



**SUSTAINABLE  
SOLAR —  
EUROPE 2024**

# Session 5: 'How to Lower the Carbon Footprint of PV Modules and Components: Sharing Industry Best Practices'

12 December 2024

# Session 5: 'How to Lower the Carbon Footprint of PV Modules and Components: Sharing Industry Best Practices'



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SolarPower Europe



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Director EU Public Affairs & Policy,  
Trina Solar

# Decarbonization with Trinasolar

Sharing Industry Best Practices

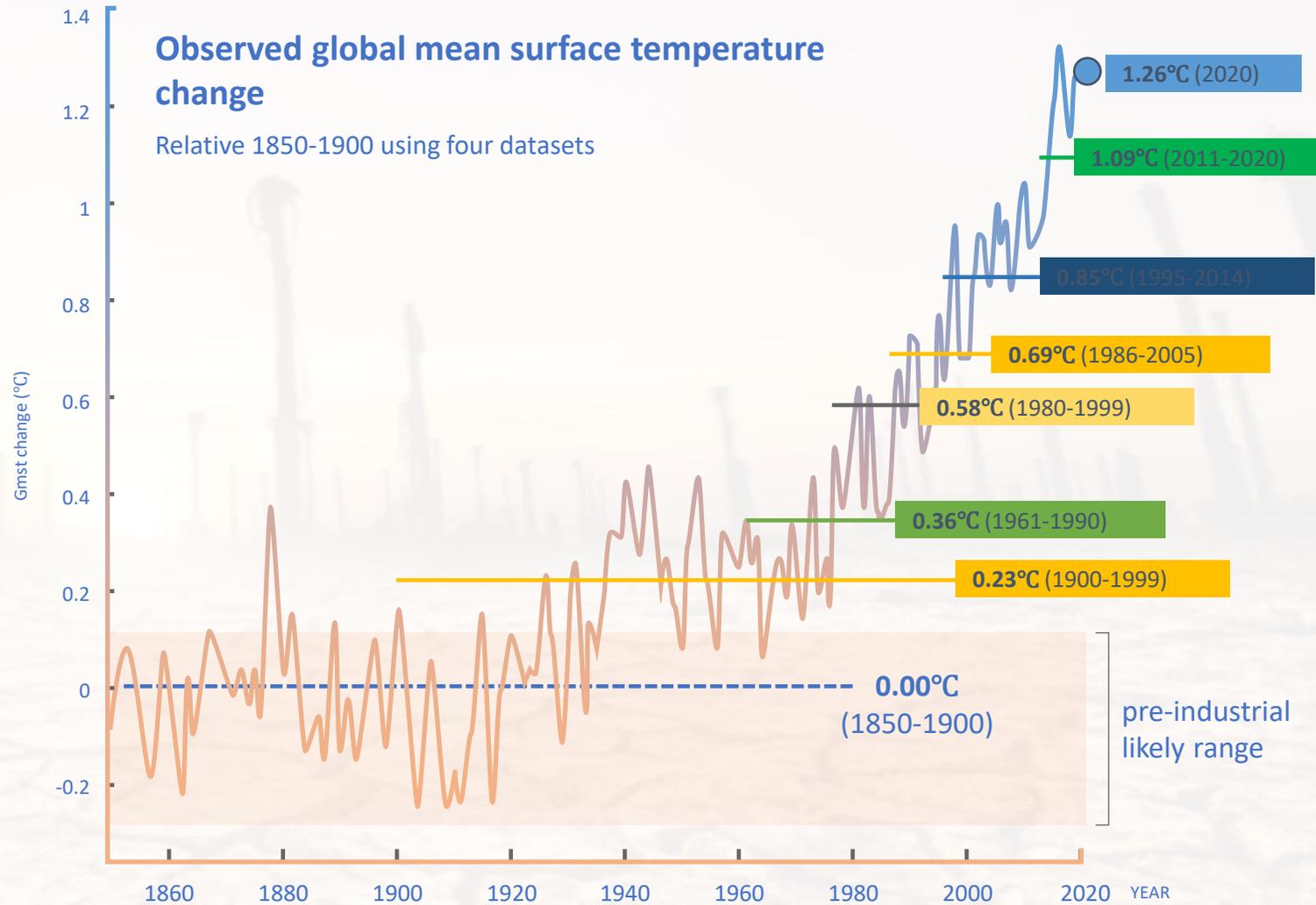
**Pia Alina Lange**

Director EU Public Affairs & Policy

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Sustainable Solar Summit 2024 | Brussels

# Global Warming



Source: IPCC, 2021. The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press. In Press.

# Climate strategy goals



GHG, electricity and water intensity targets



100% renewable energy use by 2030



Energy saving



PV systems and storage in Trinasolar facilities



Zero Industrial Park and Zero Carbon factories

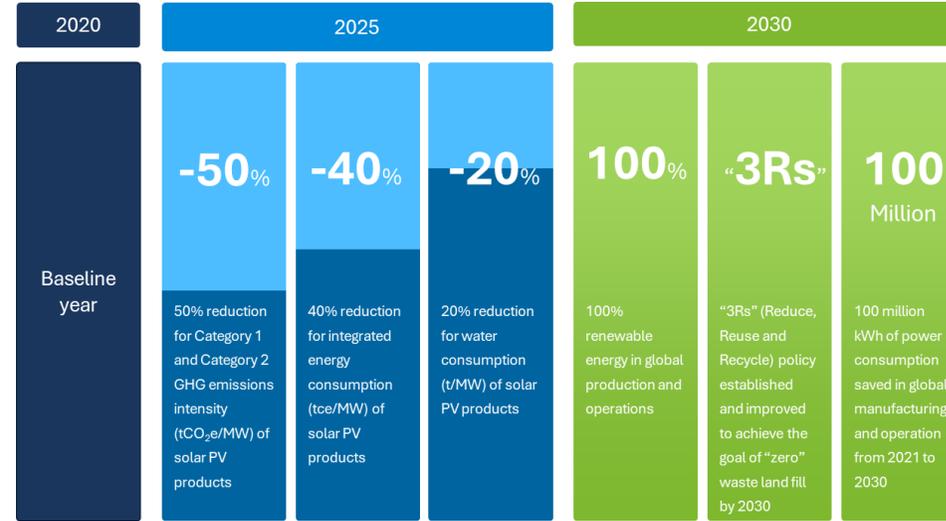


Promote a green supply chain

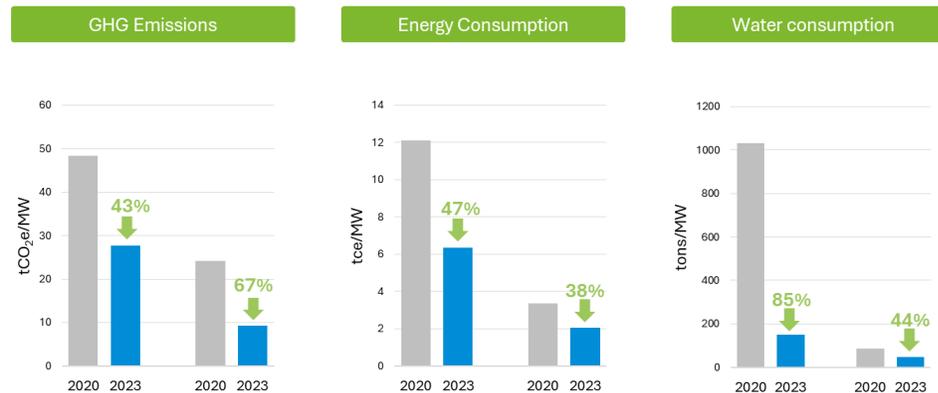


Reduce products carbon footprint

Sustainable development goals for 2025 and 2030 (2020 baseline)



**Trina Solar Yiwu**  
First zero carbon factory certificate in the PV industry. Four-star level



**Trina Solar Yancheng**  
Zero-Carbon Factory and Zero-Waste Landfill Certificates

# Recognition to our ESG efforts

**WE SUPPORT**



2023 ESG Innovative Enterprise

**Bloomberg Green**

Bloomberg Green ESG 50 list



中华人民共和国工业和信息化部  
Ministry of Industry and Information Technology of the People's Republic of China

National Green Supply Chain Management Enterprise



European Chamber  
中国欧盟商会

Decarbonisation leader



WWF Climate Solver Award



ESG rating upgraded to BBB in 2024



#2 in global solar module manufacturing ranking



For the tenth year in a row



The logo for Trinasolar is centered in the image. It features the word "Trinasolar" in a white, sans-serif font. A solid red circle is positioned above the letter 'i' in "Trina". The background is a scenic landscape of rolling green hills under a warm, golden light, with a small building visible on a distant hilltop.

Trinasolar



# Frederik Leus

XCarb Business development.  
Customer decarbonisation  
partnerships,  
Arcelor Mittal

# Mitigating the CO<sub>2</sub> eq footprint in solar: Low carbon-emissions steel for PV structures, foundations, and frames



ArcelorMittal

12 December 2024  
ArcelorMittal Europe – Flat Products

Frederik Leus

XCarb Business development, customer  
decarbonization partnerships



ArcelorMittal

Cleaner energy sources deserve cleaner solutions, starting at the design stage.

