
LAPLACE

# Enabling U.S. Solar Manufacturing:
# Laplace N-Type High-Efficiency Cell Solutions

**Speaker:**
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**RE+ - TaiyangNews – EUPD Research**

SOLAR – MADE IN THE USA Conference

Venetian Las Vegas Expo @RE+ September 8, 2025

LAPLACE Renewable Energy Technology Co., Ltd.

# Driving U.S. Solar Independence with Laplace

## *Market protection*

- Strong U.S. demand driven by IRA incentives and FEOC compliance rules
- Barriers to imports create clear opportunity for local manufacturing
- Laplace supports U.S. customers with proven turnkey solutions

## *IP (Innovation for TOPCon):*

- Robust IP portfolio and FTO (Freedom-to-Operate) analysis
- Customers protected from infringement risks
- Continuous monitoring of patent landscape for added security

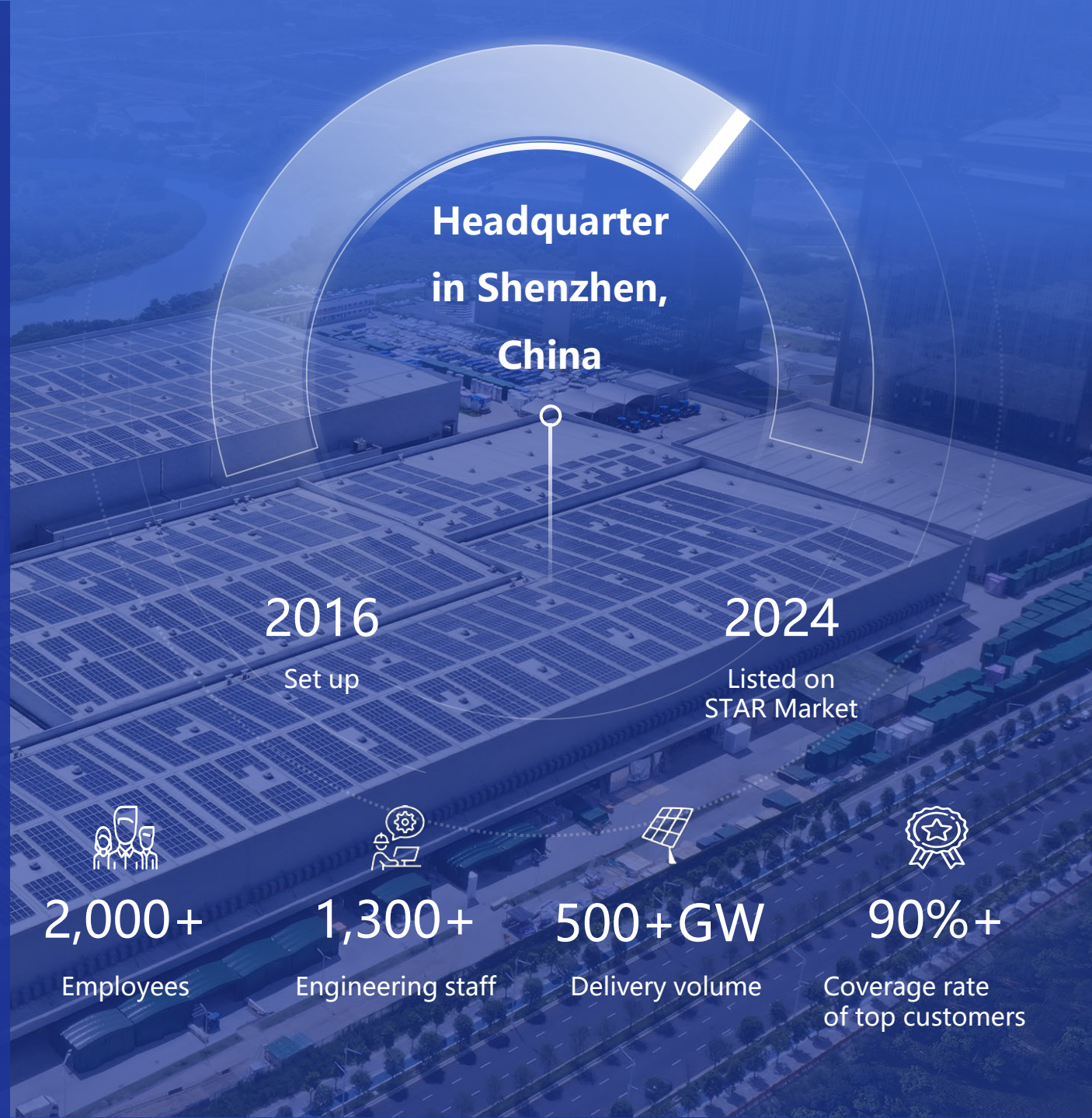
## *Technology: Leading equipment for TOPCon+ and XBC*

