

Building a Resilient PV Manufacturing Ecosystem

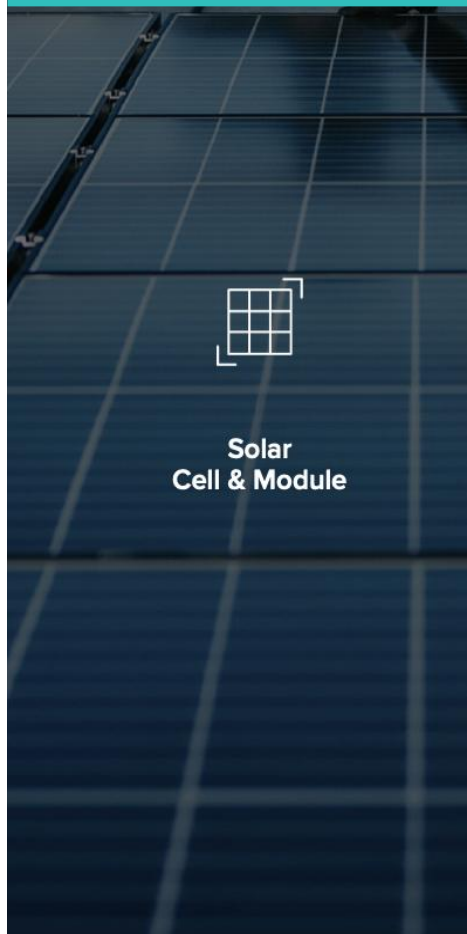
Harsh Galia, Director of PV Engineering
Qcells North America | Sept 23, 2026



