

IBC4EU - Bringing Solar Cell and Module Production Back to Europe

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et al.

11th Back Contact Workshop 2023







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

Agenda

1. Status of n-type tech
2. Why bifacial POLO-IBC/ABC/polyZEBRA/TBC/HBC (XBC)?
- 3. IBC4EU project**
4. Summary



Best module efficiencies September 2023

TAIYANGNEWS <small>ALL ABOUT SOLAR POWER</small>										
TaiyangNews Top Modules: Highest Efficient Commercial Solar Modules 09-2023										
Rank	Company	Series	Model	Wafer type	Cell Size	Cells No.	Cell Tech	Module Technology	Power (W)	Efficiency (%)
1		ABC White hole	AIKO-A620-MAH72Mw	n-type	182	144	ABC	Halfcell, back Contact	620	24
2		Hi-MO 6	LR5-72HTH-600M	p-type	182	144	HPBC	Halfcell, back Contact	600	23.2
3		Himalaya	HS-210-B132D5	n-type	210	132	HJT	Bifacial, halfcell, MBB	715	23.02
4	Maxeon	Maxeon 6	SPR-MAX6-445-E4-AC	n-type	-	66	IBC	Back Contact	445	23
5		ANDROMEDA 3.0	SPICN6(LDF)-60/BIH	n-type	166	120	TBC	Backcontact, halfcell, MBB	410	22.8
6		Tiger Neo	JKM585N-72HL4-V	n-type	-	144	TOPCon	Halfcell, MBB	585	22.65
7		Astro N5	CHSM72N(DG)/F-BH	n-type	182	144	TOPCon	Bifacial, Halfcell, MBB	585	22.6
8		Niwa Pro	JW-HD108N	n-type	182	108	TOPCon	Bifacial, Halfcell, MBB	440	22.53
9		Hyper-ion	RSM132-8-700BHDG	n-type	210	132	HJT	Bifacial, halfcell, MBB	700	22.5
9		Vertex N	TSM-NEG21C.20	n-type	210	132	TOPCon	Bifacial, halfcell, MBB	700	22.5
9		-	DAS-DH156NA	n-type	182	156	TOPCon	Bifacial, halfcell, MBB	630	22.5
9		DeepBlue 4.0	JAM72D42 630/LB	n-type	182	144	TOPCon	Bifacial, halfcell, MBB	630	22.5
9	Canadian Solar	TOPHiKu6	CS6W-560-580T	n-type	182	144	TOPCon	Halfcell, MBB	580	22.5
9		-	TWMND-72HS560-580W	n-type	182	144	TOPCon	Halfcell, MBB	580	22.5
9	Canadian Solar	HiHero	CS6R-420-440H-AG	n-type	182	108	HJT	Halfcell, MBB	440	22.5
16		-	DM580M10T-B72HSW/HBW	n-type	182	144	TOPCon	Bifacial, halfcell, MBB	580	22.45