“By utilizing low carbon-emission steel in the top two sections of an offshore tower, we can achieve **25% reduction of emission** compared to a tower made from steel made via conventional steelmaking route.” Vestas



**XCarb<sup>®</sup>**

Recycled and renewably produced

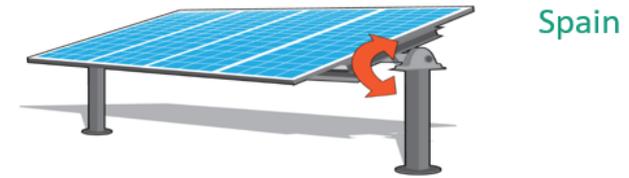


© Vestas

- Baltic Power project:**
- **1.2GW of capacity: 76 turbines from Vestas (V236 -15MW) => electricity to 1.5 million households**
  - **Supply of ~10kT XCarb<sup>®</sup> recycled and renewably produced steel plates**

## Summary - Carbon PayBack Time and Carbon Reduction

### Mounting Structure Focused Results



#### Total lifetime CO<sub>2</sub> Germany, fixed Payback

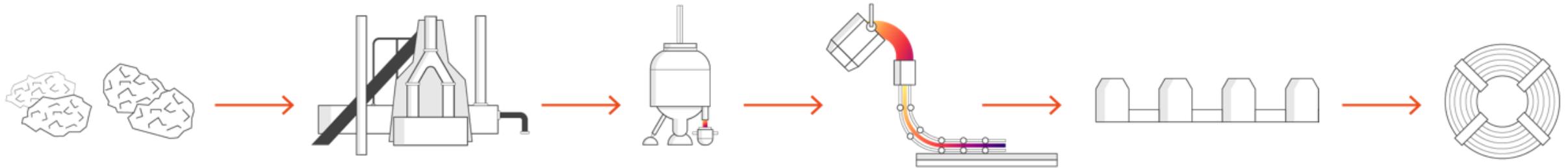
Standard Steel	XCarb <sup>®</sup> Steel
2.44 years	2.1 years

#### Total lifetime CO<sub>2</sub> Spain, tracked Payback

Standard Steel	XCarb <sup>®</sup> Steel
2.76 years	2.45 years

- Carbon Payback time can be reduced by up to 13%
- XCarb<sup>®</sup> Steel can decrease the steel manufacturing emission ratio by approximately up to 30%
- Looking at BOS components the substructure plays a major role for CO<sub>2</sub> reduction
- However, do not forget the PV modules

# Traditional steel making route: blast furnace is the main contributor to CO<sub>2</sub>e emissions



**1.**

## Iron ore / coal

Iron ore is processed to sinter and pellets  
Coal is being transformed into coke.

**2.**

## Blast furnaces

In the blast furnaces, iron is produced by reducing iron ore with coke and coal.

**~90% of CO<sub>2</sub> emissions occur during the ironmaking stage**

**3.**

## Basic oxygen steel plant

By blowing pure oxygen into the liquid iron, iron is transformed into steel.

**4.**

## Casters

In the continuous casters, liquid steel is poured into slabs of steel.

**5.**

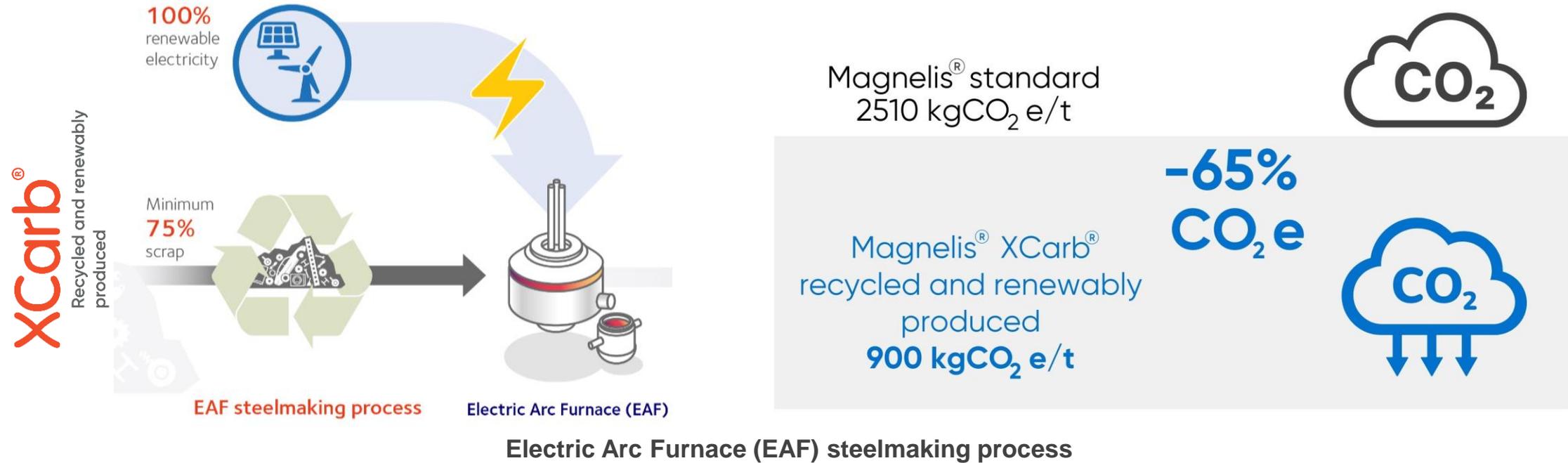
## Hot strip mill and cold mill

The steel slabs are rolled into coils of steel.

**6.**

## Coil of steel.

# XCarb<sup>®</sup> recycled and renewably produced: low carbon-emissions steel already available for solar applications



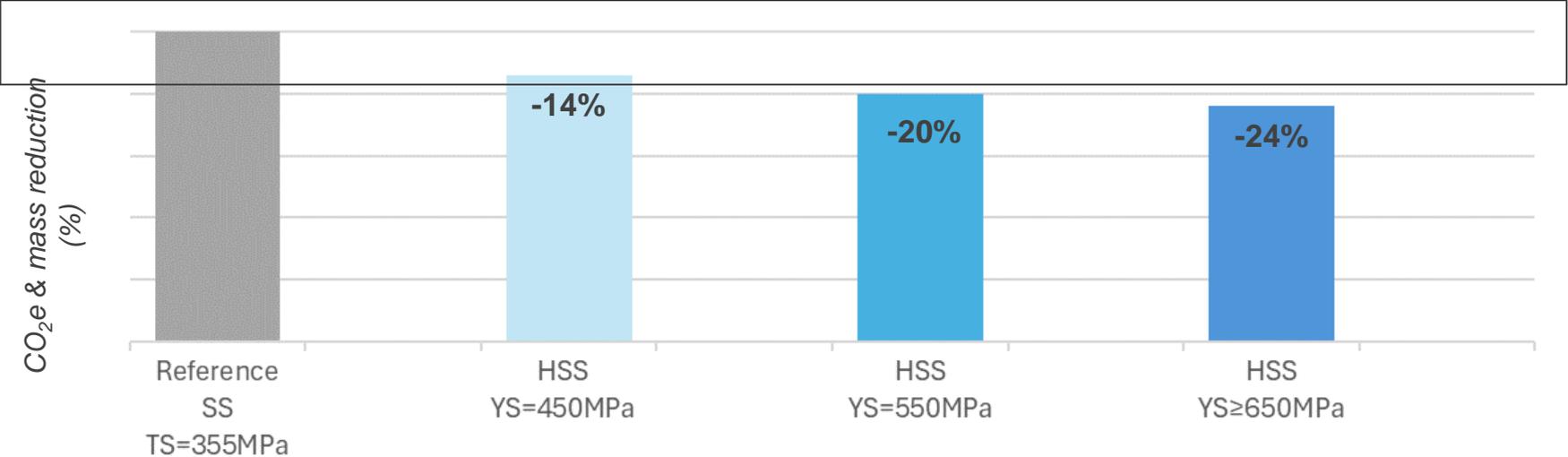
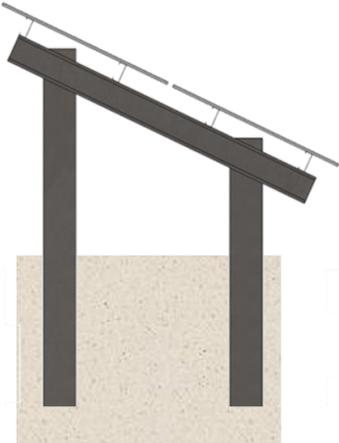
**Minimum 75% of scrap** and using **100% renewable electricity**.

Carbon footprint of galvanised material reduced by **~65% on a life cycle basis** (LCA cradle-to-gate).

