BCworkshop2025

Kalyon PV’s Cell Technology Roadmap and IBC Activities

Özlem Coşkun

Team Leader of Fundamental Research
Kalyon PV R&D
ocoskun@kalyonpv.com

Outline

- Who We Are: Kalyon PV at a Glance
- Kalyon Karapınar Solar Power Plant
- R&D Center Overview
- Why Back-Contact?
- What Makes Back-Contact Superior?
- Kalyon PV Cell Technology Roadmap
- What’s Happening in IBC4EU?
- Closing

kalyon PV

Who We Are?

350+ million $
Investment

250.000 m²
Integrated Factory

~90%
Domestic Production

2 GW
Production Capacity

Europe's First
M10 Ingot Manufacturer

2500 m²
R&D Center

Sustainable supply chain

M10, TOPCON
Suitable for any location

Production of **P Type solar cell** with PERC technologies

Türkiye's **first Ingot and Solar Wafer** manufacturer

Panel supplier for all **Renewable Energy Resource Area in Türkiye**

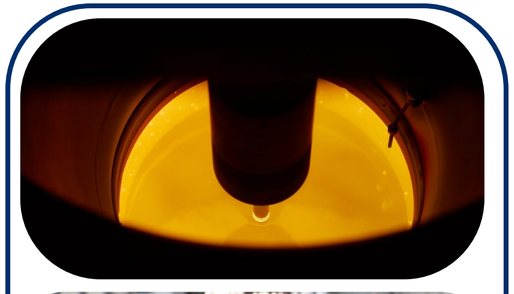
Production volume that prevents carbon emissions equivalent to **37.714 trees per year**

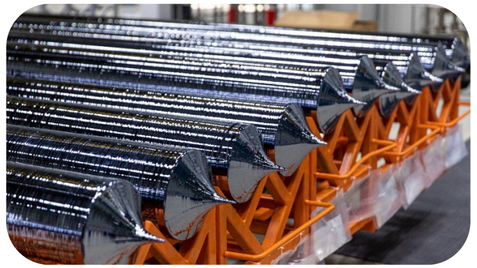
First Release 2026

TOPCon+

kalyon PV

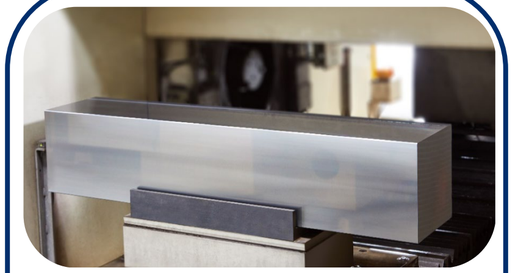
Who We Are?

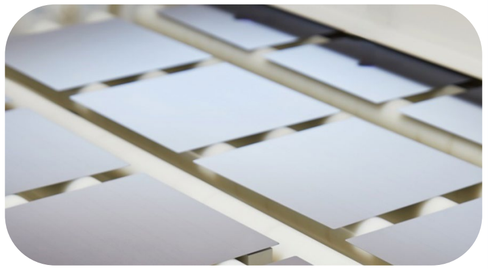




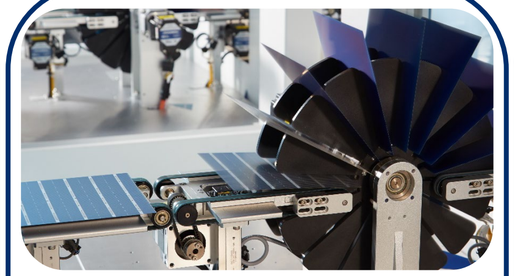
Ingot Factory

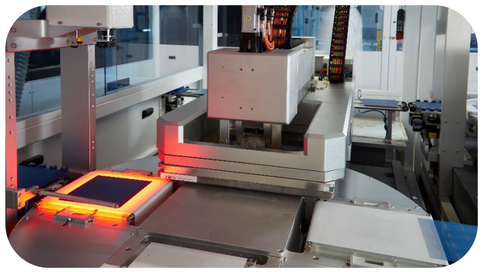
Mono-crystalline silicon is grown in furnaces reaching 1400–1450 °C, producing ingots up to 4 meters in ~55 hours.





