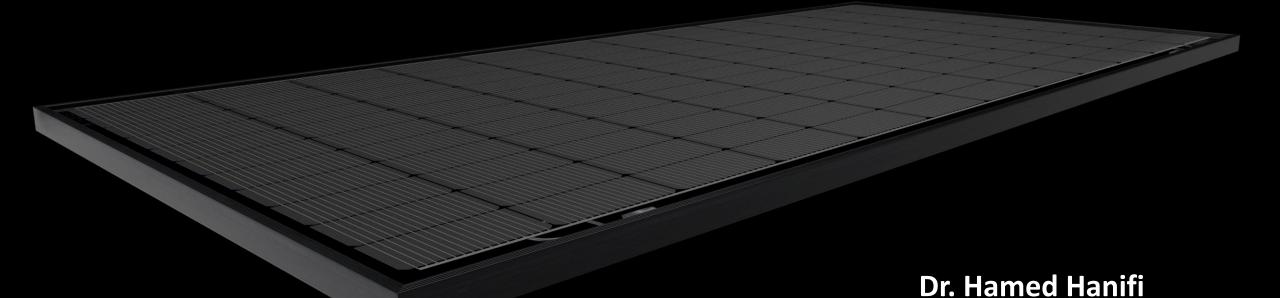
RETHINKING OF HALF-CELL INTERCONNECTION AND MODULE DESIGN: BOOSTING YOUR ENERGY YIELD AND DURABILITY



Head of Product Development and

Technical Marketing





20 years of AESOLAR



- Customer-orientated products
- Technical innovations with a German R&D group
- Global reach and partnership
- Tier 1 listed by Bloomberg NEF



AESOLAR

Intersolar 2023

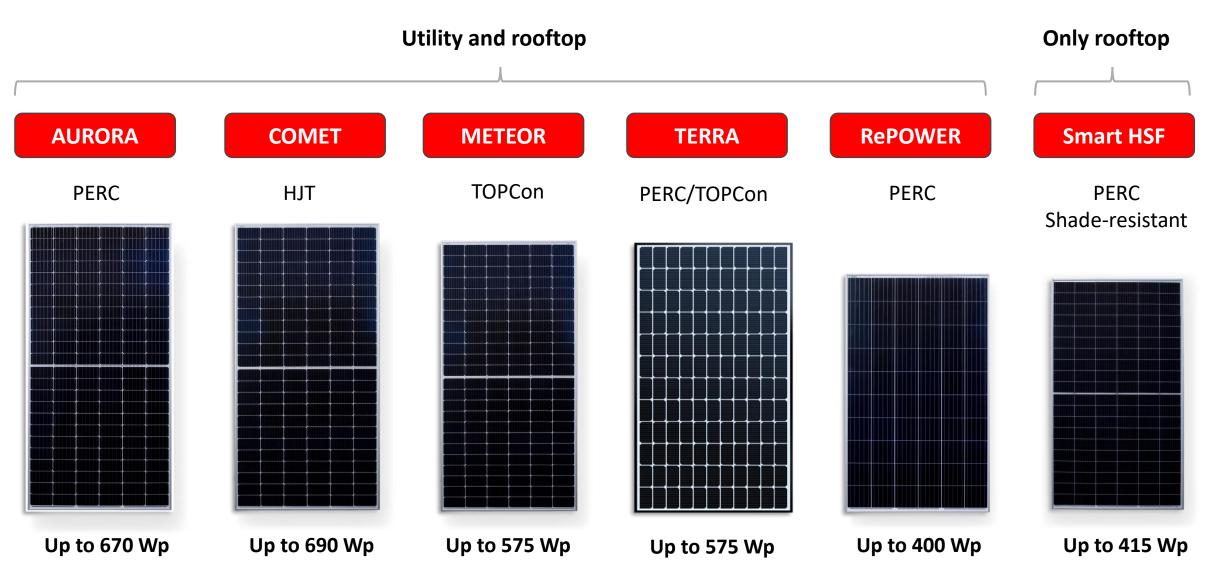


- AESOLAR presented its standard and innovative modules at Intersolar
- AESOLAR received PVEL trophy as TOP PERFORMER in reliability and performance of its modules

AESOLAR celebrated its 20 YEARS anniversary



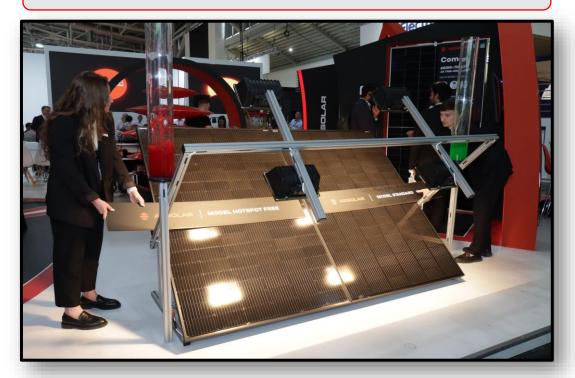
Product portfolio



AESOLAR

Innovation modules at AESOLAR

HSF 2.0: Shade-resistant PV module



- Half-cut cells
- ₱ Up to 80% more energy yield under partial shading conditions