Qcells Journey

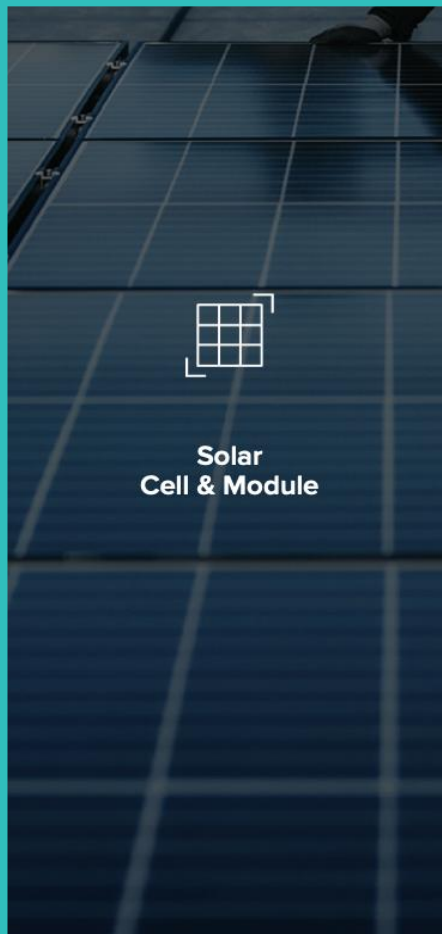
1999 - 2021

Module Excellence Era

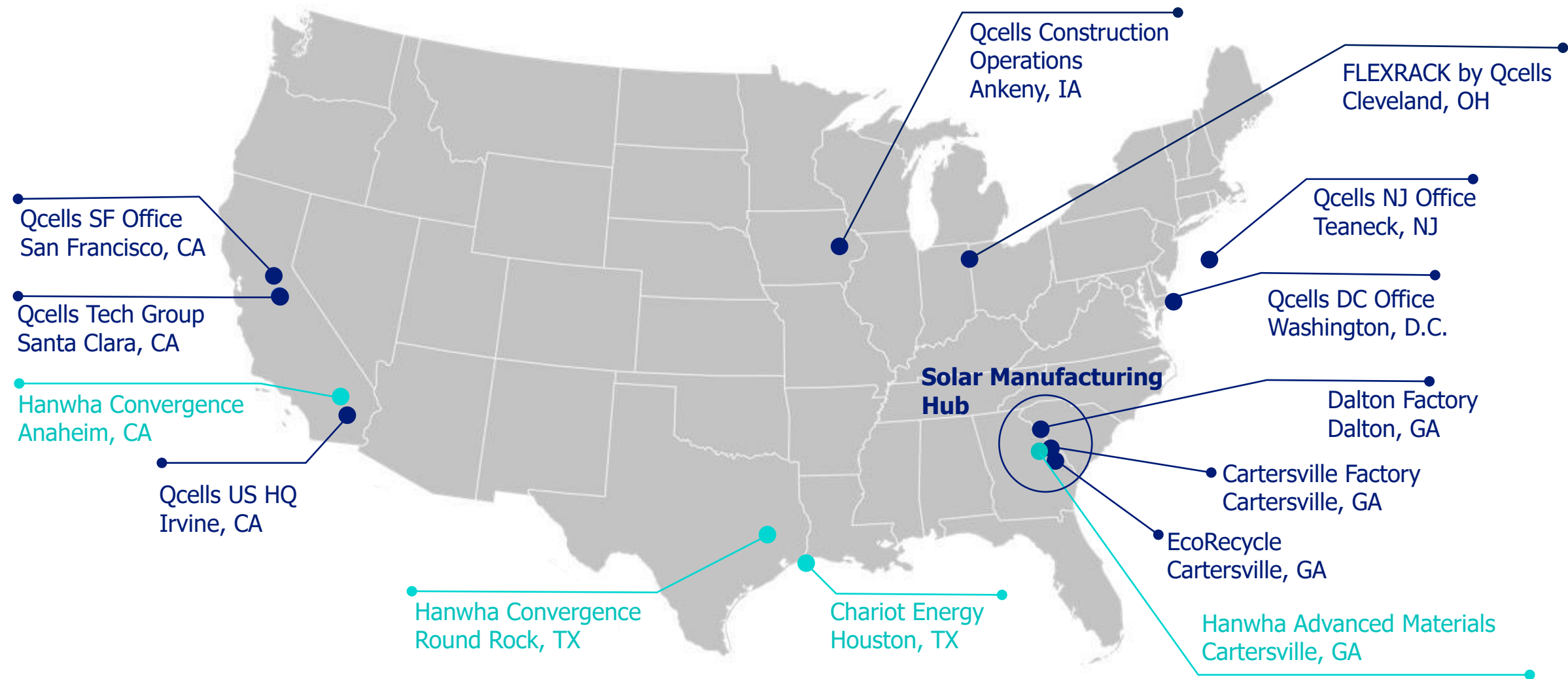


2022 - Present

Energy Solutions Provider Era



Qcells' Commitment to the Future of U.S. Energy



Dalton, GA Manufacturing Facility

MAY 2018

Dalton Plant Announcement

SEPTEMBER 2019

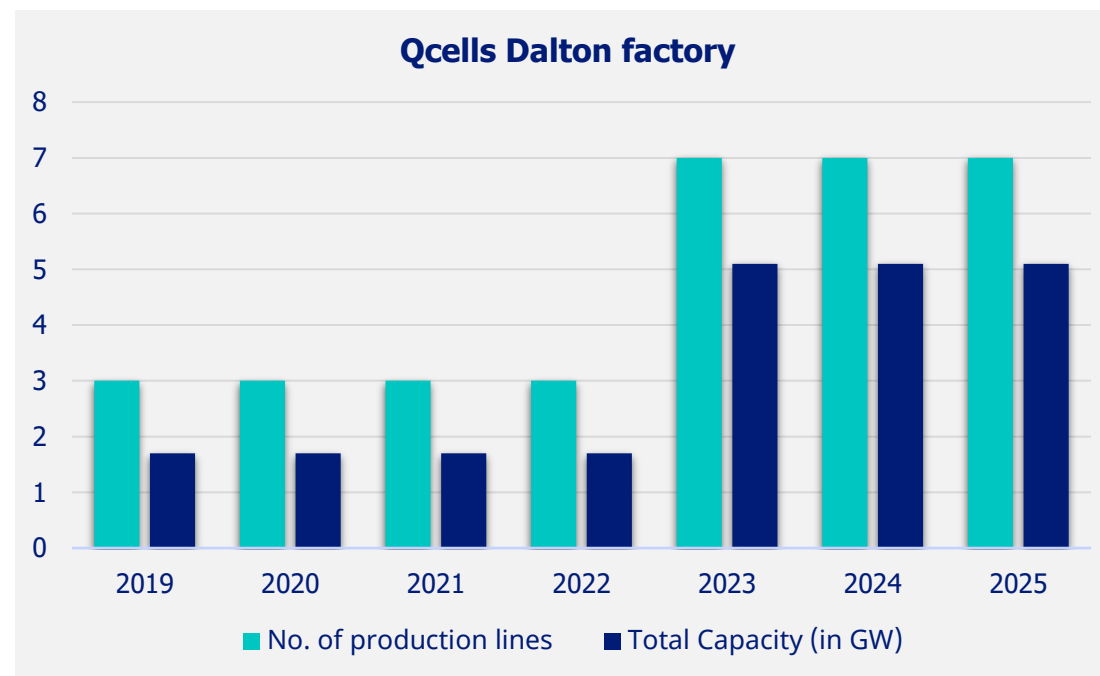
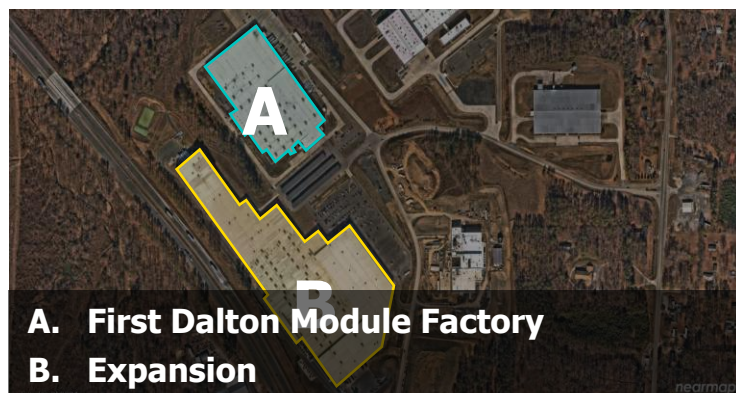
Grand Opening

MAY 2022

**Expansion Plan
Announcement**

NOVEMBER 2023

**Expansion
Completed**



- Tariffs due to Section 201 (Jan 2018) created conditions for manufacturing investment
- In 2019, the Dalton factory started with a total capacity of 1.7 GW
- With the expansion completed in Q4 2023, the Dalton facility now has a total capacity of 5.1 GW

