

The background is a deep blue with abstract, flowing lines. On the left, a large, glowing blue planet with a prominent ring system is shown. Several smaller, glowing blue spheres are scattered throughout the scene, and bright, curved lines suggest orbital paths or energy flows.

GCL

INNOVATING THE FUTURE:

TECHNOLOGY ROADMAP AND INNOVATION.

NEXT BREAKTHROUGH IN HIGH-EFFICIENCY TECHNOLOGY:
TANDEM PEROVSKITE MODULES

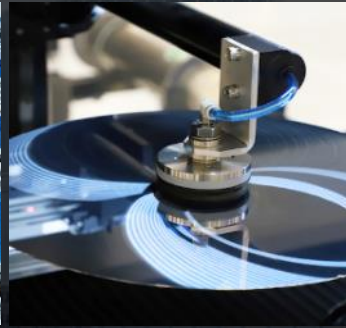
About GCL Group



Renewable Power



PV Manufacturing



Semiconductor
Material



Natural Gas



ESS Materials &
Products



EV Charging

No. **4**

amongst global Top 500
New Energy Companies

4

public listed
companies

35

years of experience
in energy sector

3,000+

patents and intellectual
properties

\$27.8 billion+

in assets

GCL Capacity Layout



Module
30GW

N-type Cell
16GW

Silicon Wafer
35GW

FBR Silicon
480,000tons
200GW

GCL SI Hefei
Module



GCL SI Funing
Module



GCL SI Wuhu
Cell



GCL SI Baotou
FBR Silicon



Fully Vertically Integrated Value Chain. Upstream.



