

 ENERGYRA | *all about return*

Lightweight Conductive Backsheet Modules

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What will we present?



Who, why and how of Energyra

Rooftop Opportunities in the EU

MWT to IBC for kWh's

How Energyra DynamIQ IBC modules are modeled to squeeze out every electron/kWh for Rooftop Applications to facilitate the energy transition and tackle the climate crisis

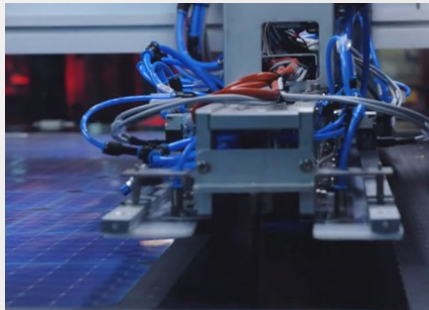
ENERGYRA[®] History



- Energyra started in 2018.
- Relunched in 2020 (Energyra Europe BV)
- Dutch Made and Solar know-how
- Close collaboration with EU research institutes
- Participant in SolarNL – National Growth Fund & IBC4EU

Modern Facility

minimal manual labour, maximum quality



- Nameplate Capacity
100MWp
- Fine-tuned to
130MWp
- IBC upgrade
140MWp

Our major goals and ambitions



Commitment to eco-friendly production processes



Use of recyclable materials (PET)



PFAS and lead free



Antimony-free components



Initiatives to reduce CO₂ footprint and prioritize local sourcing



Strategic importance of local knowledge and expertise (international developments)



Full traceability and transparency in our manufacturing processes and procurement (CSRD/ESG)