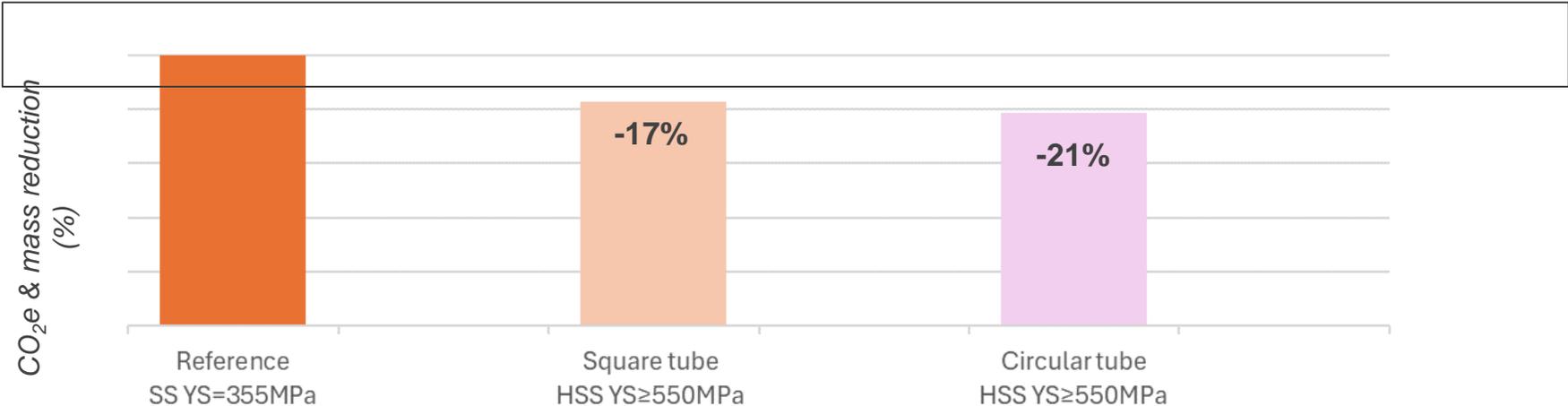
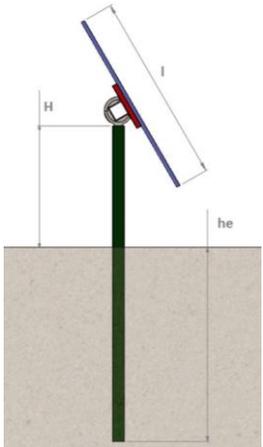
Products offered with a **verified Environmental Product Declaration (EPD)**.

# Up to 24% reduction of material usage and CO<sub>2</sub> footprint by material optimisation...

Fixed tilt

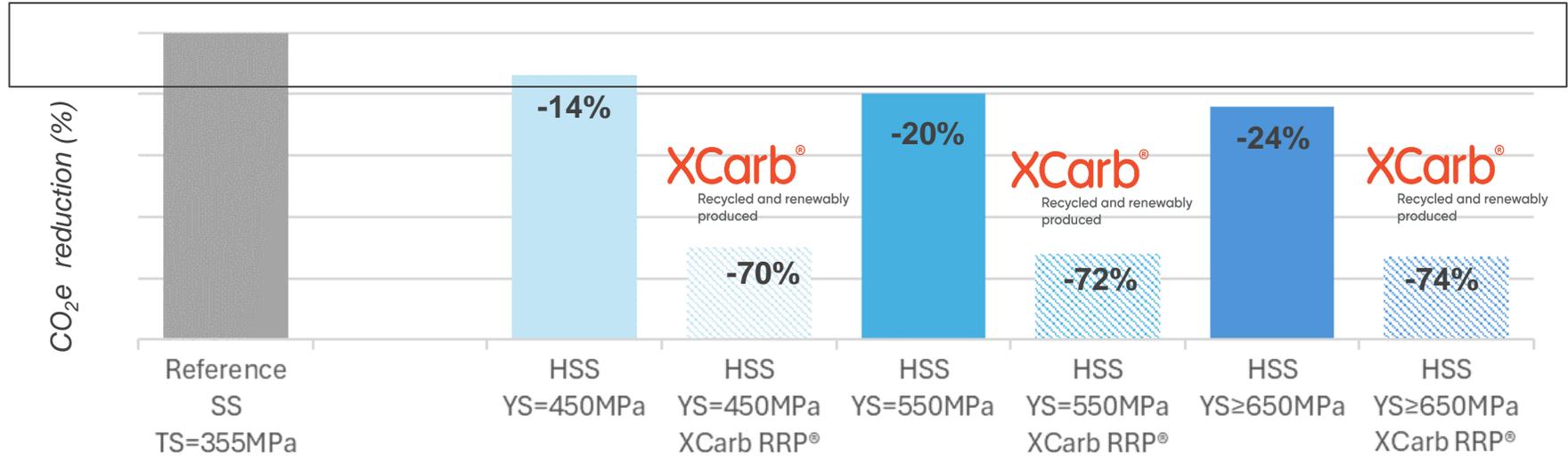
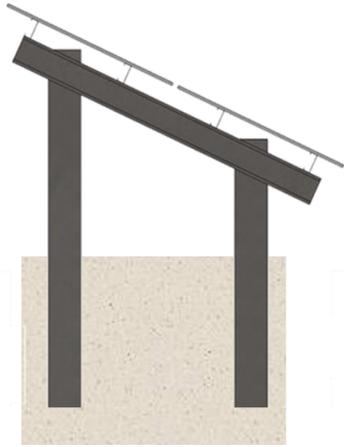


Horizontal Single Axis Tracker

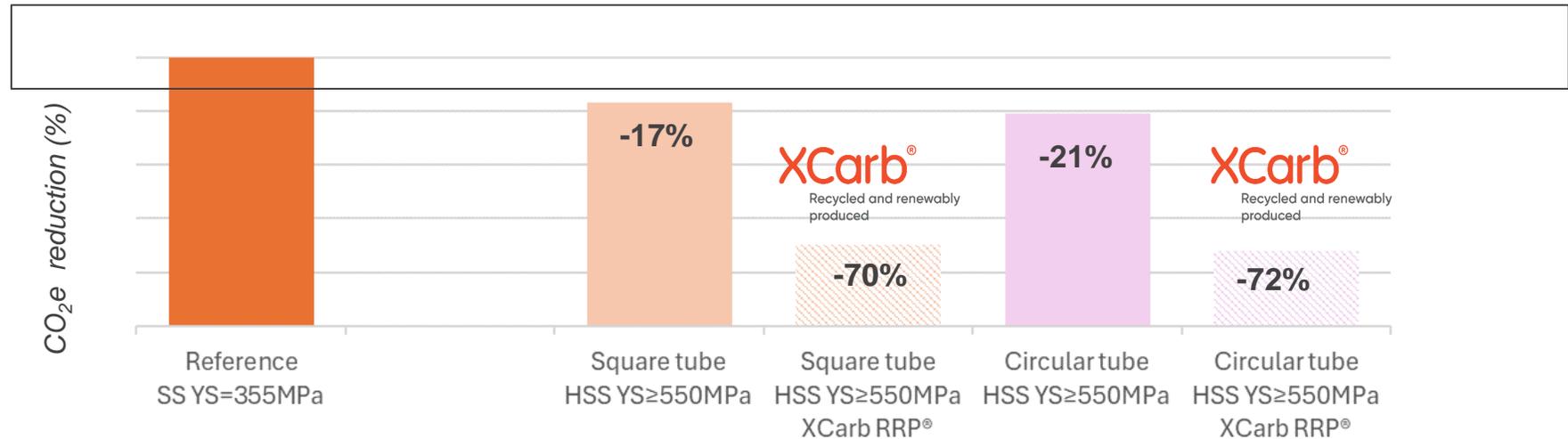
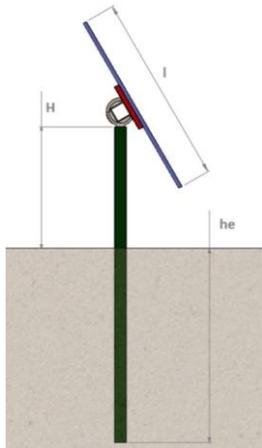


