

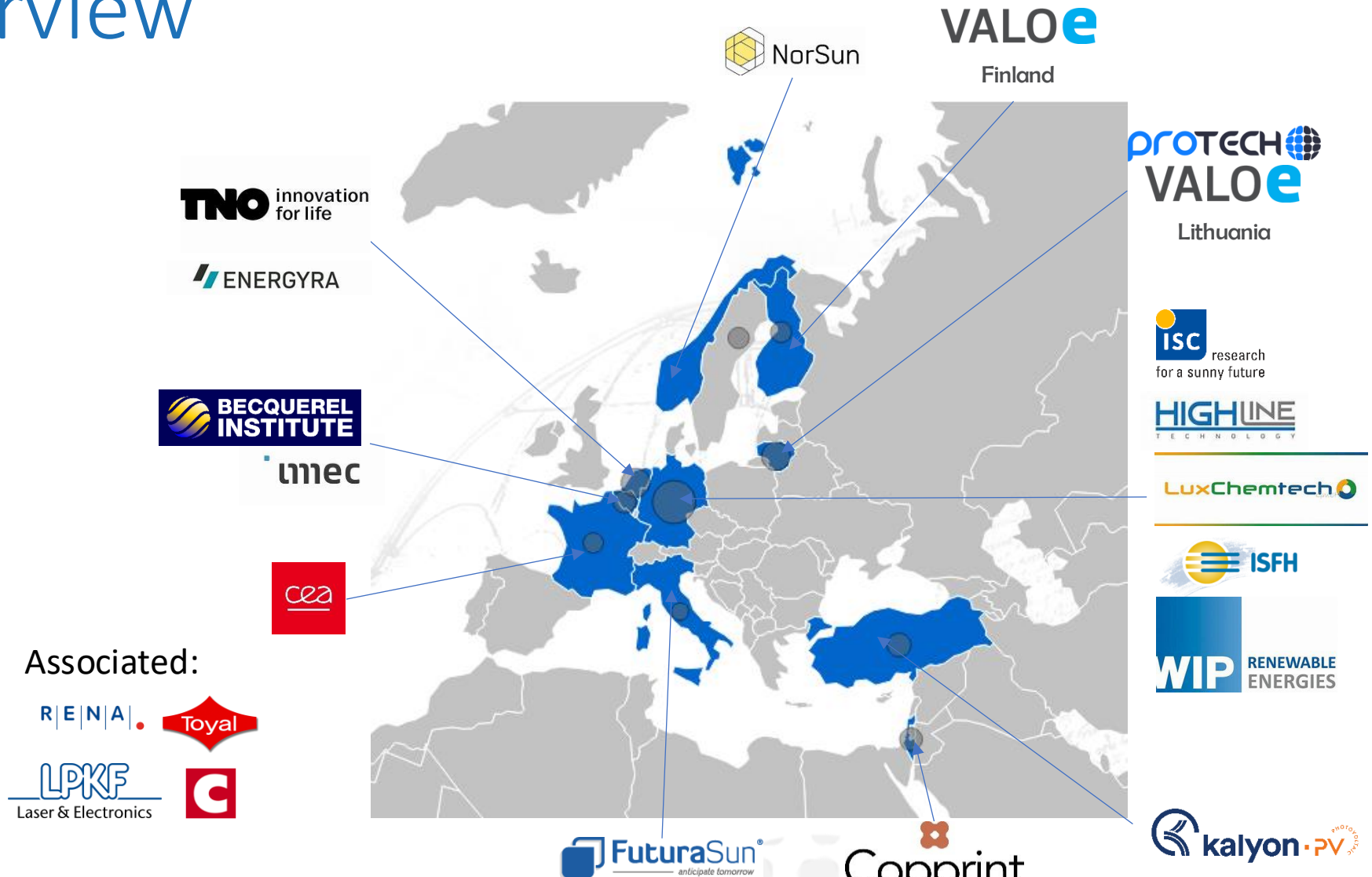
IBC4EU: Low cost IBC cells and modules made in Europe - A Horizon Europe Project's take

Dr. Florian Buchholz



Project overview

Program: Horizon Europe
 Coordination: ISC Konstanz
 Duration: 36 months
 Start date: 01.11.2022
 Funded partners: 17
 Associated partners: 4
 EU funding: ~14 mio €
 Estimated budget: 17 mio €