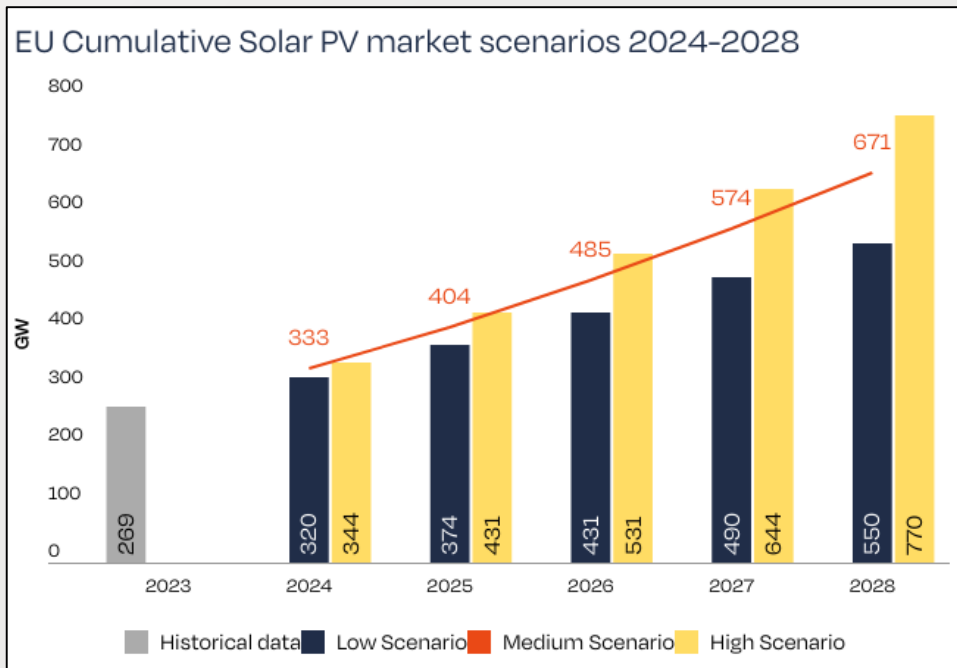


Tailor made solutions



Light weight panels

Rooftop potential



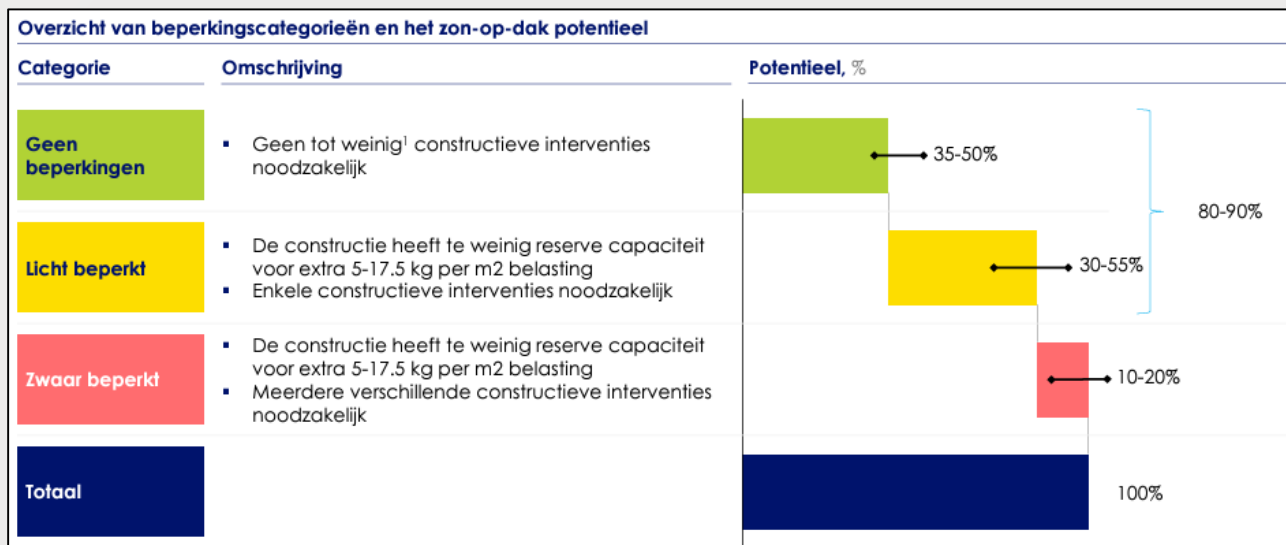
Rooftop Projects are most promising market in the EU

270GW in 2024 to total 671 GW by 2028 in Europe (~59-60% rooftop)

Case Study: The Netherlands 10-55% rooftops



are not viable because of weight bearing issues







Lightweight for C&I rooftops







with back contact technology



C&I Rooftop Requirements

-  Maximum kWp/m² or kWh/m²
-  Weight restriction <5 kg/m²
-  Low degradation
-  Low carbon footprint
-  100% recyclable
-  Shading resistance

Traditional PV modules

-  122 cell half cut PV modules Wp too low per m²
-  144/72 cell glass-glass/foil modules too heavy (> 5kg/m²)
-  3% degradation year 1, and 0.5% degradation EOL
-  >~500 kg/CO₂eq
-  98% recyclable (PFAS free)
-  Shading Resistance (high voltage breakdown)

A wide variety of use cases



Mobile Integrated
Mobile Solution



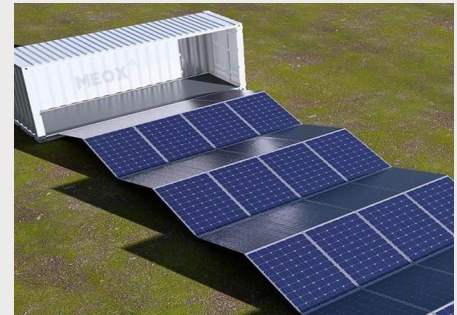
Zero Emission Zone
Solution



Bespoke Architectural
Designs



Off-grid solutions



Large-scale Mobile
Solution

DynamiQ lightweight panel



Key Features:

- Ultralight design 7.3kg (4.29 kg/m², 60% weight reduction)
- Robust and fully recyclable
- Lower NOCT/NMOT
- ~230* - 500 kg/CO₂eq

Applications:

- Ideal for rooftops with limited load capacity
- Mobile and specialized applications

