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## FuturaSun brings European n-type mono IBC 'ZEBRA' panel technology to market

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# The Company

## About Us



- › **FuturaSun** was founded by PV experts from the Venetian Region of Italy in **2008**.
- › Combined knowlegde in PV with the dynamism of the Chinese supply chain
- › **Active in almost 70 countries**
- › **1<sup>st</sup> Italian Solar Panel manufacturing in China**
- › 2 production plants located in Taizhou, China with a **annual production capacity of 1 GW.**



# N-Type technology

## Differences P-Type Vs. N-Type



### **P-Type** (positive base)

- › Mature and cost effective product
- › Doped with boron
- › One electron less making it positively charge
- › **P-type cells suffer from LID** (Light Induced Degradation)
- › Causes a reduction of efficiency up to 5%





# N-Type technology

## Differences P-Type Vs. N-Type

### N-Type (negative base)

- › **Is doped with phosphorus**
- › With **one electron more** making it negatively charged
- › This extra electron **boosts the efficiency**
- › **N-Type cells are immune to degradation issues like LID and LeTID**
- › **Low temperature coefficient** - excellent performance also at **high temperatures**
- › **More kWh per kWp**
- › **A sustainable choice for your business plan**



# ZEBRA

PV panel with 120 IBC half-cut cells

Industry standard 60 cell sizing



# N-Type technology

## Back to the original

The **very first solar cell** made of silicon was an **n-type back contact** solar cell and it was fabricated at the Bell Labs, USA, in 1954.

We are now **returning to the original** of using N-type wafers to **benefit the several advantages** that this technology has to offer.

*The New York Times - April 25<sup>th</sup> 1954*

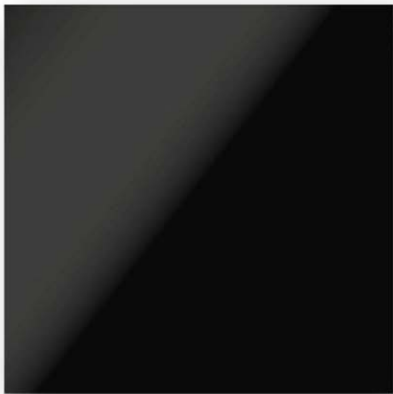
*“may mark the beginning of a new era, leading eventually to the realization of one of mankind’s most cherished dreams—the harnessing of the almost limitless energy of the sun for the uses of civilization.”*