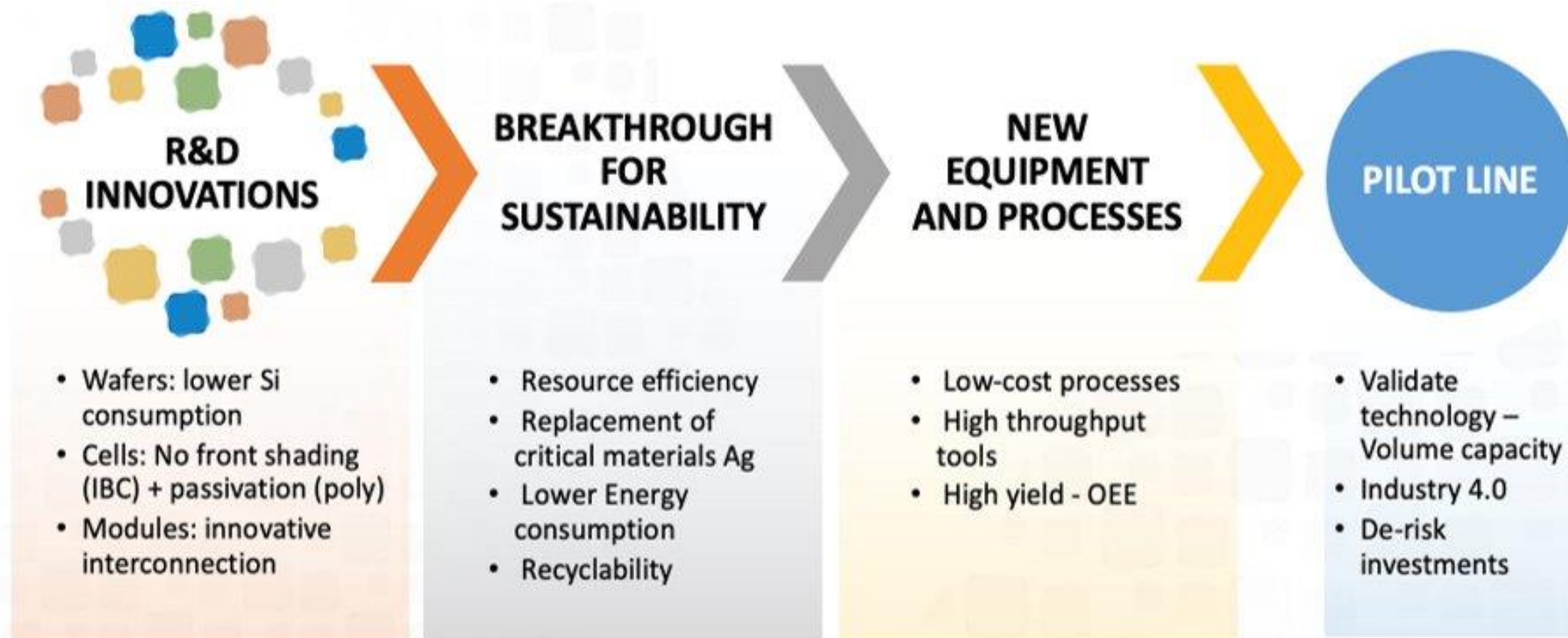


Associated:

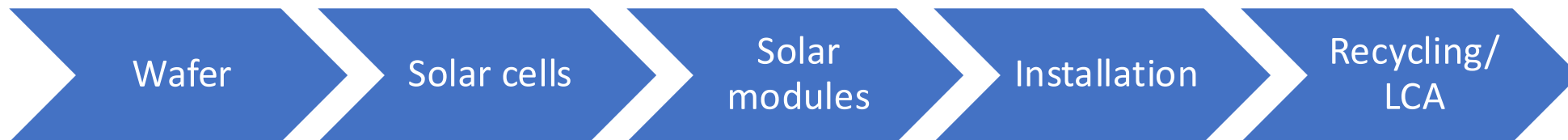


Intersolar 2024 VDMA Manufacturing stage: Gigawatt-Modulproduktionen für die Segmente Wohnen und Energieversorgung

Project overview



Project overview



(Pilot) production lines



Material / machine provider



Research institutes



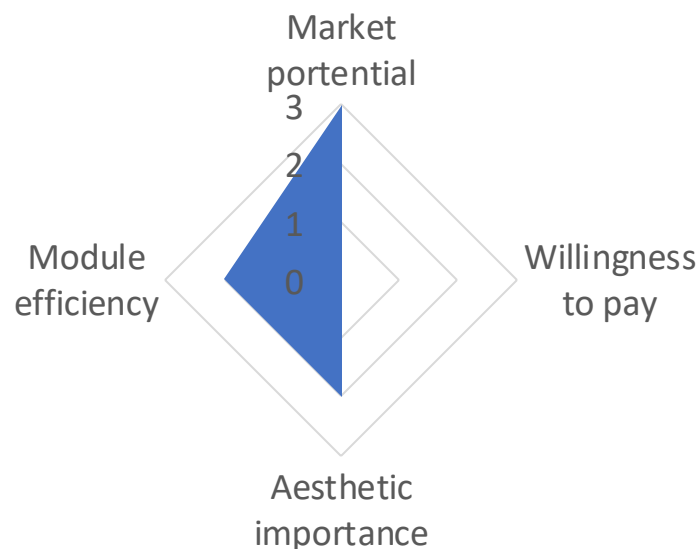
Supporting partners



Why IBC?

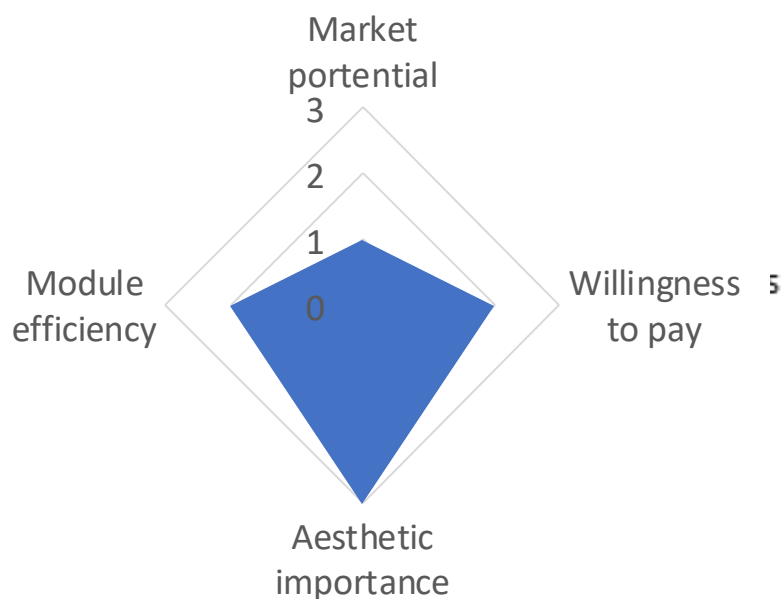


Why IBC? Rooftop PV



- **Strengths:** Technologically mature, high demand, variety of designs
- **Weaknesses:** Expensive systems
- **Opportunities:** Incentives, possibilities with battery storage
- **Threats:** Volatility of support measures

Why IBC? Building integrated PV



- **Strengths:** Full integration leading to lower cost sensitivity and higher acceptance of the technology. Drives the demand for customized manufacturing.
- **Weaknesses:** Relatively costly technology.
- **Opportunities:** Near zero energy building policies and other policies encourage development of all BIPV products. These technologies are expected to gain maturity over the coming years.
- **Threats:** Very large and diversified products exist, with no real benchmark.