4 x XBC
 9 x TOPCon
 3 x HJT

n-type technology

TOPCon/HJT >> 2TT/4TT

XBC >> 3TT/4TT

Qcells

TRINA

many more

Jinko

Tongwei

Futura Sun

SPIC

LONGi

few more

Sunpower

AIKO

ValoCell

Gold Stone

XBC technology

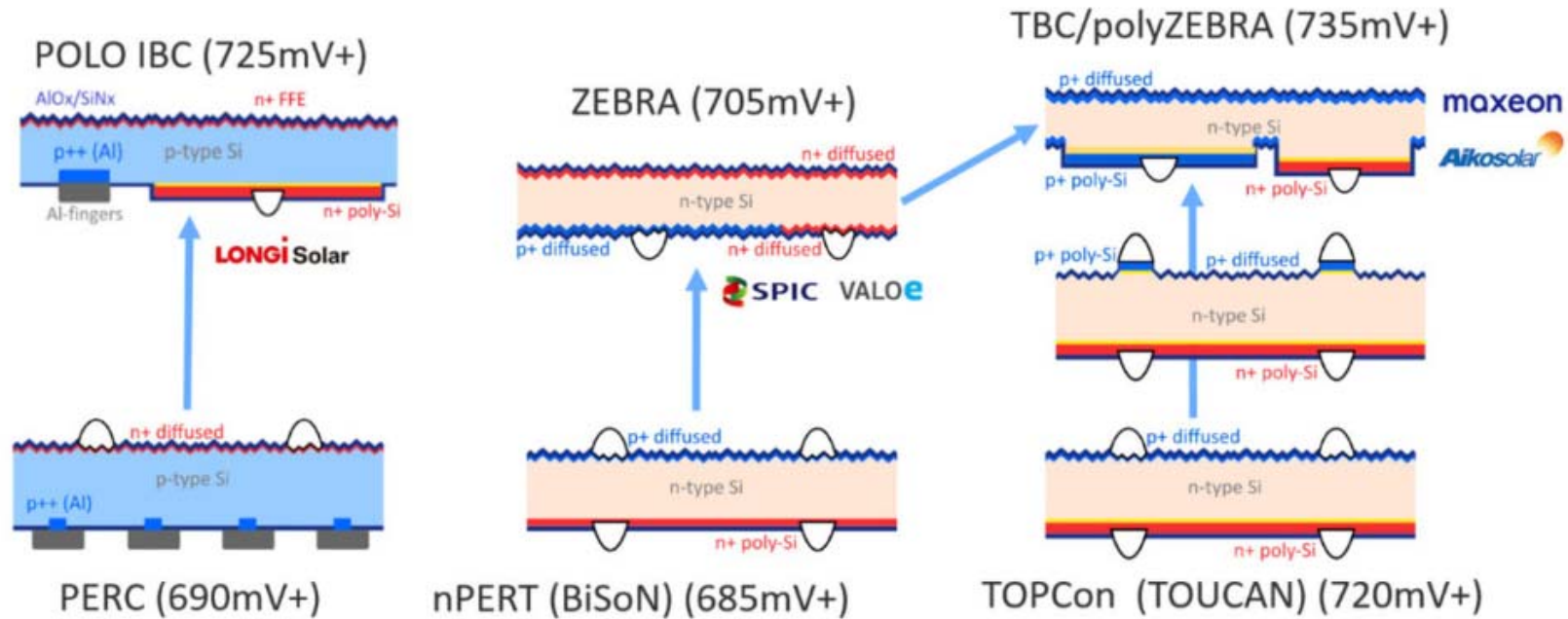


Fig. 4. Three IBC concepts based on different both sided solar cell concepts – PERC, nPERT and TOPCon.

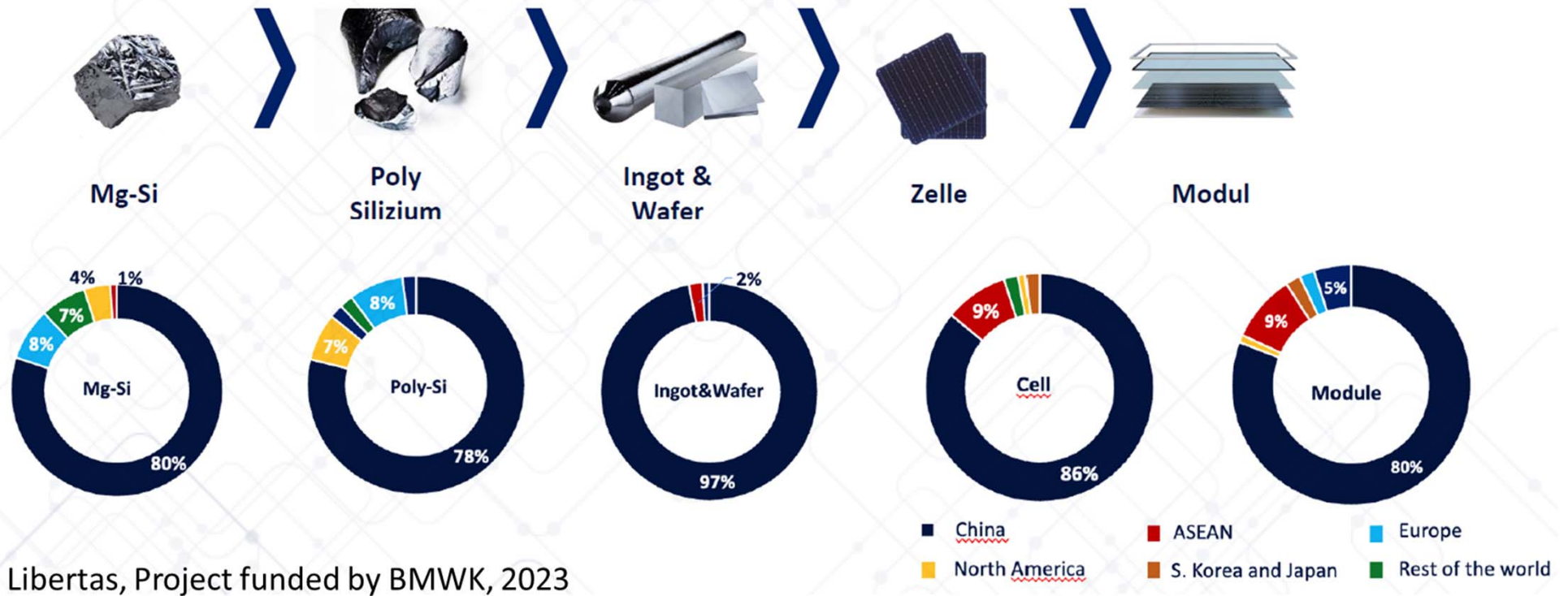
Why TBC will follow shortly after TOPCon
 By Radovan Kopecek et al.
 September 11, 2023



XBC technology will win (Asian PVSEC 2023)

