Exposolar, 17 October 2024,
Medellin, Colombia

ANSWER TO ALL YOUR RENEWABLE NEEDS

30+ years of experience
in energy solution

Six Industries
PV, Electric Mobility,
Semiconductor, Electricity,
LNG, Industrial Parks

No.2 amongst
Top 500 New Energy Enterprises

3000+ Patents
2800+ R&D team

Assets worth USD 28 Bn+

Capacity Layout

Module
30GW

N-type Cell
20GW

FBR Silicon
400,000 tons

01

Technology

Where do we come from?

Poli

Mono

M6

02

Technology

What are we looking at?

Efficiency

Reliability

FBR

Design

03

Low Carbon

What is coming Next?

TOPCon Main Products

0BB Technology

Perovskite TANDEM

GPC


Low Carbon Products
FBR
TOPCON MAIN PRODUCTS
0BB TECHNOLOGY
GPC
PEROVSKITE TANDEM
G-HOME PRO

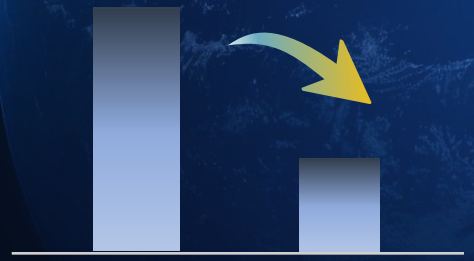
00 Vertical Integrated – Full Chain

00 FBR Granular Silicon – The Future of Silicon

GCL has the world's largest granular silicon (FBR) production capacity.

French Carbon Footprint Certificate

Carbon Emission **74%** Reduction



The carbon footprint value per kg of granular silicon is 20.74 kg of CO2 equivalent, and the carbon emission is the least in the world.

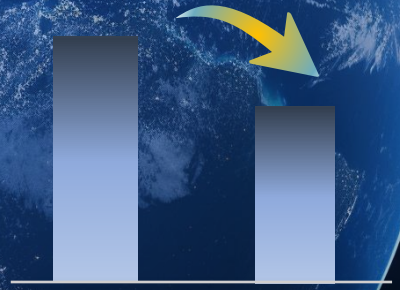
GCL FBR Tech vs Siemens method

Suitable for downstream production

effectively saving about **19%** of the cost

meeting the requirements of N-type high-efficiency products

30% Reduction



Capital Investment

75% Reduction

Power Consumption

FBR Lower Cost →

- Water Consumption ↓ 30%
- Labor Costs ↓ 60%
- Power Consumption ↓ 80%
- H_2 Hydrogen Consumption ↓ 57%

01 Technology– Where we come from?

Polysilicon

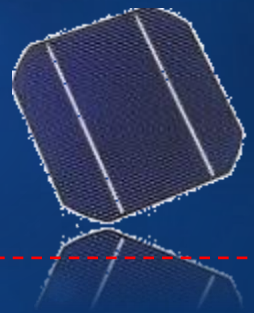
Silicon bar/ingot

Wafer

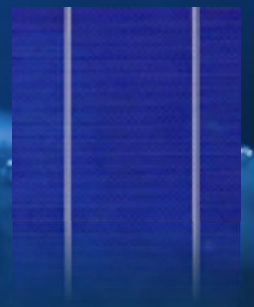
Cell

Module

Photovoltaic application system



Monocrystal technology route



Polycrystalline technology route

01 Technology– Where we come from?

P Type
Vs
N Type

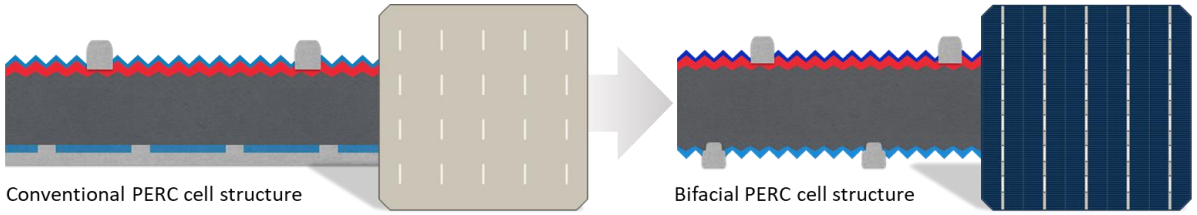
c-Si Solar Cell
Vs
Thin film

HJT
Or
Tandem

What about
BC?

PERC
Vs
TopCon

02 Technology– What are we looking at?

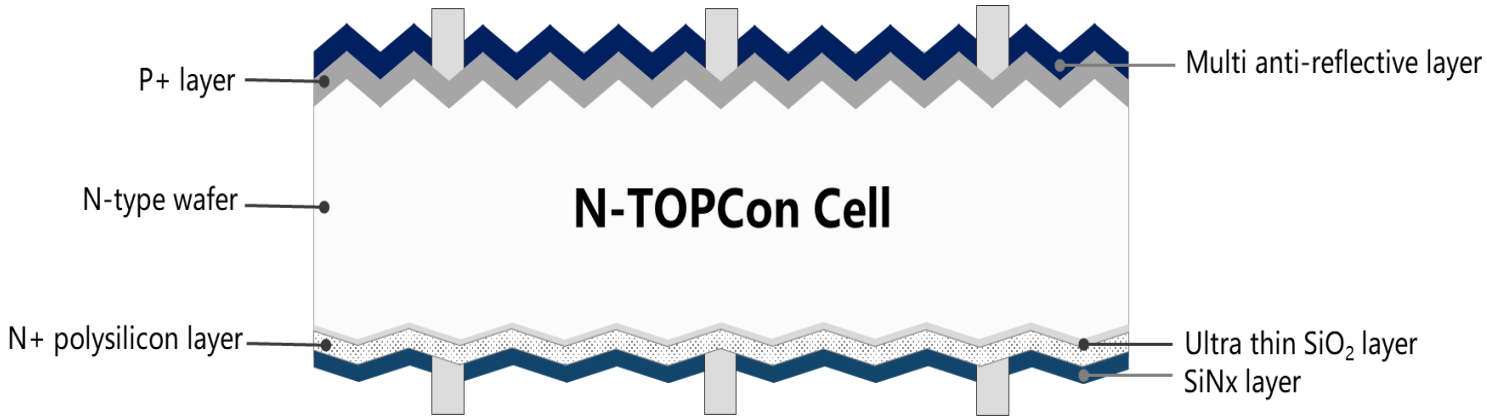


Performance and cost

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

Application

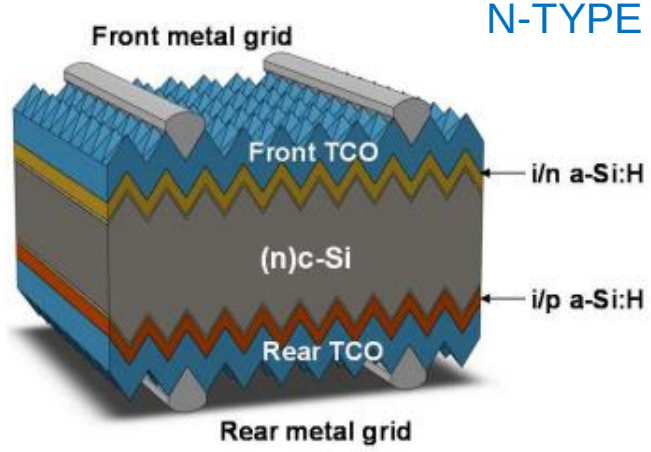
- Utility
- Commercial rooftop and carport



02 **Technology–** What are we looking at?