- Proprietary TOPCon+ and XBC process equipment delivering >25% efficiency cells
- Reduced tool count and optimized fab layout for lower CAPEX/OPEX
- Proven global deployments in Turkey, Europe, and upcoming U.S. projects

# WHO IS LAPLACE ?

**Multiple Breakthroughs in Solar Innovation:**

- **Pioneer of TOPCon for mass production**
- **Vanguard of TOPCon+**
- **Innovator of Back Contact (BC) with almost 100% market share**
- **New deposition platform for perovskite-based tandem**



# LAPLACE Experience

## PROJECT EXPERIENCE

- >500 GW of TOPCon/P-IBC/N-IBC/PERC equipment delivered (CNY ~ 17 BN, USD ~ 2.4 BN)
- >20GW outside of China from USA, Southeast Asia, and Turkey
- Biggest project: 30GW
- 800+ people in support: extensive experience in manufacturing of TOPCon & BC technology with cutting-edge performance and IP

## CUSTOMER RECOGNITION (SELECTED LIST)

LONGi
JinKO Solar
AIKO
通威太阳能 TW SOLAR
Trinasolar 天合光能
JTPV 捷泰科技
CanadianSolar
JA SOLAR 晶澳太阳能
ASTRONERGY
东磁 DMEGC
SILFAB SOLAR
VSUN Innovative & Smart