**Metallurgical
Silicon**



Silicon



Ingot



Wafers



Cells



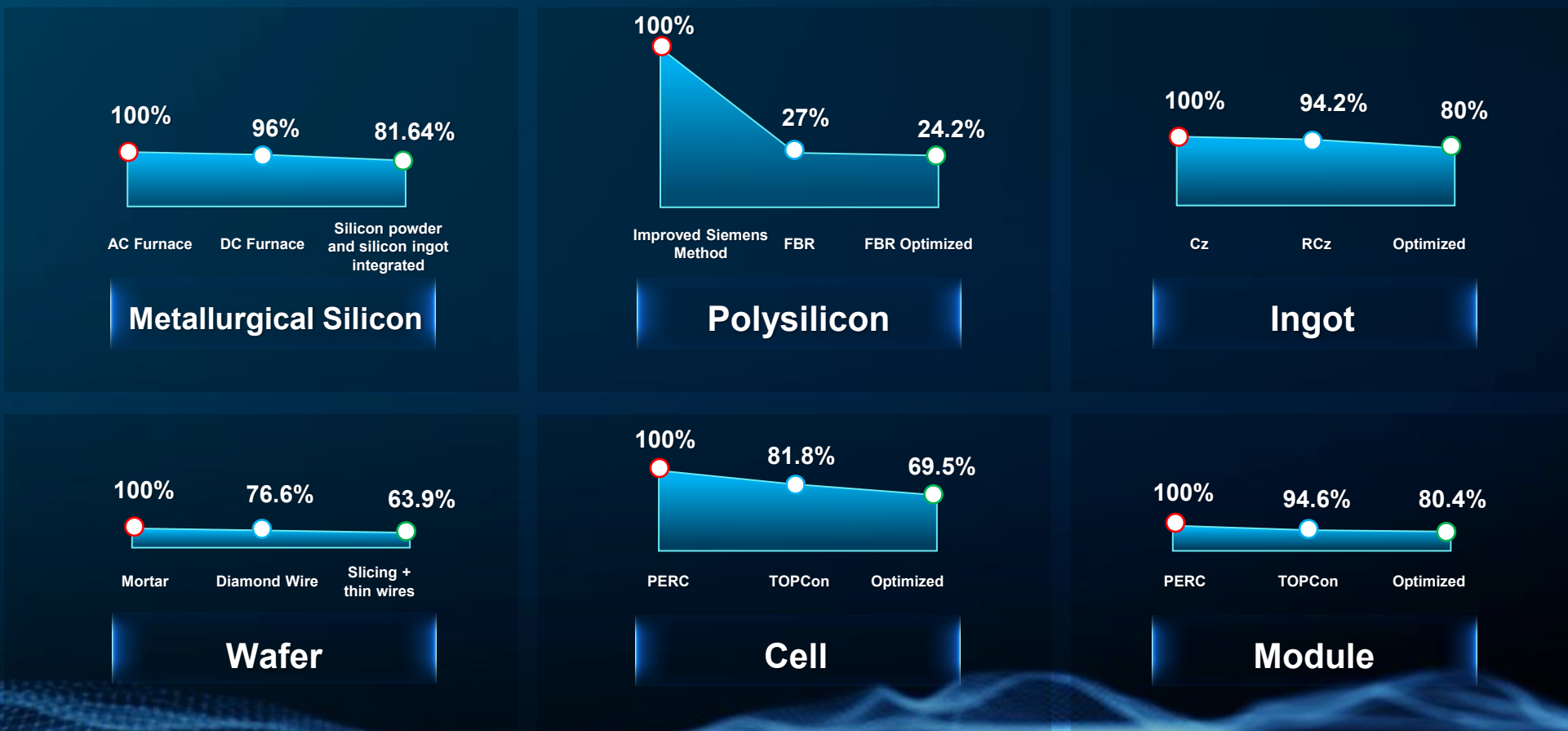
Modules



Innovative Technologies for Continuous Carbon Reduction



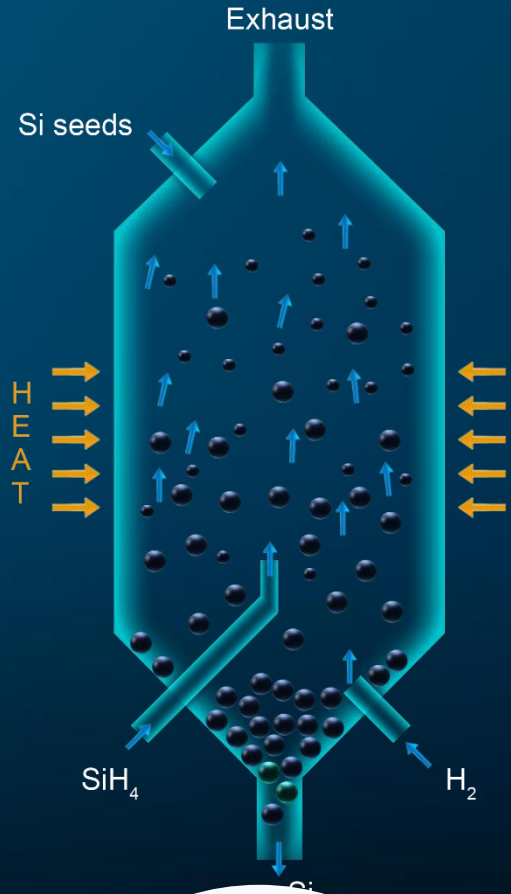
Silicon Material Accounts for ~40% Overall Emissions



• Last/Current Industry Generation • GCL • GCL Target

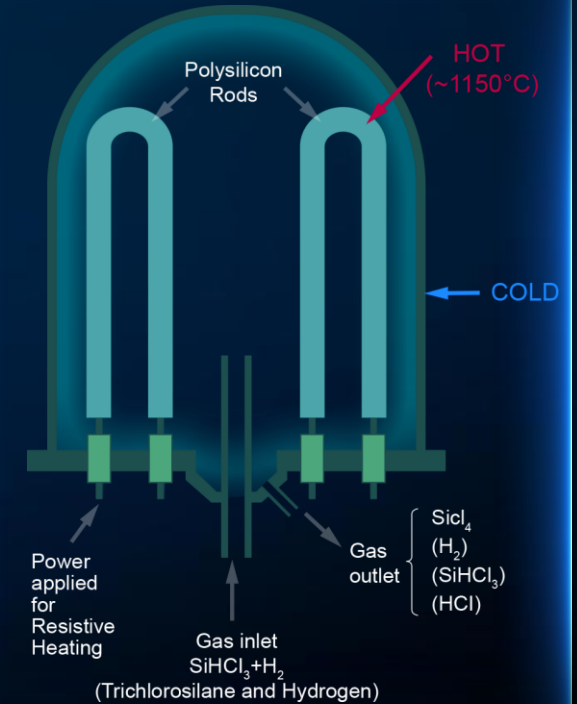
* Source: Estimation by GCL Carbon Data Platform.

What is FBR (Fluidized Bed Reactor) Silicon?



- 01.** Silicon “seeds” are inserted into a chamber filled with hot, high purity silane gas passing through it.
- 02.** The gas flow “fluidizes” the silicon seeds which liquefy as the silane gas decomposes and deposits layers of silicon on them: catalytic reaction.
- 03.** The “seeds” grow larger and heavier and heavier until they leave the chamber when they have reached sufficient size.