Summary

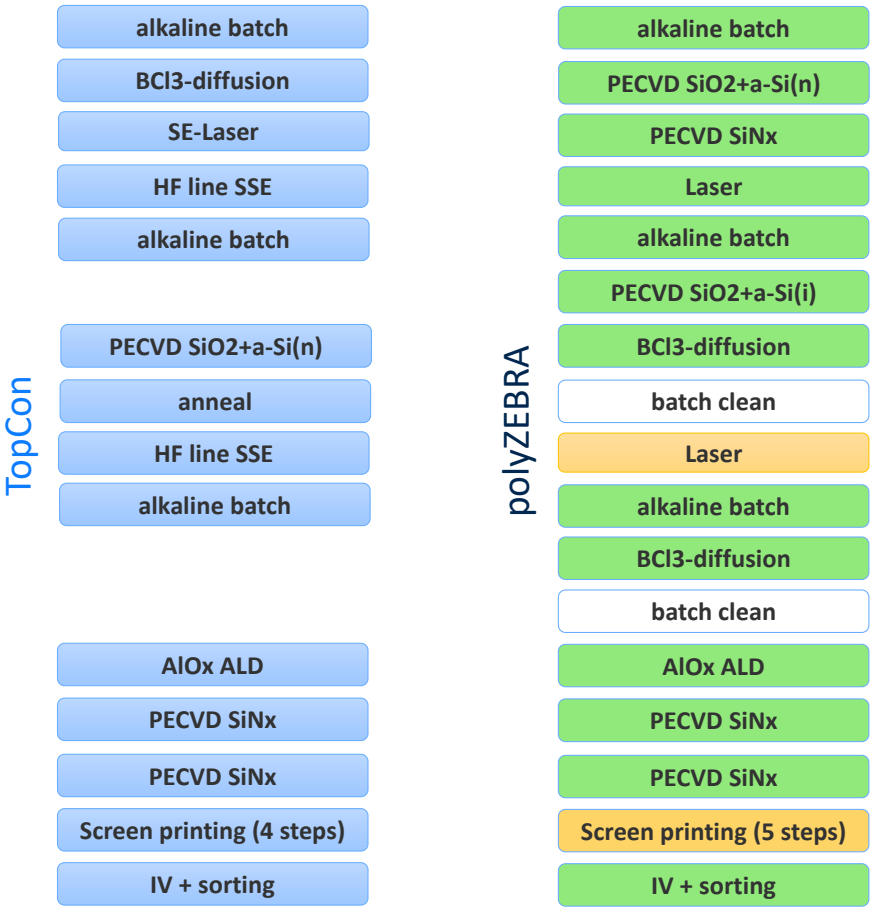
	Market potential	Cost sensitivity	Aesthetic	Module efficiency	Final appreciation for IBC4EU
IBC as conventional modules					
Conventional ground-mounted					
<i>Conventional utility-scale PV plant</i>	3	0	0	1	1
<i>Ground-mounted PV with grazing</i>	2	2	2	2	1
AgriPV					
<i>Vertical PV</i>	2	2	1	2	1,25
<i>Elevated PV – No tracking</i>	2	2	2	2	1,25
<i>Elevated PV – Tracking</i>	2	2	2	2	1,25
Floating	2	2	0	2	1
BAPV					
<i>Residential</i>	3	2	3	3	2,25
<i>C&I</i>	3	3	2	2	1,75
IBC as special modules					
BIPV					
<i>Roof solutions</i>	1	2	3	2	2
<i>Façade elements</i>	1	2	3	1	1,75
<i>Balustrades, balconies and other accessories</i>	1	2	3	1	2
VIPV					
<i>Light Electric Vehicles (LEV)</i>	1	3	3	2	2,25
<i>Commercial Electric Vehicles (CEV)</i>	1	2	2	1	1,5
<i>Buses</i>	1	2	2	1	1,5
<i>Other VIPV use cases</i>	1	2	2	1	1,5
IIPV					
<i>PV Noise barriers</i>	1	2	2	2	1,75
<i>Carports / canopies</i>	2	2	2	2	1,75
<i>Street furniture</i>	1	2	2	2	1,75
<i>Others: PV Road roofing</i>	1	2	2	2	1,75



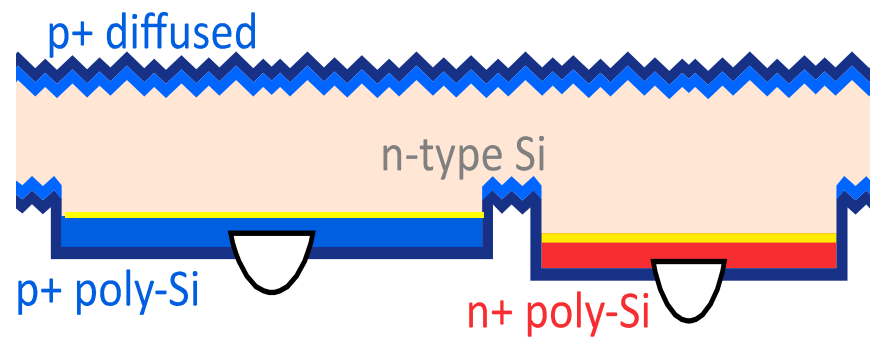
Highlights of the project



polyZEBRA



- Suitable for TOPCon w/o hardware changes (*)
- Hardware modifications needed
- Not required for TOPCon