# LAPLACE International


## International Customers

- USA
- Southeast Asia
- Turkey

## Laplace international

- Hong Kong (China)
- Southeast Asia
- Europe
- USA

## Manufacturing and R&D Sites

- Shenzhen (Headquarter)
- Wuxi
- Haining
- Taizhou
- Xi’ an
- Guangzhou

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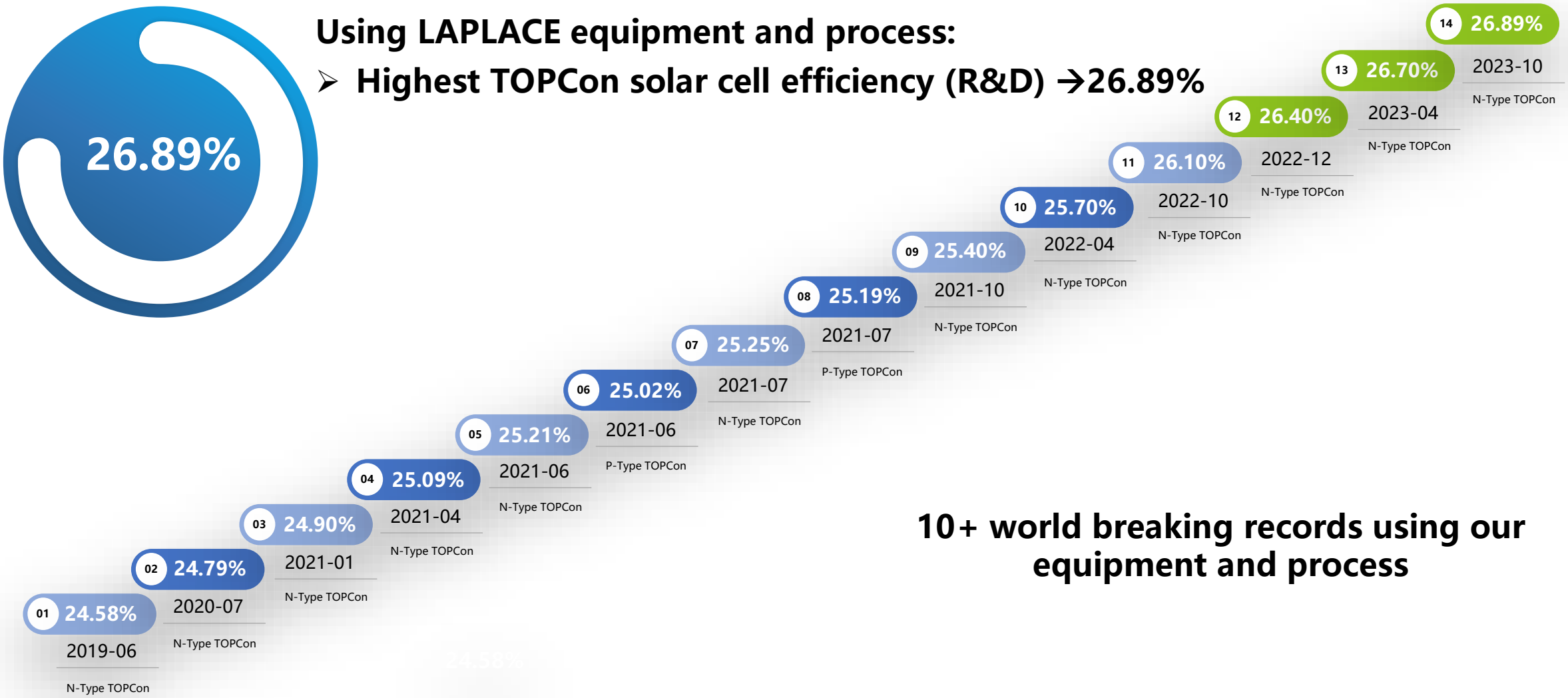
# Development of Cutting-edge Technology at LAPLACE