HJT Cell Technology

N-TYPE



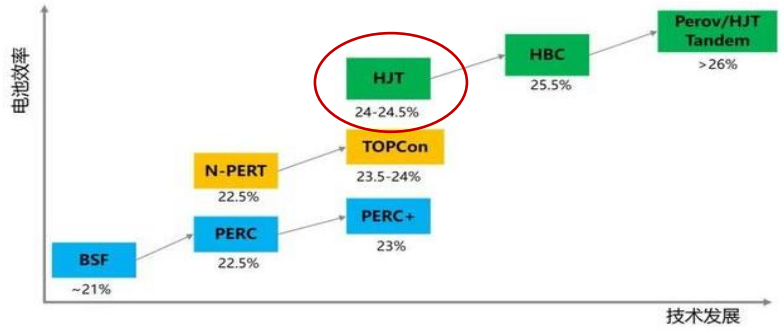
- Developed on n-type Cz Si
- Bifacial passivated structure by amorphous silicon film
- Heterostructure P-N junction
- Form conductive and antireflective layers by TCO

Cell

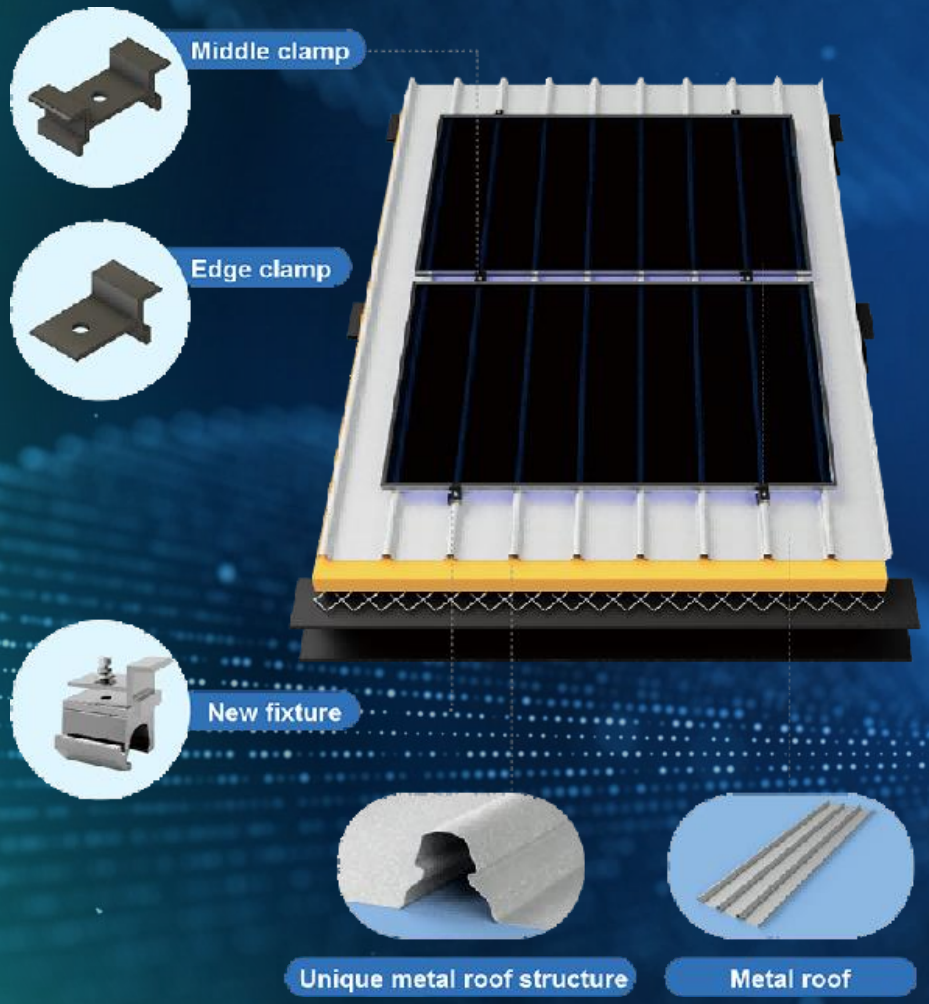
Technical advantages of HJT: four high and two low

- The four highest are high efficiency, high yield, high bi-facial rate, and high LID.
- Two low is low power degradation, low temperature coefficient.
- Good technical expansibility: it can be upgraded to HBC, perovskite /HJT tandem cell, etc

Hi-efficiency	→	24~25%
Advanced Temp. Co-efficiency PID free	→	More energy 30%+
200℃ Low temp. Manufacture	→	Lower production energy



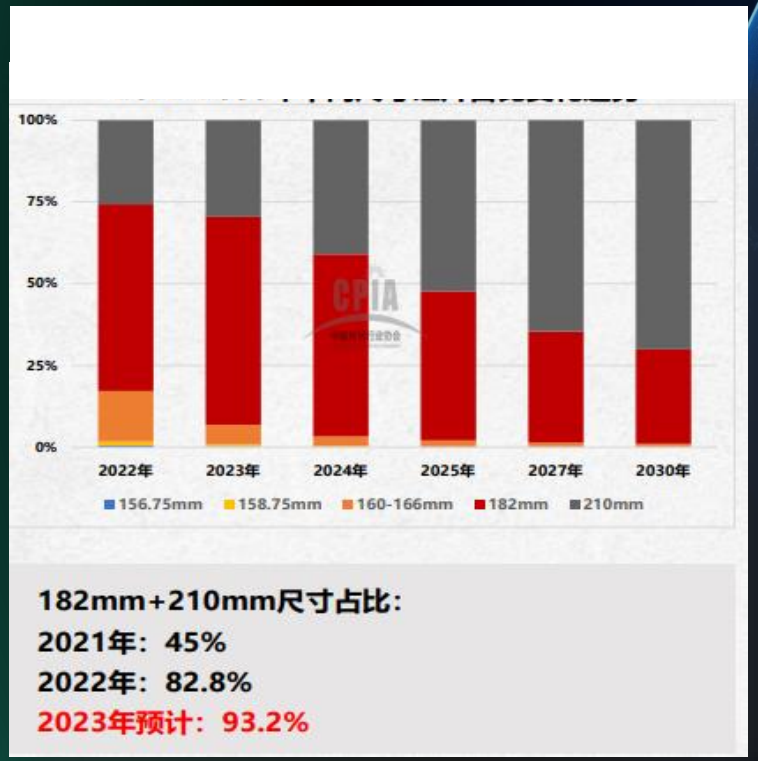
02 Technology– What are we looking at?



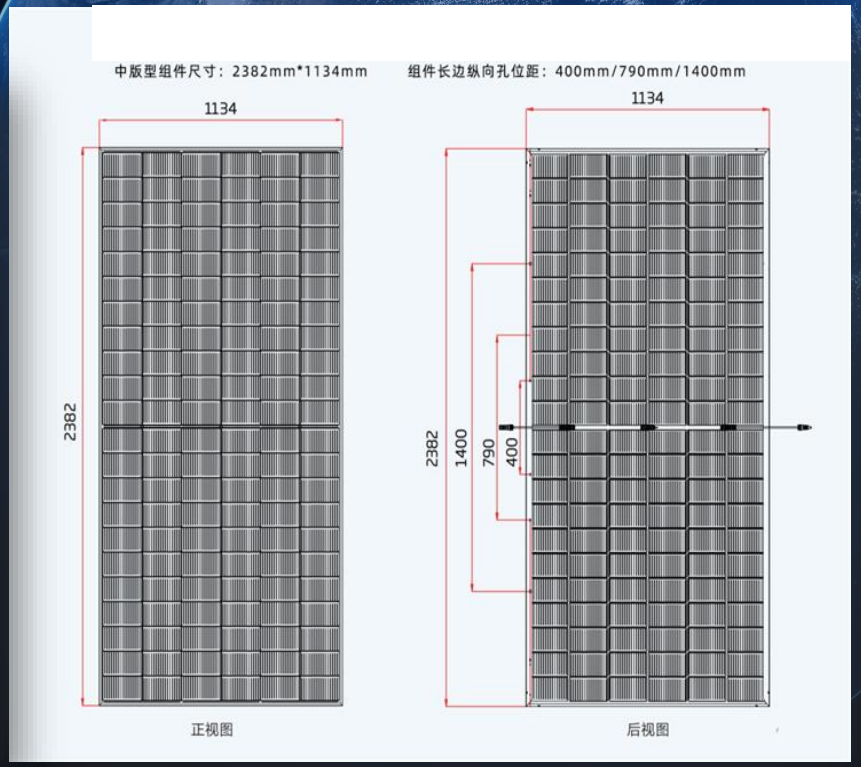
- ***M10 or M12??***
- ***66; 72; 78 Cells??***
- ***Bifacial or Monofacial??***
- ***Frame or frameless??***
- ***How I want to fix and install this modules ??***
- ***Where will I Install this modules?***