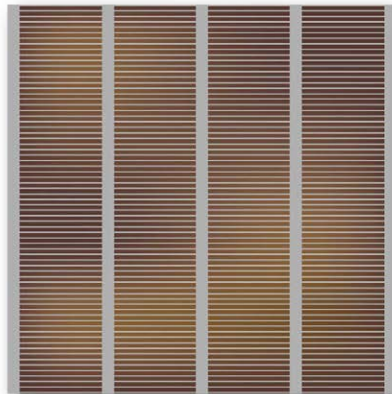




### IBC – Interdigitated Back Contact cells



front



back

- › Innovative technology **developed in Europe** by **ISC Konstanz**



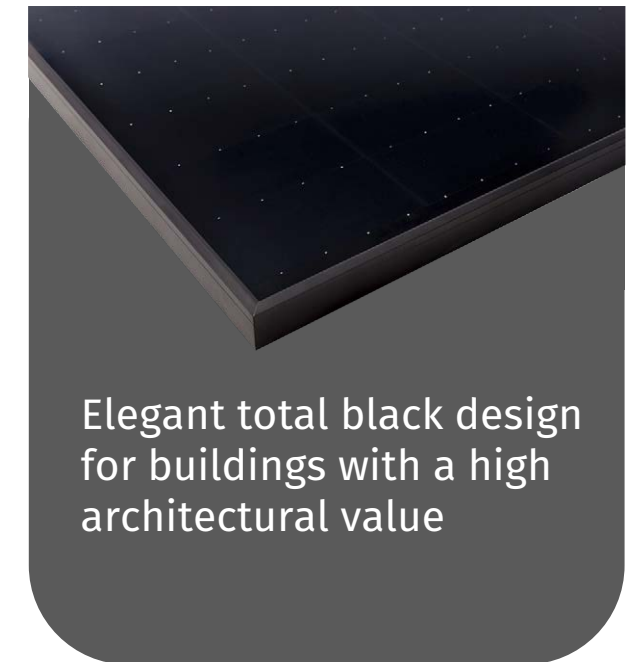
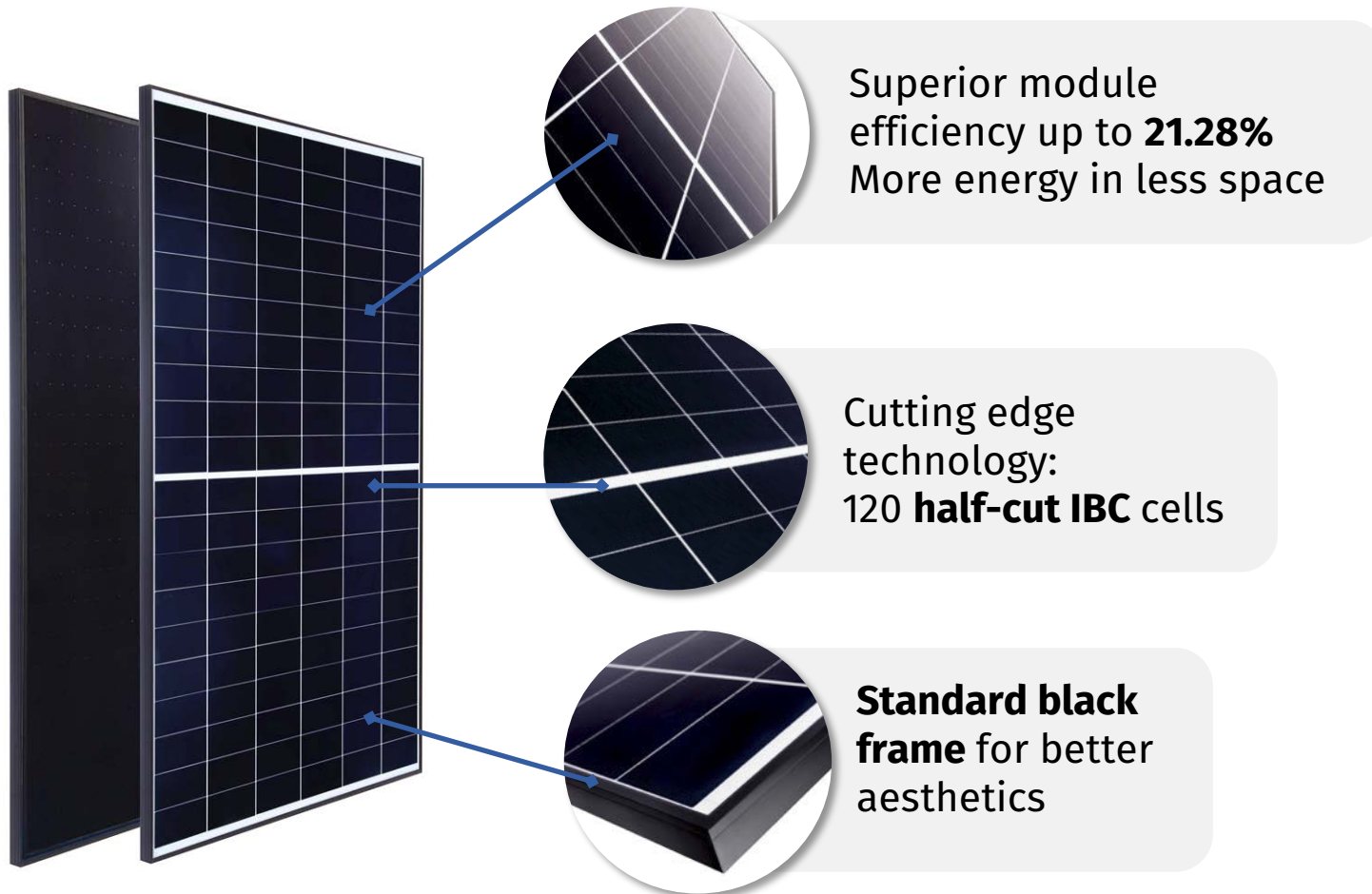
- › **Industry leading cell efficiency: 23.5%**
- › Based on **G1** (158.75 x 158.75 mm) **N-TYPE Cz-Si wafers**