## Using LAPLACE equipment and process:

- **Highest TOPCon solar cell efficiency (R&D) →26.89%**




**10+ world breaking records using our equipment and process**



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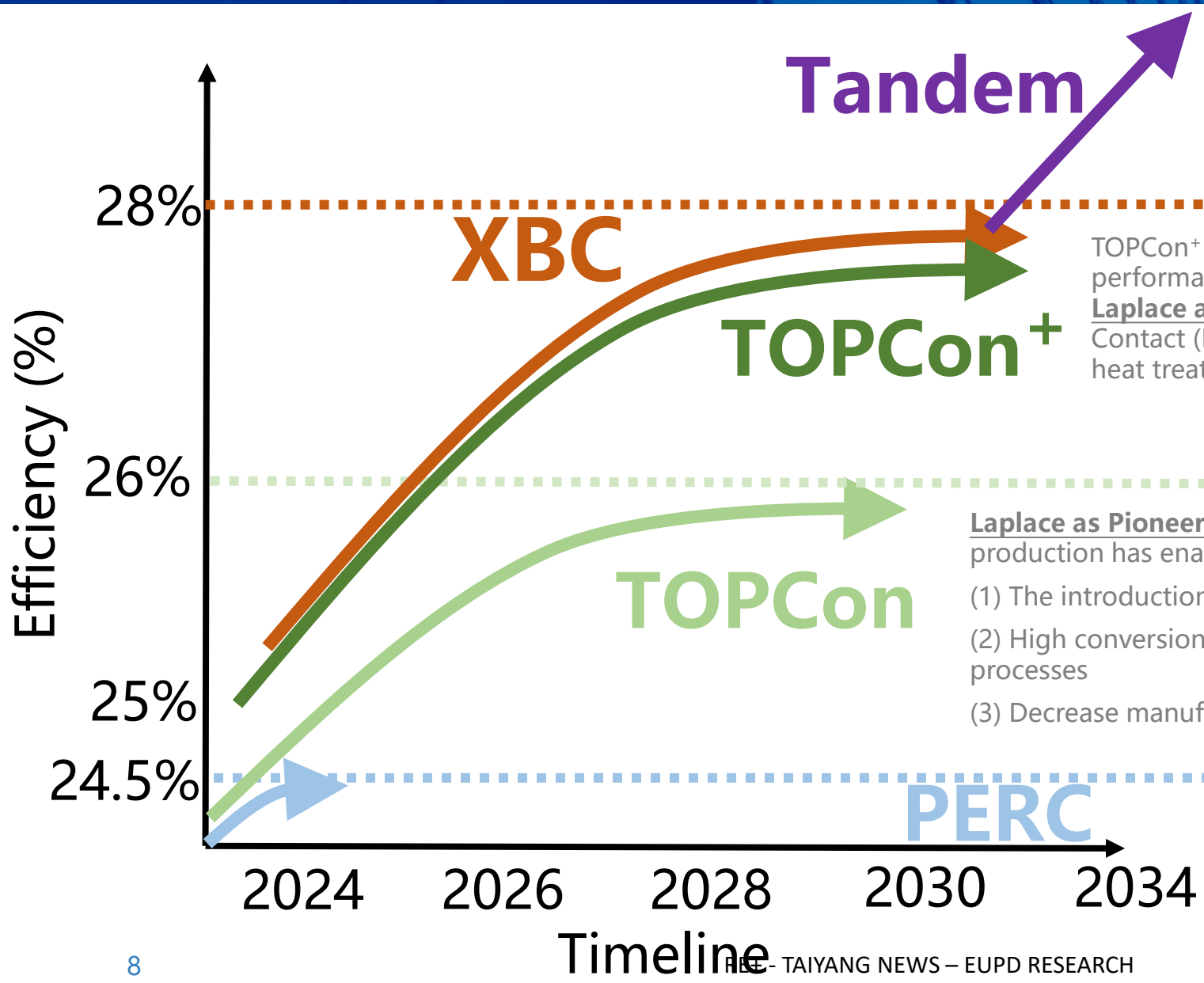
# LAPLACE Technology Roadmap




Perovskite-based tandem cells are mostly still in research phase. **Laplace developed new deposition** platforms and equipment to bring this technology to market readiness.

TOPCon⁺ and XBC are gaining momentum, offering higher efficiency performance and chances to increase significantly its market share **Laplace as Innovator** of equipment provider is at the forefront of Back Contact (BC) design and technology with almost 100% market share in heat treatment and deposition

**Laplace as Pioneer** of equiment provider in TOPCon cell technology for mass production has enabled:

(1) The introduction of the first mass production BCl3 diffusion tool,

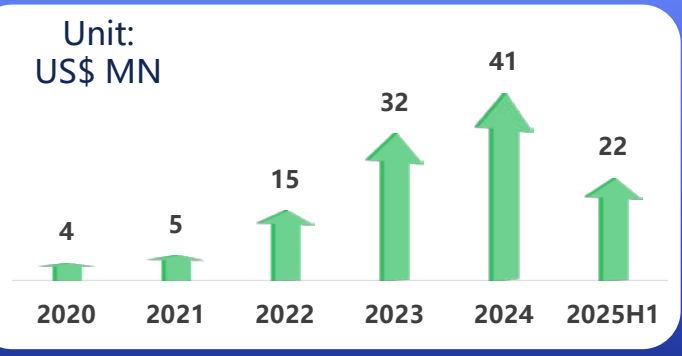
(2) High conversion efficiency performance by optimizing LPCVD and boron diffusion processes

(3) Decrease manufacturing cost by increasing drastically cell throughput

PERC has a limited efficiency potential. **Laplace as follower** provides tools with high throughput and performance

# LAPLACE innovations for TOPCon

## R&D Investment




**120+**

Million US$
Cumulative R&D expenditure

**01**

### Pioneering transition from $BBr_3$ to $BCl_3$

- > 70% cost reduction

**02**

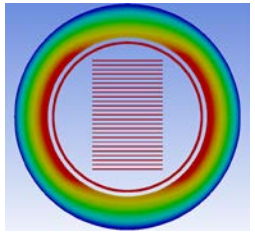
### Double-loading (back-to-back wafers)