The Siemens Process

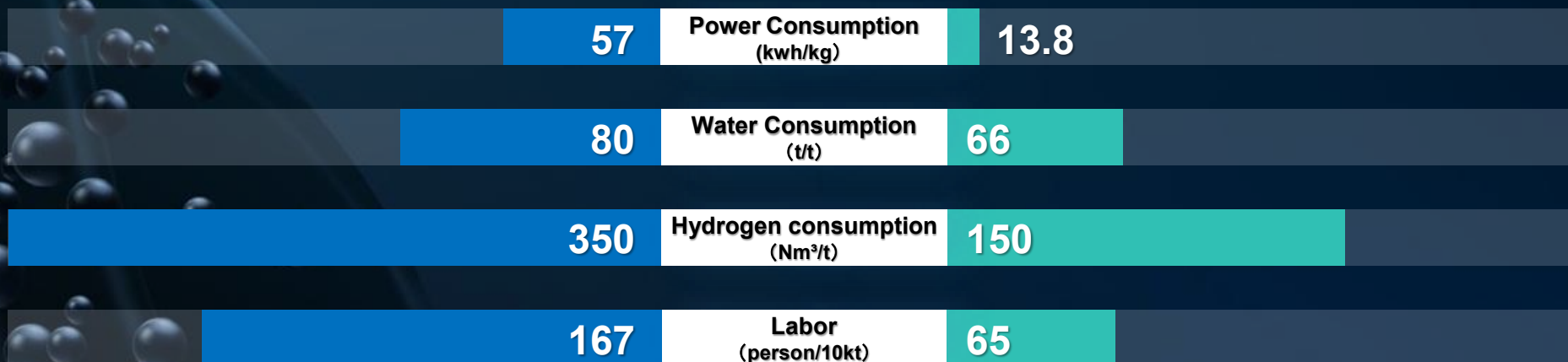


FBR Granular Silicon Reduce Emission from the Source



Improved Siemens Method Silicon Rod

FBR Granular Silicon



 **76% ↓**
Power
Consumption

 **18% ↓**
Water
Consumption

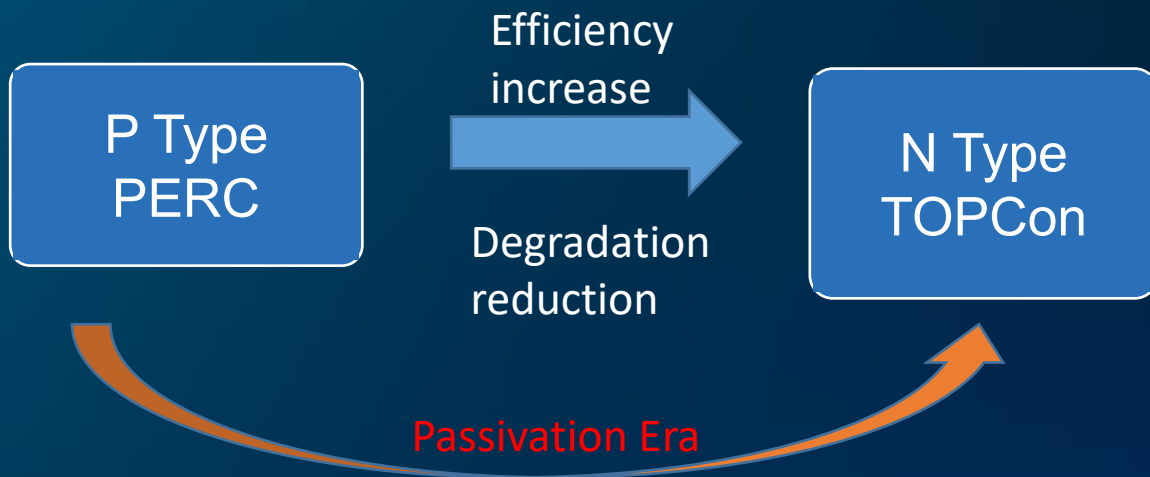
 **57% ↓**
Hydrogen
Consumption

 **61% ↓**
Labor
Cost

 **75% ↓**
CO₂
emissions

The technology's newly verified carbon footprint of just **14.441 kgCO₂e/kg** now stands as the lowest recorded value in global polysilicon production, setting a new industry standard for clean manufacturing.

PV Technology Overview



What's Next?

Efficiency increase, degradation reduction, costs,
Material dependency (silicon, silver)...

HJT?

BC?

Tandem
Perovskite?