# ZEBRA series

Standard White | FU350-360M

Total Black | FU340-350M

UP TO  
**360 W**





# IBC Cells

Electrical contacts on the back

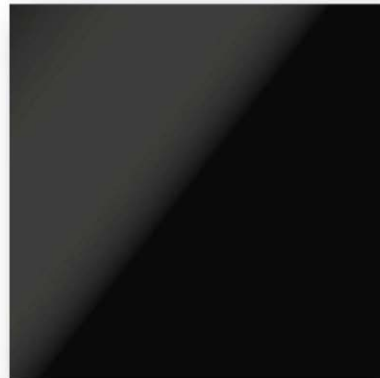


› **Standard  
Monocrystalline  
5 BB cells**



front

› **IBC – Interdigitated  
Back Contact cells**

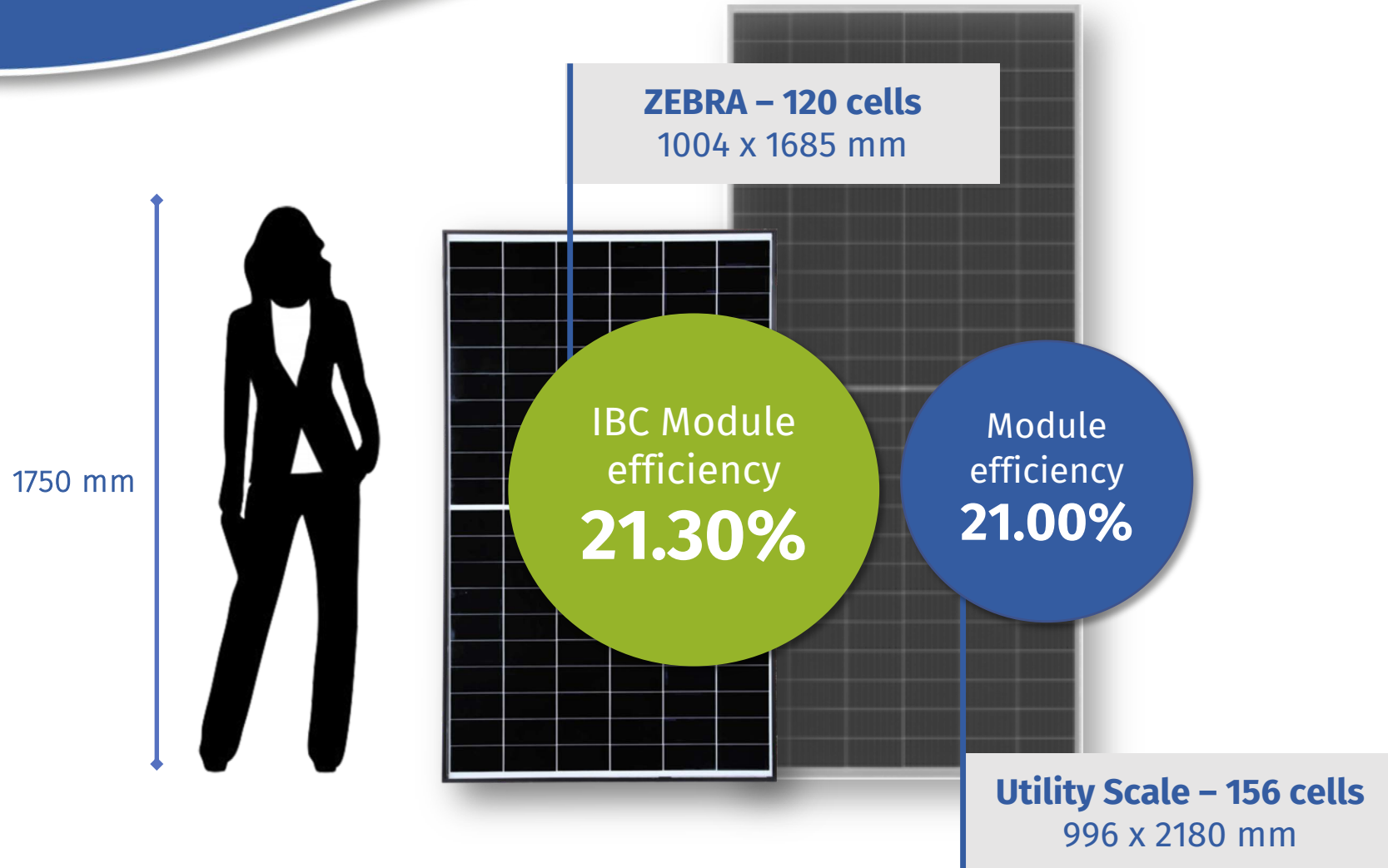


front

- › No shades on the cell caused by ribbons or busbars
- › Maximum light absorption