Wafer Factory





Cell Factory

Module Factory

1.1 GW TOPCon+ cell factory to launch in early 2026

First Release 2026

G12R TOPCon+ modules reach **26.25% efficiency** and **640 W**, delivering >15% extra energy yield

Kalyon Karapınar Solar Power Plant

1,3 GW
total installed capacity

Nearly **1.7 million tones**
of carbon emission prevented yearly

$ 1.1 Billion
investment value

20 million sqm
installation area

Football stadium space equivalent **2600** soccer fields

3,2+ million
solar module installed

Annually **3 billion KwH** electricity generation

2 million
people's daily electricity demand is provided

Europe's Largest Solar Power Plant
Kalyon PV is the main solar module supplier of the project

R&D Center Overview

R&D team of
100+ people

1.687 m²
floor area

5.760 m²
outdoor test center

Articles & presentations at **50+** national and international conventions

20+
patent applications

Ranked 9 with a €2.50 million funding acquisition under the Horizon Europe Program

31
eş zamanlı proje yönetimi

100+
project management

270+
ulusal ve uluslararası işbirliği partner sayısı

DREAM PV
PV4PLANTS
SOLARHUB
IBC4EU
TANDEM
COMET
DELIGHT
APOLLO
PEROSOLAR
SLICE

R&D Center Overview

NEXCELL

- Thin-film, perovskite, tandem & OPV cell development infrastructure
- Inert-atmosphere glovebox processing
- Deposition tools: Sputter, evaporation, ALD
- Spin coater, spray pyrolysis, doctor blade, high-temp furnaces
- Hybrid vacuum & solution-processed fabrication platform

CHARACTERISATION

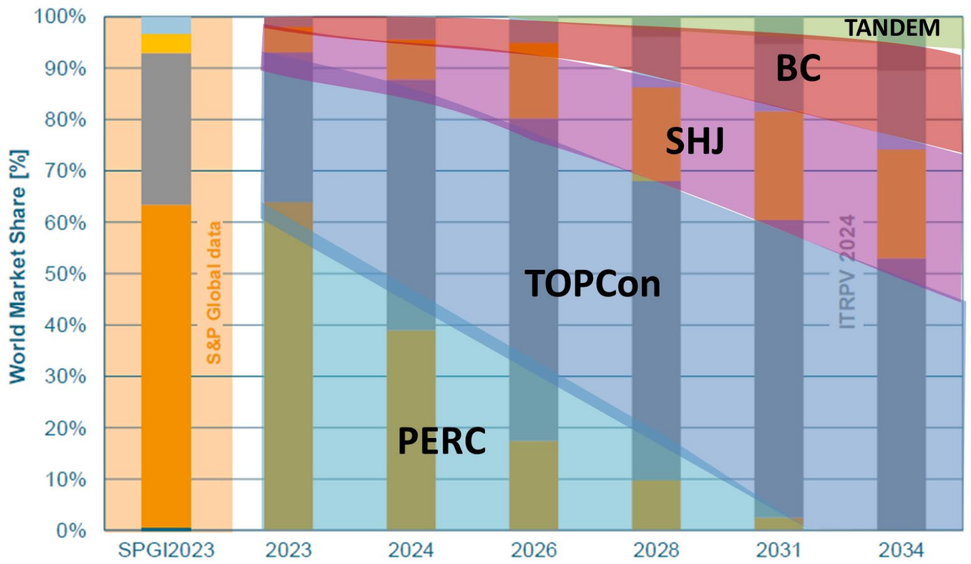
- Cell testing from 20×20 mm to M12 for all technologies (PERC, TOPCon, HJT, Perovskite)
- IV, EL, EQE, IQE, optical & electrical mapping (LBIC, CV, reflectance)
- Module IV/EL for mini-modules up to M12
- Temp & humidity testing (−40°C to +85°C, 20–98% RH)

