Efficiency — Rectangular wafer + SMBB + High-density encapsulation + Highly reliable encapsulation materials





Power
loss
down to
0.322%

- Passed ASTM E1597 standard tests (Standard Test Method for Saltwater Pressure Immersion and Temperature Testing of Photovoltaic Modules for Marine Environments).
- This recognizes the module's ability to withstand repeated exposure to salty atmospheres, immersion in seawater, and temperature changes caused by seawater splashing on modules in sunlight.

Lower power degradation

First year power degradation $\leq 1\%$, annual power degradation rate $\leq 0.4\%$, 30-year life cycle, and power generation gain of about 1.8%

Higher bifacial benefits

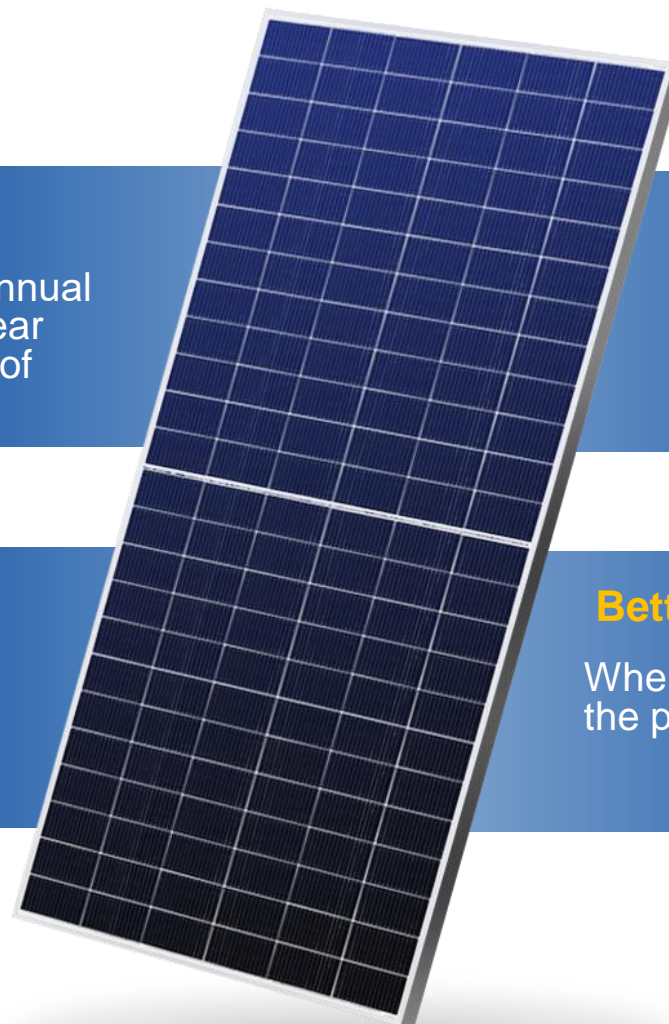
The bifaciality rate is about 80%; the power generation gain brought by a 10% bifaciality increase is around 0.8% -1.2%

Better temperature coefficient

The power temperature coefficient of the module is $-0.30\%/^{\circ}\text{C}$; in high temperature environments, the power generation gain is about 1.5% -2%

Better low light performance

When the irradiance is below $600\text{W}/\text{m}^2$, the power generation gain is about 0.2%



Part 3

Product Value of DeepBlue 4.0 Pro



Ground-mounted PV power station, location: northwest China

Project	182-72n-2278mm	182-n-2382mm	JAM72D42/LB
Module power (W)	580	610	630
Mounting		2P fixed tilt, 38°	
Inverter (kW)		320	
String quantity per mounting frame (string)		2	
Module quantity (pcs.)	222796	211456	204672
BOS costs	baseline	↓1.24%	↓1.50%
LCOE	baseline	↓0.56%	↓0.65%

Ground-mounted PV power station, location: northwest China

Project	182-72n-2278mm	182-n-2382mm	JAM72D42/LB
Module power (W)	580	610	630
Mounting		1P tracker, ±45°	
Inverter (kW)		320	
String quantity per mounting frame (string)		3	
Module quantity (pcs.)	222796	211456	204672
BOS costs	baseline	↓2.64%	↓3.11%
LCOE	baseline	↓1.27%	↓1.47%

Ground-mounted PV power station, location: northwest China

Project	182-72n-2278mm	182-n-2382mm	JAM72D42/LB
Module power (W)	580	610	630
Mounting		2P tracker, ±45°	
Inverter (kW)		225	
String quantity per mounting frame (string)		4	
Module quantity (pcs.)	219456	207872	202176
BOS costs	baseline	↓4.83%	↓6.77%
LCOE	baseline	↓1.21%	↓1.81%



C&I rooftop PV power station, location: eastern China

Project	182-72n-2278mm	182-n-2382mm	JAM72D42/LB
Module power (W)	580	610	630
Mounting	Fixed tilt, 3°		
Inverter (kW)	320		
String quantity per mounting frame (string)	28	30	28
Module quantity (pcs.)	10472	10080	9828
BOS costs	baseline	↓2.08%	↓2.75%
LCOE	baseline	↓1.18%	↓1.61%

Residential rooftop PV power station, location: eastern China

Project	182-72n-2278mm	182-n-2382mm	JAM72D42/LB
Module power (W)	580	610	630
Mounting	Fixed tilt, 30°		
Inverter (kW)	15		
Module quantity (pcs.)	17		
BOS costs	baseline	↓4.91%	↓7.93%
LCOE	baseline	↓2.63%	↓4.28%

DeepBlue 4.0 Pro modules offer lower BOS & LCOE, delivering greater customer value

↓ **2%-4.5%**

Lower BOS

↓ **2.5%-6%**

Lower LCOE

DeepBlue 4.0 Pro **VS** p-type module

↓ **1.4%-2.8%**

Lower BOS

↓ **0.7%-1.6%**

Lower LCOE

DeepBlue 4.0 Pro **VS** Original n-type module



4 high-efficiency modules + 1 regular module using only 1 wafer type

Harvest the Sunshine

www.jasolar.com