# FU350-360M ZEBRA

Dimension comparable to a standard  
60 cell panel



# Why ZEBRA panels are immune from LID and LeTID?

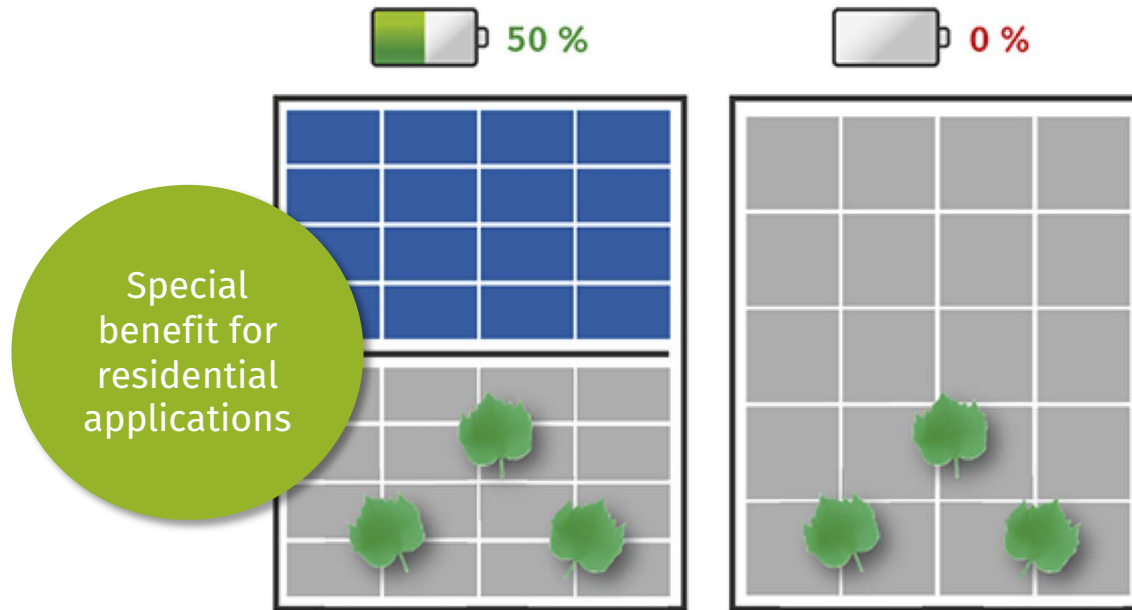
- › LID is the degradation of the module, which occurs in the **first few hours of sun exposure**. 95% of the cells worldwide are subject to this effect, in particular high efficiency cells.
- › LID causes a **reduction in efficiency from 1 to 5 %**.
- › The **LeTID degradation** combines the **effect of light with the effect of high temperatures** and can also create **power losses between 1 to 6 %**.
- › Since N-Type cells are doped with **phosphorus and not boron**, **Zebra cells are immune** to these phenomena.
- › **ZEBRA cells do not degrade under UV illumination**.

LID  
Light Induced  
Degradation



# ZEBRA – IBC half-cut technology

Improved behavior under shaded conditions



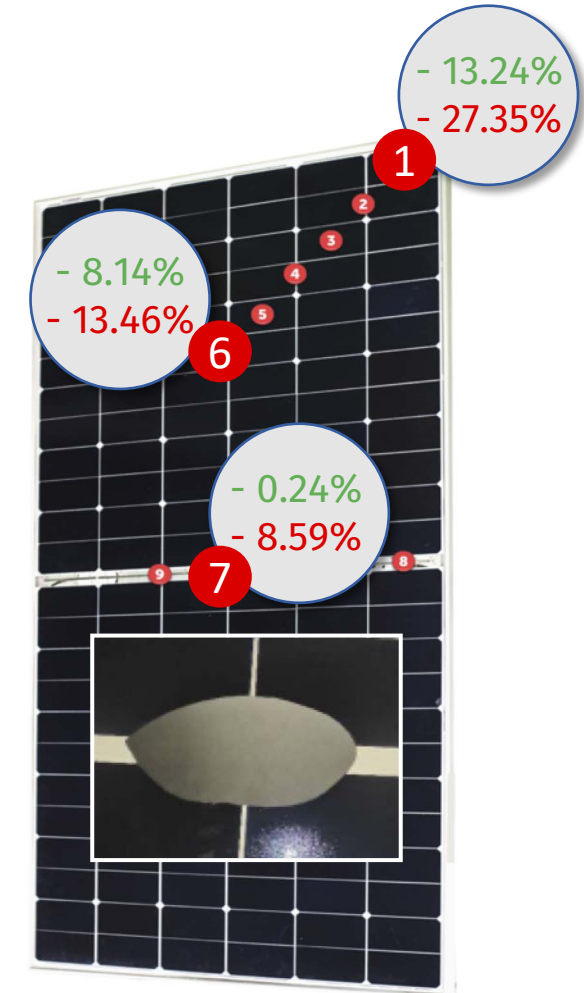
- › **ZEBRA** is the **only IBC module** available **with half-cut cells**
- › **2 independent section** design secures a higher energy yield in case of shading
- › **Shading, a typical problem of residential installations**
- › **Simplifies the design of the installation**
- › **Minimize the need of optimizers**

# ZEBRA

## Improved behavior under shaded conditions

- › Test to verify **the loss due to localized shadows** (leaf positioned on the red dots)

Location	ZEBRA loss	PERC loss	Mark
No Shading	0.00%	0.00%	Shaded 0 cells
1	13.24%	27.35%	Shaded 1 cell
2	8.62%	12.45%	Shaded 2 cells
3	14.19%	28.50%	Shaded 1 cell
4	10.61%	13.40%	Shaded 2 cells
5	14.40%	28.98%	Shaded 1 cell
6	8.14%	13.46%	Shaded 2 cells
7	0.24%	8.59%	Shaded 4 cells
8	11.83%	18.63%	Shaded 2 cells
9	1.63%	7.19%	Shaded 4 cells