02 Technology– What are we looking at?

Technology Trend：n Type + TopCon + thinner wafer + Large size module + XBC



Data source: PV InfoLink



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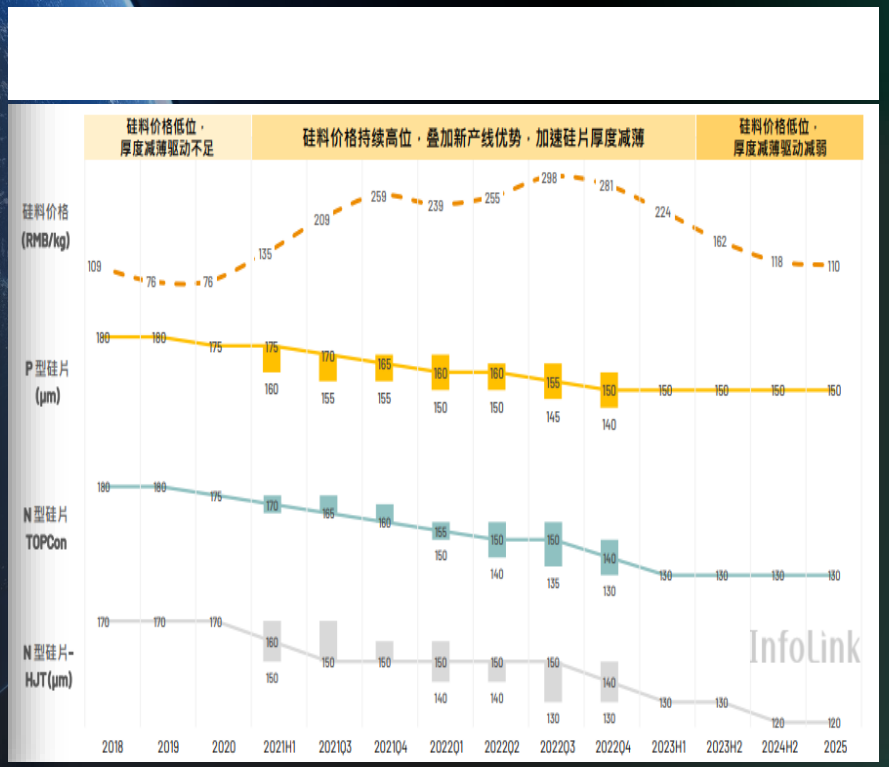


Data source: PV InfoLink

02 Technology– What are we looking at?

TOPCon Modules applicable to all scenarios

NT10/72GDF
NT10/78GDF

Bifacial Dual Glass
Monocrystalline Module

600Wp+

NT12R/66GDF

Bifacial Dual Glass
Monocrystalline Module

620Wp+

NT12/66GDF

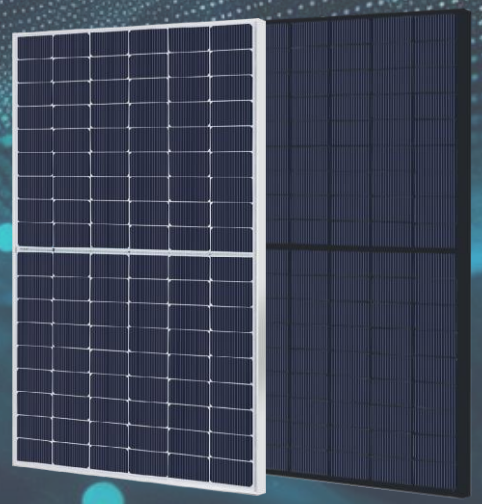
Bifacial Dual Glass
Monocrystalline Module

720Wp+

NT10R/54GDF
NT10R/54BGDF （black frame）

Bifacial Dual Glass
Monocrystalline Module

450Wp+



French Low carbon certification for TOPCon Modules

02 Technology– What are we looking at?

NT10/72GDF
NT10/78GDF

Bifacial Dual Glass
Monocrystalline Module

600Wp+

- M10 Cells (182x182)
- High efficiency
- Low degradation
- Low Temperature Coefficient
- Currents below 16 A
- Higher Voltage
- Excellent Mechanical Resistance
- Special Applications (Floating, C&I, other)
- Module size: 2278*1134mm
- Eff：22.7%+

02 Technology– What are we looking at?

NT12R/66GDF

Bifacial Dual Glass
Monocrystalline Module

620Wp+

- M12R Cells (210x182)
- High efficiency
- Low degradation
- Low Temperature Coefficient
- Currents below 18 A
- Lower Voltage
- Excellent Mechanical Resistance
- Improve power / string (Nr. of modules / string)
- Very Balanced Module Design
- Module size: 2382*1134mm
- Eff：22.6%+

02 Technology– What are we looking at?

NT12/66GDF

Bifacial Dual Glass
Monocrystalline Module

720Wp+

- M12 Cells (210x210)
- High efficiency
- Low degradation
- Low Temperature Coefficient
- Higher currents
- Lower Voltage
- Lower Mechanical Resistance
- Optimize power / string (Nr. of modules / string)
- Large Size Module Design
- Module size：2384*1303 mm
- Eff：22.5%+

■Transportation Capacity Analysis

The Container utilization rate of NT12R/66GDF is the highest, the transportation capacity is 5% higher than NT12/66GDF.

Module Type	Module Size（mm)	Package NO. (pcs)	Package Size/mm	40’ HC	40’ HC Total Capacity/W
NT10/72GDF-590W	2278*1134*30	36	2320*1125*1270	740 pcs	436600
NT12R/66GDF-615W	2382*1134*30	36	2400*1125*1270	720 pcs	442800
NT12/66GDF-705W	2384*1303*33	33	1320*1130*2500	594 pcs	418770
NT10/78GDF-640W	2465*1134*30	36	2320*1125*1270	576 pcs	368640

02 Technology– What are we looking at?

0BB Techonology – High Efficiency Module

Topcon+0BB

Power

Increase 2W

Conversion efficiency

Relatively imcrease 0.3%

Higher efficiency

Equipped with 0BB technology, the welding belt is directly connected with the fine grid, shortening the current transmission distance and improving the power of the module.