M10
(182x182)

M12R
(210x182)

M12
(210x210)

「Notes」

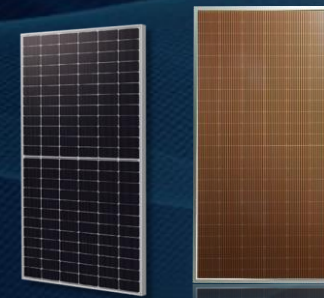
Fewer cells - lower Voltage

Smaller cell - lower current

Thickness from 165 microns to
130 microns

Number of module per string
limited by voltage

Inverter compatibility by current



PV Modules Portfolio TOPCon – Main Products Family



NT12R/48GDF

Bifacial/Monofacial
Dual Glass
Monocrystalline Module

Up to
450Wp+



NT12R/54GDF

Bifacial Dual Glass
Monocrystalline Module

Up to
510Wp+



NT10/72GDF

Bifacial Dual Glass
Monocrystalline Module

Up to
600Wp+



NT12R/66GDF

Bifacial Dual Glass
Monocrystalline Module

Up to
640Wp+



NT12/66GDF

Bifacial Dual Glass
Monocrystalline Module

Up to
720Wp+



TOPCon 2.0 Product Value



The same version
Power enhance

20W +

Higher Power Gain

Module Efficiency > 24%
High Bifacial factor
Dust prevention function

High Reliability

Yield optimization
Superior performance in Utility applications

Green and low-carbon

Green supply chain
Precise carbon tracking



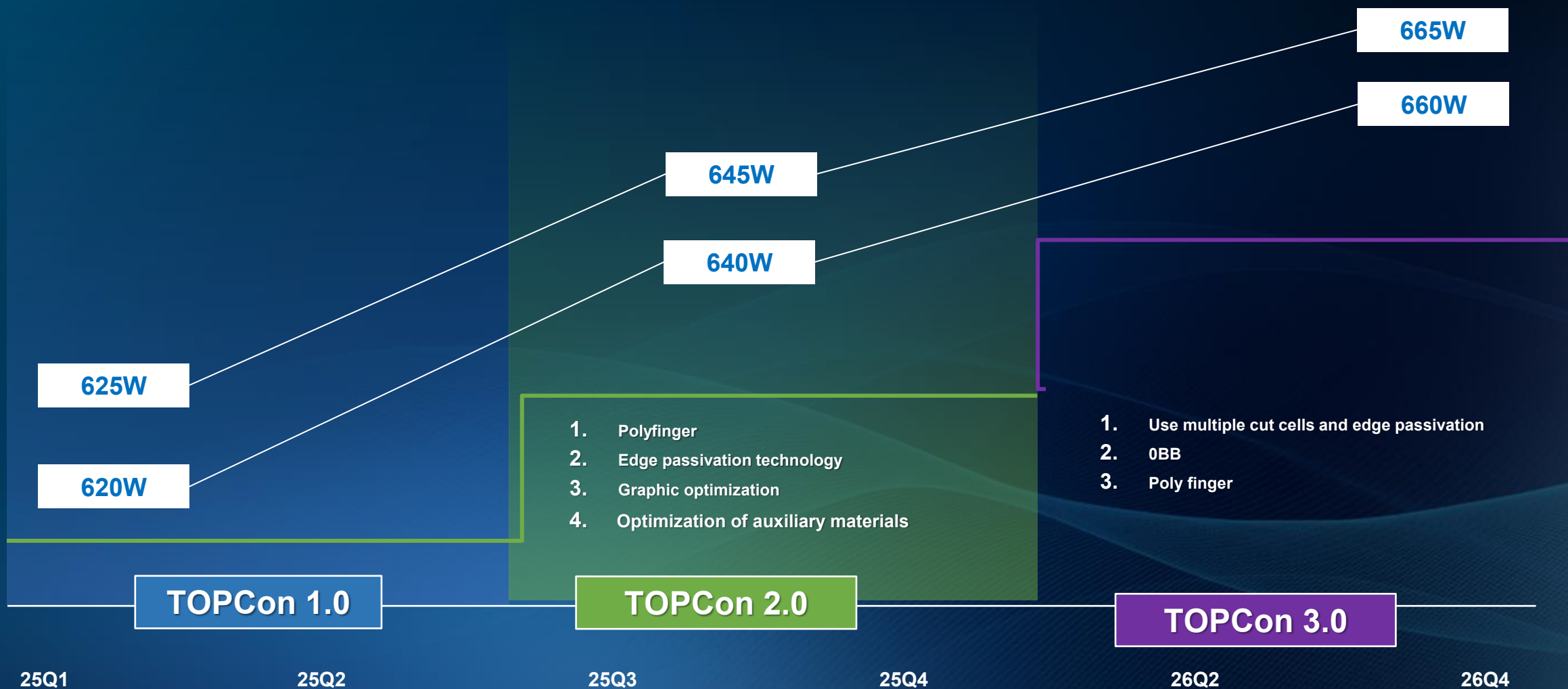
Lower Degradation

Temperature Parameter -0.25%/°C
First year degradation < 1%
Liner power degradation < 0.40%

Technology innovation for higher performance

- Polyfinger
- Edge passivation technology
- Graphic optimization
- Optimization of auxiliary materials
- 0BB