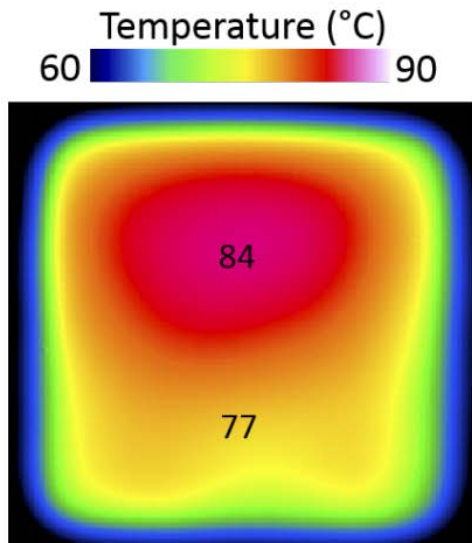


# ZEBRA

## Lower Hot-spot risk

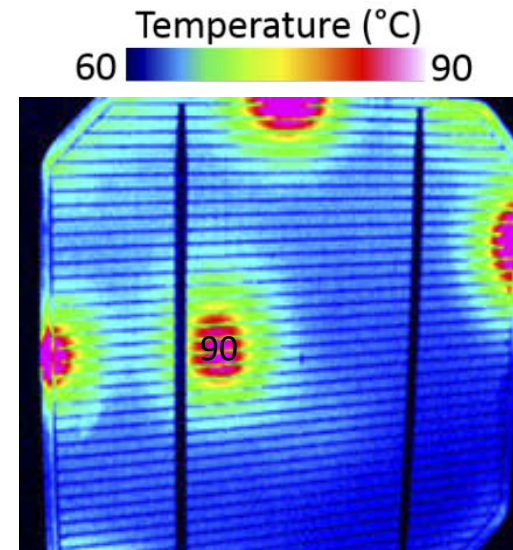
- Thanks to the distributed junction, **ZEBRA dissipates the power in reverse bias over a larger area** and remains at a lower temperature, **minimizing the risk of damaging the panel.**

### › ZEBRA IBC CELL



\*lab stress test

### › PERC CELL





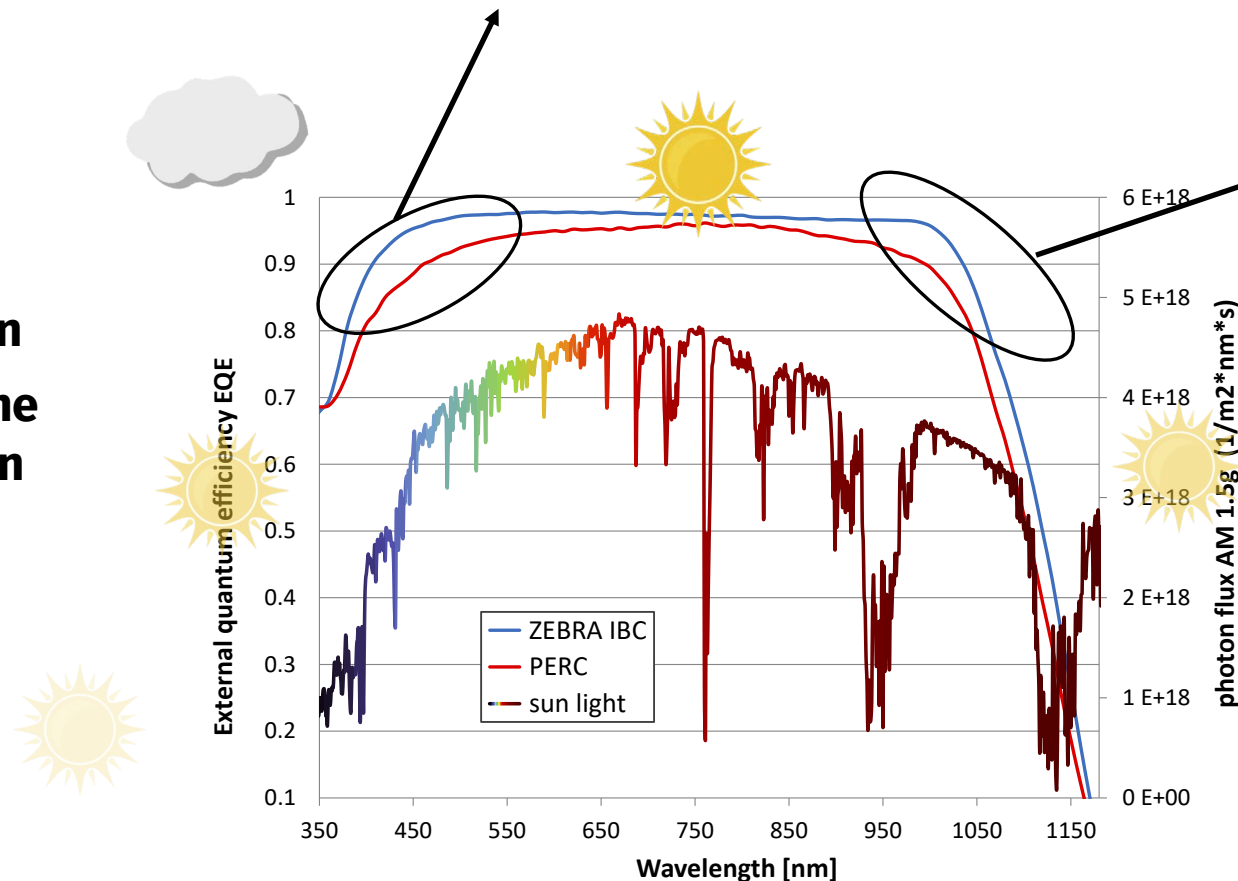
# ZEBRA

## Improved low light performance



- **Higher output / longer duration**
- Inverter switches on **earlier in the morning** and switches off **later in the evening**