Globally first IEC61215/61730 certified framed polymer light weight panel



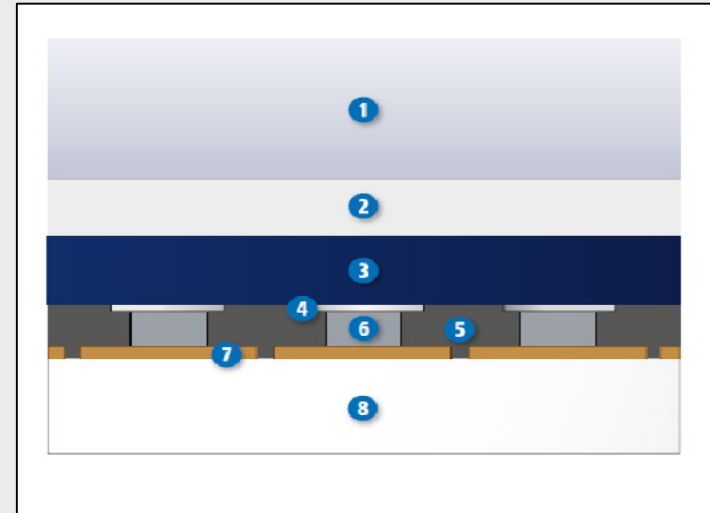
**based on EU wafer according to TNO*

Inside CBS Back-contact



low stress manufacturing

- Minimal Cell handling
- Low-stress & low temperature process
- Lead-free & low temperature solder paste
- Very low resistive losses for an improved CTM
- Reproducible automated process
- Minimal human handling during process



- ① GLASS
 - ② ENCAPSULANT
 - ③ CELL
 - ④ REAR SIDE METALLIZATION
 - ⑤ REAR PERFORATED INSULATOR
 - ⑥ CONDUCTIVE ADHESIVE / SOLDER PASTE
 - ⑦ PATTERNED COPPER FOIL
 - ⑧ BACKSHEET
- } IBC CELL
- } CONDUCTIVE BACKSHEET



DynamiQ (IBC) roadmap



Current Situation

- MWT PERC +
- - 0.36%/K Temp. Coefficient
- 365 Wp - 375 Wp
- 3% Year 1, 0.5% Year 2 - EOL
- 7.3 kg lightweight
- 1.7m² (220 W/m²)

Roadmap

- ✓ xBC
- ✓ - 0.26%/K temp.coefficient
- ✓ 390 - 405 Wp
- ✓ 1% Year 1, 0.35% Year 2 - EOL
- ✓ ~7.3 kg lightweight (4.3 kg/m²)
- ✓ ~1.7 m² (238 W/m²)
- ✓ High shading resistance

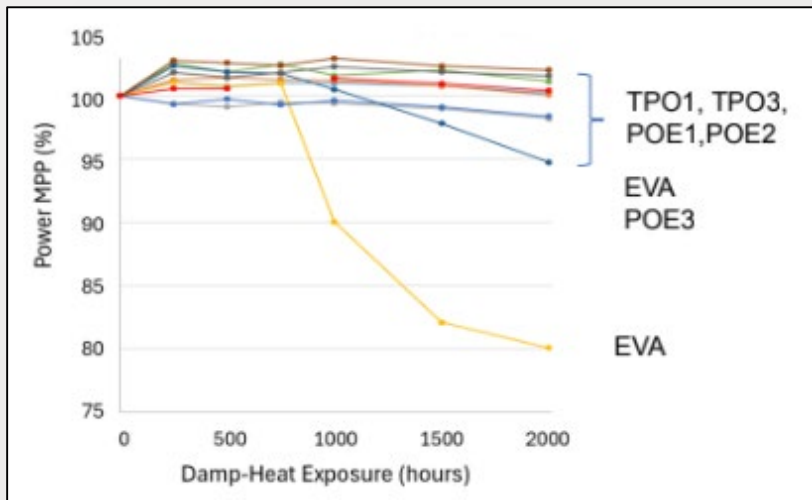
Opening 10% more the rooftop C&I market that was considered not viable for a PV system due to mechanical rooftop constraints (kg/m²) to more kWh