# ... and up to 74% when material optimisation is coupled with low CO<sub>2</sub> emissions material

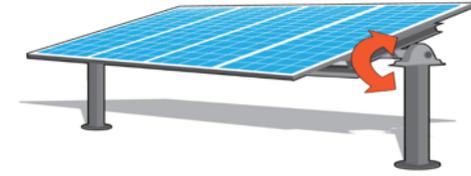
Fixed tilt



Horizontal Single Axis Tracker



# Balance of System (BoS) Results Horizontal Single Axis Tracker PV Plant

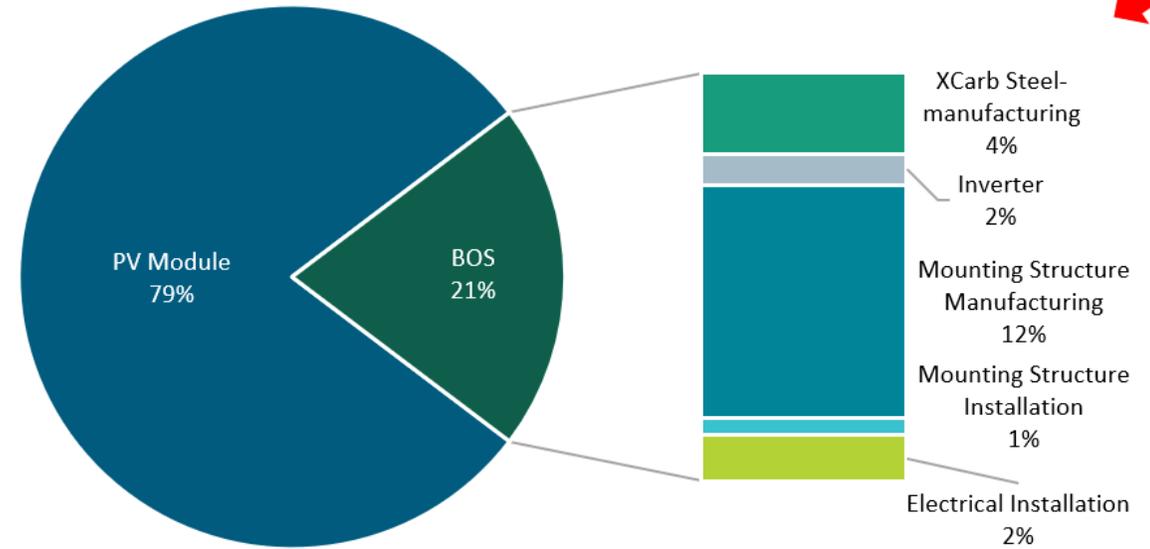
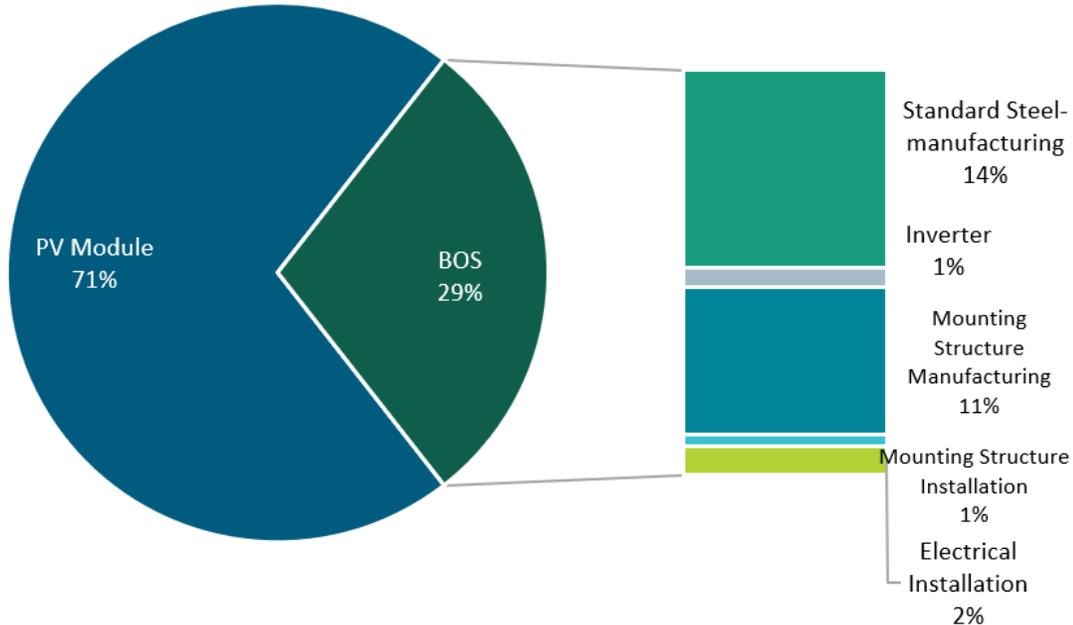


## Standard Steel

## XCarb® Steel

Climate Change kg CO<sub>2</sub> eq.

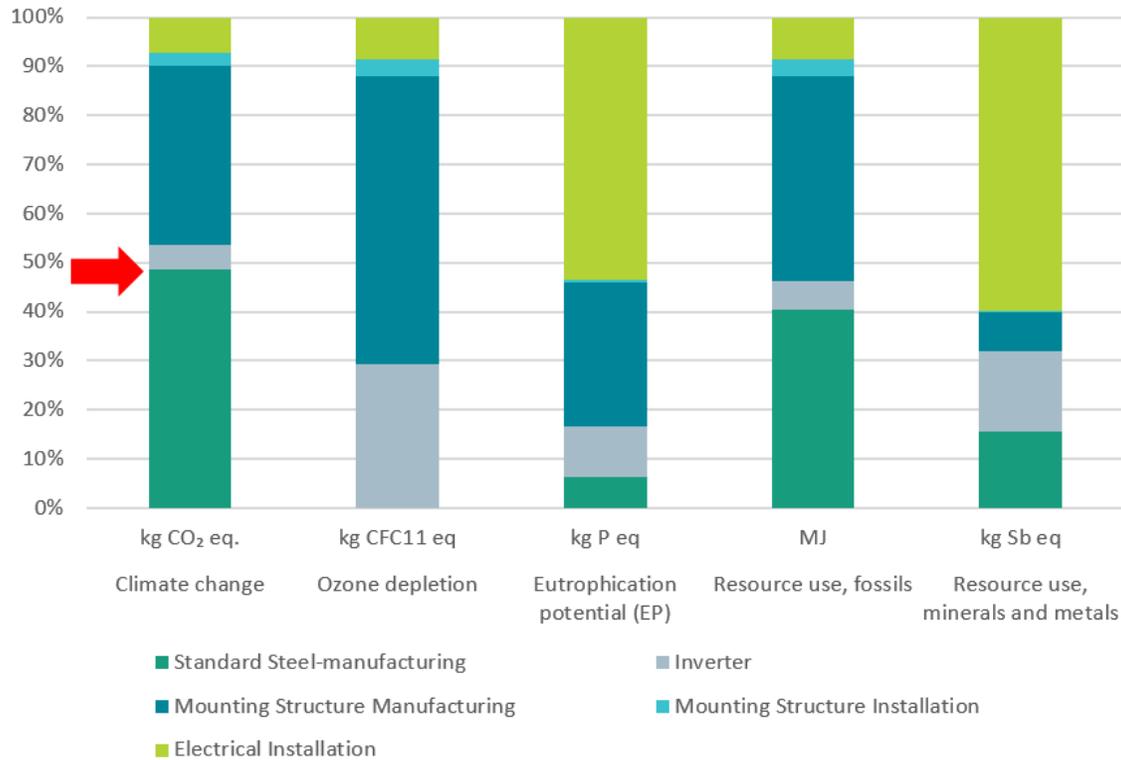
Climate Change kg CO<sub>2</sub> eq.



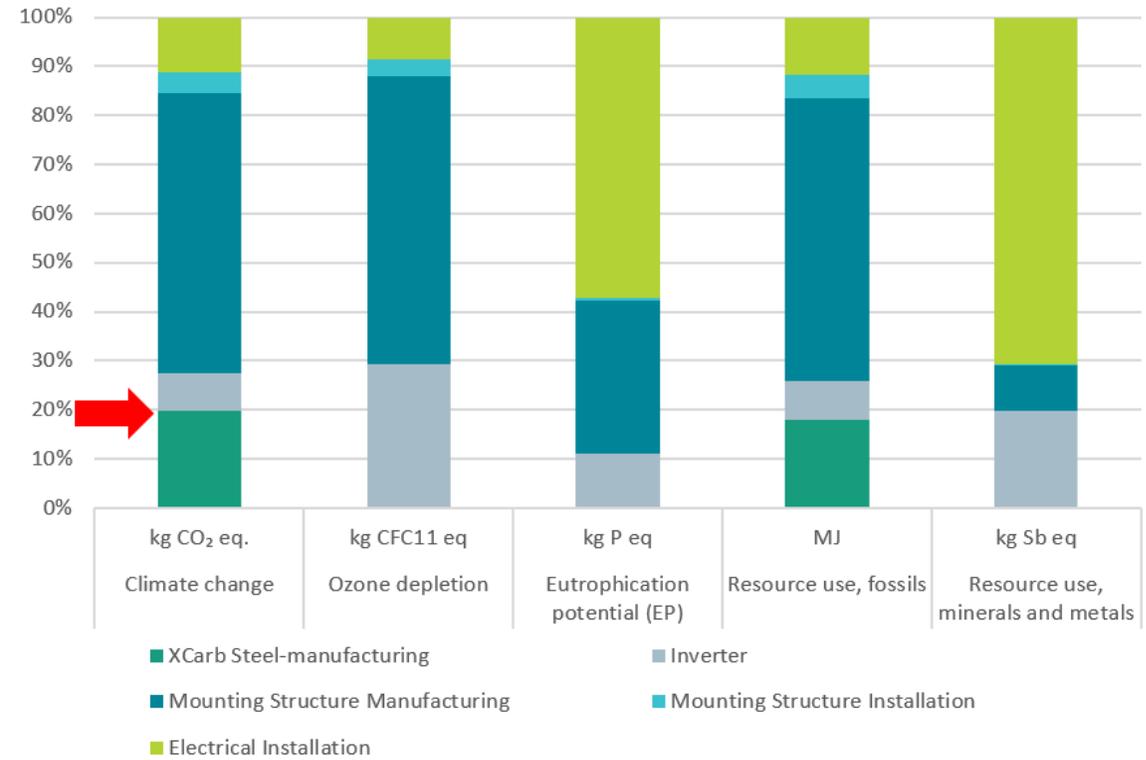
# Balance of System (BoS) Results

## Focus on Balance of System and Impact Categories

Environmental Footprints of BoS (HSAT - Std. Steel)