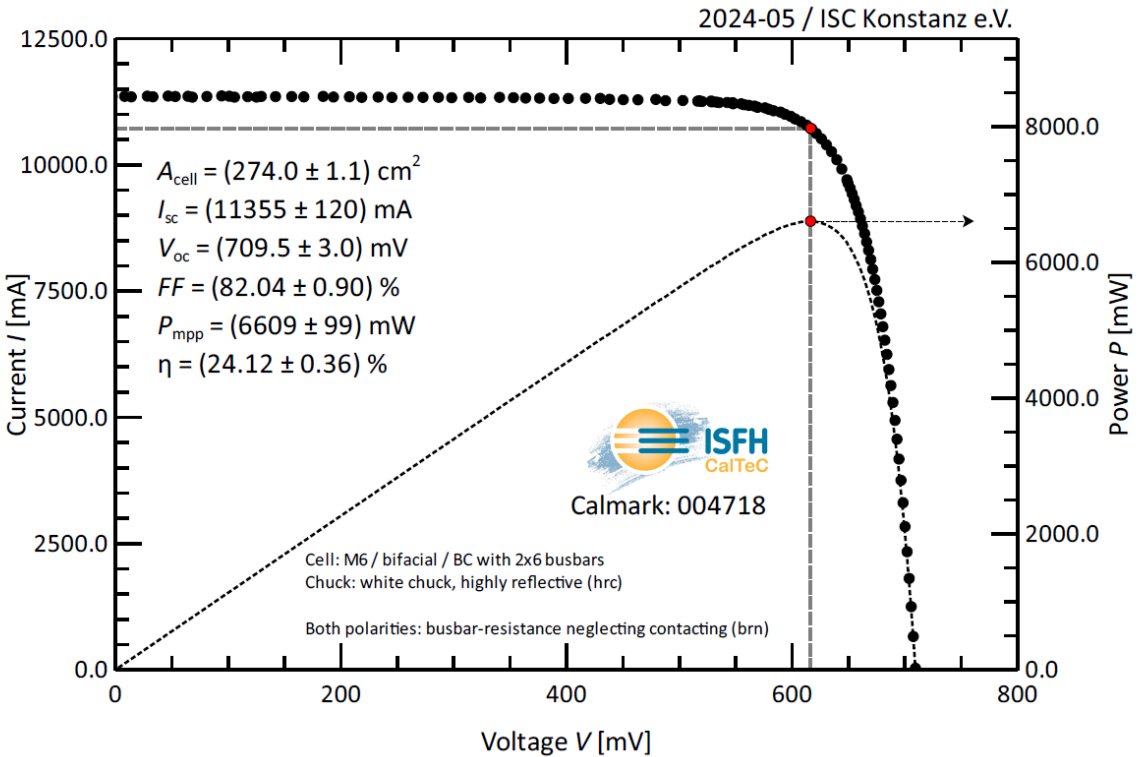


Highlights of the project



polyZEBRA

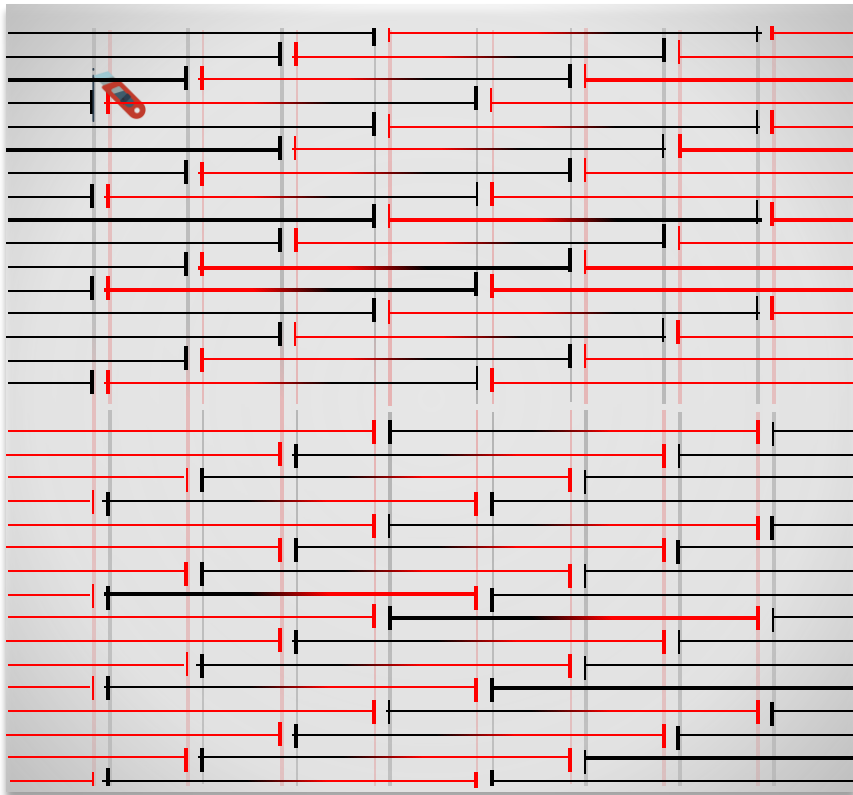
- 25%+ expected
- Can be pilotized in ZEBRA or TOPCon factory
- Low breakdown voltage
- Ultra low silver consumption due to Cu-screen printing
- Patent pending [EP4195299A1]