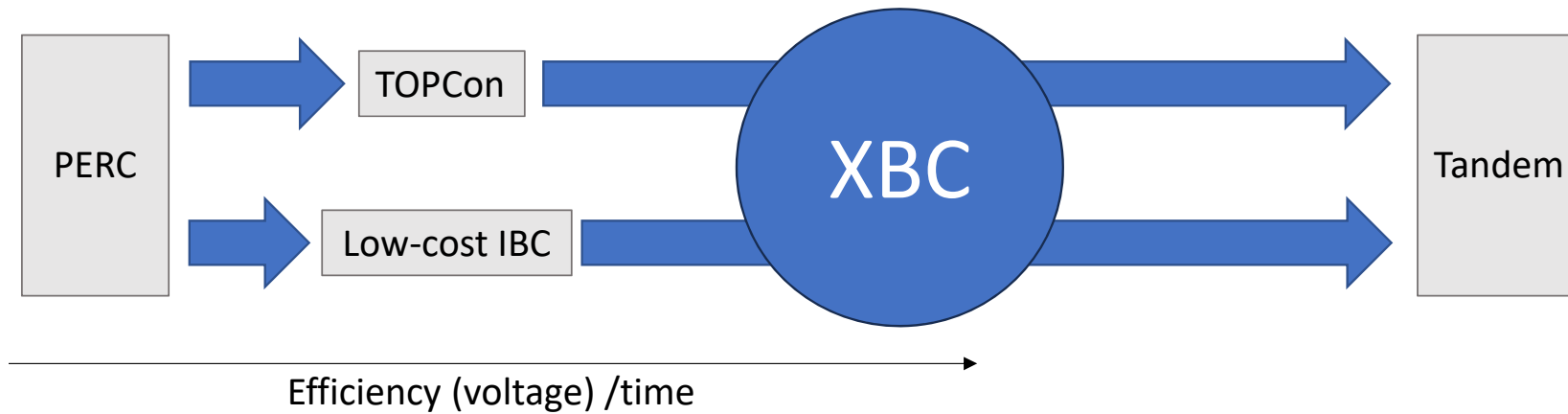


Motivation of IBC4EU



Motivation of IBC4EU

- c-Si evolution



Goal of IBC4EU - Bringing Solar Cell and Module Production Back to Europe

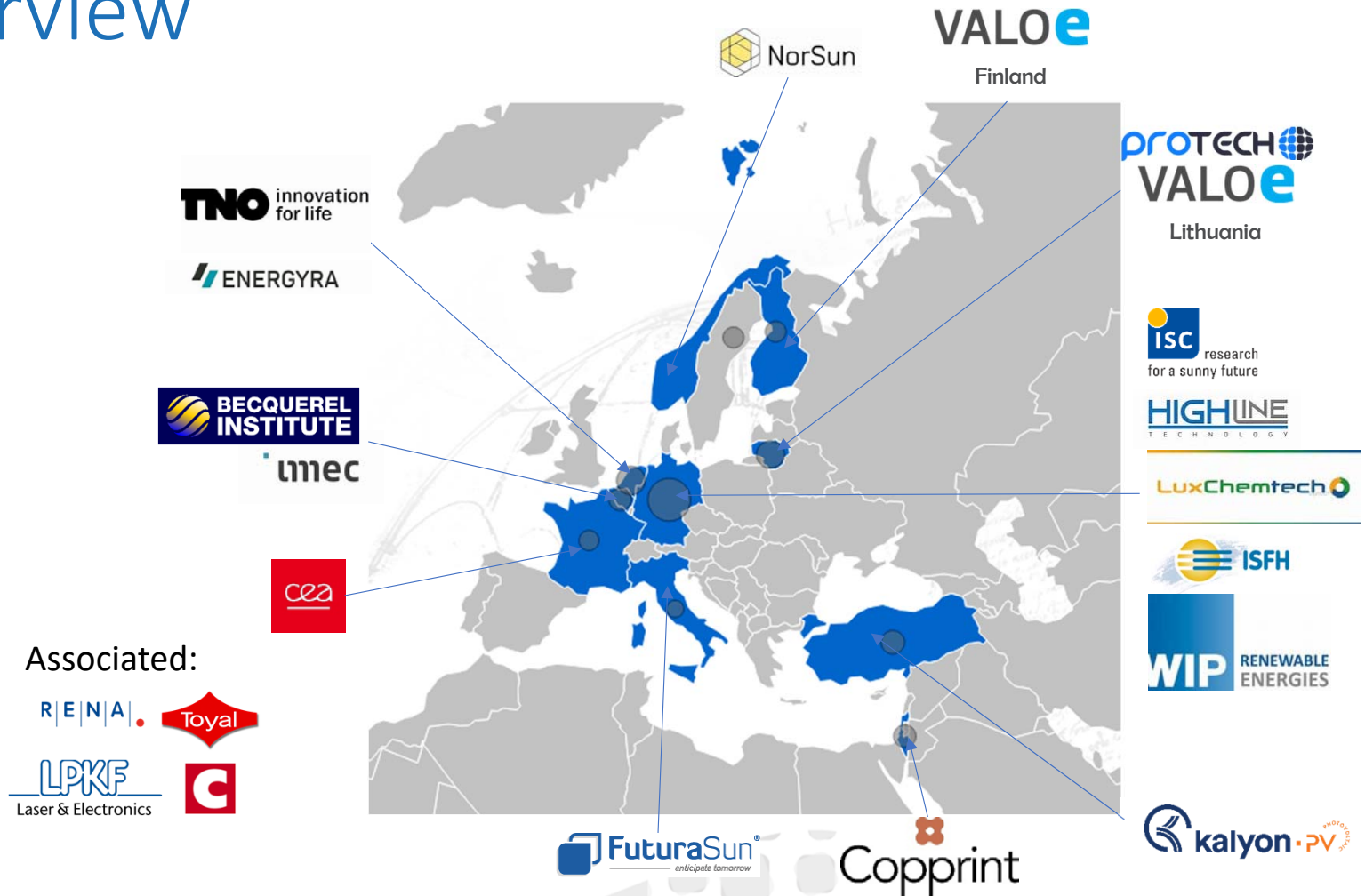
To develop and demonstrate **at pilot line level** cost-competitive and sustainable industrial production of **IBC based PV products along the value chain**: from **ingots** and **wafers** to **solar cells** and **modules**.