- Diffusion, Oxidation and LPCVD
- Doubled throughput without need of change in process flow
- Highest throughput for LPCVD, much lower CoO in comparison with PECVD

**03**

### In-House Heating elements

- Improved thermal uniformity, shorter processing time
- Longer quartz parts lifetime



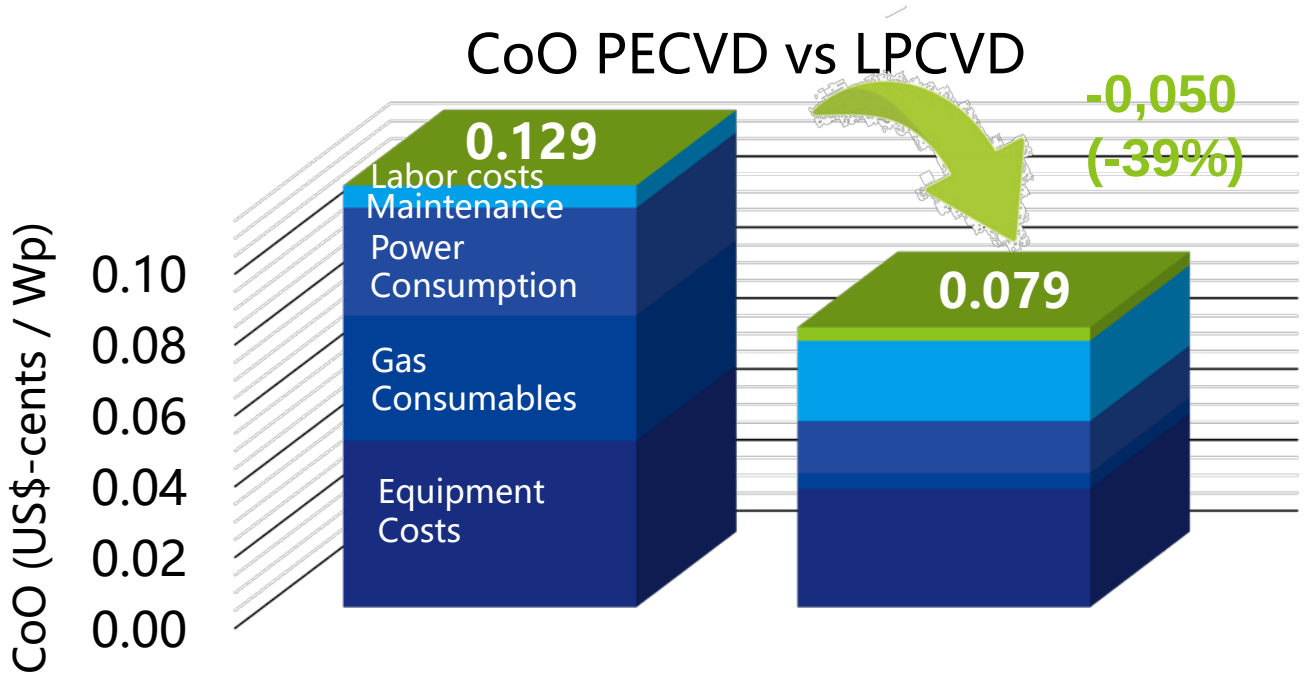
**04**

### Quartz tube inside coating

- Pre-coating by nano crystallization technology
- Tube lifetime increase to over 6-9 months