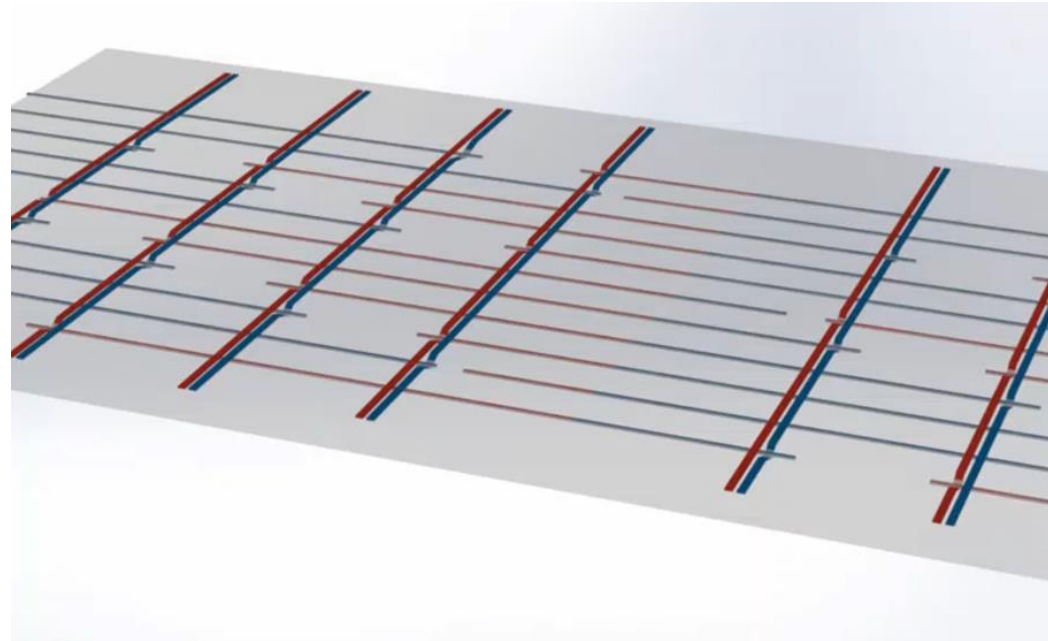
Development of 3D interconnection



3D Interconnection foil **Fabrication**

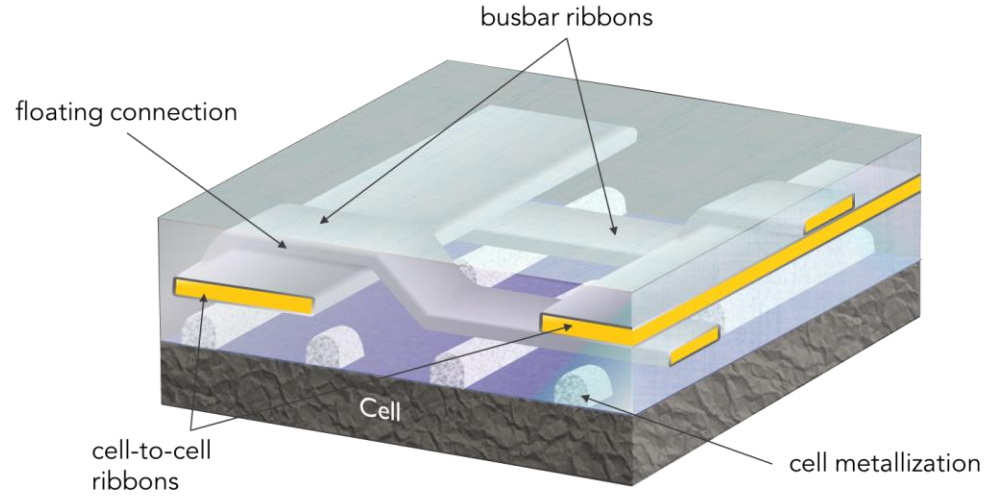
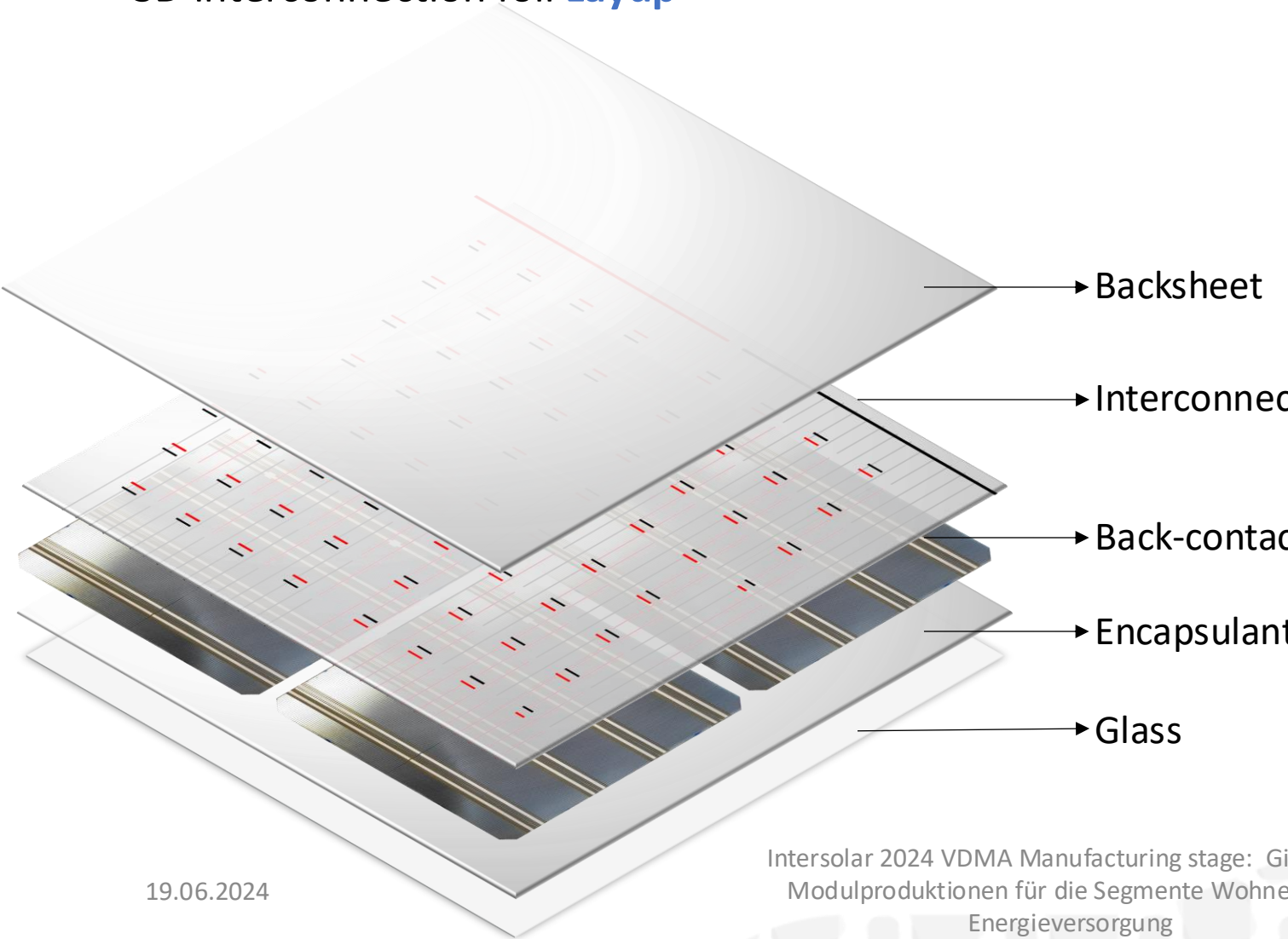