Environmental Footprints of BoS (HSAT - XCarb® Steel)



# Combining Magnelis® coating + XCarb® recycled and renewably produced steel to build sustainable solar infrastructures

## Example of PV plant & solar trackers in Portugal

Gonvarri Solar Steel and Iberdrola will install 41 MWp of solar trackers made from ArcelorMittal's recycled and renewably produced Magnelis® XCarb® for a project in Portugal



<https://europe.arcelormittal.com/newsandmedia/europenews/news-2023/xcarb-gonvarri-solarsteel-iberdrola>

# Key takeaways



1. ArcelorMittal is a solid and innovative partner for solar PV projects.
2. Cleaner energy sources deserve cleaner solutions; the available XCarb<sup>®</sup> steel coated with Magnelis<sup>®</sup> can contribute to lower emissions.
3. Our facts and figures are backed by EPDs, LCA, and performed by third parties.
  - 1 tonne of Magnelis<sup>®</sup> = 2.51 tonnes of CO<sub>2</sub> equivalent
  - 1 tonne of Magnelis<sup>®</sup> XCarb<sup>®</sup> recycled and renewably produced = 0.9 tonne of CO<sub>2</sub> equivalent
  - the carbon payback time of a ground-mounted PV farm can be reduced by 15%.
5. Magnelis<sup>®</sup> coatings are continuously upgraded to meet solar PV constraints.
6. The momentum for decarbonisation has begun – stay tuned!

# Thank you



ArcelorMittal



ArcelorMittal



# Yuliya Katsyuk

Sustainability Manager,  
FuturaSun

SUSTAINABLE  
SOLAR \_\_\_\_\_  
EUROPE 2024

# Lowering the Carbon Footprint

Our ongoing commitment

**Yuliya Katsyuk, Sustainability Manager at FuturaSun - Sustainable Solar Europe 2024**

A two-story peach-colored building with a terracotta roof and green shutters. It features a balcony with a metal railing and a striped awning. The building is surrounded by lush greenery and a hillside in the background. The text "About FuturaSun" is overlaid in the center.

*About FuturaSun*

# New Production in EU

## Lower carbon footprint

- Cells from our facility with EU IP and traceability
- Use of European components
- Reduction of transport-related emissions
- Recycling
- Certifications: LEED and BREEAM
- NZIA compliant
- Short term: GHG emissions of the panels below 400 kgCO<sub>2</sub>eq/kWp
- Mid term: below 300 kgCO<sub>2</sub>eq/kWp



# Carbon footprint of the technology range

## High efficiency PV modules



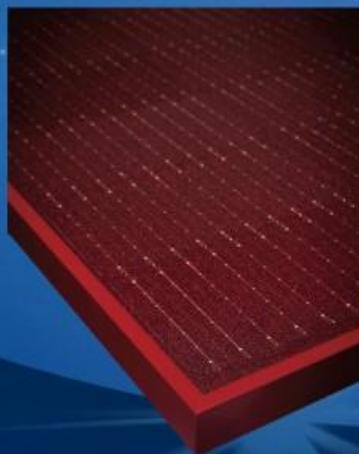
### N-type

**Silk® Nova**  
420 - 700 Wp  
Backsheet & glass-glass



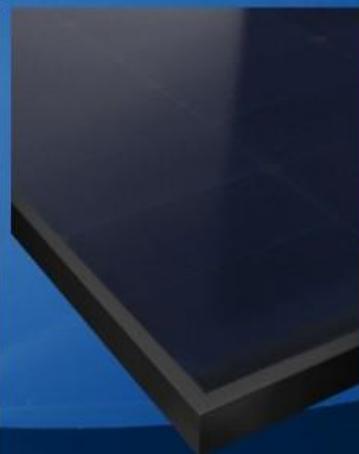
### PERC

**Silk® Plus**  
400 - 550 Wp  
Backsheet & glass-glass



### N-type

**Silk® Nova Colour**  
360 - 390 Wp  
Red, Orange, Silver, Green



### IBC

**IBC ZEBRA**  
420 - 430 Wp  
High aesthetic value



### HTJ

**Velvet**  
430 - 470 Wp  
Glass-glass

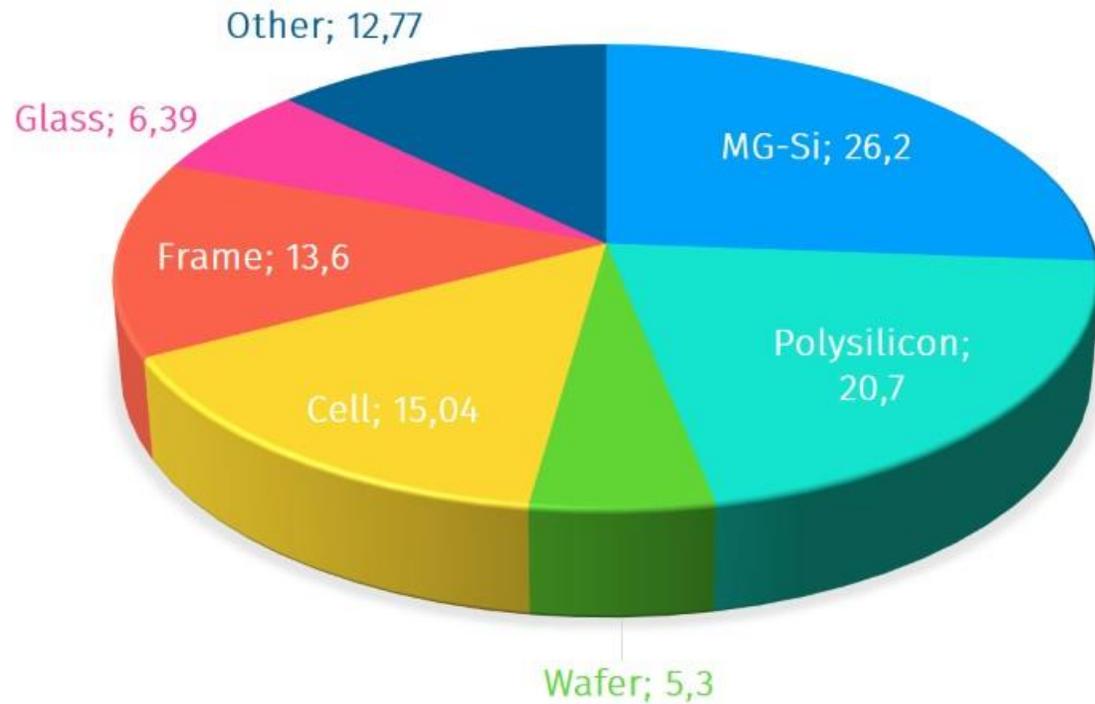


### Repowering

**Mono & Polycrystalline**  
190 - 455 Wp  
For repowering plants

# Life Cycle Assessments

## Impact of processes and materials



Process	Impact (%)
MG-Si	26,2
Polysilicon	20,7
Wafer	5,3
Cell	15,04
Frame	13,6
Glass	6,39
Other	12,77
TOTAL	100

# How are we reducing our carbon footprint?

<b>R&amp;D</b>	Bifacial perovskite modules
<b>Mid Term</b>	IBC4EU* project
<b>Short Term</b>	Alternative materials for frames Higher durability
<b>Right now</b>	Carbon Neutral PV modules



\*This project has received funding from the Horizon Europe Programme for Research and Innovation (2021-2027) under grant agreement No 101084259.