ENERGY STORAGE

- Full validation from cell→module→ powerbox
- Electrical, mechanical & thermal performance testing
- Cycle-life & accelerated aging evaluations
- Safety tests, including thermal runaway analysis
- In-house prototyping & assembly for rapid development

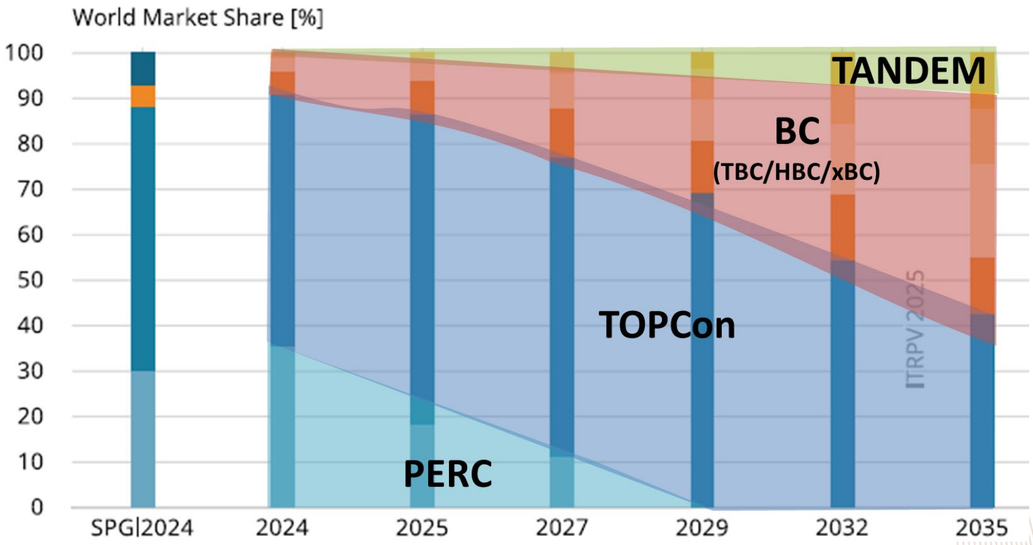
Why Back-Contact?