- Busbar ribbons are incorporated in encapsulant foil
- Cell-to-cell ribbons are incorporated
- Low melt T solder coated conductors



Development of 3D interconnection

3D Interconnection foil Layup

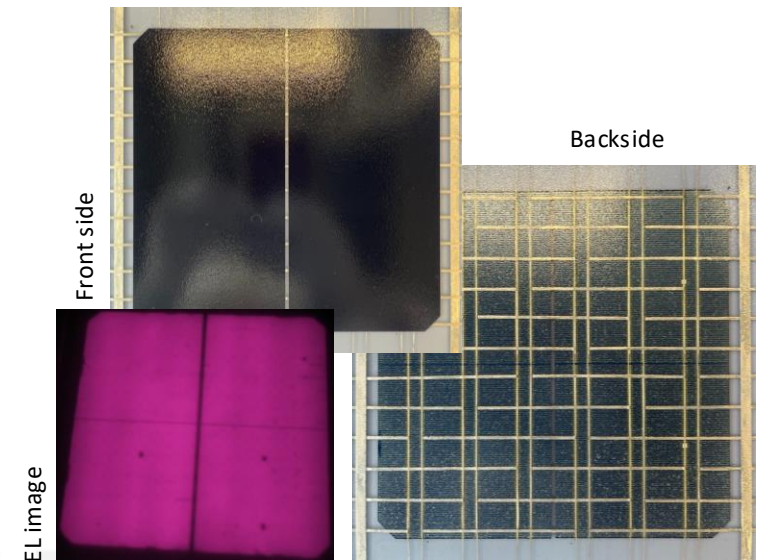


Development of 3D interconnection



3D Interconnection foil **Advantages**

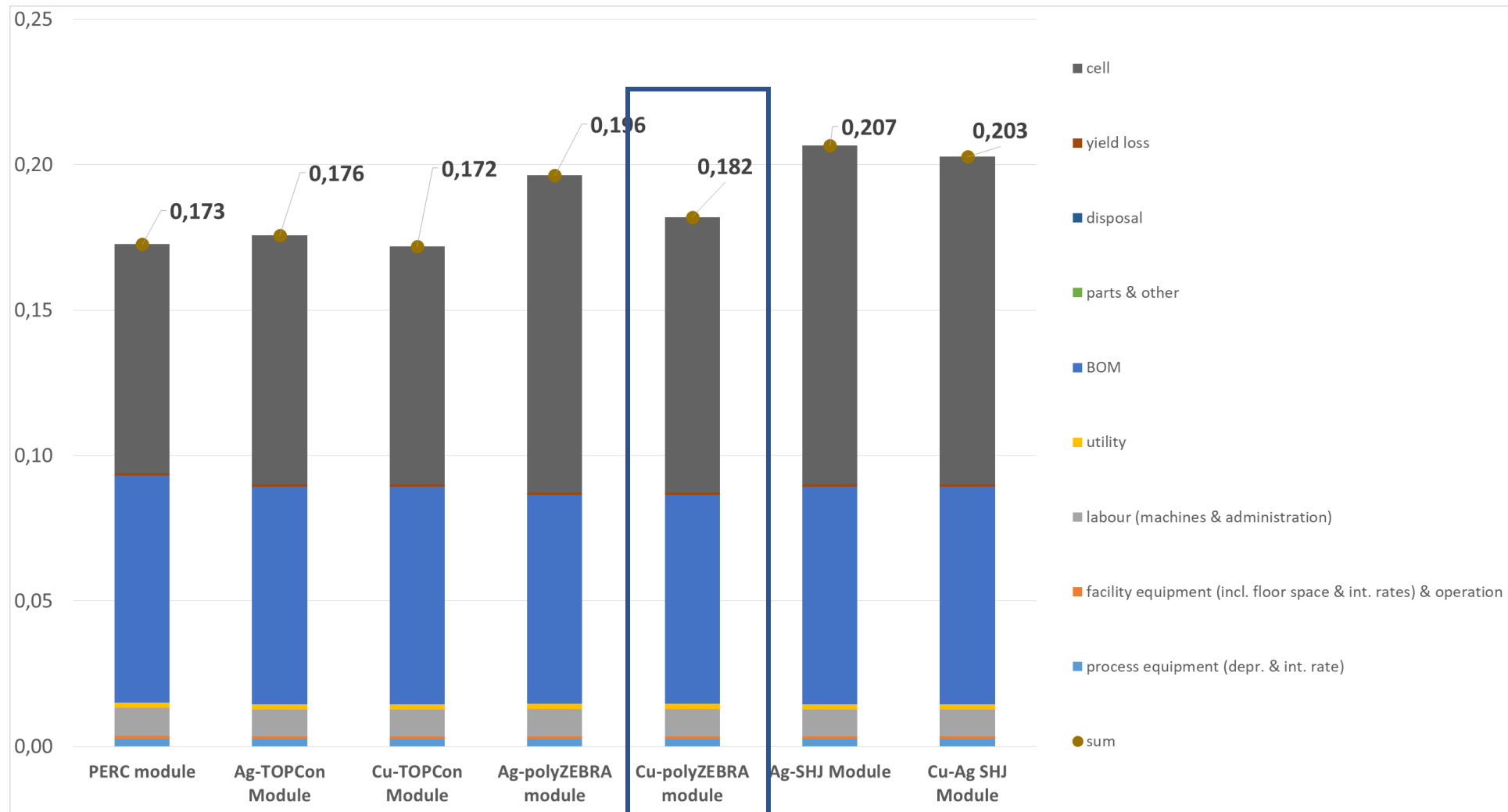
- Enables **busbar-less cell metallization** (direct cell finger contacting)
- **Low thermal stress** interconnect (integrated stress relief structures, Low melt T)
- Optically **bifacial** modules (with transparent backsheet)
- **1 low-accuracy alignment step** module assembly
- **Reduced materials** diversity & usage:
 - <60% **Cu** (compared to tabbing-stringing)
 - Integrated backside **encapsulant**
 - Potential for **solder** reduction
 - Currently developing thin **contact foil** version
- Potential for **series- & parallel** cell interconnection
 - Tuning U, I module requirements
 - **Partial shading** mitigation