TERRA: Half-cell module with add-ons



- No self-shading on the rear side
- # High tolerance on partial shading when mounted in portrait
- ₱ High resistance against wind and snow due to the module design

MOTIVATION



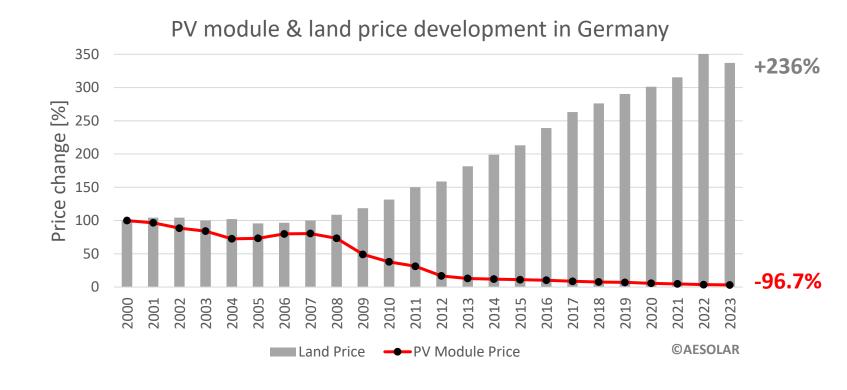
Challenges of TeraWatt PV in Europe

Europe plans 1 TW of solar installation until 2030

Challenges

- Land limits
- Land prices

More "Energy" per area

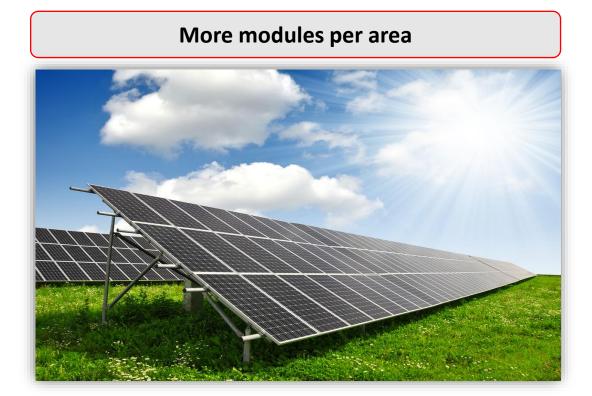


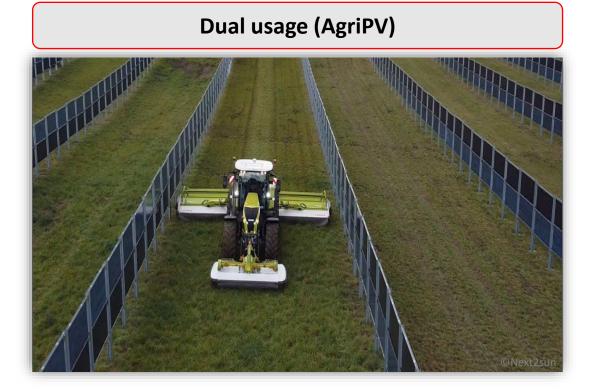
MOTIVATION



Highest benefit from land

\$ Optimization of **combined efficiency** of land and system becomes a new topic.





INTRODUCING TERRA

A boost to TeraWatt era

Bill of materials

- Half-cell module with uniform design
- Up to 550 W with PERC Technology
- Up to 575 W with TOPCon Technology
- Aluminium or Plastic frames

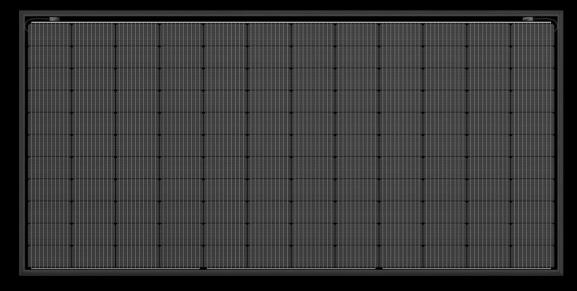
Technical highlights

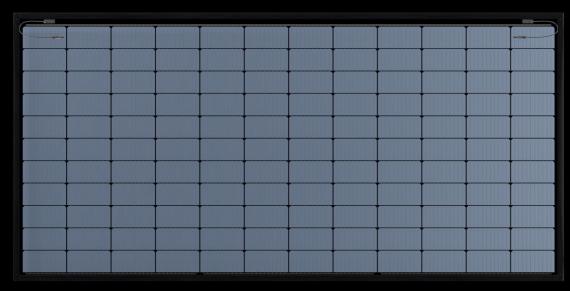
- No Self-shading
- Snow and Wind-resistant
- Shading tolerant