Different cell technologies 2024 Edition



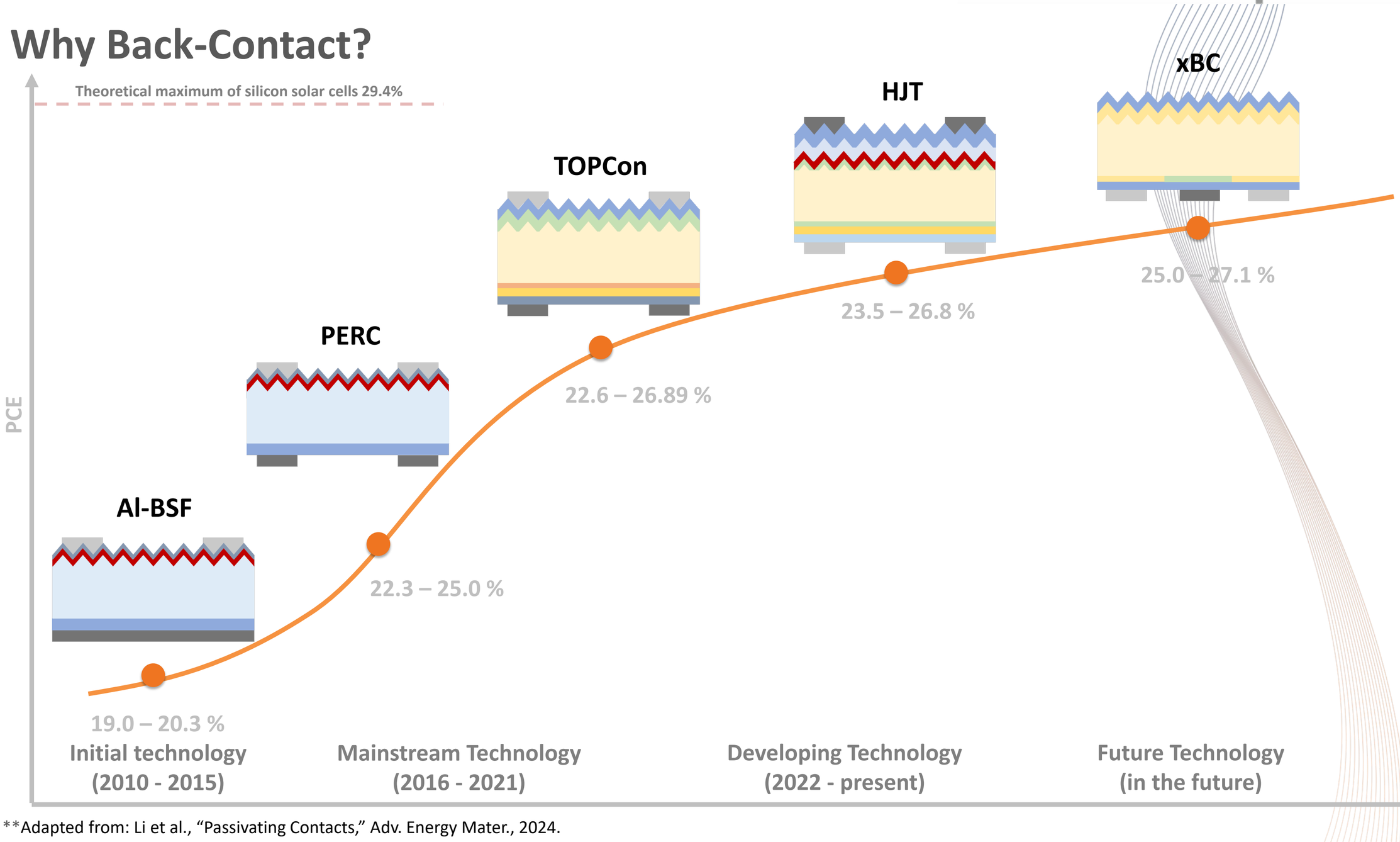
- ITRPV projects xBC concepts to rise to ~33% market share.
- TBC is expected to be more dominant than HBC.
- BC is the fastest-growing pathway toward tandem-ready architectures post-2025.

Different cell technologies
For all contributors 2025 Edition



**ITRPV 2024 & 2025

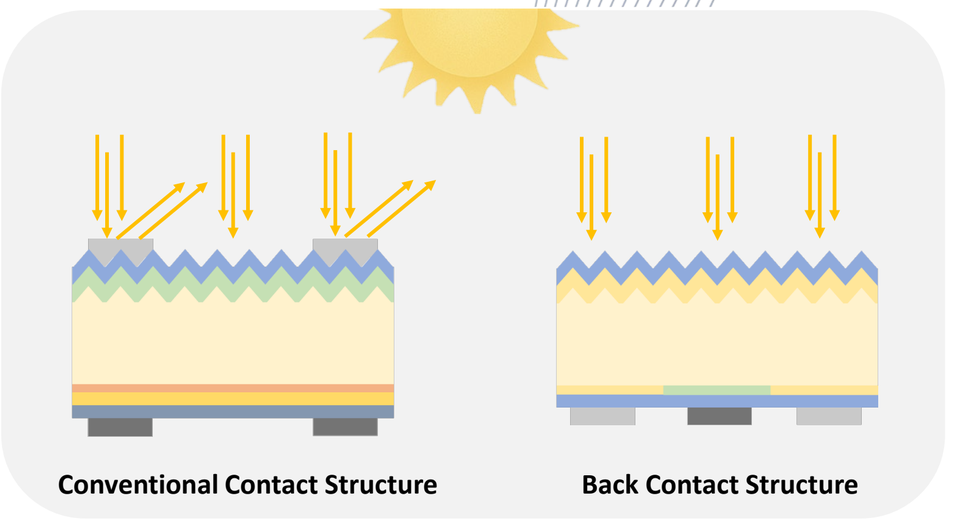
Why Back-Contact?