Lower loss

More welding tape is connected with the fine grid, which can effectively reduce the power generation loss after invisible crack

Lower BOS&LCOE

More efficient module, lower initial investment, diluted cost per watt-hour

Low temperature coefficient

The temperature coefficient of Pmax is -0.29%/℃, without fear of high temperature, higher power generation gain

02 Technology– What are we looking at?

GRPU Frame – Excellent Stress Endurance

NT10/72GDF

580-600W

Bifacial Dual Glass
Monocrystalline Module
GRPU Frame

600W
Maximum Power output

23.2%
Maximum Module Efficiency

0~+5W
Power Output Guarantee

Highly yield strength of GRPU Frame

990MPa

100% rebound after stress release

Greatly reducing the potencial crack

02 Technology– What are we looking at?

GPC – High Efficiency PV Module

640-660Wp Ultimate 'Black'

LID free
increased power generation

24.4%
Module efficiency

Better weak light performance

-0.8% annual degradation for the 1st year
0.35% for the years after

2382*1134*30 mm / 2.70sqm

N-TBC / half-cell technology

02 Technology– What are we looking at?

Sea Floating Module – Suitable For Sea Surface

GCL-NT10/60GT

Monocrystalline Module
450-485W

485W
Maximum Power Output

21.6%
Maximum Module Efficiency

0~+5W
Power Output Guarantee

High conversion efficiency due to top quality wafers and advanced cell technology

PID

Selected encapsulating material and stringent production process control ensure the product is highly PID resistent and snail trails free

1500V

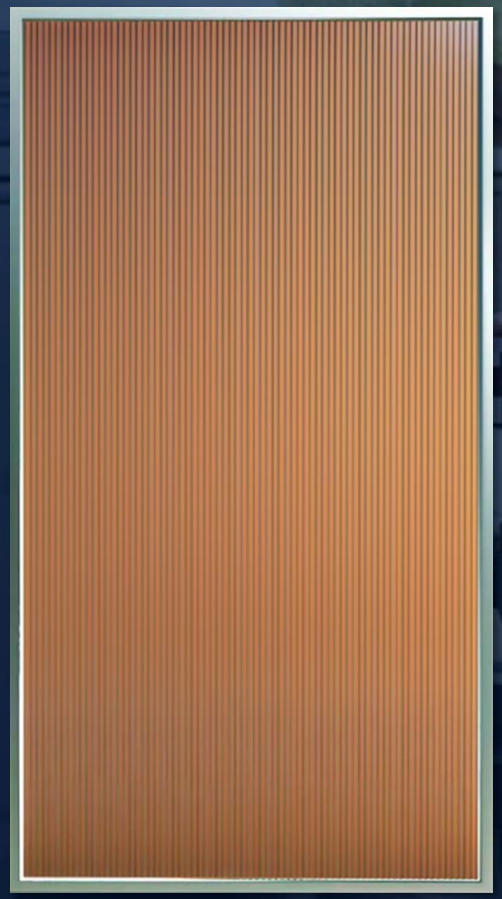
Withstand up to 1500V system voltage effctively reduce BOS cost

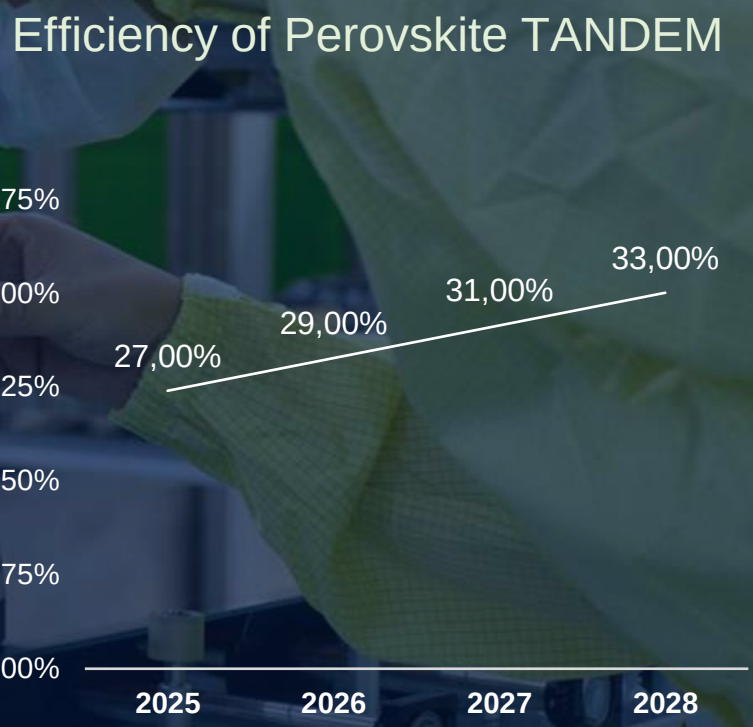
03 Technology– what is coming next?

Perovskite TANDEM – Hybrid is even better

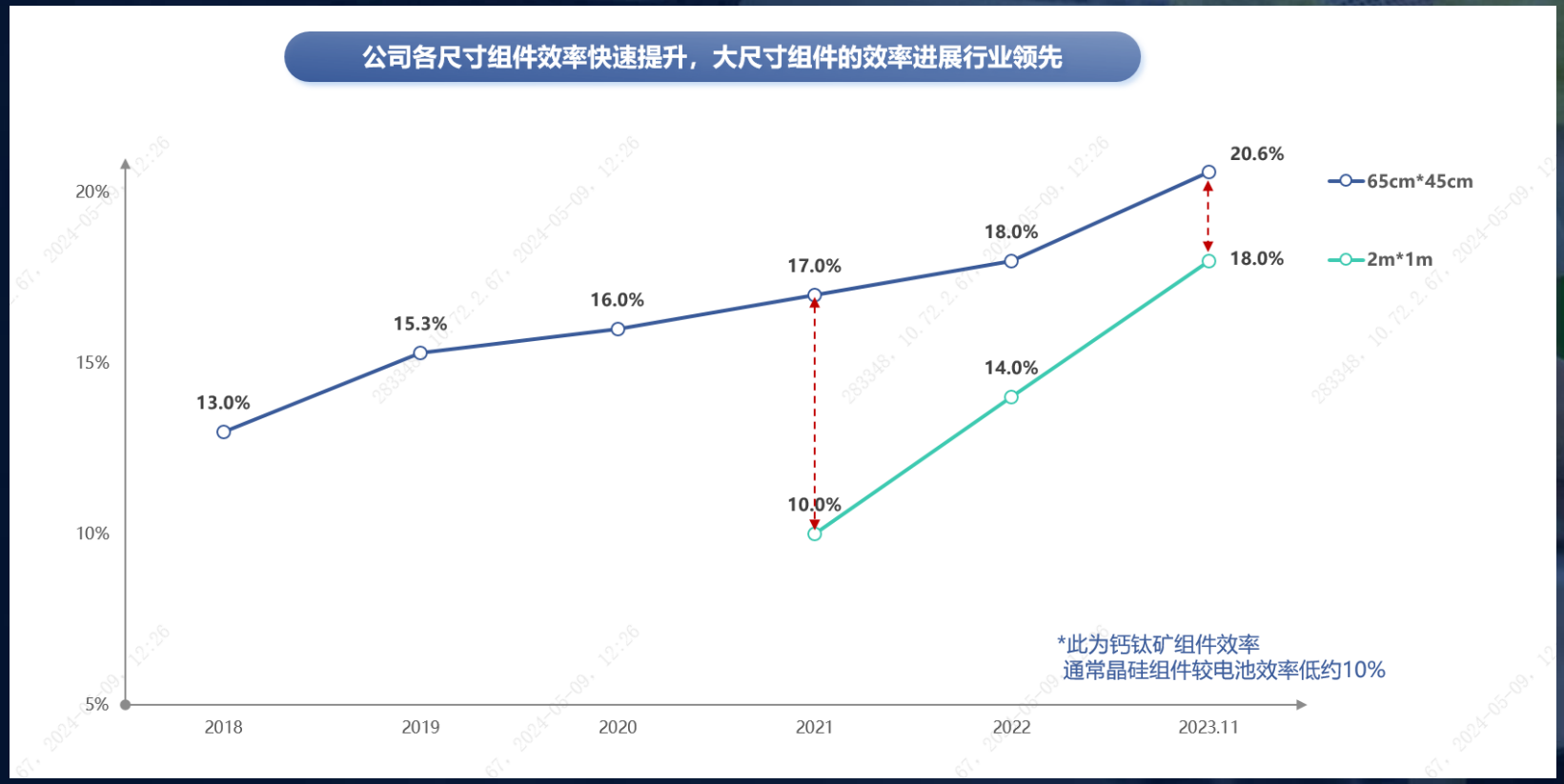
- Perovskite silicon TANDEM Module efficiency over 25% in 2024
- 25W higher power than TBC Module
- Kunshan GCL Optoelectronic Material Co., Ltd. plans to achieve 2GW capacity in 2025