TOPCon2.0 Product Roadmap



PV Modules Portfolio - GPC 2.0 Product Line



Higher Power Gain

Cell Efficiency > 27.5%
Maximize light utilization
Dust prevention function

High Reliability

Reduces the risk of cell micro-cracks
Superior performance against
shadow shading

GPC2.0

NR12R/66GDF

660W+

24.4%

2382×1134×30 mm

GPC2.0

NR12R/54BGDF

500W+

23.72%

1800×1134×30 mm

Lower Degradation

Temperature Parameter -0.25%/°C
First year degradation < 1%
Liner power degradation < 0.35%

Pure Appearance

No busbar in front side
All-black appearance

Green and low-carbon

GCL SiRo modules
Full supply chain traceability

Roadmap – Utility & DG



Product series Utility	Product type	Dimension (mm)	2025Q3	2025Q4	2026H1	2026H2	2027H1
TOPCon 1.0	NT10/78GDF	2465*1134*30	640	645	/	/	/
	NT10/72GDF	2278*1134*30	600	600	600	605	/
	NT12R/66GDF	2382*1134*30	620	625	625	630	635
	NT12/66GDF	2384*1303*33	715	715	720	725	730
TOPCon 2.0	NT12R/66GDF	2382*1134*30	635	640	645	650	660
TOPCon 3.0	NT12R/66GDF	2382*1134*30	/	/	650	655	670
GPC 2.0 (Back Contact)	NR12R66DGF	2382*1134*30	/	/	/	660	675

Product series DG	Product type	Dimension (mm)	2025Q3	2025Q4	2026H1	2026H2	2027H1
TOPCon 1.0	NT12R/54GDF	1962*1134*30	510	515	515	520	525
	NT12R/54BGDF	1962*1134*30	500	505	505	510	515
	NT12R/48BGDF	1762*1134*30	445	445	450	450	455
	NT12R/48GDF	1762*1134*30	450	450	455	455	460
TOPCon 2.0	NT12R/48GDF	1762*1134*30	460	460	465	470	475
GPC 2.0 (Back Contact)	NR12R48BDGF	1762*1134*30	/	/	500	505	510

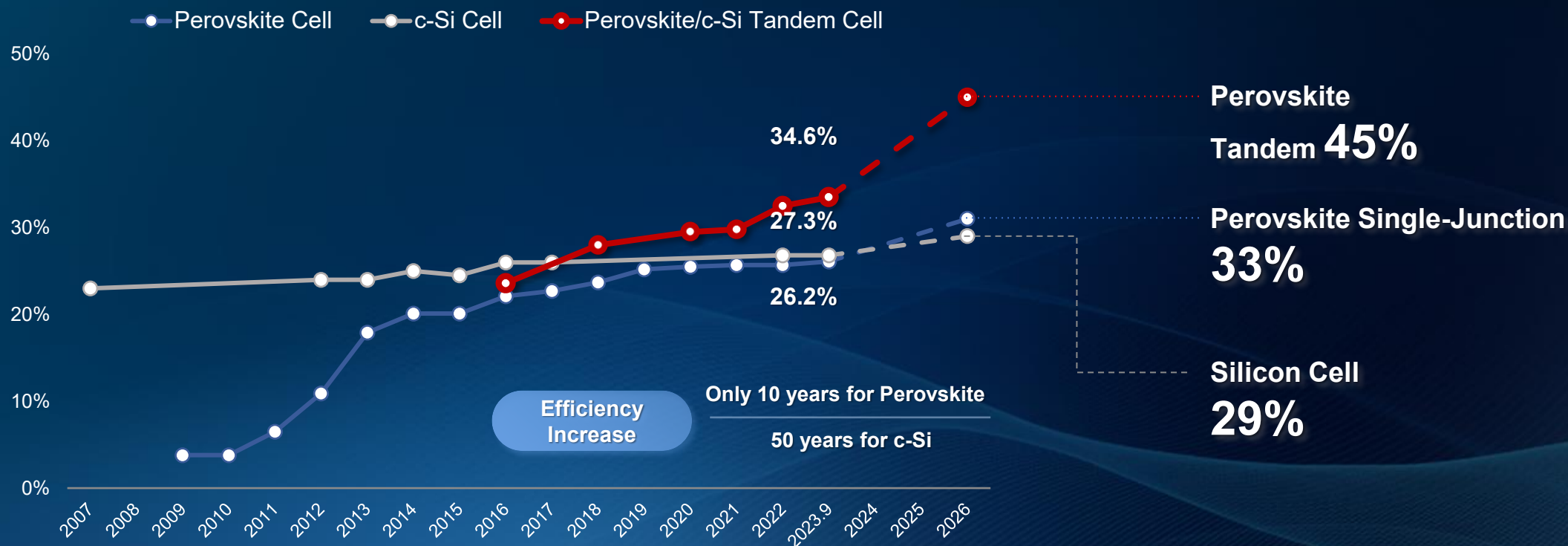
*from 2025-09-11

Perovskite Tandem Cells: The Only Viable Path to Higher Efficiency



Conversion Efficiency of Different Solar Cells

Theoretical Efficiency Limit



Source: NREL, Solarbe

Perovskite is Highly Designable



Perovskite is a type of material with molecular formula ABX_3

----- $CaTiO_3$ (the “original” perovskite)