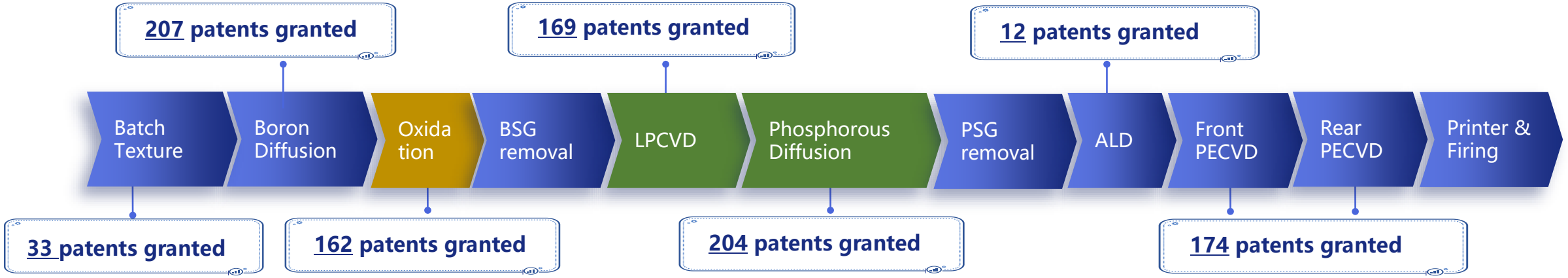
# LAPLACE LPCVD route

- **Laplace has improved the tool efficiency:**
  For M10 wafers, besides double loading, GEN 4 Laplace tools have 2400 wafers/tube while GEN 5 has 2880 wafers/tube
- **Quartz tube inside coating:**
  Pre-coating by nano crystallization technology increased tube lifetime to over 6-9 months

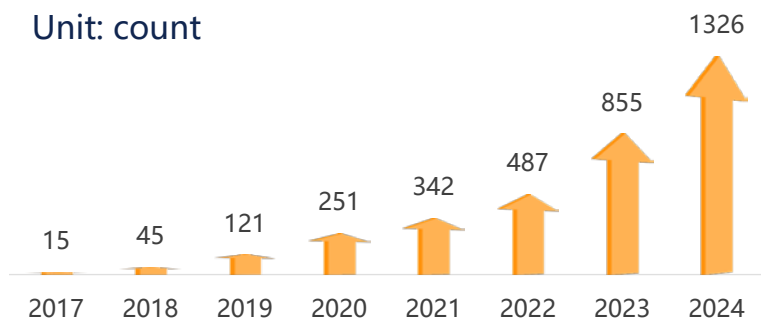



GEN5 tools (double loading) combined with increased tube lifetime have improved significantly the CoO of LPCVD with today a **~40% lower CoO than PECVD.**

# LAPLACE Equipment Patent Portfolio




## Accumulated Patent Applications




**1,300+**
**Applied Patents**

**700+**
**Granted patents**

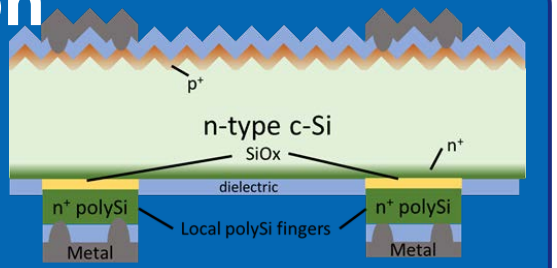
- Laplace has a strong patent portfolio and is protecting its customers
- Laplace continuously analyses upcoming patents and lawsuits to ensure a seamless adaptation of upcoming technologies.

Laplace proprietary **TOPCon process flow, and LPCVD with ex-situ doping** technology allows customers to manufacture and sell TOPCon products to the USA and Europe

# Why TOPCon+ and BC Technologies are taking over TOPCon

## TOPCon

### TOPCon+

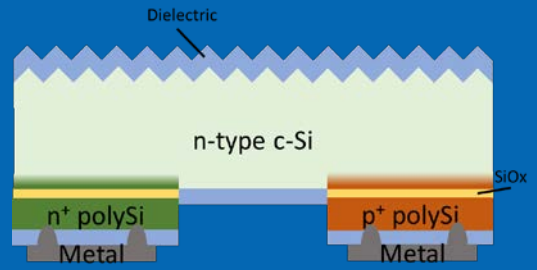



Eff. up to **27.62 %** [1]