Cartersville Manufacturing Facilities

JANUARY 2023

**Cartersville Plant
Announcement**

MARCH 2023

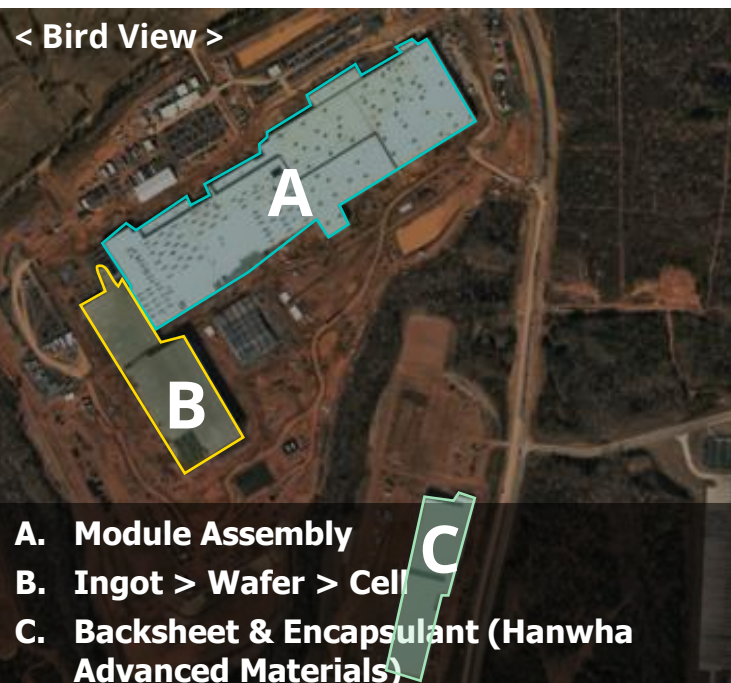
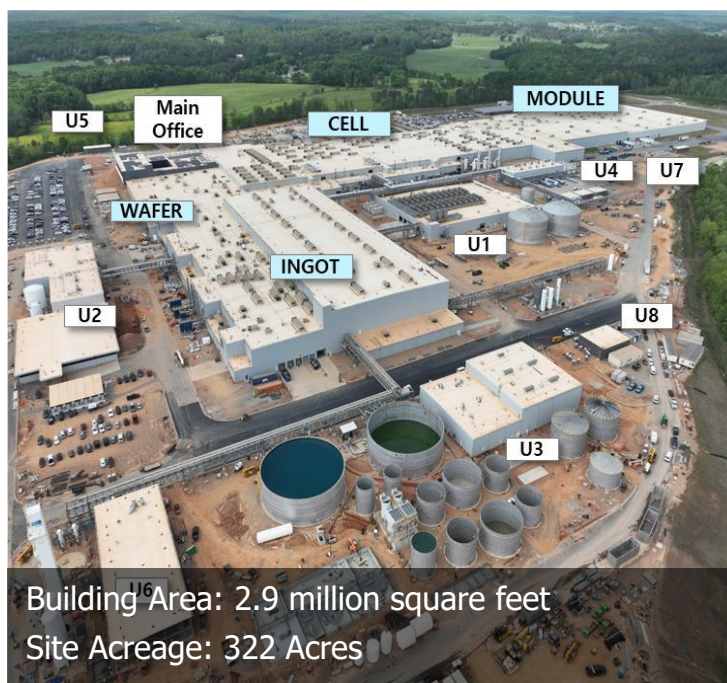
**Hanwha Advanced
Materials Plant
Announcement**

MAY 2024

Module Assembly Started

JUNE 2026

**Cell Production
Started**



- **\$2.8 billion+** investment to build an integrated solar supply chain in the U.S.
- **4,000+** Georgia advanced manufacturing jobs created