Launch date

From end of 2023







features

\$ AESOLAR

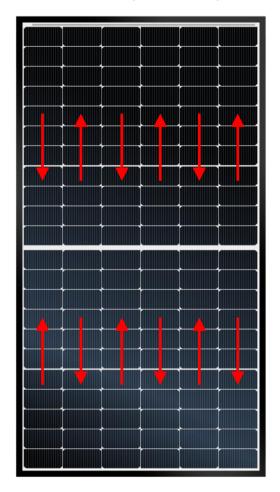
Interconnection

- **\$** Classical half-cell module
 - Cells are in series in each block
 - Top and bottom blocks are in parallel

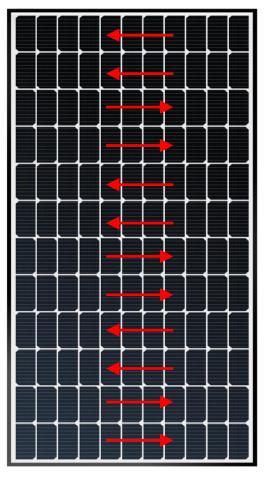
‡ TERRA

- Twin sub-strings in parallel
- Twins are connected in Series

Half-cell (Mirrored)



Half-cell (Uniform)



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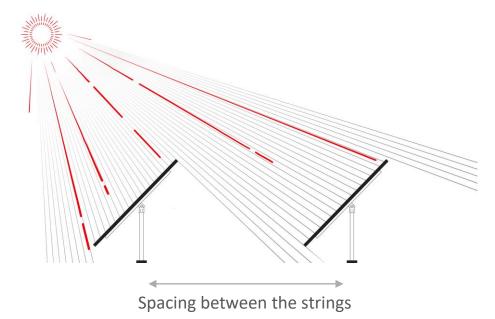
Dr. Hamed Hanifi Hanifi et al. Solar Energy, 2020

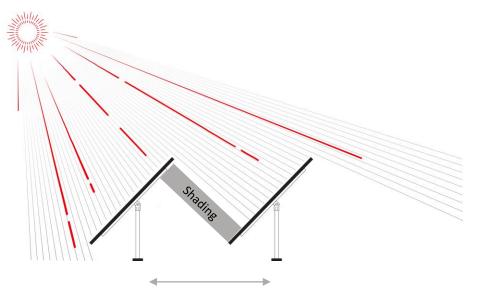


Increased yield for PV systems

- High land acqusition costs and high module efficiencies might affect the systems designs
 - Justifies to reduce the space between the strings and accept partial shading in parts of the day
 - Pack more strings in a limited area
 - Longer modules for repowering projects

Shading-tolerant modules





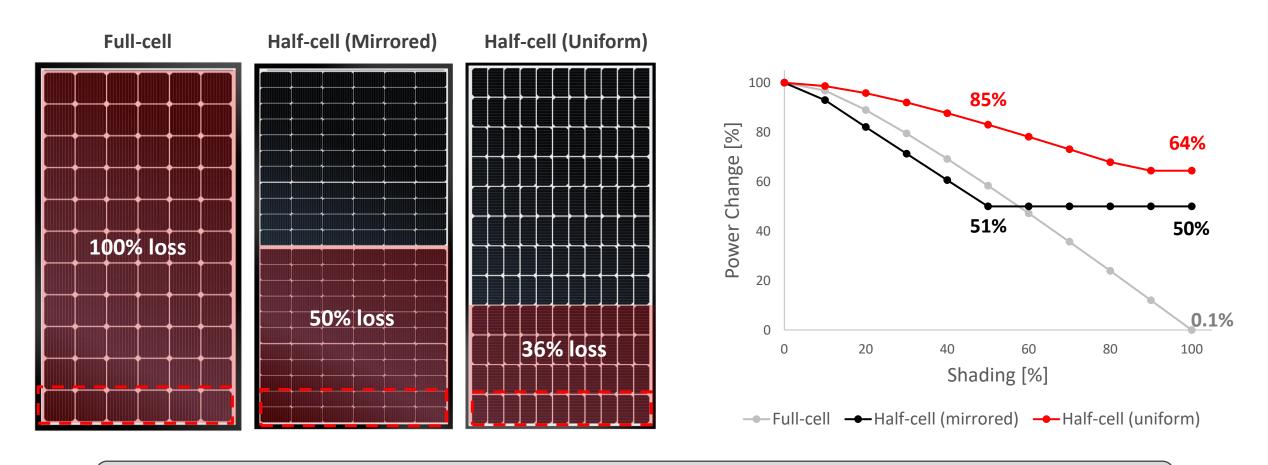
Reduced spacing between the strings

11



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Partial shading



More "Energy" after reducing the space between the strings and accepting of partial shading