> **Bringing bifacial TBC to utility scale**



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:

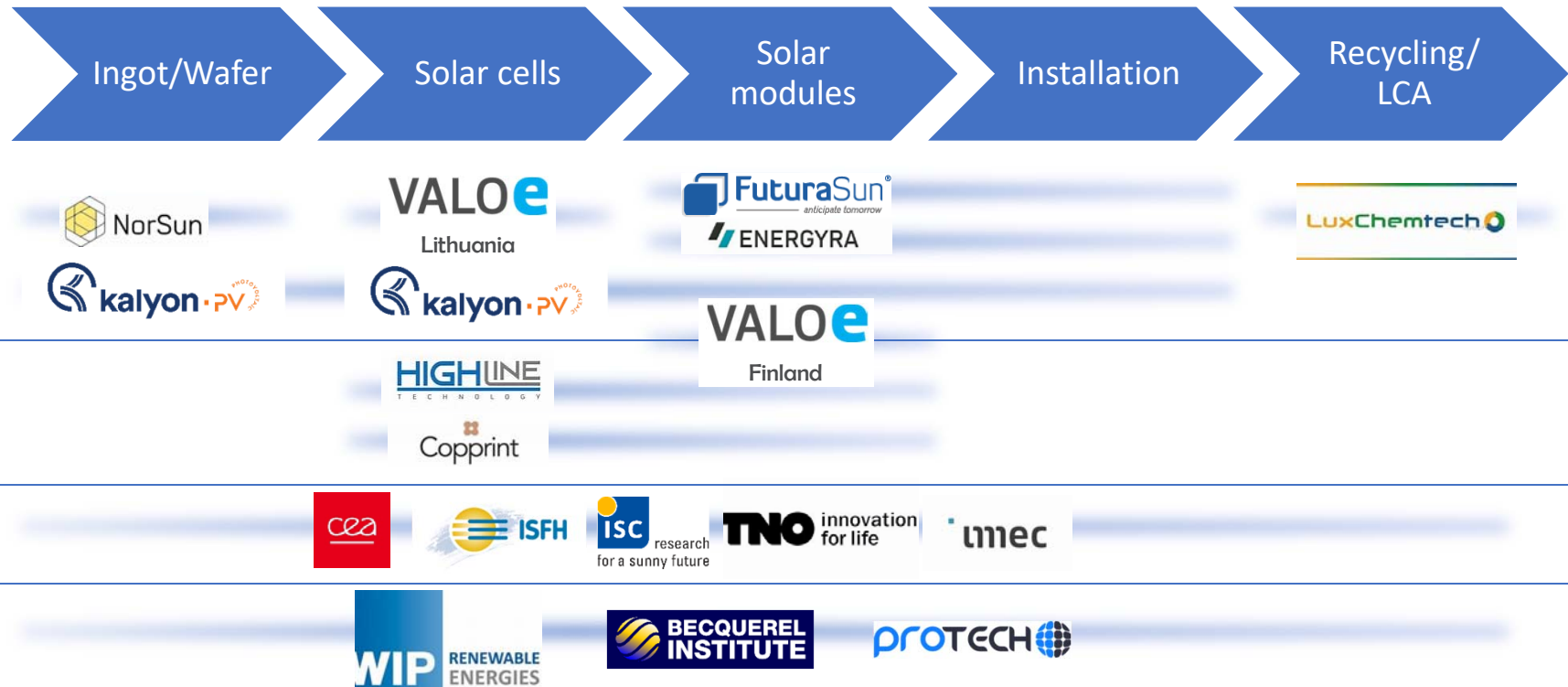




Project overview