A BOM for durability/reliability

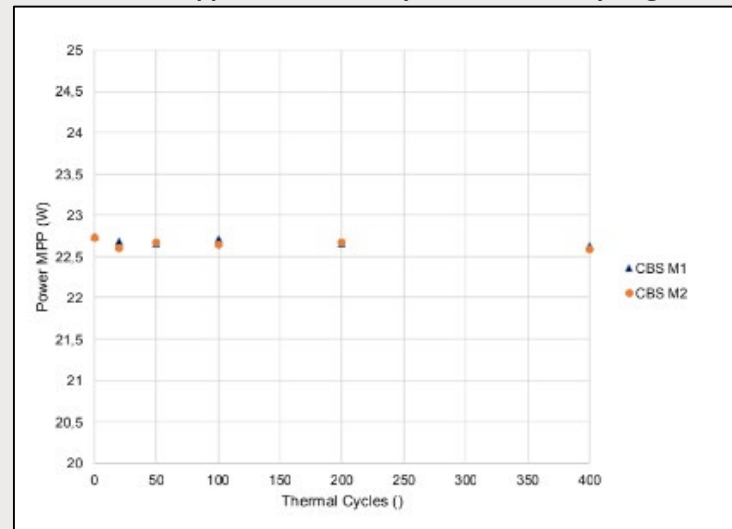
Mini-module results



Mini Module Pmpp loss after 2000 hours with different encapsulants



Mini Module Pmpp Loss after 400 cycles of thermal cycling with CBS



Careful consideration for UVID, PID-s/p and interconnect failures as leading rising challenges for some TOPCON/IBC modules



Conductive Backsheet Output



Cell inter-connection technologies	Ribbons	Multiwire	Conductive backsheet (CBS)	Shingling	Paving/tiling
Schematic view of cell technologies (full cell)					
Cell-to-module loss (CTM)	3.8%	3.8%	2.4%	2.2%	3.6%
Power density	189 W/m ²	189 W/m ²	202 W/m ²	195 W/m ²	199 W/m ²
Power output ¹	314 Wp	314 Wp	334 Wp	297 Wp ²	314 Wp

Address potential quality issues (mechanical stresses on cells) due to stringing in the event of severe weather events

Field Studies of MWT CBS



- ✓ Higher efficiency as compared to MBB
- ✓ Better Low-irradiance behavior
- ✓ Lower NMOT

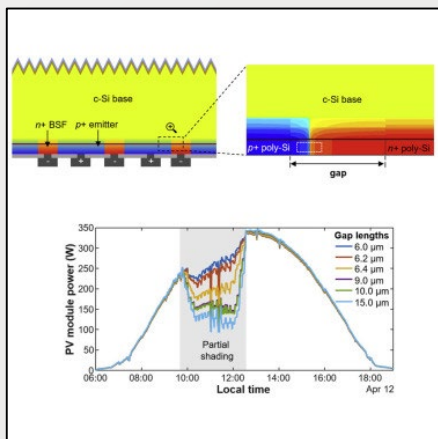
Module	MBB	CBS
Cell Tech	PERC	MWT PERC
#Cells	120 half cells	66 full cells
Interconnection	MBB	CBS
m2	1.83 m2	1.77 m2
Lisbon, PT Yield		
Module Efficiency	+0.9%	+5.6%
Low Irradiance	0.0%	+1.7%
NOCT	0.0%	+1.3%
Combined	+0.9%	+8.6%



Low voltage breakdown **benefits**



Yield vs Low Voltage Breakdown



Maxeon Whitepaper on shaded cell temperatures for different technologies

Panel Type	Unshaded Cell Max Temp	Shaded cell, Max Temp	Shaded Cell without Diode, Max Temp	Hotspot Observations
Half-cell Ribbon-based Back Contact	62 °C (144 °F)	153 °C (307 °F)	> 550 °C (>1022 °F)	Severe bubbling, burning of back sheet and encapsulant
Half-cell Front Contact TOPCon	58 °C (136 °F)	142 °C (288 °F)	> 550 °C (>1022 °F)	Severe bubbling, burning of back sheet and encapsulant
Half-cell HJT	60 °C (140 °F)	162 °C (324 °F)	305 °C (581 °F)	Significant bubbling, discoloration of back sheet and encapsulant
Full-cell IBC. Maxeon 7	59 °C (138 °F)	85 °C (185 °F)	78 °C (172 °F)	No visible or measurable impact
Full-cell IBC. Maxeon 6*	63 °C (145 °F)	104 °C (219 °F)	103 °C (217 °F)	No visible or measurable impact