Higher generation on **cloudy days**, when **light** is shifted to **blue**

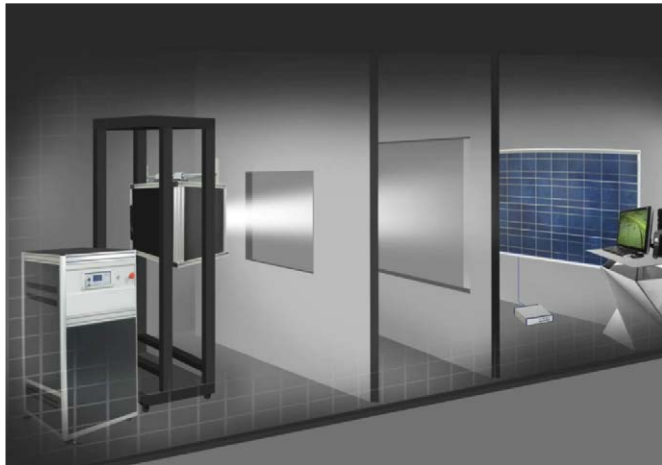


Higher generation in the mornings and the evenings, when **light** is shifted to **red**

EQE comparison of ZEBRA cell with industrial 9BB PERC cell, measured at **ISC Konstanz**

# Factory Vs Outdoor

**Factory:** perfectly perpendicular light



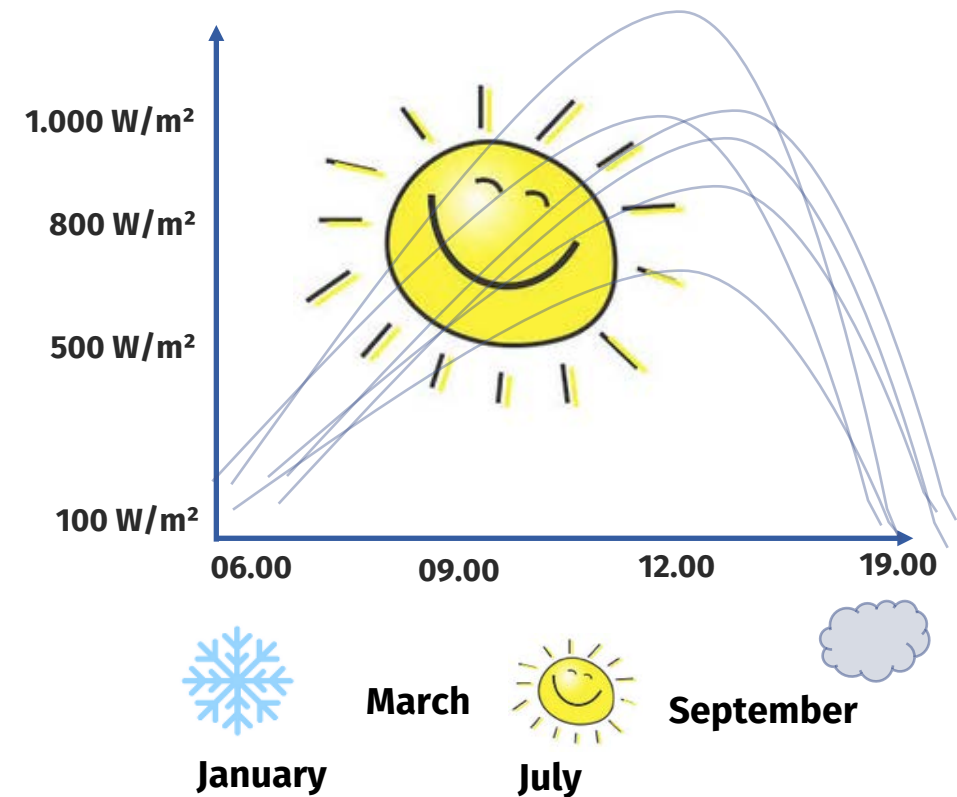
**STC**

1.000 W/m<sup>2</sup>

A.M 1,5

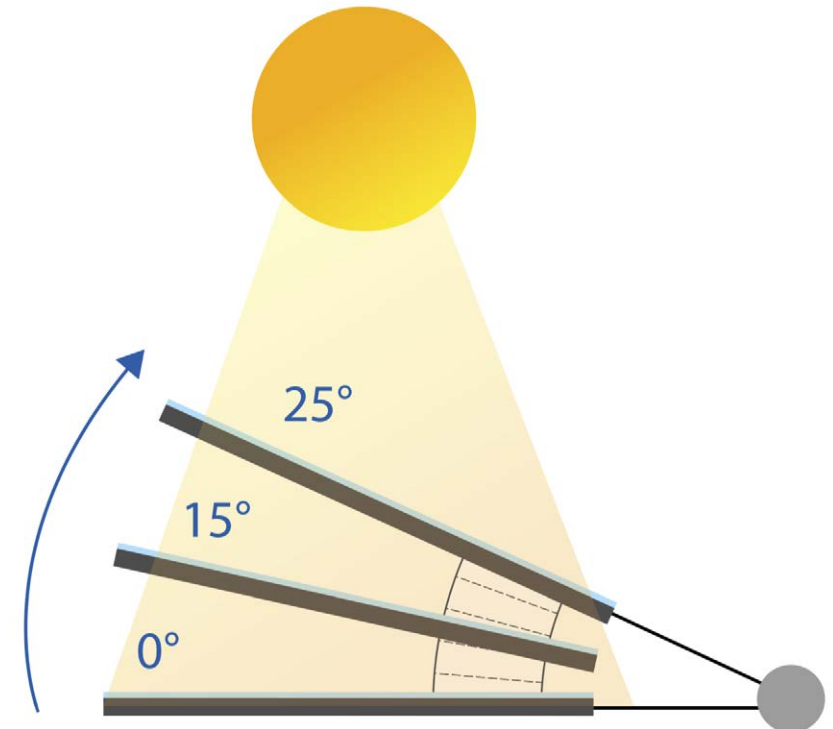
25 C°

**Outdoor:** various tilts and angles



- › Test to check the performance at different angles compared to perpendicular **STC conditions**.

Angle	Power Gain ZEBRA	Power Gain PERC
0°	100.0%	100.0%
5°	103.4%	100.9%
10°	102.9%	100.7%
15°	101.2%	99.5%
20°	98.6%	97.1%
25°	94.8%	93.2%





The **temperature coefficient** indicates the module's power loss with **increasing temperatures**.

A low temperature coefficient **ensures a higher yield during hot weather conditions**.