Polysilicon



Ingot



Wafer



Cell



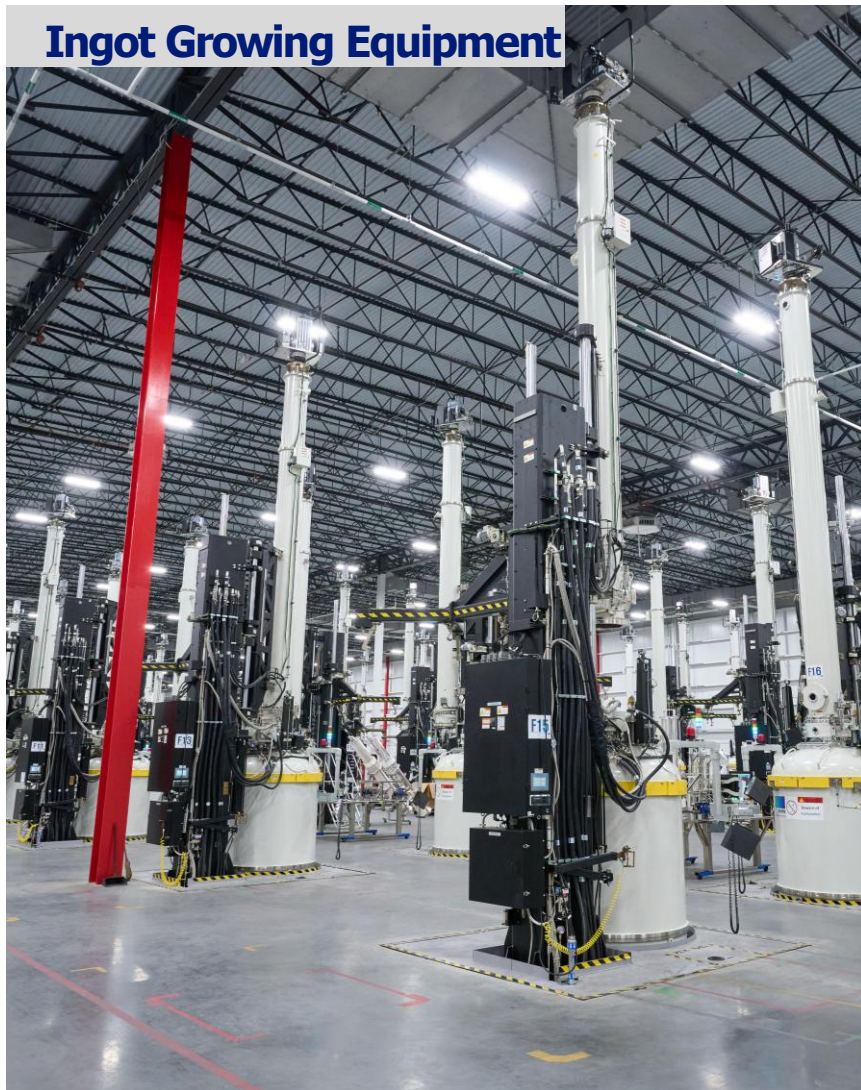
Encapsulant &
Backsheet



C-Si PV Module

Cartersville Manufacturing Facilities

Ingot Growing Equipment



Wafer Equipment



Cell Equipment



Cell Traceability & Quality Assurance – TRA.Q™



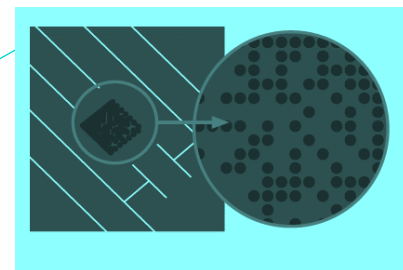
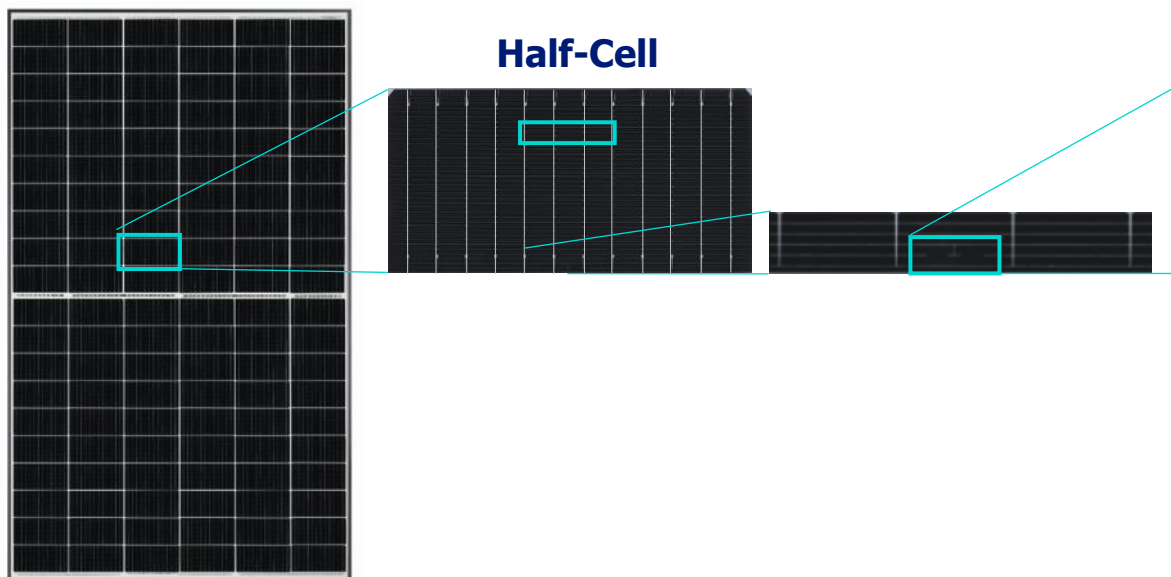
Tra.Q™

- Every Q.ANTUM DUO and Q.ANTUM NEO solar cell contains Traceable Quality technology (Tra.Q™) since 2009
 - Wafer-to-cell-level tracking for all cells
 - Electrical performance tracking (IV data)
- Linking process & inline measured parameters with cell IV data enables big data analytics & machine learning
- Using AI and smart factory concepts, we can rapidly ramp up manufacturing lines and ease production optimization

Module

Half-Cell

Tra.Q™ Laser Data Matrix

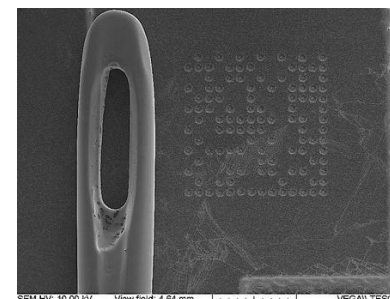


A unique laser ID marking on each cell

10 GW/yr cell

→ **>1.2 B cells/yr**

→ **>3 M cells/day**



Qcells' Quality Leadership

Top Brand

Robust 20+ year history of award-winning innovations and rated as a top module brand for 5 consecutive years in the U.S.



Top Quality & Technology

Outstanding durability and world-class performance as validated by top global institutions including RETC and Kiwa PVEL.



Best-in-Class Warranty

Extended 25-year product and performance warranties* that reflect our commitment to quality products built to last.

*Applicable to select solar module products



No.1 Market Share

Top market share in the U.S. residential & commercial markets.*

*Source: Wood Mackenzie US Distributed Solar Leaderboard



Tier 1 Bankability

Tier 1 solar manufacturer backed by Hanwha Group, a multi-national corporation and 7th largest conglomerate in South Korea.