**Similar requirements**

- **Stable, uniform, thermal SiOx**
- **Lasers gain importance**

### XBC

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| | TOPCon+ | TOPCon | Back Contact |
|---|---|---|---|
| **Bifaciality:** | **85 %** | **80 %** | **70 %** |
| **Manufacturing Complexity** weighted score | **7 (moderate)** | **6 (moderate)** | **10 (hard)** |
| **Required manpower:** | **103 %** | **100 %** | **120%** |

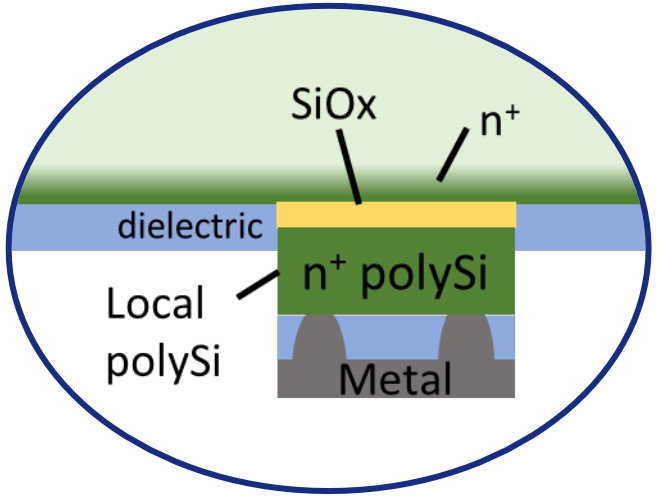


[1] Q. Wang et al., Prog. Ph. Res. Appl., 2024, doi.org/10.1002/pip.3839

# Why LAPLACE has a leading role for TOPCon$^+$ and XBC Technology

Most important demand for all TOPCon plus and XBC cells:
**Stable, reproducible, uniform, thermal SiOx layer**

——> Implementation to TOPCon plus and XBC requires the use of **LPCVD for the deposition of both the tunnel SiOx and polysilicon layers**




For localized polySi, either as polySi fingers or XBC design, lasers are the most cost-efficient way for patterning

**Laplace developed advanced laser technology for all critical steps in TOPCon plus and XBC manufacturing**

Our Turnkey technology is **fully compatible** for the polySi implementation in TOPCon$^+$ and XBC cells, with equipment already delivered and operating successfully.

# LAPLACE Equipment Portfolio for TOPCon Cell Line

Wet etch | B Diff. | Oxidation | Etch & Clean | LPCVD | P Diff. | Etch & Clean | ALD | Front PECVD | Rear PECVD | Metallization | Test Sort

## Heat treatment

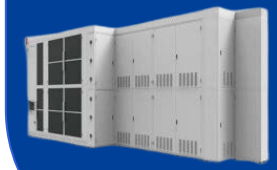
**Solid State diffusion and Oxidation**

**Boron Diffusion**

- Pioneering BCl3
- 5TH GENERATION
- > 1,000 machines delivered
- Rank first by market share

**Oxidation & Annealing**

- 5TH GENERATION
- > 700 machines delivered coating film.



**Phosphorous Diffusion**

- 5TH GENERATION
- > 400 machines delivered
- Larger production capacity, and can reduce costs

## Deposition

**LPCVD**

- 5TH GENERATION
- > 1,300 machines delivered
- Rank first by market share

**ALD**

- 2ND GENERATION
- Double-layer sealing ensures the uniformity of the coating film.

