

# Webinar powered by

DSM Advanced Solar

**24 September 2020**

4 pm – 5 pm | CEST, Berlin

3 pm – 4 pm | BST, London

7 am – 8 am | PDT, Los Angeles

10 am – 11 am | EDT, New York



**Mark Hutchins**

Editor | pv magazine



# Back-contact's move to the front



**Hugo Schoot**

DSM Advanced Solar



**Paolo Maccario**

Silfab Solar



**Radovan Kopecek**

ISC Konstanz



rado

# ZEBRA IBC technology

## low cost IBC in mass production

Dr. Radovan Kopecek et al.

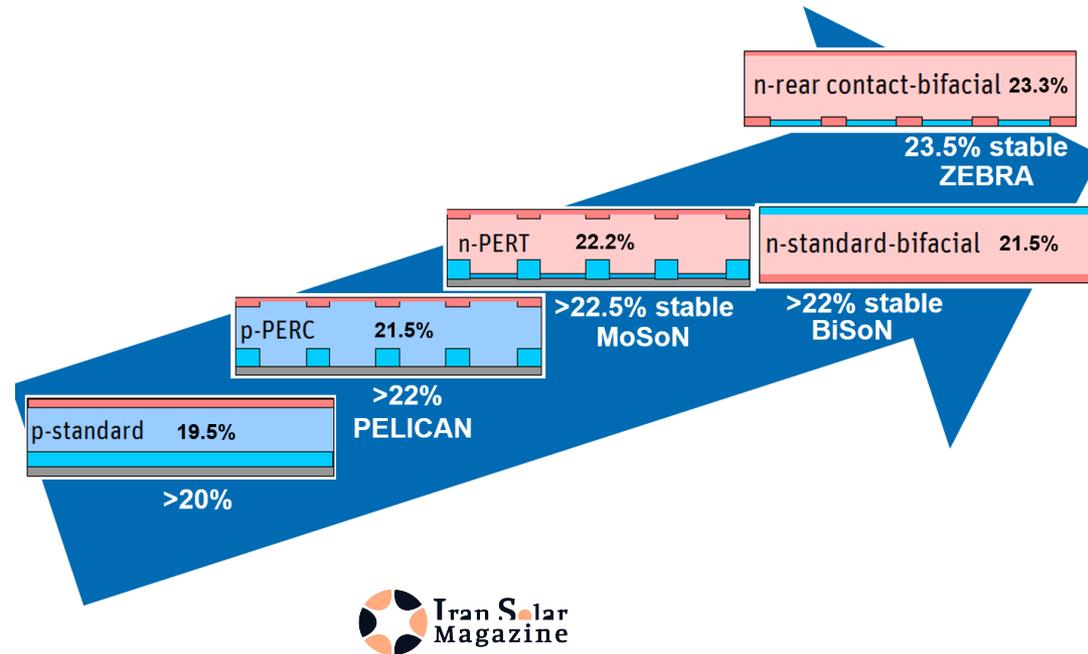
**ISC Konstanz** technology transfer

**ZEBRA** technology, mass production

**Future of PV** which c-Si technology will win?

## International Solar Energy Research Center e.V.

- a nonprofit organization
- Founded in 2005
- R&D on c-Si solar cells, modules and systems
- Technology transfer
  