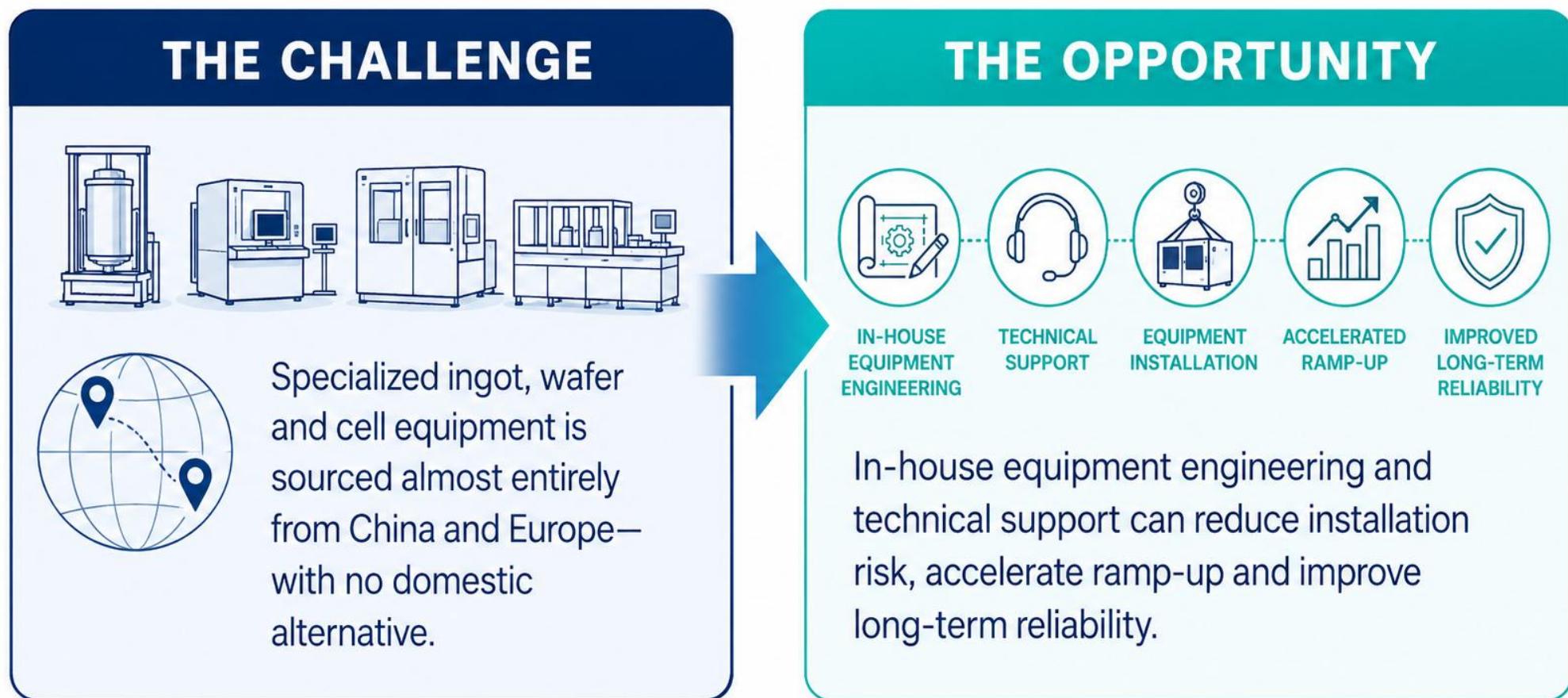
U.S. Manufacturing

Qcells operates the largest solar module factory of its kind in the Western Hemisphere and is building an integrated silicon based solar supply chain, manufacturing components to finished products here in the U.S.