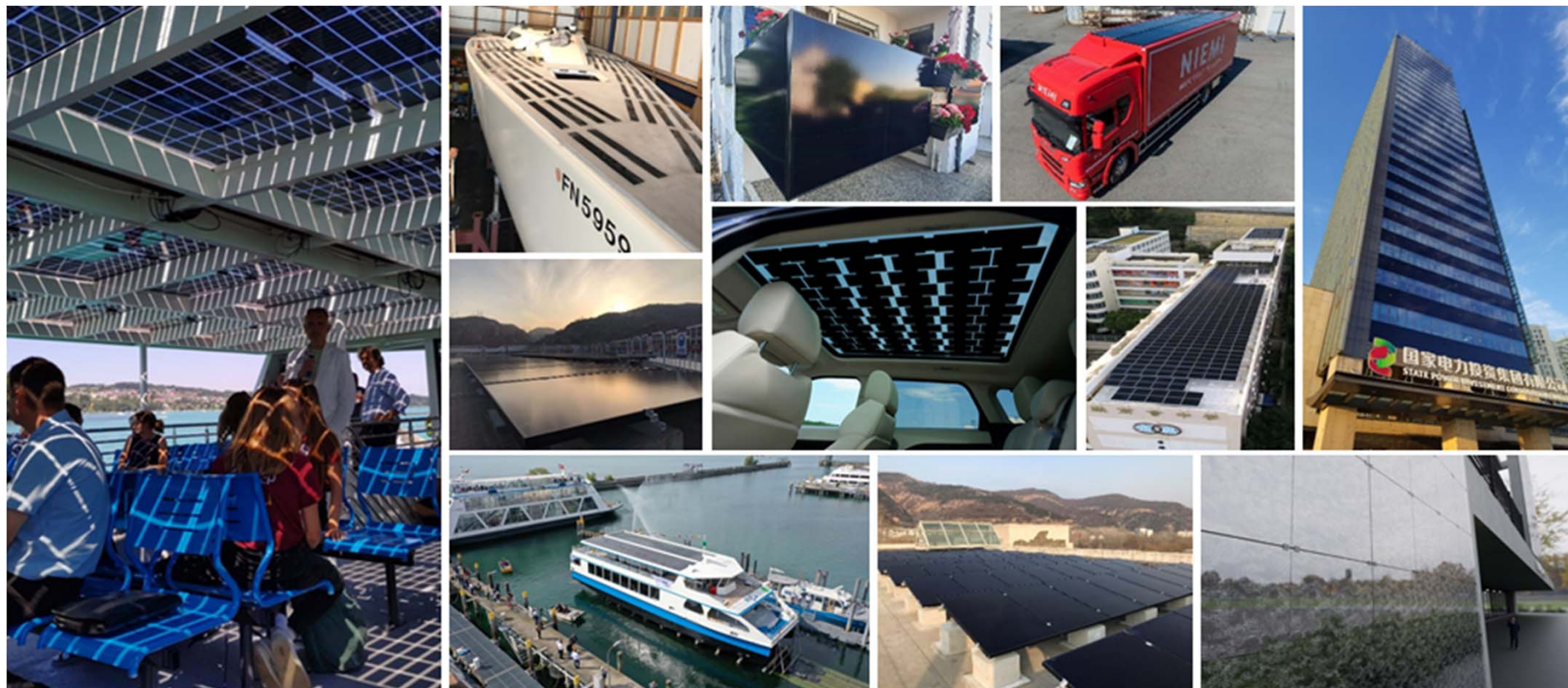


Project overview



Why IBC?

VALOE
Finland

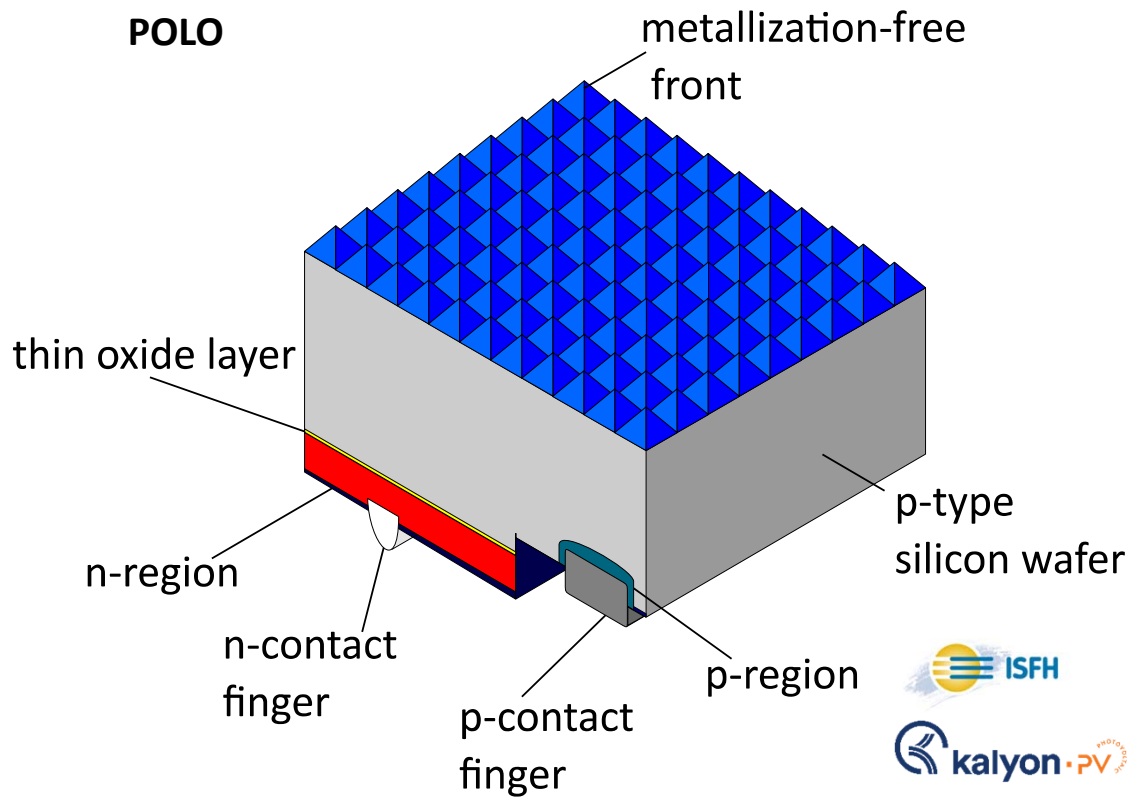


Why XBC in IBC4EU?