- About 60 employees
- Turnover about 6-7 Mio€/a



cells

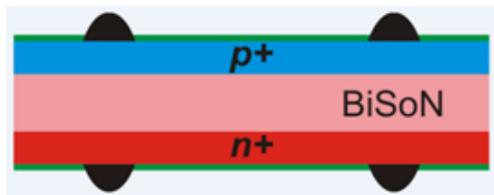


modules

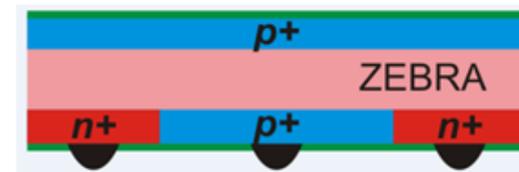


systems

# BiSoN (nPERT) and ZEBRA (IBC)



21.5+%

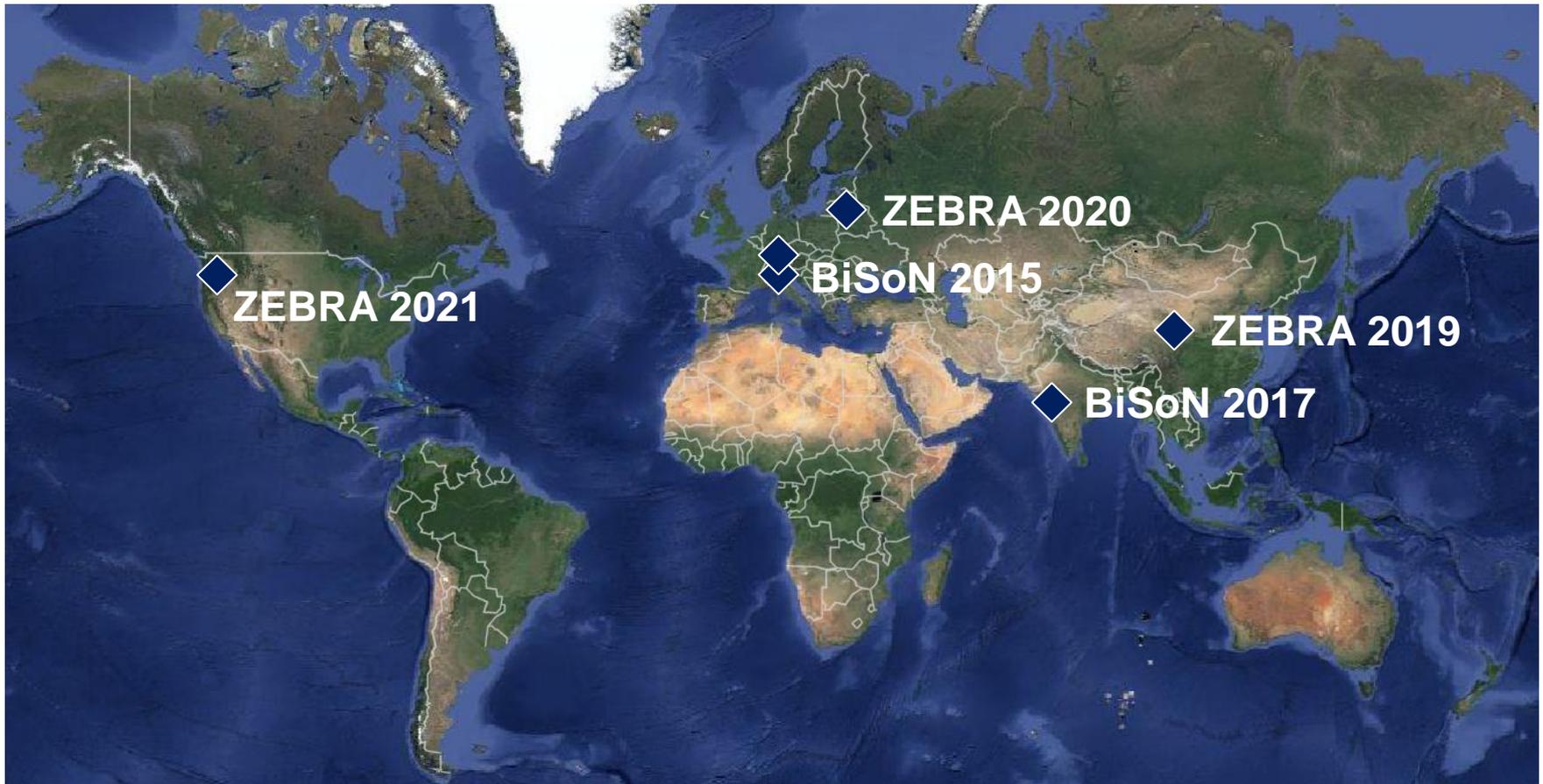


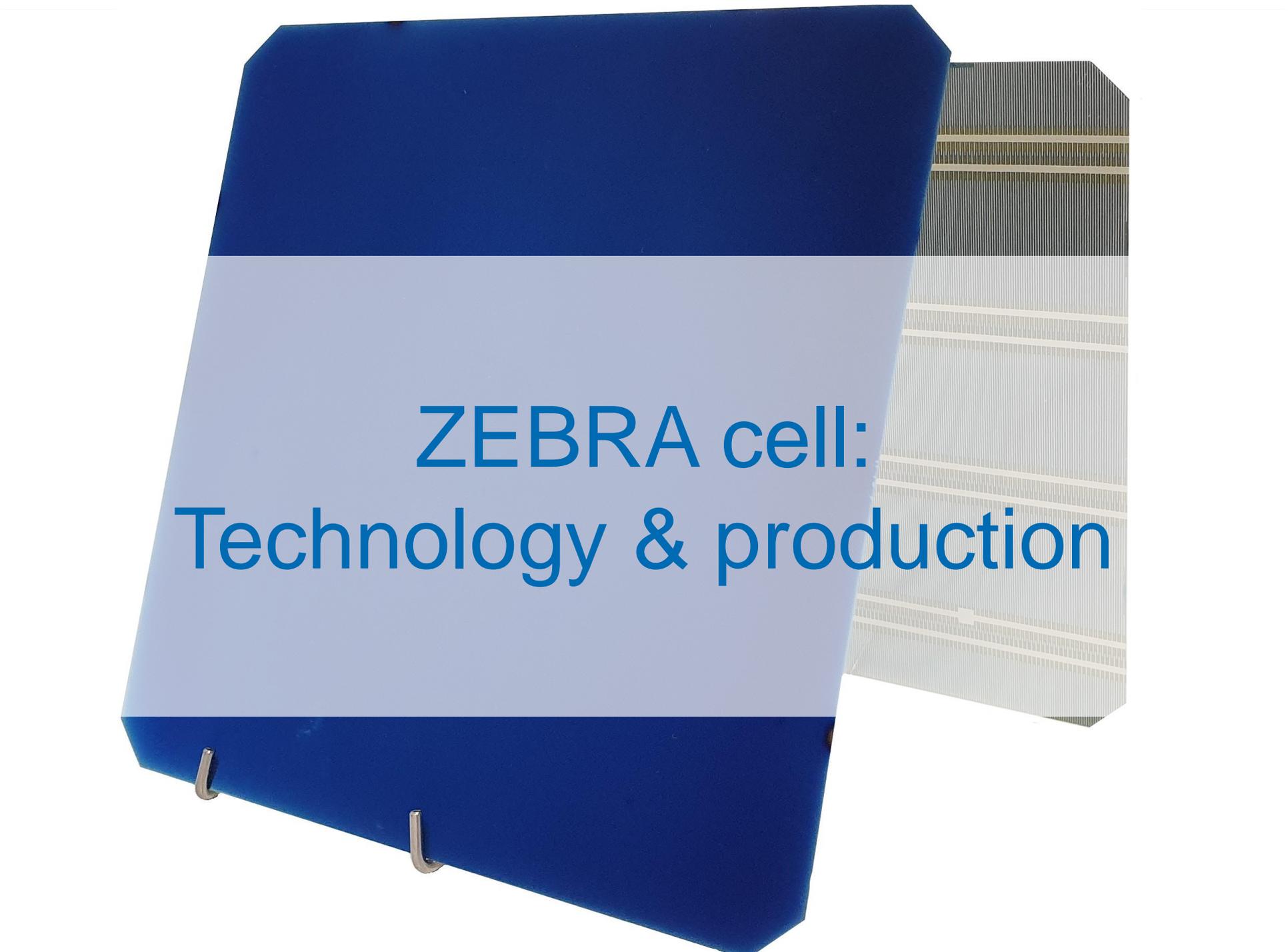
23.5+%

# ISC Konstanz 's technology transfer



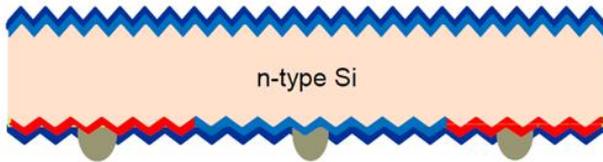
International Solar Energy  
Research Center Konstanz



A blue binder with a white page is shown in the foreground. The page has the text 'ZEBRA cell: Technology & production' written on it. In the background, a ZEBRA cell component is visible, which is a rectangular object with a grid of vertical lines and horizontal bands.