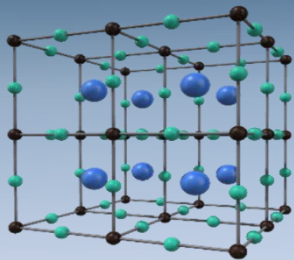


$A = Ca^{2+}$

$B = Ti^{4+}$

$X = O^{2-}$

----- ABX_3 : Octahedral crystal structure



$A = CH_3NH_3^+,$
 $CH(NH_2)_2^+, Cs^+ \dots$

$B = Pb^{2+}, Sn^{2+} \dots$

$X = I^-, Br^-, Cl^- \dots$

Perovskite Can Be Designed to Specific Needs

----- Perovskite material in 2009



A

B

X_3

----- Continued evolution (2023)



A

B

X_3

Single Junction Module (Module Efficiency: 20%)



IEC 61215/61730 Certificate



Single Junction Module Structure

Perovskite on Glass



Glass

Perovskite

POE

POE

Glass

Glass

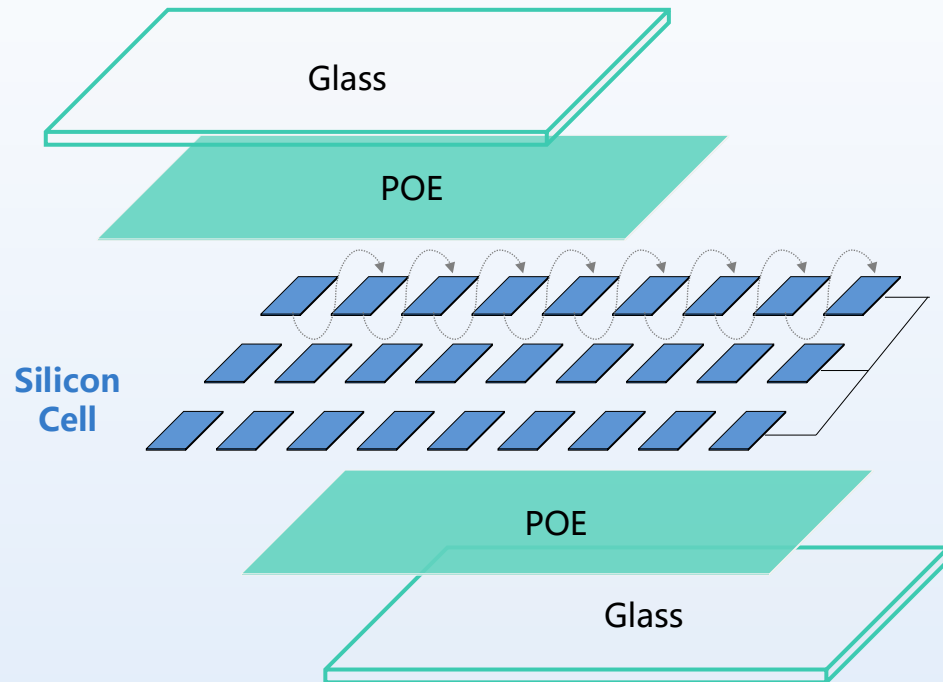
Perovskite fabricated directly on glass
Encapsulated by glass and POE

2m² Single Junction Module



Silicon Module Structure (Module Efficiency: 23%)