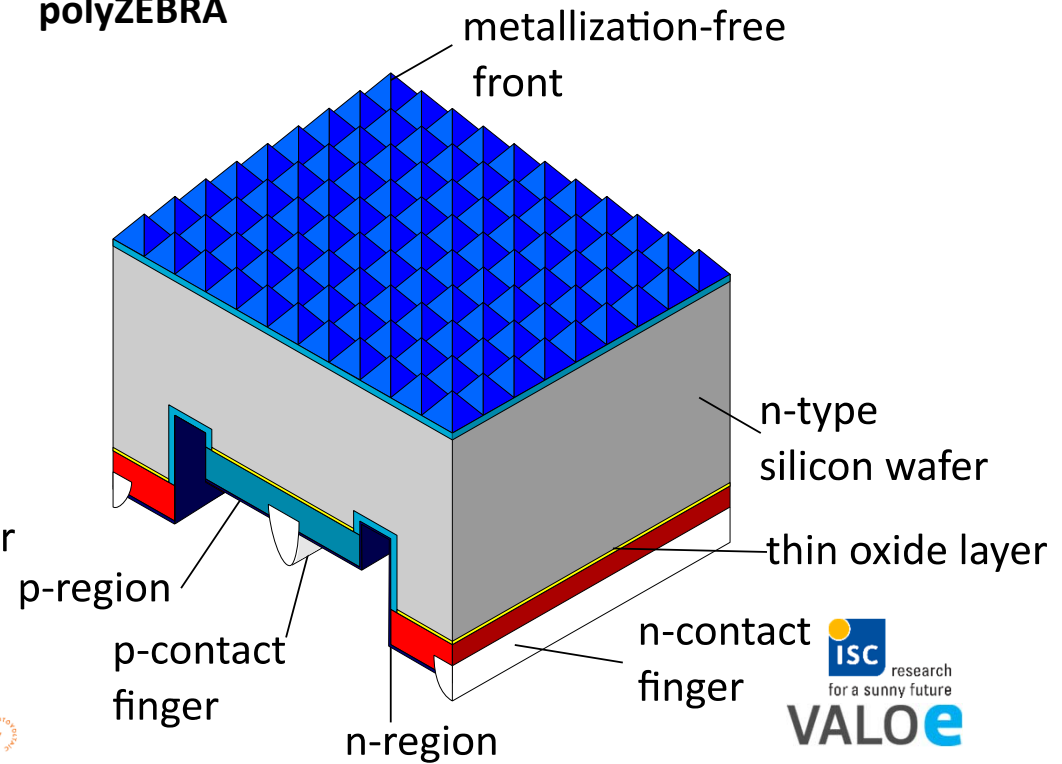


Low-cost IBC upgrade

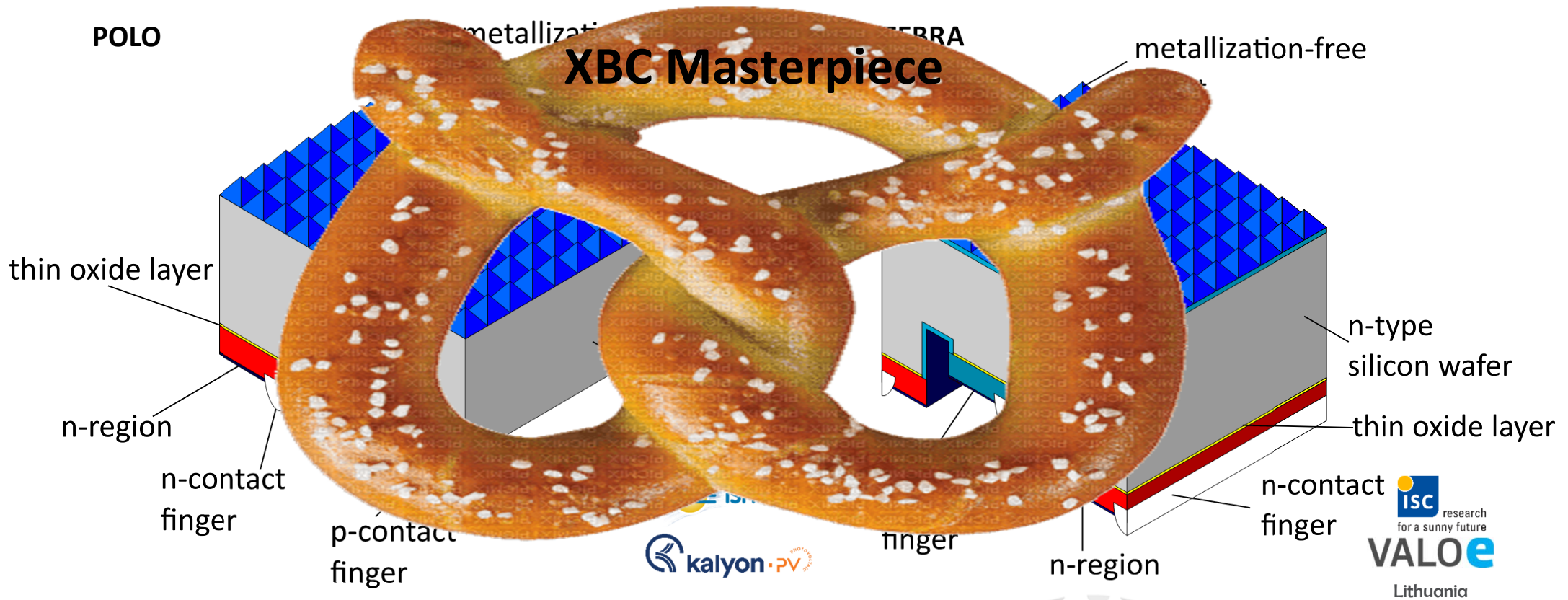
POLO



polyZEBRA



Low-cost IBC upgrade



Low-cost IBC upgrade

POLO

- Largely based on PERC+ production equipment
- Very lean process sequence^{*1,2}
- Efficiency goal: >25%

Innovations:

- Local deposition of poly-Si by shadow mask PECVD
- Reduction of silver content

*1: EE. Bende et al., 7th Metallization and Interconnection Workshop, Konstanz, Germany (2017).