*Everything, everywhere and all at once!*



# Contacts

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**Yuliya Katsyuk**  
**12/12/2024**

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# Jerzy Rudnicki

Senior Technical Manager,  
Astronergy

# Advances in Lowering The CO2 Footprint: PV Manufacturing



**ASTRONERGY**

12/12/2024

Jerzy Rudnicki – Senior Technical Manager



# ASTRONERGY At The Forefront Of TOPCon Mass Production

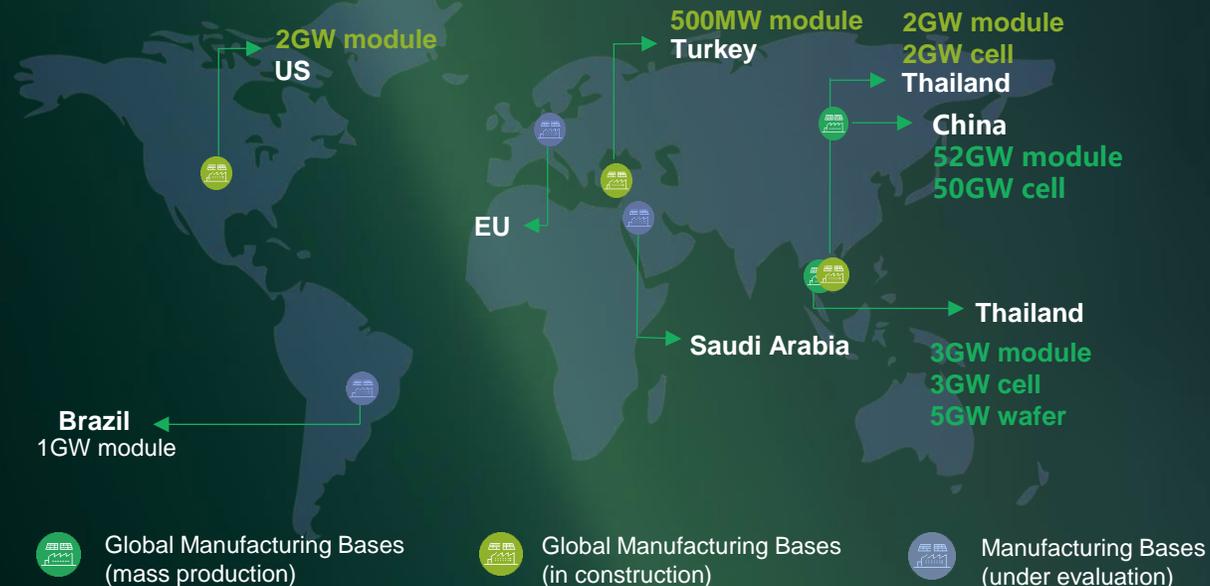


ASTRONERGY

- Solar PV manufacturer since **2006**
- A brand of the CHINT Group (1984)
- A Long-Term **Tier 1** Company
- Accumulated shipments **>100GW**
- **Mission:** To create a sustainable and net-zero carbon world with solar power



## MANUFACTURING FACILITIES

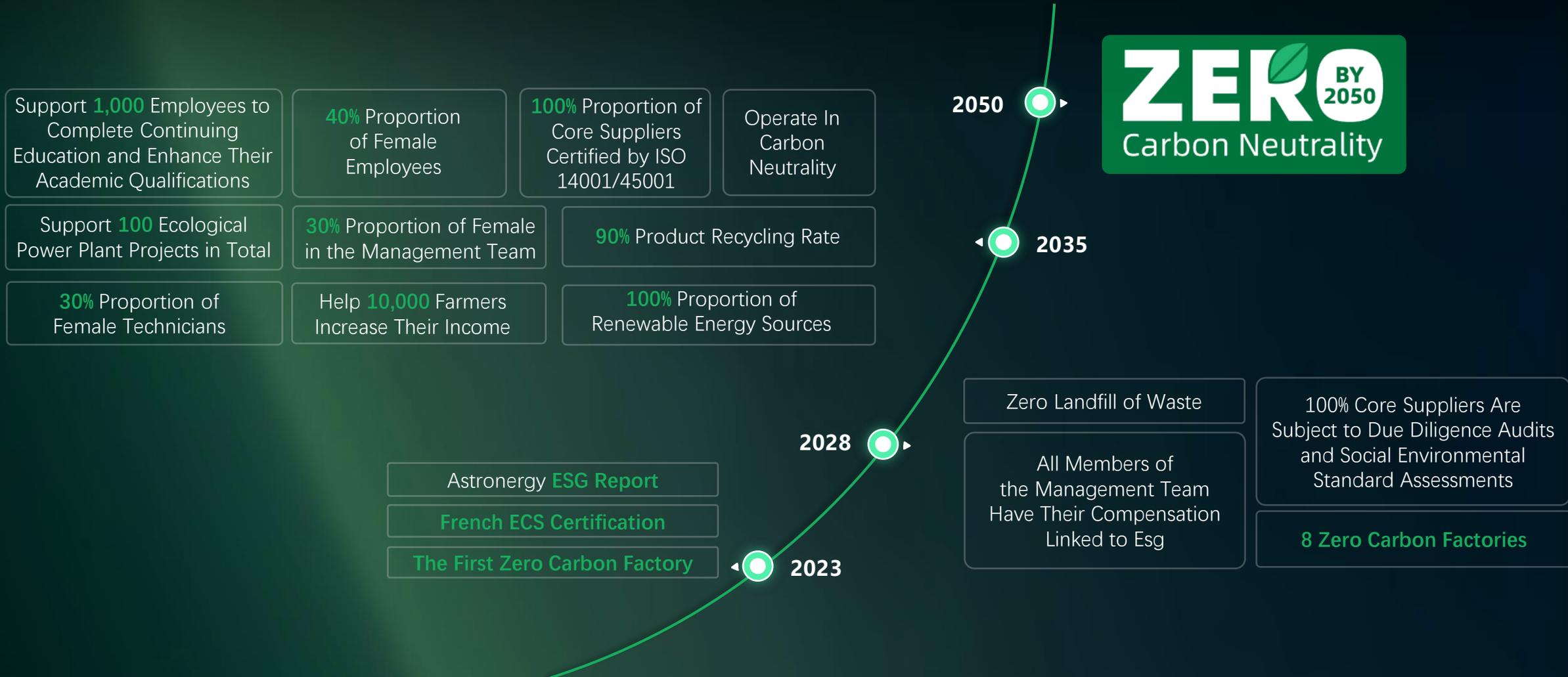


- **9** China Based Manufacturing Plants
- **3** International Manufacturing Plants: Thailand, Turkey, US (in construction)
- **91%** of manufactured cells are N-type (TOPCon)
- Annual capacity e.of 2024: **55GW Modules**
- Rapid growth: Since 2022 production capacities has been **tripled**

# Sustainability Strategy Roadmap



ASTRONERGY





# Zero Carbon<sup>7</sup> Solar Panel

FROM ZERO TO ZERO

Product Lifetime Assessment





# Green Manufacturing – Yancheng Zero Carbon Factory

## YANCHENG BASE:



### Rooftop PV Power Plant

**26,590**      **11.18** million kWh  
 Pv modules installed      Electricity annually

**80,000** m<sup>2</sup>      **6,376** tons  
 Coverage      Carbon emission reduced



### PV Carports

**4,614** m<sup>2</sup>      **220**  
 Coverage      Motor vehicles parked

**920,000** kWh      **400**  
 Electricity annually      Non-motorized vehicles parked



### PV Powered Lighting system

**200+**      **31,080** kWh  
 Streetlights installed      Electricity annually

**17.7** tons  
 Carbon emission reduced

### Additional Interventions implemented:

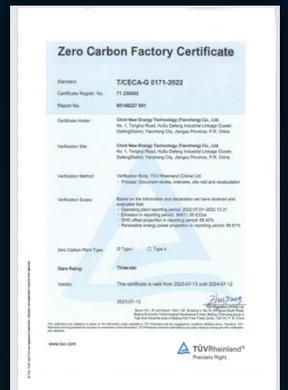
- Water-saving Fixtures
- Waste management
- Green Building Materials
- Energy & Carbon Emission Intelligent Management System
- Green Energy Certificates Trade



First Zero Carbon Factory In The World  
 Certified by TÜV Rheinland

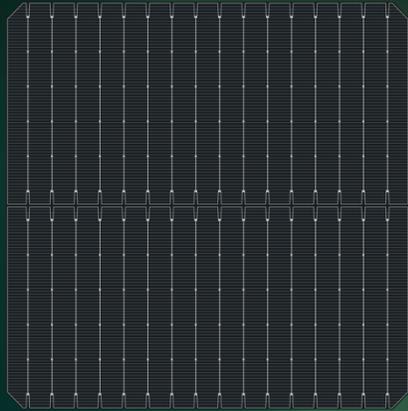
### During reporting period:

- >69% of energy came from renewables
- GHG offset proportion >65%
- Emissions ~64.5kTCO<sub>2</sub>e