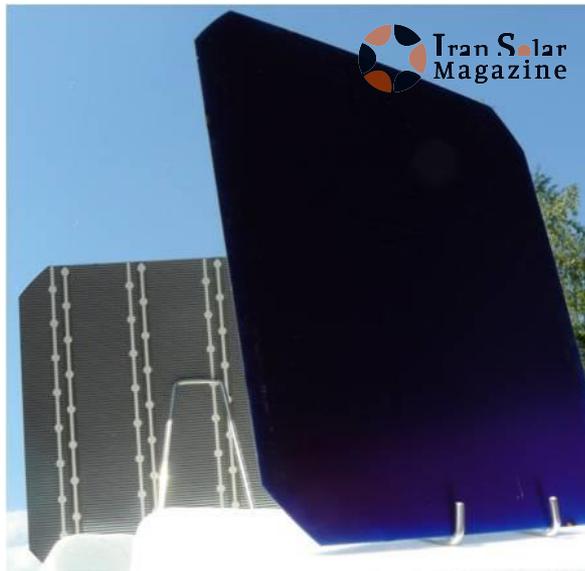
# ZEBRA cell: Technology & production

# ZEBRA cell: key features



## 23.5%+, 700mV+

- based on standard **n-type** Cz-Si wafers
- screen printed firing-through contacts
- **no passivating contacts**
- 3D-interconnection of fingers with busbars enables compatibility with **any wafer format**
- $\text{BBr}_3$  and  $\text{POCl}_3$  tube furnace diffusion steps
- in-situ surface passivation → **no  $\text{AlO}_x$  required**
- **bifacial** IBC cell with bifaciality factor of  $> 70\%$
- 3D-interconnection of fingers with busbars enables compatibility with **any wafer format and interconnection technology**



Photograph of the front and back side (mirrored)

V.D. Mihailetchi *et. al.*, **Patent pending:** WO2013087458A1  
V.D. Mihailetchi *et. al.*, Energy Procedia, 77, 534–539 (2015)

# ZEBRA cell: process steps

PERC cell process:

Texturing & cleaning

$\text{POCl}_3$  Diffusion

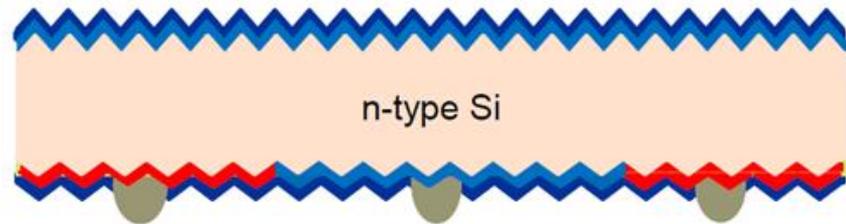
PSG & single side etch

PECVD  $\text{SiN}_x/\text{AlO}_x$  rear

PECVD  $\text{SiN}_x$  front

Laser contact opening

Screen printing



Additional steps required for ZEBRA:

PECVD  $\text{SiN}_x$  rear (mask)