协鑫 GCL
CATHAYCAPITAL
IDG Capital
SEQUOIA CAPITAL 红杉中国 | CHINA
Tencent 腾讯
TEMASEK





03 Technology– what is coming next?



- 2 m2 of perovskite single-junction module

Currently, the conversion efficiency is **19.04%**
After the GW-level production line reaches full capacity, the conversion efficiency will be **22%**
In the future, the conversion efficiency will be **26%**

- Large-area perovskite stacked modules

Currently, the conversion efficiency is **27.34%**
After the GW-level production line reaches full capacity, the conversion efficiency will be **28%**
In the future, the conversion efficiency will be **32%**

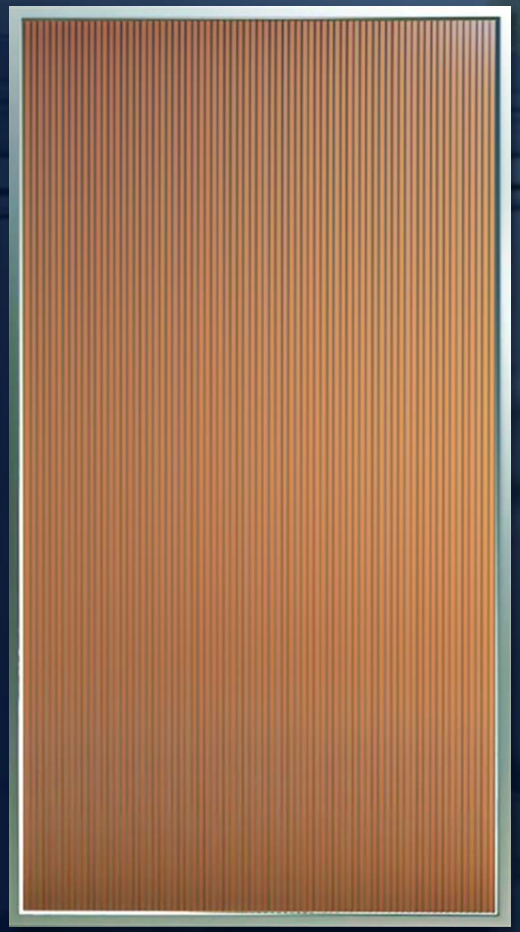
03 Technology– what is coming next?

Perovskite

钙钛矿

The world's largest perovskite

We have independently developed large-size perovskite photovoltaic cell modules, built the world's largest 100MW perovskite module mass production line with the highest module efficiency certification, and became the world's only company to obtain commercial certification for practical perovskite modules. With the core technology and industrial advantages of perovskite cells.



Main Characteristics of GCL Perovskite Photovoltaic Modules

Features of GCL Perovskite PV Modules

大尺寸 Large Dimension

2000 MM X 1000 MM

效率高 High Efficiency

19.04 %

The efficiency of large-area single-junction modules has been increased to

碳排放低 Low carbon emissions

90 %以上

Perovskite layer reduces carbon emissions

低成本 Low Cost

50 %左右

The manufacturing cost will be as low as that o crystalline silicon modules.

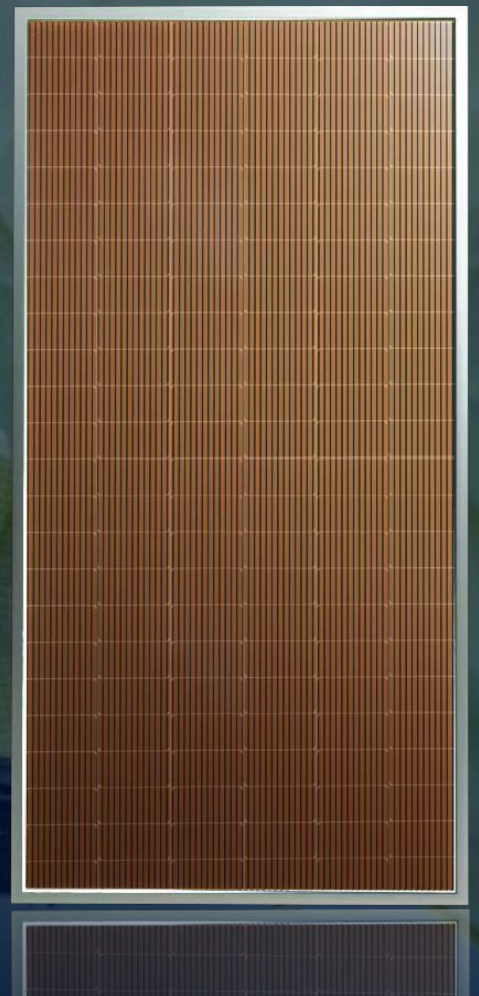
03 Technology– what is coming next?

Ultra-large size: 2000mm×1000mm
High efficiency: Steady-state efficiency reaches 26.36% @1.71㎡
(In June 24, the 100MW pilot line achieved 27.34%@2050cm㎡.
A large-area laminated module with a conversion efficiency of more than 27% will be launched before the end of the year with a size of 2㎡)

The long-term mass production efficiency target of stacked modules is 35%. Perovskite stacked modules have huge room for technological improvement, allowing the photovoltaic industry to return to the essence of technology-led development and get rid of the current ineffective internal competition.

The company's first parallel solution is compatible with all crystalline silicon routes, empowering existing crystalline silicon production capacity, and jointly promoting the reduction of power generation costs with the crystalline silicon industry.