**PECVD**

- 5TH GENERATION
- > 600 machines delivered
- Larger production capacity, and can reduce costs

## Automation

Loading, transfer, up to full automation for entire cell line

- > 2,000 machines delivered

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LAPLACE Become a global leader in photovoltaic equipment and solution

# New Laplace Tools For TOPCon+ and Back Contact

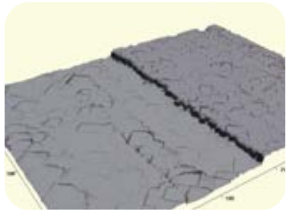
## Atomic Edge Passivation Deposition Complete Solution (EPD)

**Function:** Cut wafers in half and passivate to edges to recover the losses
**Mechanism:** Non-destructive laser is used to separate the wafer in two pieces. Half cells are stacked to a coin-stack and a passivation layer is deposited on the edges.
**Dimensions:** 19,04 x 4,60 x 3,70 m
**Throughput:** 10000 pcs/h (M10)

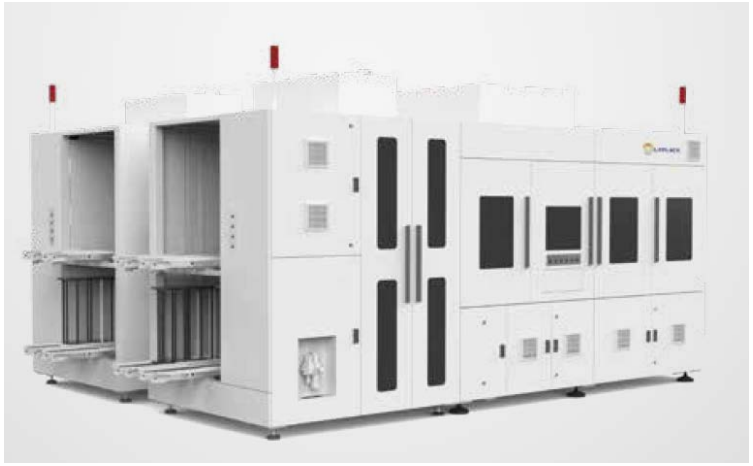
## Poly Thickness Removal via Laser Ablation

**Function:** Reduce parasitic absorption, increase conversion efficiency and bifaciaity factor
**Mechanism:** Remove poly-silicon locally
**Dimensions:** 5,56 x 4,00 x 2,80 m
**Throughput:** 9000 pcs/h (M10)

**3D morphology of etching edge**



## XBC Cell Laser Contact Opening



Function:
Structure doped layer pattern

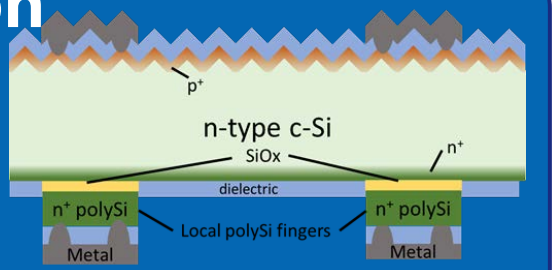
Mechanism:
Remove local layer by ultrafast laser

Throughput:
≥ 3600 pcs/h (M10)

# What is Next:

## TOPCon

### TOPCon+

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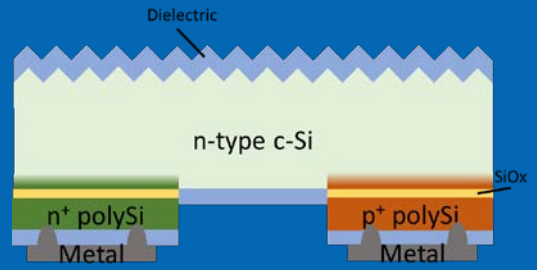


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## Tandem

- Perovskite-based tandem cells are mostly still in research phase
- Laplace has developed new platforms and equipment that are currently in pilot lines
- Laplace ready to enter the US market with our new Perovskite platform



[1] Q. Wang et al., Prog. Ph. Res. Appl., 2024, doi.org/10.1002/pip.3839

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# COME SEE US

*Innovation. Protection. U.S. Solar*

## LAPLACE BOOTH **V7720**

LAPLACE

From: LAPLACE

2025

To: RE+Vegas

Date: **September 09-11**

Booth: **V7720**

Venue:

**201 Sands Avenue Las Vegas, NV 89169**

A Global Leader in N-type High-efficiency Solar Cell Manufacturing Solutions

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Email: sales@laplace-tech.com

*Laplace – Global Leader in High-Efficiency Solar Cell Equipment*