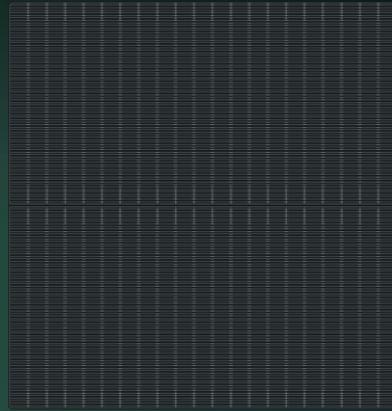


# ASTRO N7s ZBB CORE TECHNOLOGY

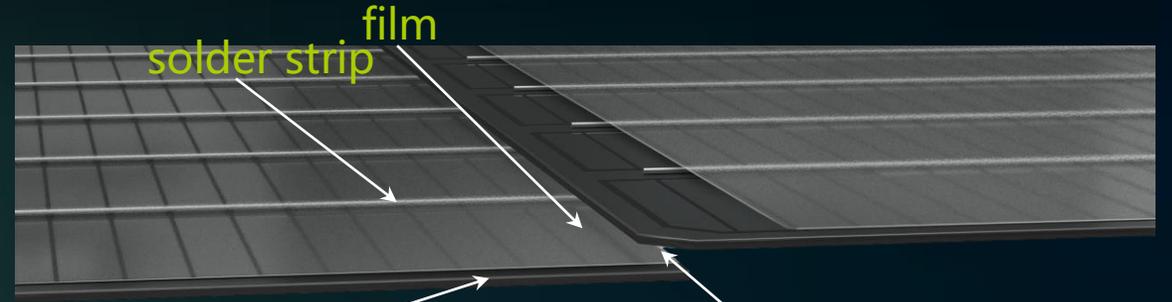
## PV cell



Traditional metallization design with multi busbar



Zero busbar design



The film extends over the cell overlap, providing a cushioning effect that reduces the risk of hidden cracking.

### IMPLEMENTATION:

- Using soldered thin cell connectors to replace cell busbars
- ZBB interconnection:
  1. Application with low-temperature soldering to fix the connectors on PV cells;
  2. Forming ohmic contact during lamination (second soldering)

### RESULT:

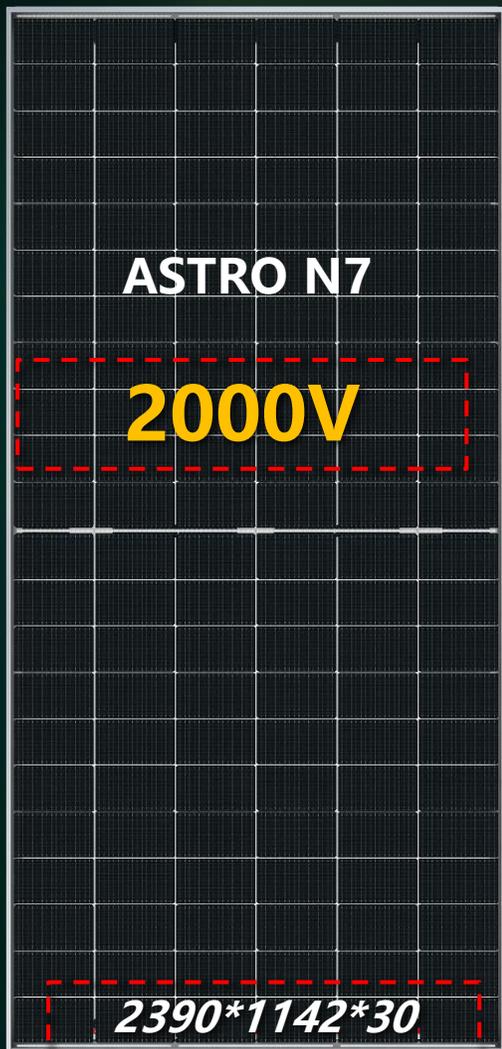
- Reduced energy consumption (low temp. process)
- Reduced raw material (silver)

ZBB is currently implemented also in N5 series

# High Voltage System -ASTRO N



ASTROENERGY



### Optimized System

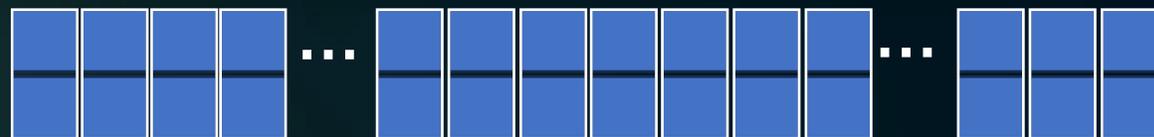
ASTRO N7 uses 210R wafer, Low Voc leads to a larger string size, improving string capacity by 38%

### Better BOM

Better combination of encapsulation film, lower the effect of PID under high system voltage

## 2000V system advantage

Lowest ambient temperature: -10°C



1500V 28pcs in series

### ASTRO N7 2000V 38pcs in series



Land saved

**3.6%**



BOS save

**0.29 c\$/W**



Power yield increased

**0.5%~1%**



# Stephan Margeth

Head of Sales MEA Asia  
Kaco

# Welcome to KACO new energy

Best inverters for photovoltaics, battery storage, and  
energy management

# Guidelines for more sustainability.



We design our **processes** to be both **climate-friendly** and **efficient**.



We **develop** and **produce** **CO<sub>2</sub> neutral**.



We support our employees, suppliers and customers in **optimizing their ecological footprint**.



We enable **innovative thinking and acting**.



We develop **innovative solutions** for the **energy transition**.



We develop and maintain **strategic partnerships** in order to grow.



We promote a **diverse, inclusive and tolerant culture** of togetherness.



We offer **attractive working conditions**.



We actively support **the individual needs of our employees**.

# EPD - Overview

## EPD – Type I

- Voluntary third-party programs based on multiple criteria, which award a license entitling the holder to use environmental labels on products indicating the general environmental compatibility of products within a certain product category on the basis of life cycle considerations.



## EPD – Type II

- Environmental claims made, without independent third-party certification, by manufacturers, importers, distributors, retailers or anyone else likely to benefit from such a claim.

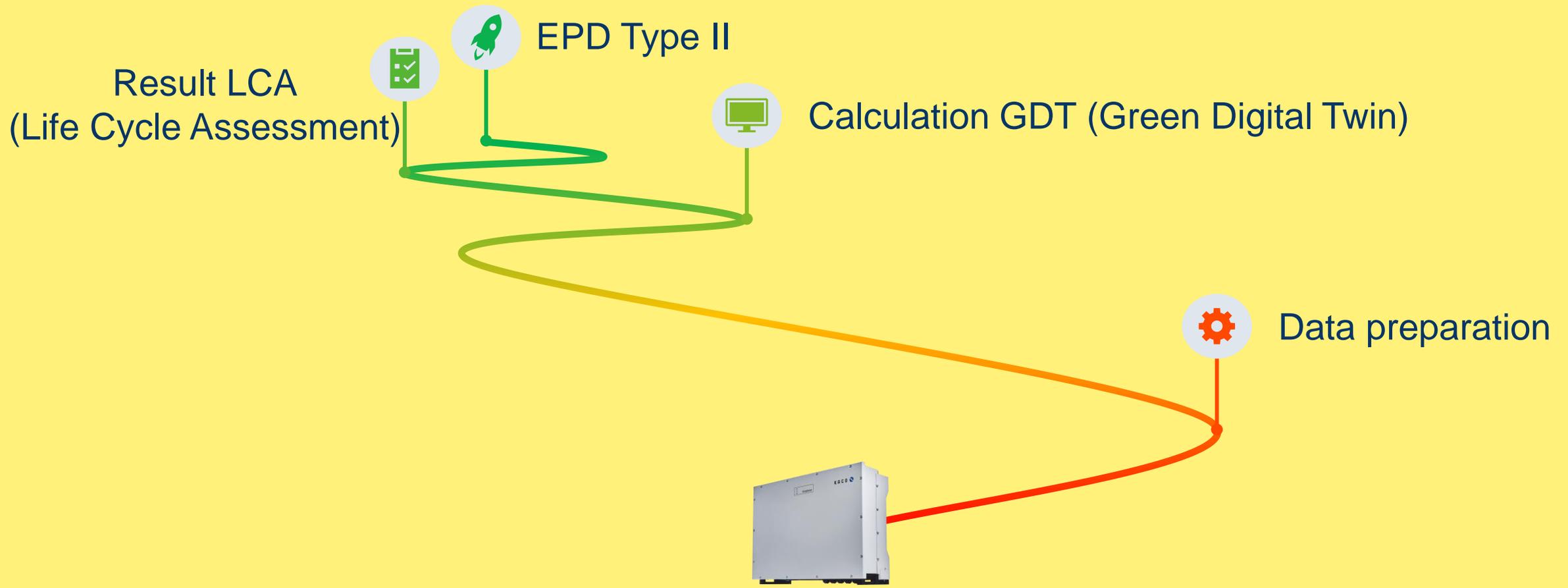


## EPD – Type III

- Environmental declarations with quantified environmental data using predefined parameters and, where appropriate, additional environmental information.  
Verification and publication by an independent third party.

source Siemens AG

# EPD Type II - From finished product to EPD



# Environmental Product Declaration.

## Materials composition

The following chart outlines the overall material composition of the calculated reference product. Product weight of 83,37 kg adds up with packaging weight of 6,78 kg to a total weight of 90,15 kg. Packaging consists of Box, Foil Film Wrap Bag, Label, Paper.