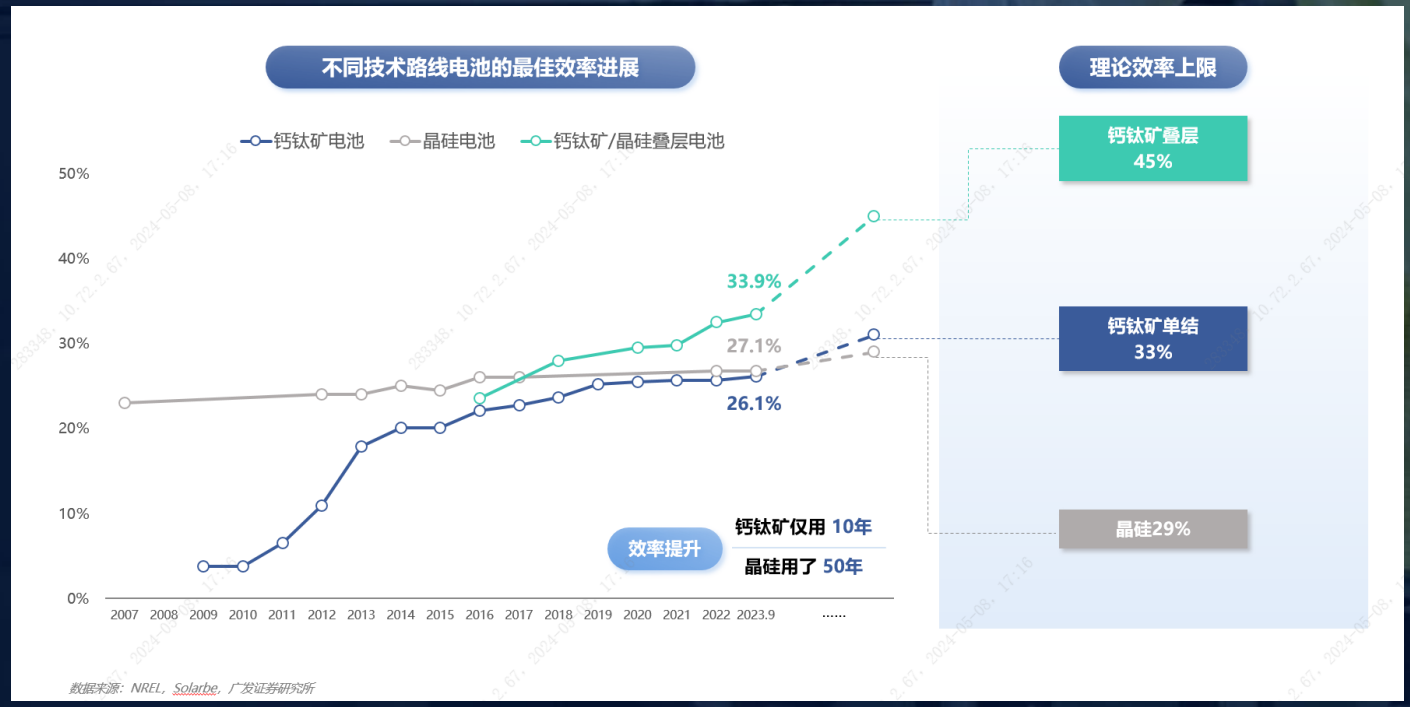
Perovskite stacked modules are about to enter the commercialization stage. In 2024, the company will launch a 27% module of 2 square meters, and further expand it to 2.88 square meters in 2025.



03 Technology– what is coming next?

Product advantage 1: Efficiency

Perovskite has a high efficiency ceiling, and the efficiency ceiling of single junction/stacked layers has obvious advantages over crystalline silicon.



Product advantage 2: cost

With large-scale mass production, the cost of perovskite will be reduced by 50%+ compared to crystalline silicon

Product advantage 2: cost

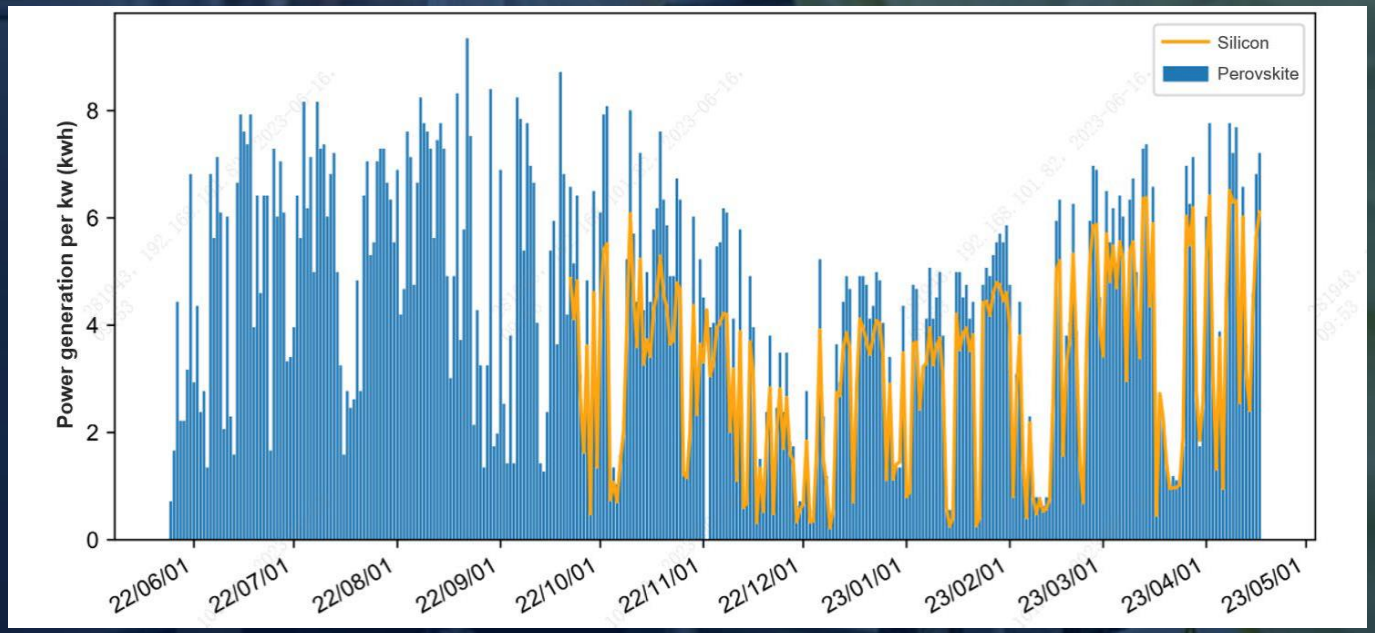
Comparison between perovskite stacked modules and crystalline silicon modules:

- Perovskite stacked modules → Lower cost per watt - can increase power by 60%, only increase cost by 20%
- Perovskite stacked modules → Power station system cost can save at least 30% compared with crystalline silicon modules

03 Technology– what is coming next?

Product advantage 3: better temperature coefficient and low-light performance

At the same power, perovskite modules can generate 5%-10% more electricity than crystalline silicon modules.

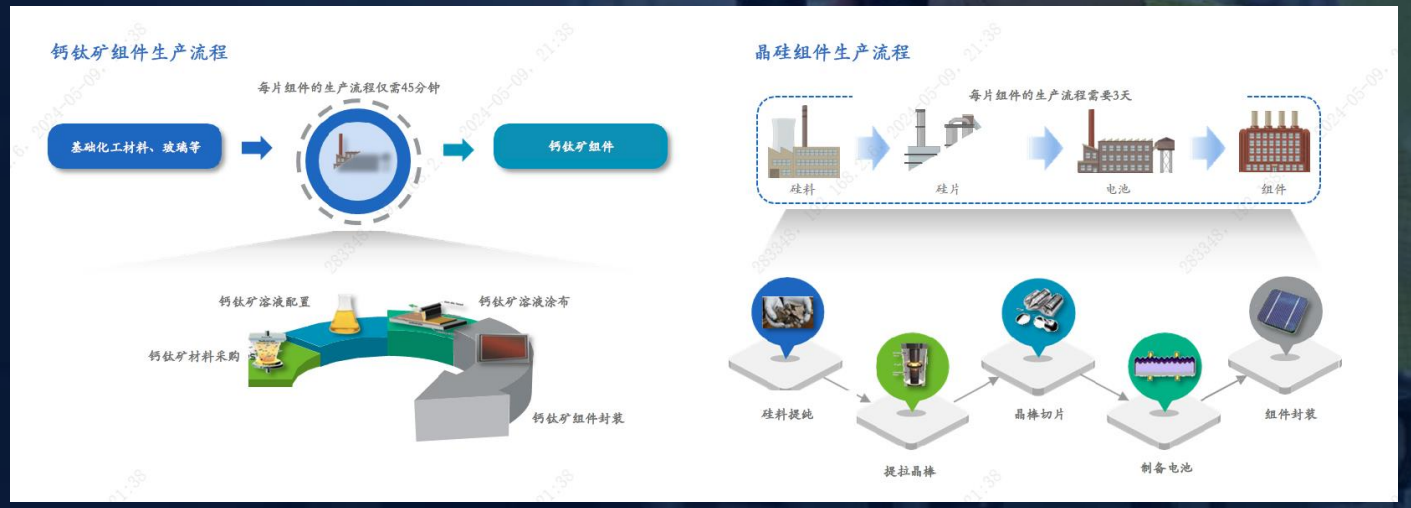


The company has built a small demonstration power station with components including crystalline silicon, cadmium telluride, and perovskite, and observed the power generation capacity of different types of components under the same natural environment.