**ZEBRA voltage 700 mV** – ensures a low temperature coefficient.



Excellent  
temperature  
coefficient of  
**-0,300%/°C**



adds 3% of  
power in  
average  
operating  
conditions

# Accumulative financial gain over time

Cost difference: IBC ZEBRA Vs PERC

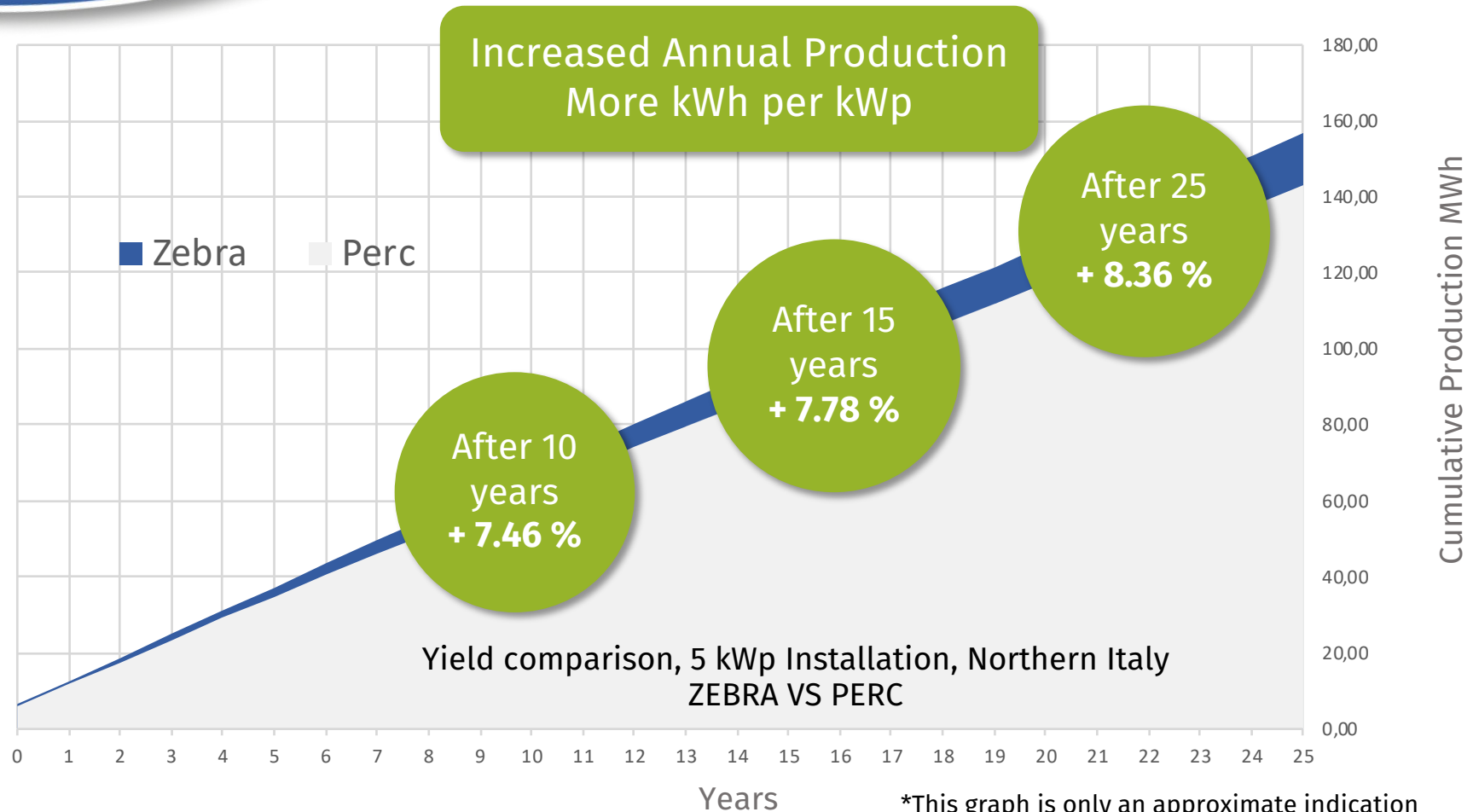
■ Loss  
■ Gain




\*This graph is only an approximate indication

# More kWh per kWp

## Comparison with traditional installations





- 
- › **Perfection in aesthetic design**
  - › **Superior energy performance**