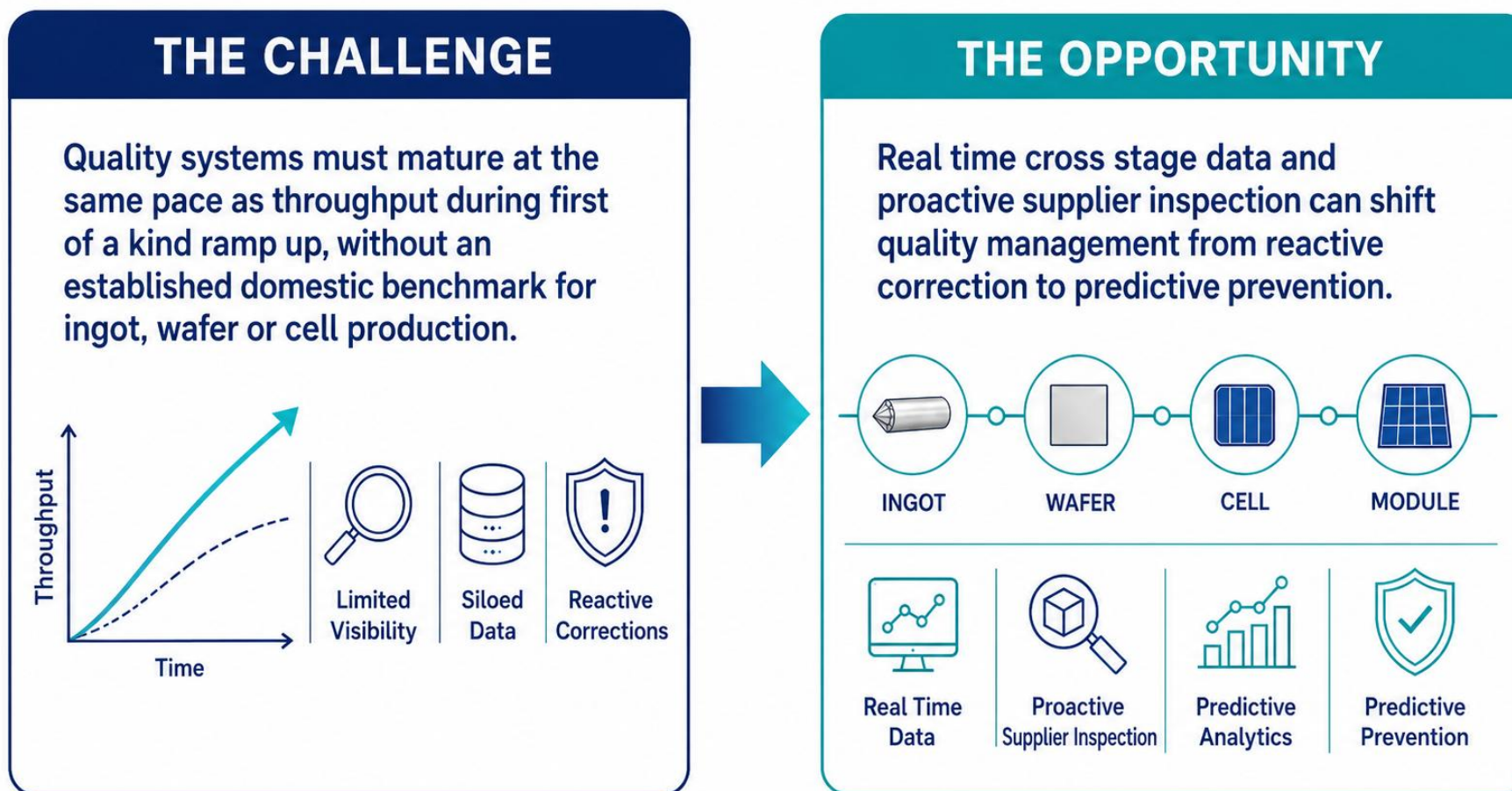
Manufacturing Equipment Supply

Global equipment concentration creates sourcing, lead-time, and support risks, while in-family engineering capabilities enable faster installation, stronger technical support, and more resilient operations.



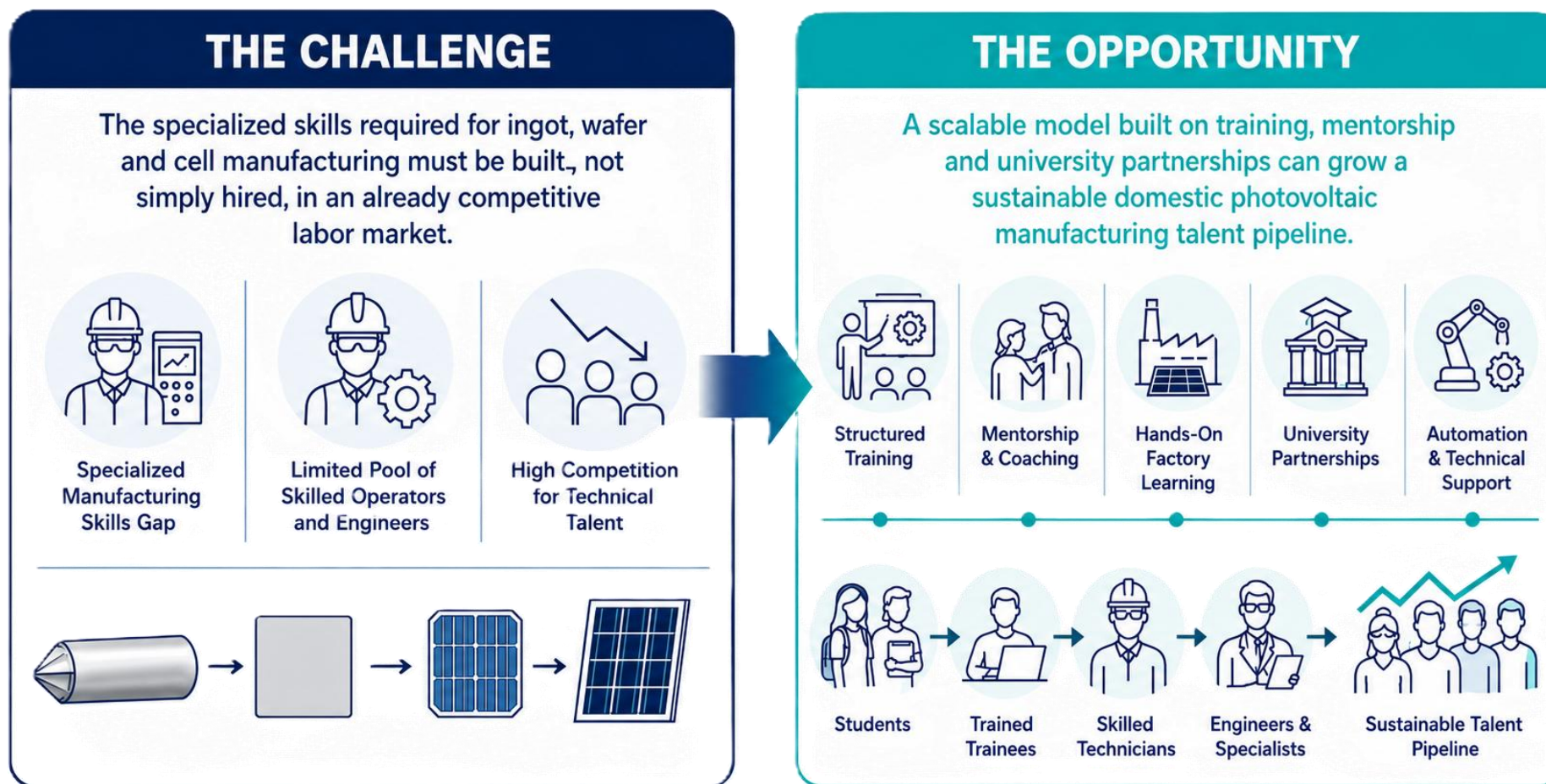
Quality Systems

As first-of-a-kind production scales, quality systems must mature alongside throughput, using real-time data and proactive supplier inspection to shift from reactive correction to predictive prevention.