Agri-Photovoltaics (AgriPV)

Dual usage of land for energy and agriculture

Benefits:

■ Increased combined efficiency per area

‡ Challenges:

- Self-shading of module components affects the energy generation from the rear side
- Increased wind-loads

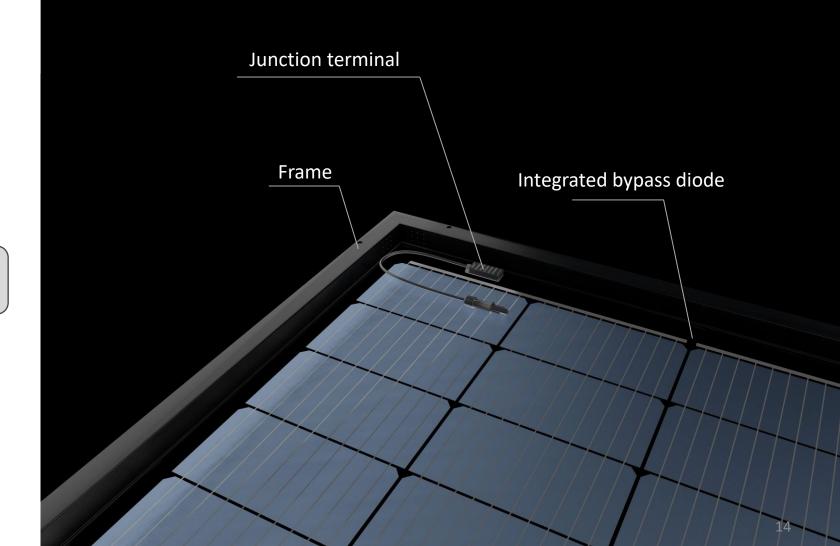


No self-shading

- No self-shading on the rear side from
 - Junction box
 - Cables
 - Frame
- **\$** Less cable work

Highest bifaciality in module level



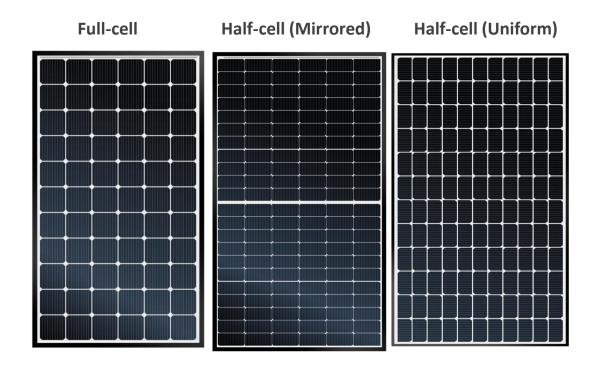




Durability against mechanical loads

‡ Challenge:

- Wind and snow induce mechanical loads
 - breakage of cells
 - bending of the laminate



Dr. Hamed Hanifi

AESOLAR

Durability against mechanical loads

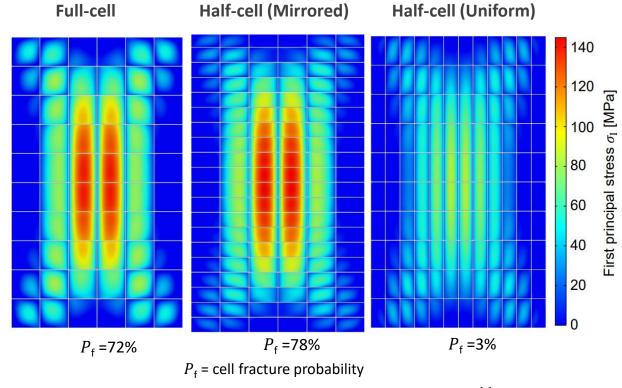
Challenge:

- Wind and snow induce mechanical loads
 - breakage of cells
 - bending of the laminate

Solutions:

- Using smaller cells
- Putting the long side of the cells in parallel to the longer side of the module to reduce stress caused by bending

Up to 75% less fracture probability



First principal stress on the back side of the solar cells at 5400 Pa [1]

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TAKEAWAY MESSAGE

■ TERRA is a standard module for all applications with add-ons

- Main features of Terra:
 - No self-shading
 - High durability against wind and snow
 - High tolerance against partial shading
 - Highest bifaciality in module level
- A perfect choice for vertically mounted applications
- Project owners pay for efficiency and power [€/Wp] but they need energy [€/kWh]!

TERRA promisses a longer lifetime and higher energy yield to achieve a lower LCOE without changing the materials





THANK YOU VERY MUCH FOR YOUR ATTENTION!



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