Example 6BB ZEBRA 2x 1/2-cut cell with 3D interconnect

Production costs in EU (Q2/2024)

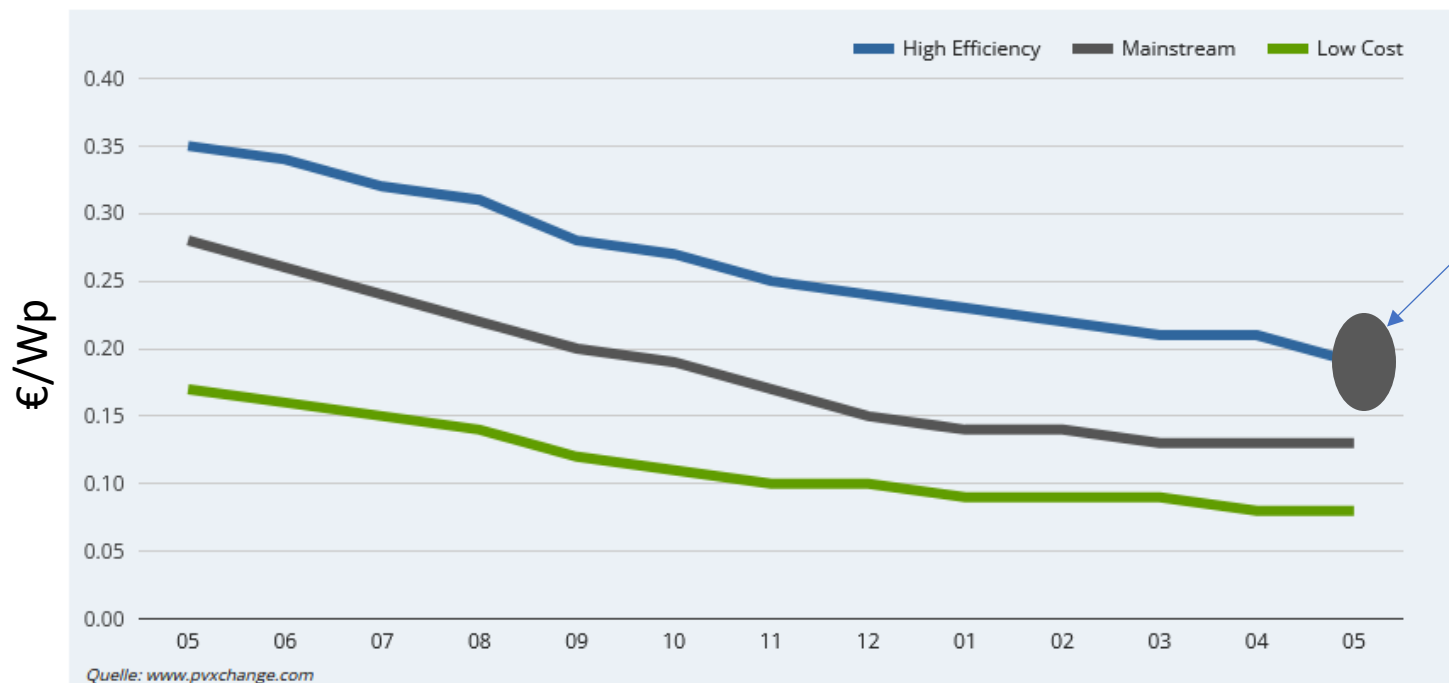
- 5GW integrated
- EU
- Silver: 850€/kg
- wafer (M10) n-type: 0,25



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PV made in the EU?