Silicon Module Structure



Glass

POE

Silicon Cell

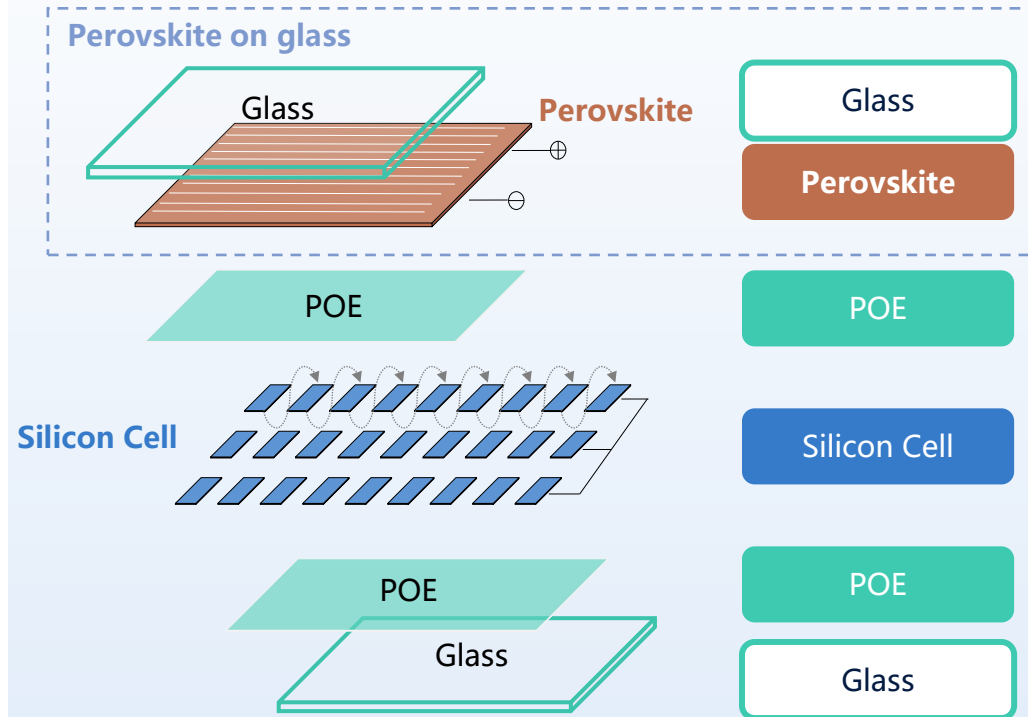
POE

Glass

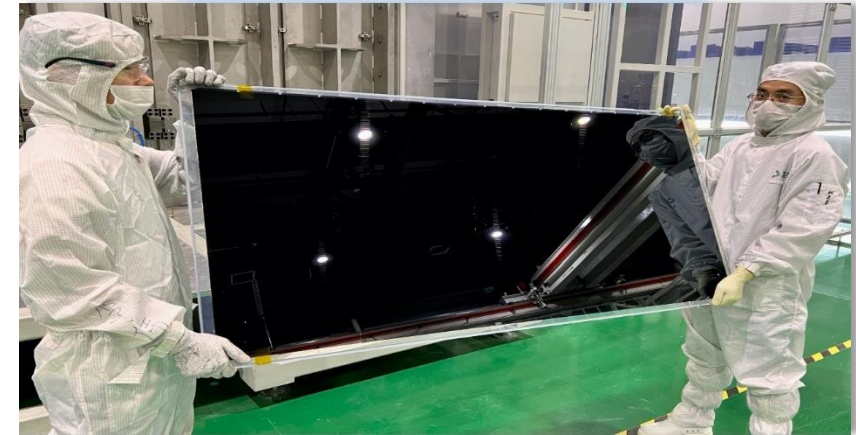
Tandem Module Structure (Module Efficiency: 28% / 30% (lab))