  - › **More kWh per kWp**
  - › **Reliability & Availability**
  - › **Competitive cost compared to other high-end panels**

# ZEBRA

## Warranties

### Product guarantee

**25 YEARS**

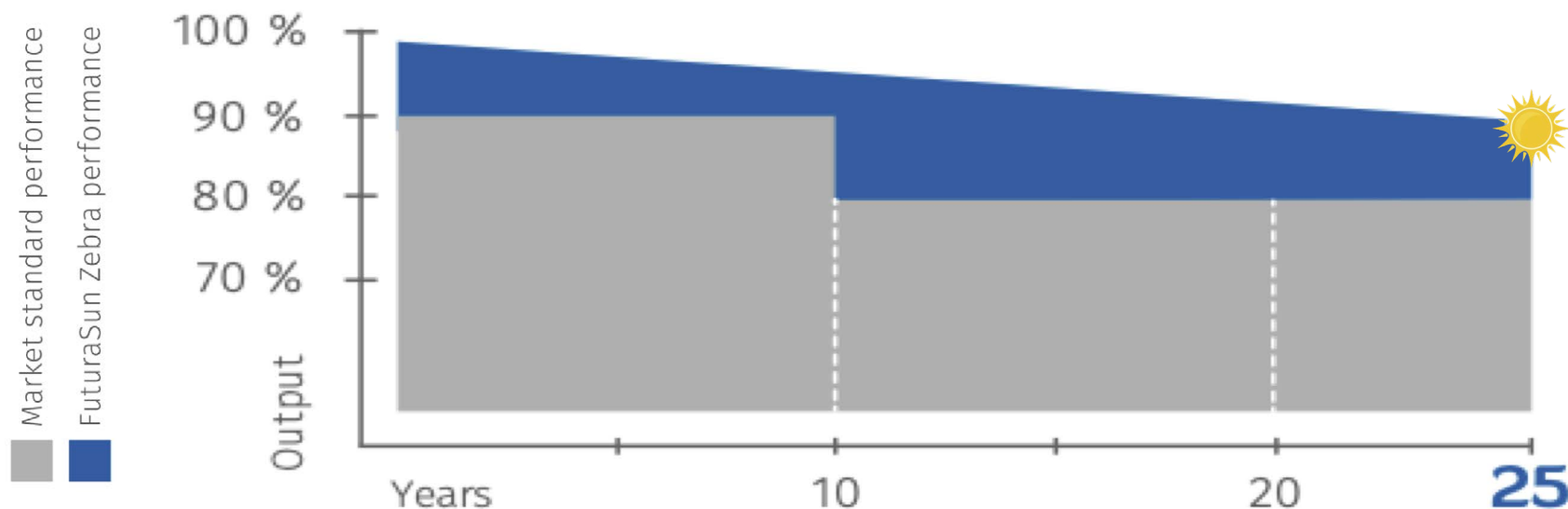
### Performance guarantee

Max power decrease **0.4%/year**

**1<sup>st</sup> year degradation - 1.0%**

99% at the end of first year

**89% at the end of 25<sup>th</sup> year**



# Thanks for your attention!

Please contact us for more information!



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