Workforce Development

Building a domestic talent pipeline for ingot, wafer, and cell manufacturing requires coordinated training, academic partnerships, and automation to close specialized skills gaps and support sustainable growth.



PV Workforce Development

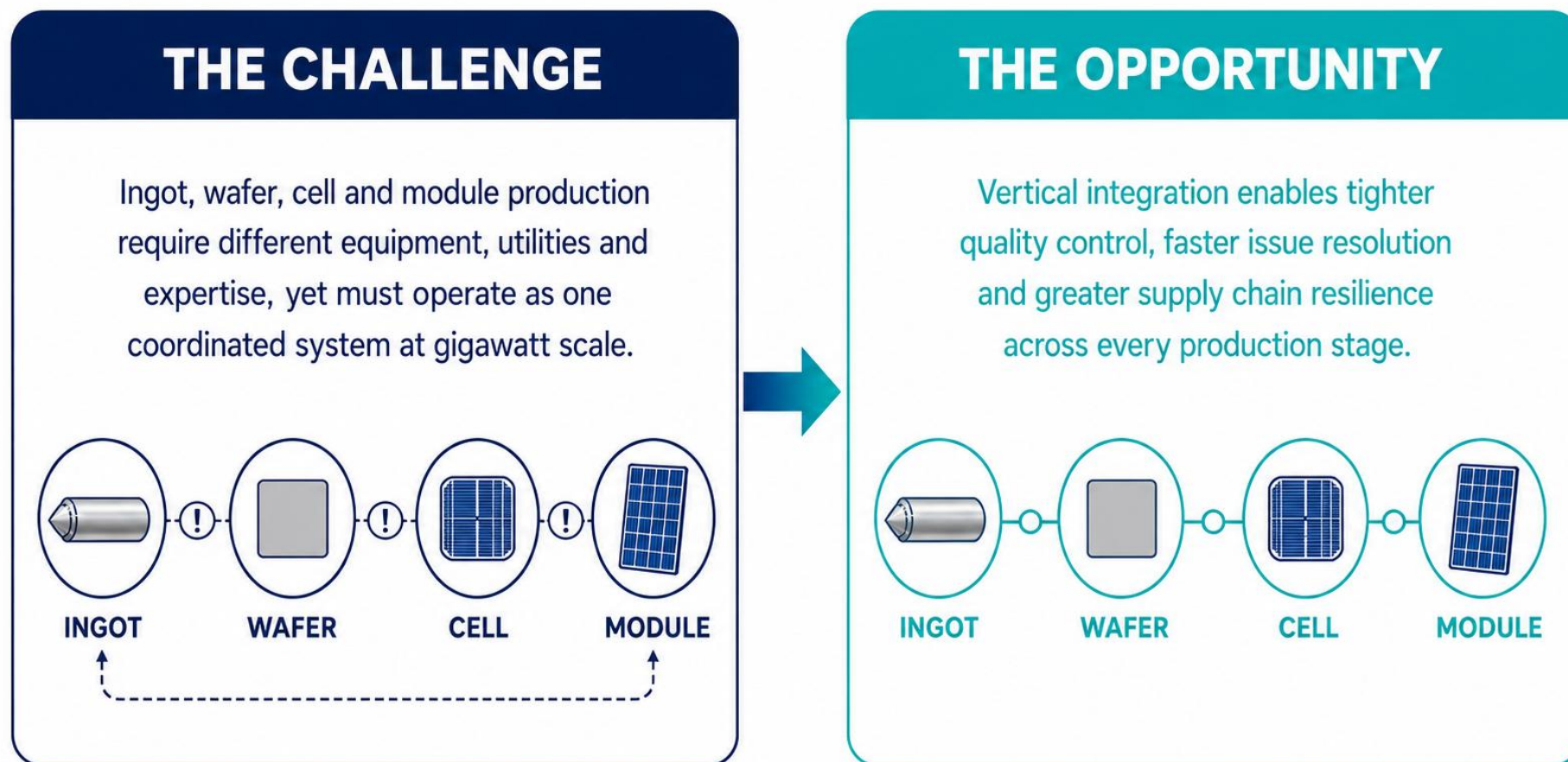
Building a diverse, skilled PV supply chain workforce

- **Skilled Workforce Development:** > 3,000 team members trained in advanced manufacturing, automation, and quality control
- **Mentorship Program:** New hires undergo a 12-week job-based training program
- **Local Talent Investment:** Strategic partnerships with local high schools, colleges and workforce programs to build a sustainable local talent pipeline
- **Continuous Learning Culture:** Ongoing technical and leadership training supporting career mobility and innovation



Scaling Vertically Integrated Manufacturing

Scaling four distinct manufacturing stages at one site requires seamless coordination of production, utilities, and grid infrastructure to manage complex ramp timelines and achieve reliable output.