*2: F. Haase et al., Proc. of the 46th IEEE PVSC, Chicago, IL, USA, 2200-2206 (2019).



polyZEBRA

- Upgrade (100% compatible with ZEBRA back-end)
- Developed in Highlite (H2020)
- Efficiency goal: >25%
- IP secured

Innovations

- Streamlined process for pilot production
- PECVD-based poly-Si depositions
- Hybrid metallization based on Cu screen printing

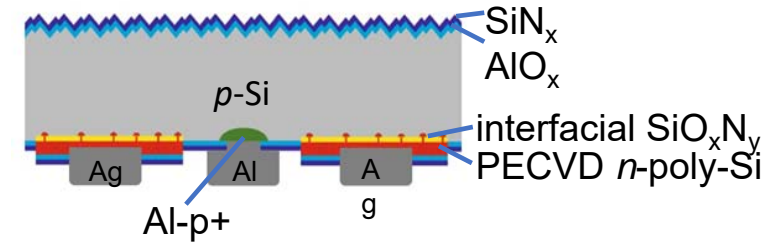


POLO IBC solar cell concept



- process approach^{*4,5}:
Local deposition of PECVD-SiO_xN_y/ *n*-a-Si through a glass shadow mask from LPKF
- Local PECVD process successfully transferred from lab-tool to industrial c.plasma tool
- Current status: solar cells (M2) with 23.7% efficiency, *iV*_{oc} for non-metallized samples: 740 mV

POLO IBC solar cell*1



More details in presentation from V. Mertens (and J. Lossen)

Lab-type tool:

Single wafer Clustertool from Von Ardenne



Industrial tool:

c.plasma tool from centrotherm

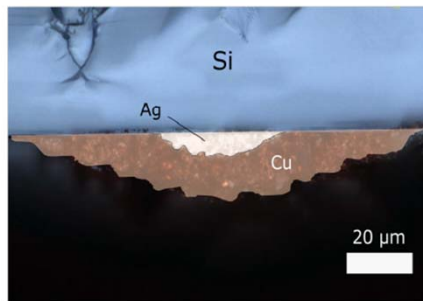
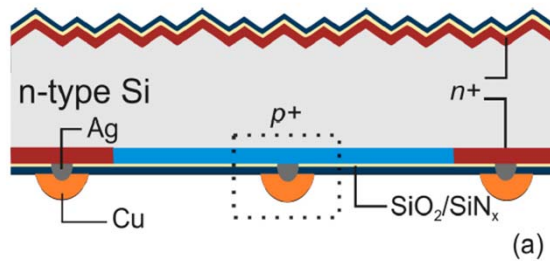


*4: M. Stöhr, 37th EUPVSEC, 521 (2020).

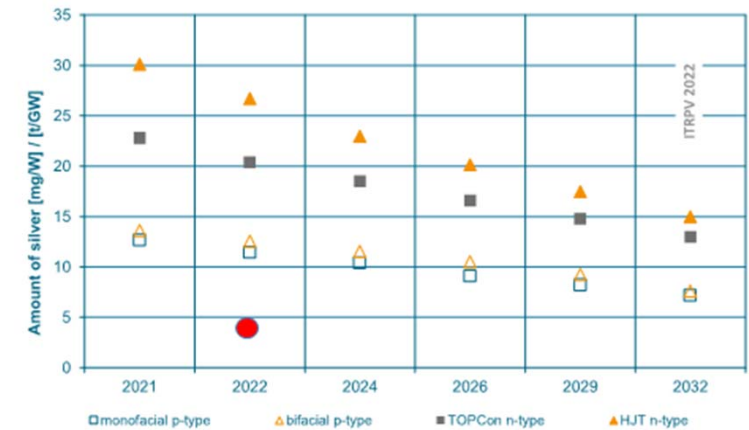
*5: T. Dullweber, SNEC (2021).



Cu-ZEBRA and Cu-polyZEBRA



Trend for remaining silver for metallization per Watt (front + rear side)
(Values for M6 + M10 cell size, average)



- All screen printing based
- Longterm stability has been demonstrated
- Current status of Cu-polyZEBRA: Solar cells (M6): 24%

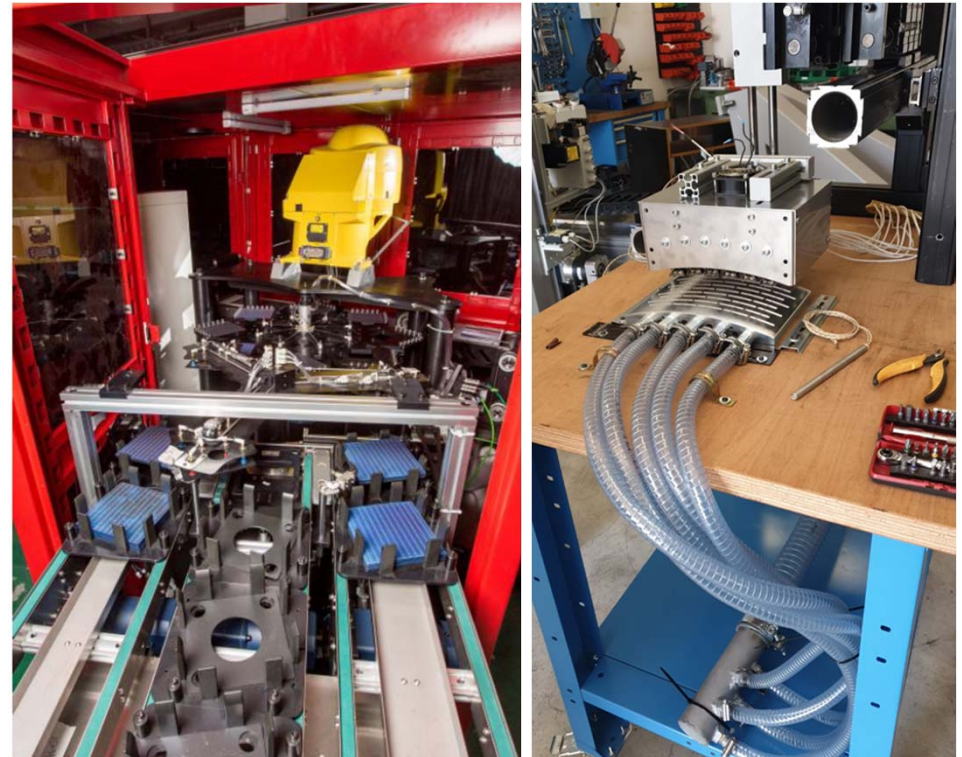
More details in presentation from J. Linke