03 **Technology–** what is coming next?

Product advantage 4: The production process is more environmentally friendly, and carbon emissions are reduced by more than 90%

Its production process reduces industrial pollution such as mining, crushing, and refining. The synthesis temperature is less than 200°C, and the carbon emission of the perovskite layer is reduced by 90%.



03 **Technology–** what is coming next?

History & Product application cases

- The first empirical application test of perovskite products in the aerospace field: In December 2023, the Suzaku-2 Yao-3 carrier rocket was successfully launched at the Jiuquan Satellite Center.
- The Honghu-2 satellite carried by it uses perovskite solar cell modules manufactured by sisters companies of GCL Group and officially enters the space orbit for testing and accumulation of raw data.
- The first commercial large-scale perovskite single-junction module demonstration application project in China: At the end of 2023, GCL Group won the bid for the perovskite demonstration power station project of Huaneng Qinghai Power Generation Co., Ltd., which has now been completed and entered the commissioning stage.
- The world's first perovskite stacked module demonstration application project: In early 2024, GCL Group and Hong Kong and China Energy signed a strategic cooperation agreement to jointly invest in the construction of a perovskite stacked module demonstration and empirical project.
- The project has now entered the site selection and planning stage%

03 Technology– what is coming next?

Possible applications

Photovoltaic power station

Building Photovoltaics

Mobile scene

03 Technology– what is coming next?

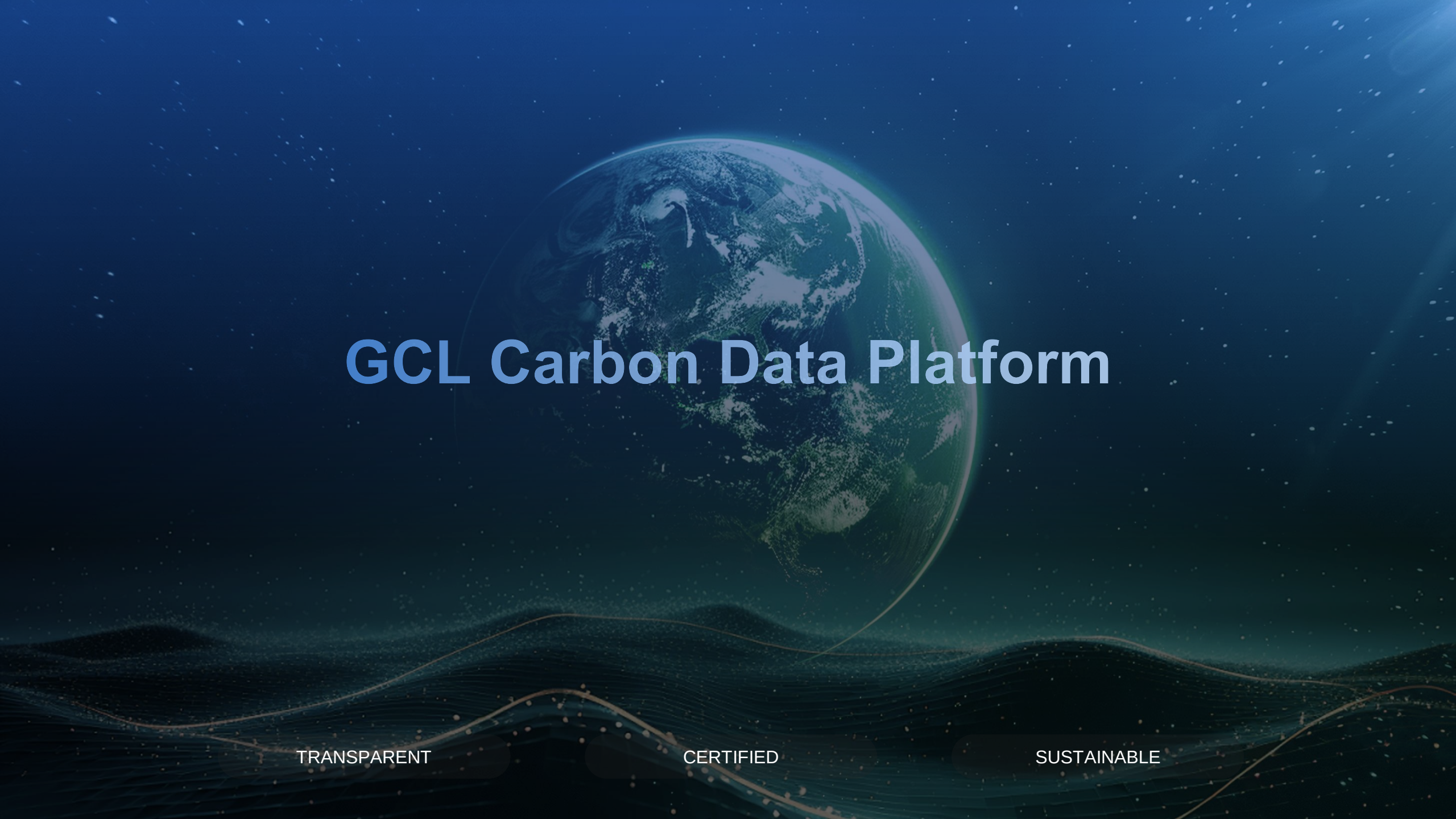
The first GW-level stacking production line is expected to be put into Production in 2024

Location: Kunshan, Jiangsu

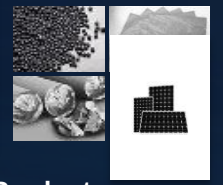
Year of commissioning: 2024

Module type: 2.88 square meters laminated module

Module efficiency: 27%


GCL Carbon Data Platform
TRANSPARENT
CERTIFIED
SUSTAINABLE

GCL vertical industrial chain further helps reduce the carbon footprint emissions of the single crystal, benefiting from the FBR granular silicon technology (GCL's black technology), the carbon footprint is about 10% to 20% lower than the average carbon emissions of the same model products of companies in the industry, with significant low-carbon advantages;
Granular silicon + thinner silicon wafer (150~165 μm) will greatly reduce the carbon footprint of single crystal and make products more competitive.



- **182 single and dual glass modules (400~555W)**
- **210 single and dual glass modules (590~670W)**