Technology Outlook & Tandem Progress

Next generation of cell technology Q.ANTUM NEO

- Expected learning rate: 0.5% per year
- Up to 0.8% abs. efficiency potential vs. Q.ANTUM
- Superior yield and reliability

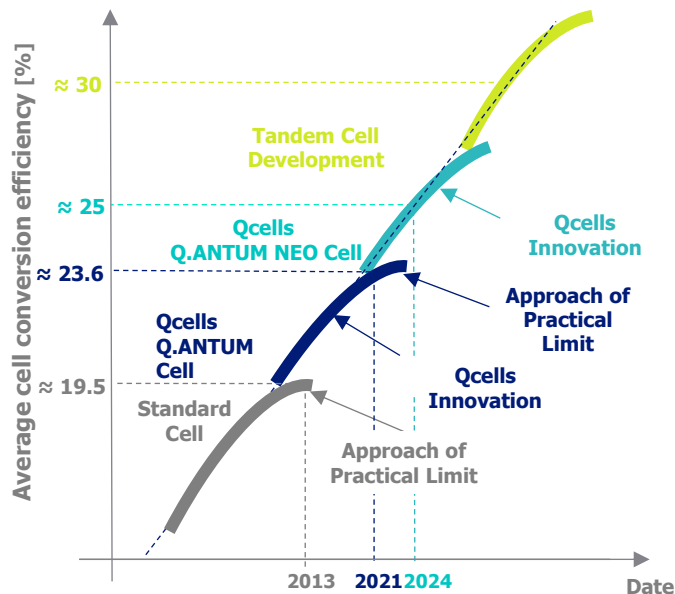
Tandem technology: efficiency potential >30%

- Q.ANTUM PRO combines perovskite and silicon (2-terminal)
- High- and low-energy light capture exceeds the single-junction limit



Tandem development

Qcells plans TOPCon cells as future bottom cells. Development and scale-up continue.



Cell & Batch Efficiency

28.6% / >29%

Cell / batch median. Full-area M10 (330.56 cm²), module-ready wafer. Cell independently verified Dec 2024. Batch median on high-throughput tools, May 2025.

Stress Testing

4 tests passed

UV15, TC200, HF10, DH1000
IEC / UL 61215-2:2021. Power: IEC TS 60904-1-1. Independently confirmed May 2025.

TÜV Rheinland Certification

July 16, 2026

IEC 61215 + UL 61215 compliance. Qcells reports an industry first. German pilot-line M10 cells/modules met defined degradation limits.

Outdoor Testing

~1 year stable power

Thalheim R&D (~1 year). Third-party demo site (~6 months). Qcells-reported, June 2026. Certification advances commercialization.

Germany: R&D labs, module tests and PV fields. Bitterfeld-Wolfen tandem pilot line uses scalable processes. Thalheim outdoor tests.

Korea: Pangyo R&D and national projects. Jincheon tandem pilot line (\$100M announced 2023). Pilot lines operate in Korea and Germany.

EPEAT – Sustainability Ecolabel

- Sustainability Ecolabels for electronics products empower consumer choice & purchasing decisions
- EPEAT is a Type I Ecolabel created by the **Global Electronics Council (GEC)**
 - Individual product-level certification per country
 - Leading global resource for sustainable electronic products, with registered products from Fortune 500 leaders to emerging brands
 - EPEAT follows a strict, comprehensive criteria verified by an independent third party
- Federal Acquisition Regulation (FAR) Part 23 requires all U.S. Federal Agencies to procure 95% EPEAT-registered electronics

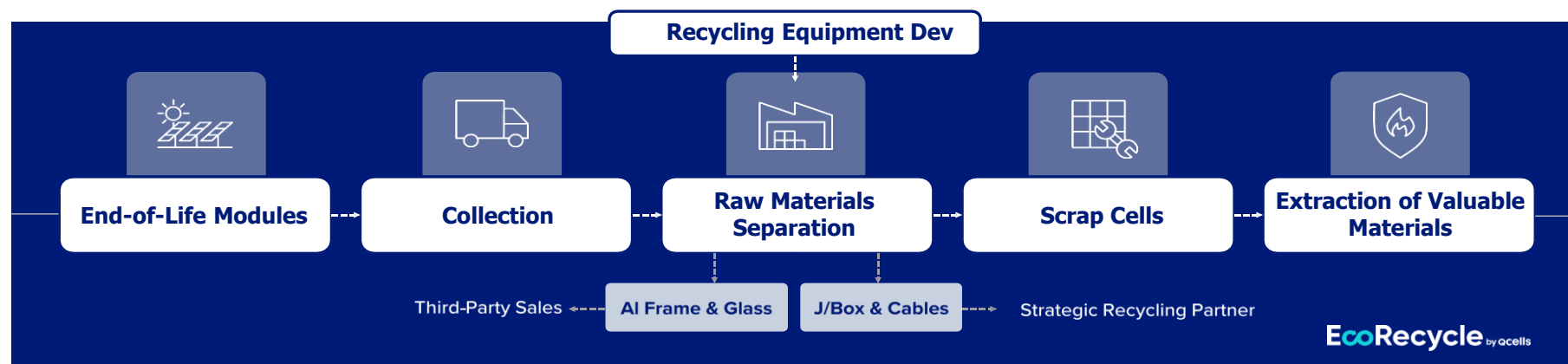


Commitment to Sustainability

Closed Loop Recycling

- EcoRecycle by Qcells addresses solar waste in factory and as first-generation installations reach end-of-life
- Qcells will be the first U.S. company with a complete solar value chain from manufacturing to recycling
- Facility in Cartersville, GA, spans 68,000 sq ft and will recycle up to 500,000 modules annually (250 MW/year), reducing CO₂ by 10,000 tons by 2028

EcoRecycle by Qcells



Thank Q!



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