N. Chen et al. Solar RRL 7.2 (2023):2200874
Buchholz, PVCellTech 2023
D. Rudolph, MIWS 2023

FuturaSun ZEBRA cell interconnection by stringing

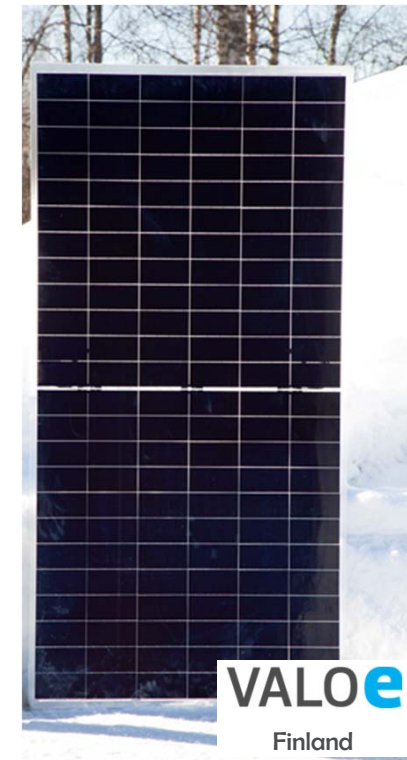
- Patented stringing concept, optimize the system for multi busbar ZEBRA cells
- The soldered strings without mechanical tension → no problems in the module's lifecycle
- High throughput and ready for future technology evolvemements

More details in presentation from L. Hirvonen



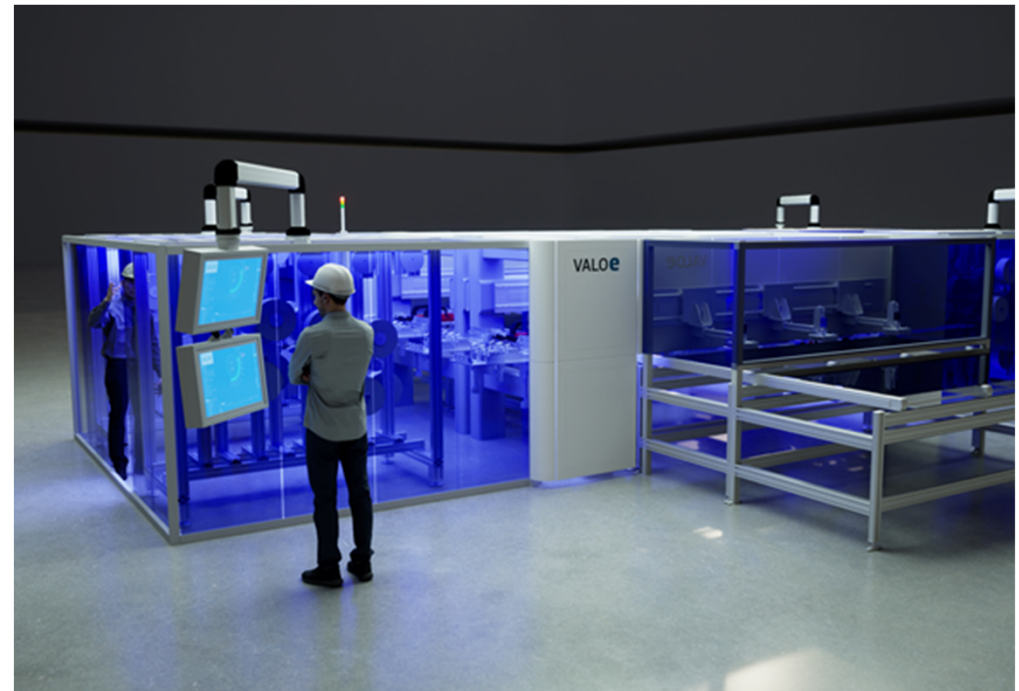
Low cost bi-facial backsheet for ZEBRA IBC cells

- High bi-faciality
- Cost similar to traditional stringing
- Both glass-glass and glass-foil construction possible
- Compatible with all back-contact assembly lines
- Easy change between different cell sizes, layouts, etc.



Pilot scale manufacturing of back sheets

- Valoe will build 60MW pilot line in IBC4EU project
- The backsheet will be piloted by Valoe and other project partners
- Valoe will sell the manufacturing equipment and/or backsheet



More details in presentation of T. Savisalo

IBC4EU approach

Pilot production in Europe

- Highest performance
- Excellent aesthetics
- European equipment available
- Supply chain in Europe for most critical materials available

NEXT: Mass production (GW scale) ?!

Thank you!

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<https://www.linkedin.com/showcase/ibc4eu>
<https://www.linkedin.com/in/dr-florian-buchholz-90789675/>

Project Partners



Associated Partners



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