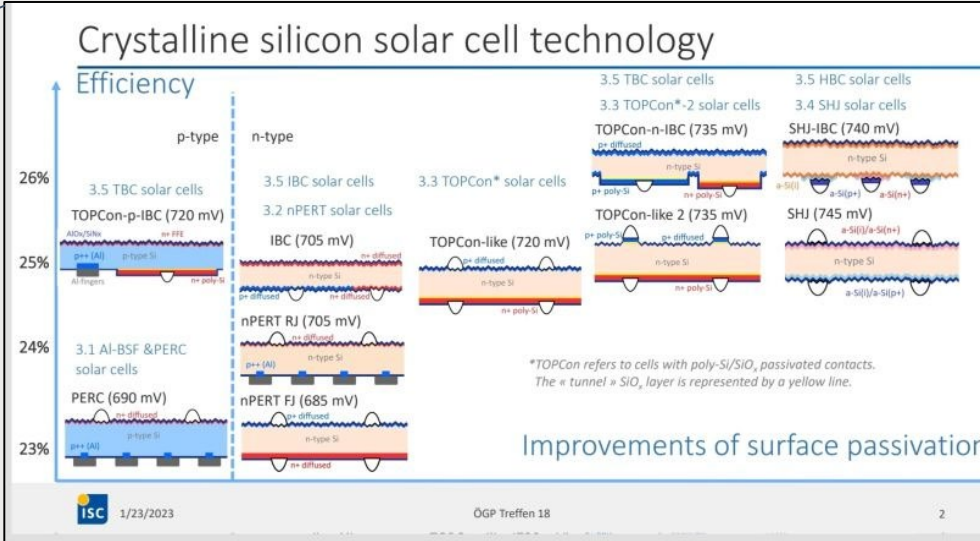
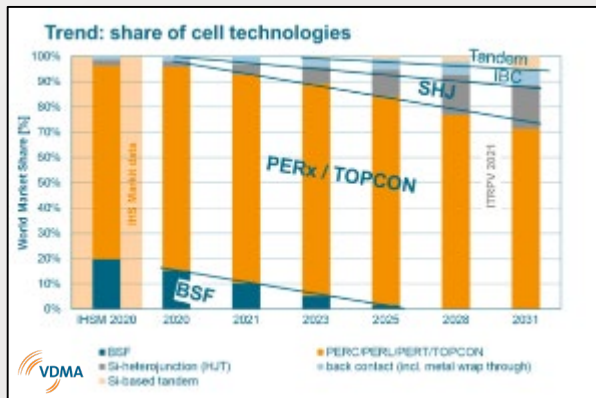
* Although not tested in this latest round of outdoor hotspot testing, Maxeon 3 (IBC) panels offer equivalent protection from damaging hotspots. Maxeon can provide additional test results for earlier generation Maxeon 3 panels upon request.

Up to 7.9% more potential yield in specific use cases and lower hotspot temperatures

Solar PV Cell Selection for CBS



Selection depending on low voltage breakdown, rooftop application in polymer BOM, machine limitations, metallization, vendor availability and efficiency & degradation profile

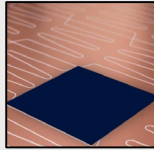




Lightweight BC technology



- Local production for responsible and environmental friendly production and developing local knowledge & know how



- Opening up to 50% additional rooftop potential

- Shift to IBC modules coming with lower temp coefficients, shading resistance, smart BOM selection & w/m² with focus on kWh

- Creating new opportunities in mobile energy and special shapes



Thank you!



Any questions, queries, worries, conundrums or headaches?

Kind thanks to all the industry & research partners

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