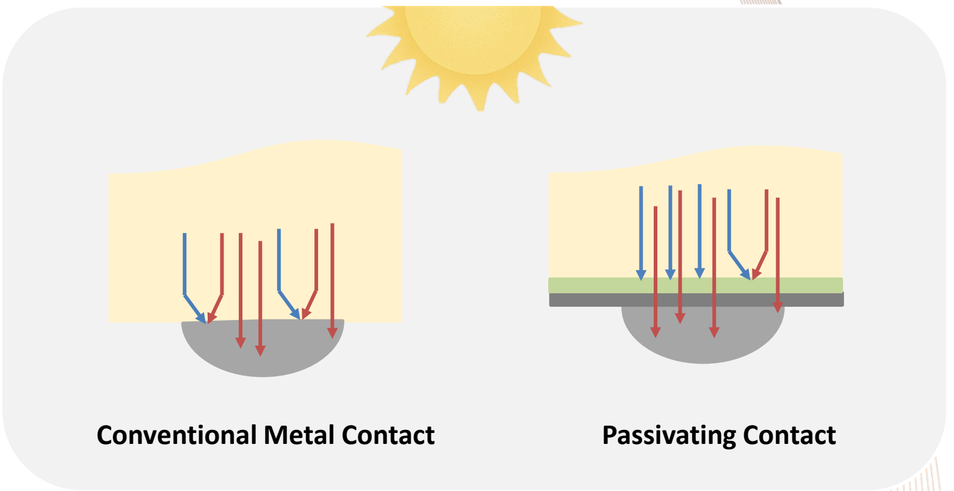


**Adapted from: Li et al., “Passivating Contacts,” Adv. Energy Mater., 2024.

What Makes Back-Contact Superior?

- ✓ **Zero front-side shading** → +1.0–1.2 mA/cm² higher JSC
- ✓ **Lower front-side recombination** → higher VOC
- ✓ **Higher module CTM** (+1.5–2%)
- ✓ **Ideal bottom-cell platform for Perovskite–Si Tandem**
- ✓ **Better reliability & superior aesthetics**
- ✓ **Natural extension of TOPCon** passivating-contact technology
- ✓ Passivating contacts (poly-Si, POLO, TOPCon) deliver the **lowest recombination and highest Voc**
- ✓ Passivating contacts + rear-side layout → **highest efficiency potential for Si solar cells**





**Adapted from: Altermatt, “Fired up for passivated contacts”, Nat. Energy, 2018, pp. 718–719

Kalyon PV Cell Technology Roadmap

2020

G1 PERC
Cell & Module Production

2021

M10 PERC
Cell & Module Production

2023

M10 TOPCon Module Production

2025

G12R TOPCon+ Cell & Module Production

(Launch of the investment)

2025 - 2035

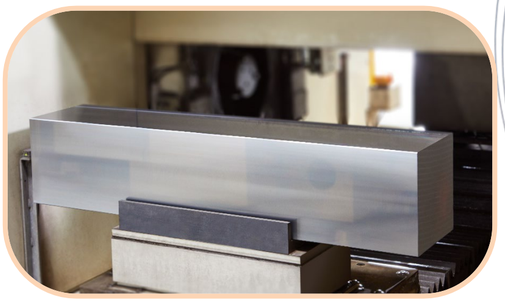
- TOPCon+
- BC Cell Structures
- Perovskite Solar Cells
- 2T / 4T Tandem
- 3T Tandem