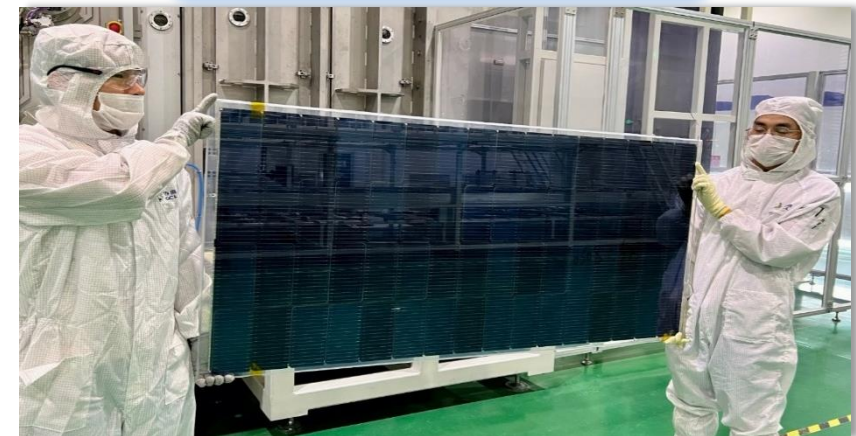
Module-Level Tandem Structure



Front Side: Perovskite 19%



Back Side: Silicon 7-8%



Module Level Tandem: Easier to Commercialize

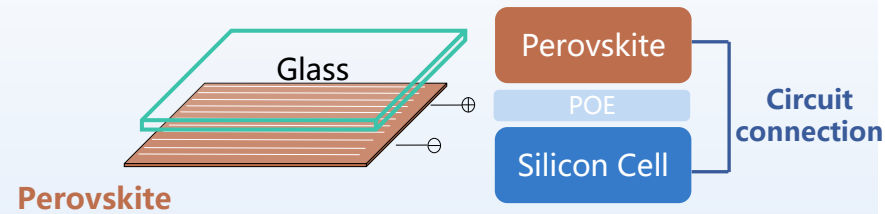


Tandem Structure



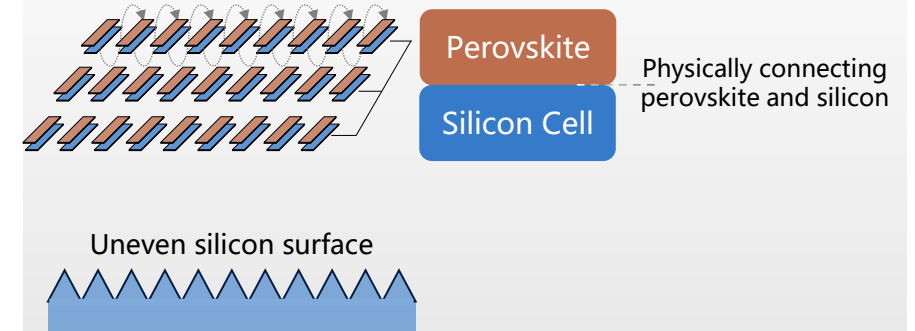
Structural Characteristics

GCL: Module Level Tandem (Parallel Structure)



- ✓ Fabricating perovskite on glass is more viable
- ✓ **Compatible with all silicon technology (PERC, Topcon, HJT, etc.)**
- ✓ Broader band-width selection for perovskite material – more mature and abundant selection

Others: Cell Level Tandem (Series Structure)



- × Uneven silicon surface negatively affects the quality of perovskite layer
- × **Customized development with specific silicon technology**
- × Less perovskite material selection for narrow band-widths
- × Problems with edging effect, spectrum matching, etc.
- × Fabrication of metal bus bars

PilotProject: 4MW Pilot with Huaneng Group



Demonstration Project Phase I (1MW)



Strategic Cooperation with China Huaneng Group

项目 产品 产业化 指标	产能※	300kW	10MW	100MW	产线实体
	销量※	0	0	4-6MW	外部销售合同或系统内部使用/试用订单 (2023 年为华能项目订单)

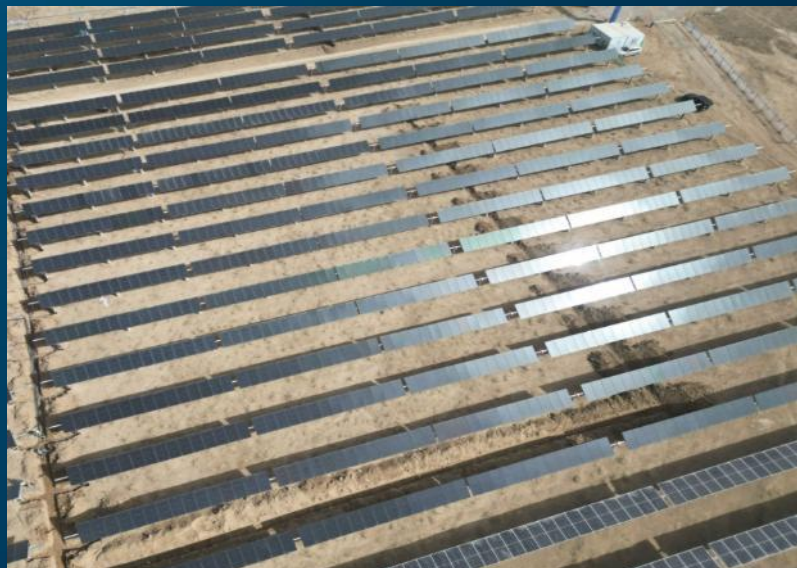
Project background: Chinese government releases supportive policies to advance third-generation perovskite technology

Plant Capacity: 1MW built, expandable to 4MW

Plant Location: Qinghai Province

Modules Used: 2m*1m perovskite single junction modules

PilotProject: 4MW Pilot with Huaneng Group



2024: 2.0m² Perovskite Module, 1MW, Qinhai Province



2025: 2.0m² Perovskite Module, 3MW, Qinhai Province



2025: 2.0m² Perovskite Module, 1MW, Inner Mongolia



2024: Rooftop Solar Project, Jiangsu Province



2024: Carport Project, Guangdong Province

The First Tandem Perovskite GW-Level Stacking Production Line



Kunshan – 1 hour from Shanghai

Part 1 commissioned – 500 MWp capacity
Large format 1.15 x 2.4m tandem modules

Ramp up and certification
by end Q2 2026



Bright Sunny Future!!

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

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T H A N K Y O U