certisolis
TEST - CERTIFICATION PHOTOVOLTAÏQUE
Evaluation Carbone simplifiée

GCL Carbon Data Platform

World's first blockchain-based carbon data platform for photovoltaic industry

Traceable Reliable Tamper-proof

Accurate carbon reduction in every link

A transparent and green supply chain

Six Major Links

Carbon Data Collection

Production & Logistics

Business

Purchasing Materials

Authoritative Certification

TÜVRheinland®

ISO certification

ecoinvent

Carbon Data Platform

ANT Blockchain

TaaS Technology

Carbon Footprint Management

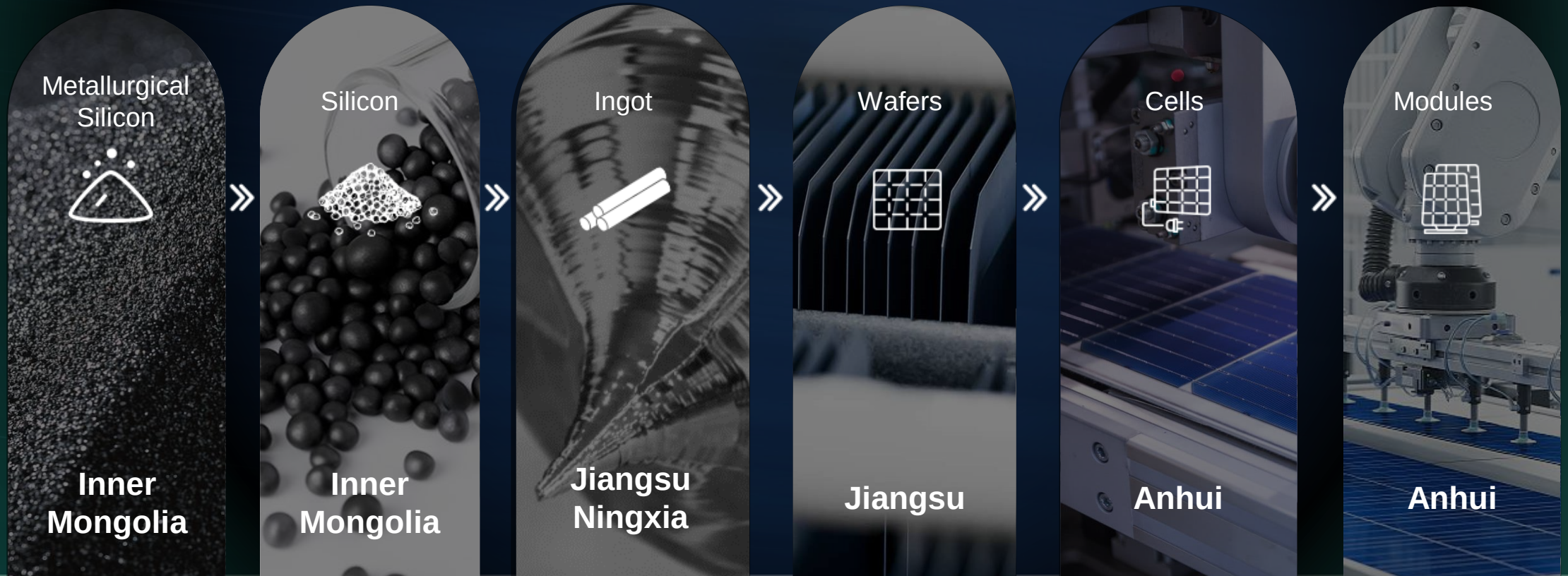
Trace, control, update the optimal carbon data

Supply Chain Traceability Management

Six-level carbon traceability from raw materials to products

Supported by Ant Blockchain

TUV Rheinland authoritative certification



Unique Code for Each Product

Supply Chain Traceability

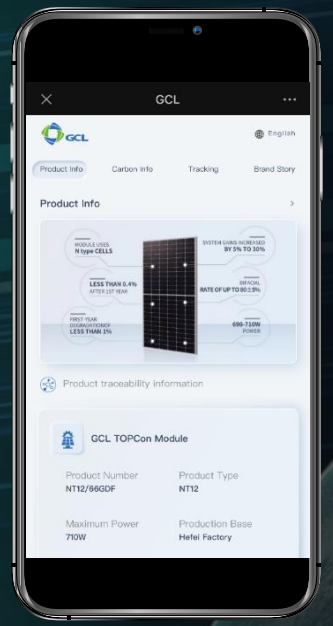
Dynamically upload traceability data in real time

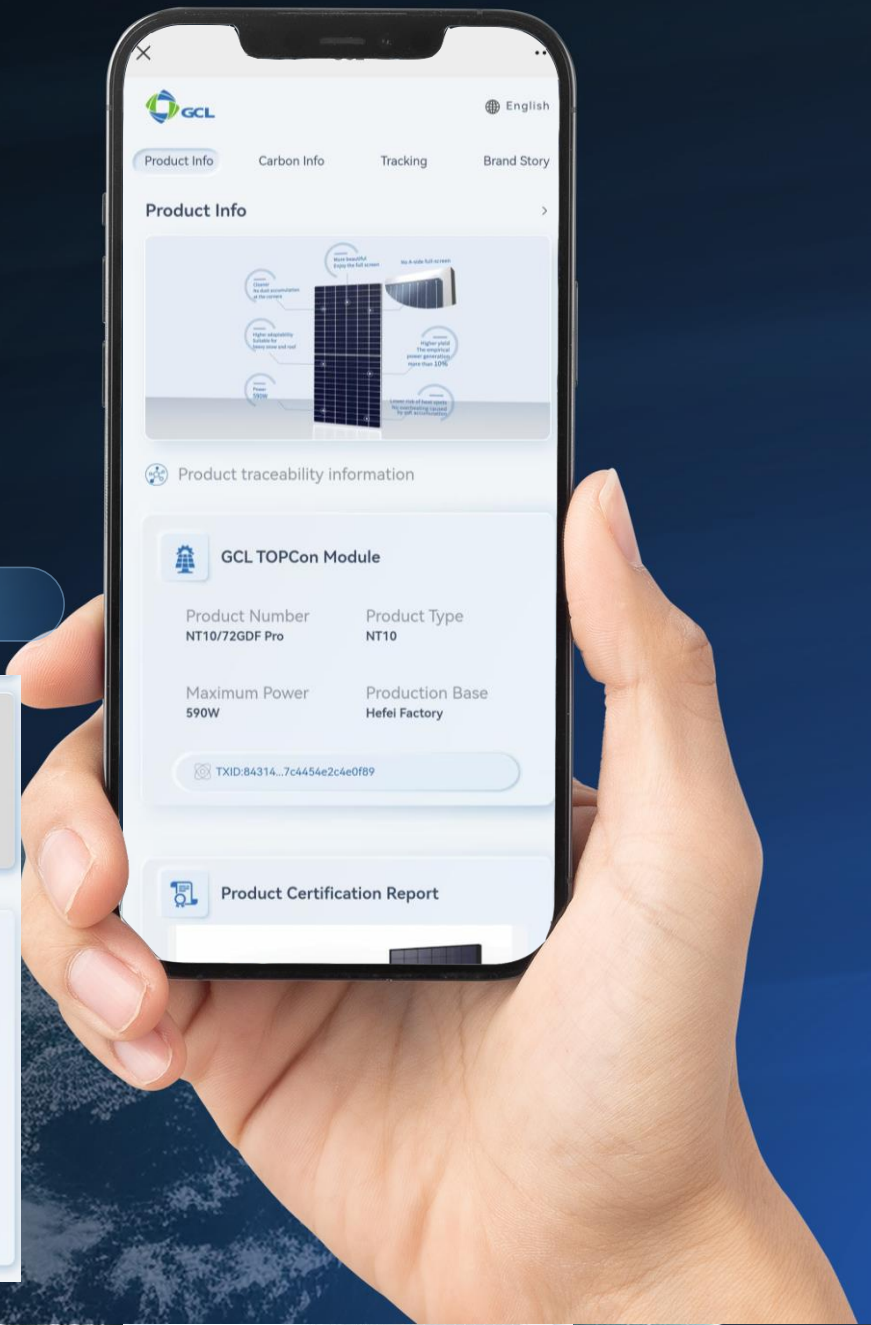
Visual Dashboard

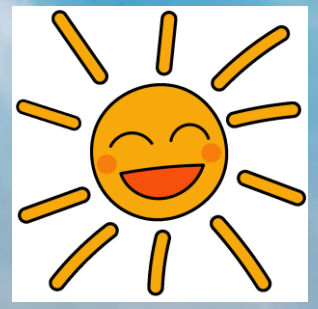
PRODUCT INFO.

CARBON INFO.

TRACKING







Bright Sunny Future!!

GCL SI pledges to help its clients towards a bright and sustainable future

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Bringing Green Power to Life

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