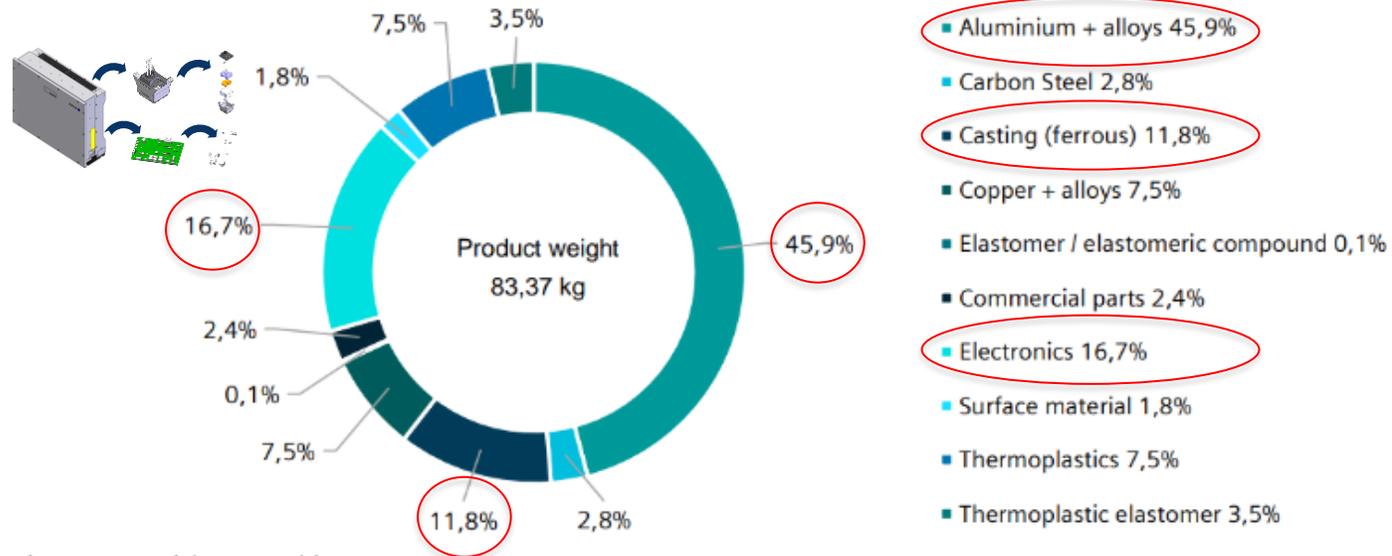


Figure 2 Materials composition

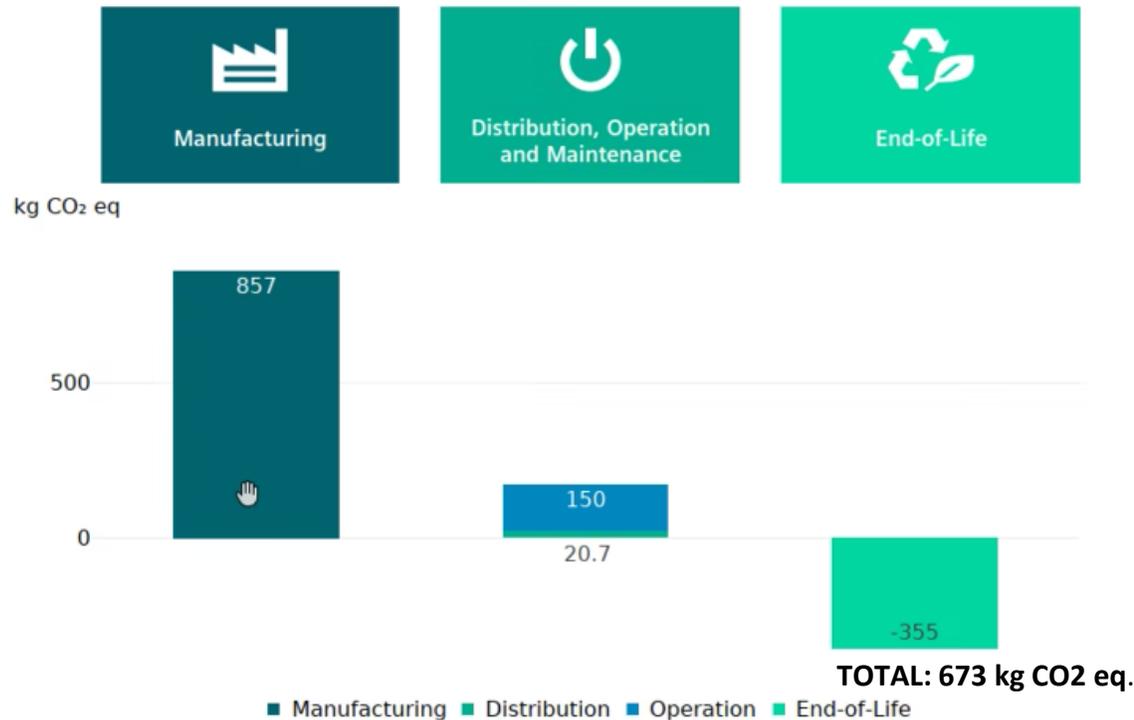
## Life cycle stages and reference scenarios

Manufacturing	Operations	End-of-Life
 <p>This stage covers the extraction of natural resources, production of raw materials, transport, manufacturing, packaging and transport distances.</p>	 <p>This stage covers the product's distribution, installation, use and maintenance. Different operating conditions e.g., use of eco-energy-mix can lead to deviations from the standard scenario.</p>	 <p>This stage covers the disassembly, material recycling and thermal treatment of all recyclable materials as well as the disposal of all other materials.</p>
Scenarios	Scenarios	Scenarios
<p><b>Energy model used:</b> Supplier: EU-28: Electricity grid mix</p> <p><b>KACO location:</b> DE: Green Electricity</p> <p><b>Transportation model used:</b> According to EN 50693, and primary data supplier location</p>	<p><b>Energy model used:</b> EU-28: Electricity grid mix</p> <p><b>Use scenario:</b> 4,78 W – 12h per day for a reference lifetime of 20 years</p> <p><b>Transportation model used:</b> Container Ship, New Panamax 120000 DWT 14000 TEU 19000.0 km Truck, 7.5 t – 12 t gross weight 1000.0 km</p>	<p><b>Energy model used:</b> EU-28: Electricity grid mix</p> <p>Avoided burden method</p>

# Environmental Product Declaration.

## Climate change

This chart shows the overall impact of the product on climate change – total. The manufacturing phase is the lifecycle phase with the biggest overall impact of the maintenance free reference product. Different operating conditions can lead to deviations from the reference scenario.



## End-of-life results

The end-of-life stage was modelled by using state of the art processes, including sorting and material separation. The end-of-life parameters are calculated according to IEC TR 62635 and EN45555.



It leads to:

- an overall **product recyclability of up to 79%** mainly due to metal content
- an **energy recoverability of up to 12%** from plastic materials
- a **minimum disposal rate of 9%**

The exact final values depend on the used recycling process and add up to 100%

**Note:** The device should not be disposed of as unsorted municipal waste. Special treatment for specific components may be mandated by law or recommended for environmental reasons. Observe all local and applicable laws

# Product Portfolio Overview

Masters of the strings – covering all your bases

A seamless spectrum of advanced **3-phase string inverters** provides turn-key solutions for all your PV projects – whatever the size or location.

Right from the smallest units up to the compact power-houses our products deliver **top performance** combining **robustness** with **maximum ease of use**.

For solar power stations, we have developed the **Virtual Central** system approach: it combines the economical advantages of a de-centralized approach with all the benefits of centralized designs.

On top, we offer solutions for **energy storage** and **reactive power compensation**: shift your yield to later times of use, reduce the electricity bill of your busi-ness or become part of intelligent grid management.



# THANK YOU FOR YOUR ATTENTION.

**KACO new energy GmbH**  
**A Siemens Company**  
Werner-von-Siemens-Allee 1  
D-74172 Neckarsulm  
[kaco-newenergy.com](http://kaco-newenergy.com)

# Panel discussion



**Frederik Leus**

XCarb Business  
development,  
Arcelor Mittal



**Jerzy Rudnicki**

Senior Technical  
Manager,  
Astronergy



**Pia Alina Lange**

Director EU Public  
Affairs & Policy,  
Trina Solar



**Yuliya Katsyuk**

Sustainability  
Manager,  
FuturaSun



**Stephan Margeth**

Head of Sales MEA  
Asia  
Kaco



**Raffaele Rossi**

Head of Market  
intelligence,  
SolarPower Europe

**SUSTAINABLE  
SOLAR \_\_\_\_\_  
EUROPE 2024**

**THANK YOU**

**inter  
solar**  
connecting solar business | EUROPE

**Solar Promotion GmbH**

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