$\text{BBr}_3$  Diffusion

BSG etch

Saw damage etch

**COO ZEBRA < 2 x COO PERC**  
(COO IBC > 3 x COO PERC)

# Ramp-up at SPIC/HHSD



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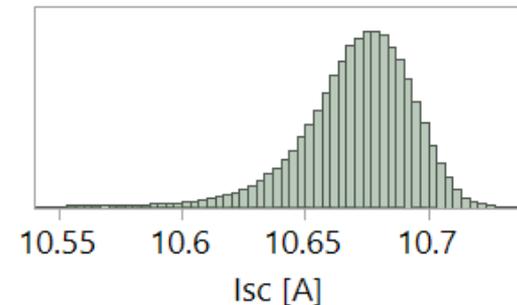
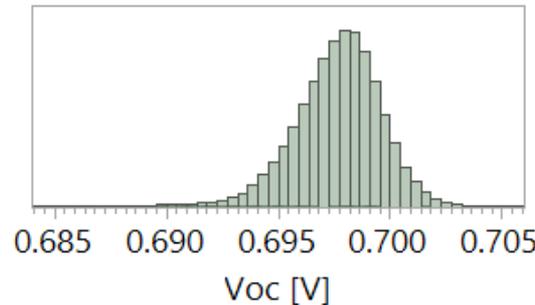
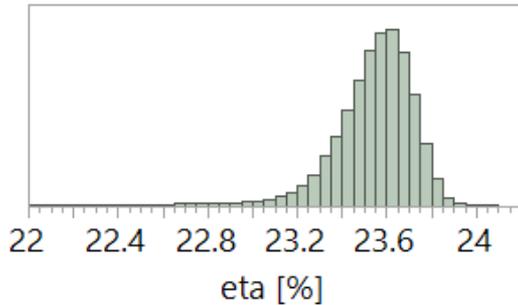


After completion of the construction of the **200 MW<sub>p</sub>/year cell & module factory of SPIC/HHSD in Xining (China)**, a joint team from the company SPIC/HHSD and from ISC performed the transfer of the technology and ramp-up (start in Q4/2019) of the industrial cell & module line.

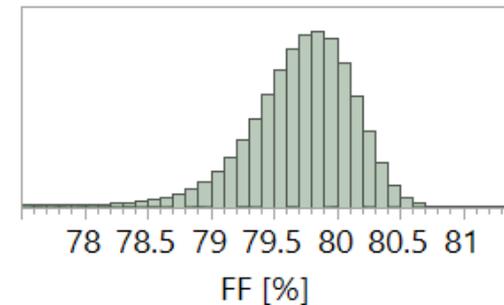
# Industrial cell results: I/V parameters



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 Iran Solar Magazine	$I_{sc}$ [A]	$V_{oc}$ [mV]	FF [%]	eta [%]
average	10.67	697.6	79.8	23.6
best cell	10.69	701.1	80.7	24.0



Details about I/V parameters measured on the sample batch of 286,264 solar cells manufactured on SPIC's industrial cell line: distribution, average values and champion cell result.

# ZEBRA modules at FuturaSun



- reducing the Ag-paste consumption by increasing the number of busbars per polarity to **6+ busbars** → finger cross section can be lower
- ZEBRA modules with **conductive backsheet (CBS)** → part of the shift electrical conductivity from the Ag-based metal grid of the cell to the copper (or Al-) based ECBS
- For parts of the metal-grid, substitute Ag-paste by **Cu-paste** (as already done e.g. for HJT cells) or by Al-paste.

# CBS ZEBRA module in 2016



310+W<sub>p</sub>  
no LID  
no PID

## pv magazine

News ▾ Features ▾ Events ▾ Awards ▾ Partner news ▾ pv magazine test

### Zebra IBC cell with 24% efficiency moves to large-scale production

Netherlands based manufacturer Energyra this week introduced a new back contact module, which it has developed in partnership with Dutch research institute TNO and Germany's ISC Konstanz. A prototype module was unveiled yesterday in a small presentation at Energyra's factory in Zaandam, Netherlands. The company is targeting large-scale manufacturing by the end of 2020.

SEPTEMBER 4, 2020 MARK HUTCHINS



ZEBRA 60 cell module

TNO



ENERGYRA

## Will PV become an (bifacial) IBC market?

### We believe yes.

### Why?

Because it is easier to implement passivating contacts and easy to interconnect. **polyPERC IBC and (poly)ZEBRA IBC to come.**

**LET US BRING ZEBRAS  
ON EVERY ROOFTOP!!**