Successful bid on 10GW TOPCon:
<0.10\$/Wp



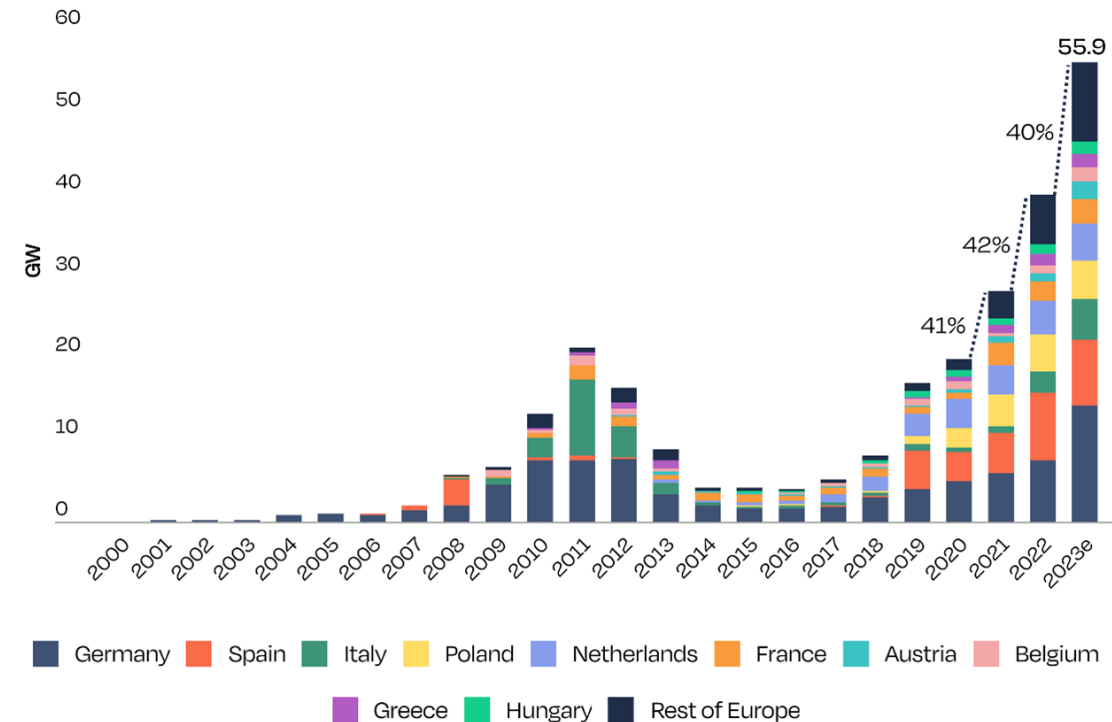
European/ Chinese(?)
manufacturing costs

<https://www.pvxchange.com/Price-Index> **May 2024**

Why should this be attempted nevertheless?

- ENERGY SECURITY: we cannot be dependent from extra-EU supply only. Should apply for oil, gas, wind or solar
- The cake will be big enough eventually.

EU-27 Annual Solar PV Installed Capacity, 2000-2023



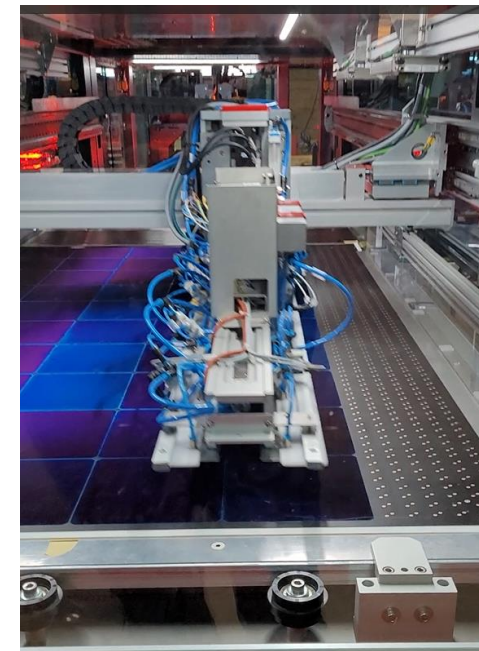
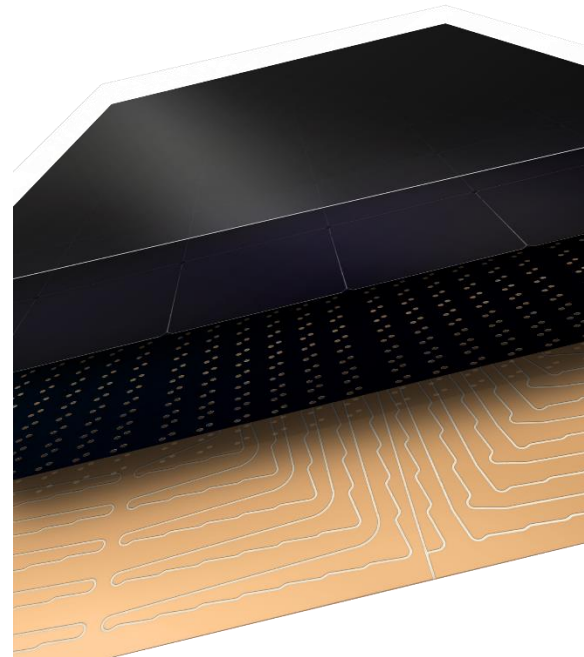
SOURCE: European Market Outlook for Solar Power 2023-2030



Energyra's approach

Back contact MWT/IBC production line! (With flexible design possibilities!)

- Made with thermoplastic polyolefin (tpo)
- Lightweight front sheet 4,1kg/m²
- As many components as possible from Europe
- PFAS Free
- Fully traceable raw materials, also available in digital-twin after production



Valoe's approach

Back contact advantages in string design

It allows for

- Freedom in cell placement for
 - Better area coverage,
 - Attractive design and
 - Partial transparency
- Better string design to allocate for
 - Partial shading
 - Orientation mismatch
 - Desired voltage (max 60VDC)
- No need to have diodes every 20 cells simplifies design and connections.



USPs

EU IBC will allow for

- Flexible form factors
- Individual BOMs
- EU-made
- Integrated
- Long term availability
- Replacements



How to recreate a value chain?



Can we bring production back to Europe?

- 2024: Made in EU = module produced in EU (no requirements for BOM)
- 2025: Made in EU = module produced in EU
- 2026: Made in EU = module produced in EU, with the existing EU supply chain components, therefore everything but to cell
- 2027: Made in EU = all the BOM made in EU, eventually with less than 10% in value from abroad

Summary and outlook

Can we bring production back to Europe?

- Difficult times
- EU-based IBC is maturing
- We can be different!
- There are still business cases!
- In a terra watt era: Even niches will be big!
- Low-cost IBC has the potential for utility scale applications
- Strategic importance more and more realized!

Thank you!

Dr. Florian Buchholz
ISC Konstanz



Project Partners



Associated Partners



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