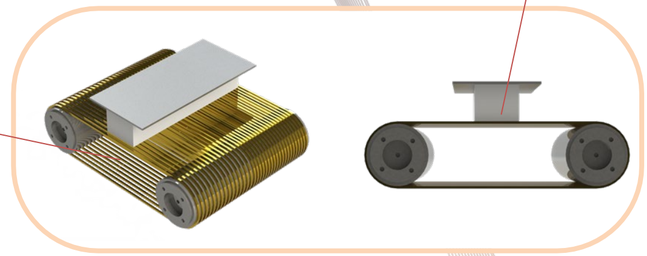
What's Happening in IBC4EU? Kalyon PV

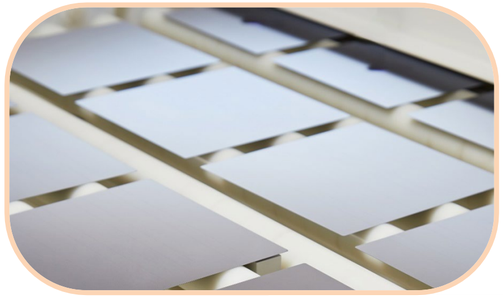
Ingot & Wafer

- ✓ Ga-doped ingots (0.8–6 Ω·cm) for p-type IBC
- ✓ Thinner wafer roadmap → reduced kerf loss
- ✓ Tungsten wire → smoother surfaces, lower saw marks
- ✓ Wafer uniformity improvements for POLO/IBC processes

- **Ingot production for BC cell**
- **Wafer thickness reduction → KERF loss reduction**







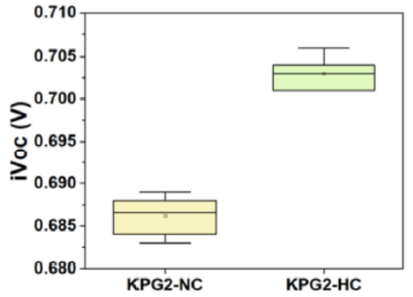
**Dullweber etal., 'Optimized Ga-doped Cz Wafers fro POlO IBC..' EU PVSEC 2024.

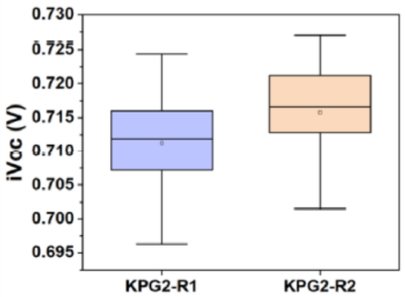
This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No.101084259

What's Happening in IBC4EU? Kalyon PV

POLO IBC

- **Wet chemical process optimization for POLO IBC production**
  - ✓ PERC production equipment was used for all processes
  - ✓ High-quality cleaning additional step effect on the performance of the solar cell
- **Metallization design studies for M10 size**
  - ✓ M10 metallization mask & layout development



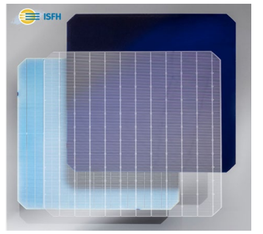


KPG2-NC: High-quality cleaning is not applied

KPG2-HC: High-quality cleaning is applied

KPG2-R1: Wafer resistivity range is 1.0 Ωcm – 1.09 Ωcm

KPG2-R2: Wafer resistivity range is 1.1 Ωcm – 1.3 Ωcm



- **Wafer resistivity effect**
- **Evolution PERC production equipment suitability for POLO IBC production**

**Dullweber etal., 'Industrial implementation of 24%-efficient POLO IBC…' EPJ Photovoltaics, 2025.

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What’s Happening in IBC4EU? Kalyon PV

Module Outdoor Testing

- IBC and PERC reference modules successfully installed at the outdoor test site
- Setup: 3 × IBC modules + 1 × M10 PERC reference module
- Data collection continues with initial energy yield observations.

- **Performance comparison of the BC modules with PERC module**

This project has received funding from the European Union’s Horizon Europe research and innovation programme under grant agreement No.101084259

Özlem Coşkun

ocoskun@kalyonpv.com

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THANK YOU

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