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13 November 2024

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pV magazine  
**webinars**

# Mitigating the CO2 footprint in solar: low-carbon steel for PV



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ArcelorMittal



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ArcelorMittal




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and PV Power Plants

Fraunhofer ISE

# Welcome!

Do you have any questions?  

Send them in via the Q&A tab.  We aim to answer as many as we can today!

You can also let us know of any tech problems there.

We are recording this webinar today. 

We'll let you know by email where to find it and the slide deck, so you can re-watch it at your convenience.  

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



ArcelorMittal

13 November 2024  
ArcelorMittal Europe – Flat Products



ArcelorMittal

@Image copyright: ArcelorMittal Spain

# Agenda

1. Cleaner energy sources deserve cleaner solutions
2. XCarb® as a response and a solution
3. XCarb® versus standard steel: LCA benefits in PV farm structures
4. Magnelis®: reduce, reuse and recycle,  
backed by Environmental Product Declarations (EPD)
5. Success stories along the value chain



ArcelorMittal

Steel  
manufacturing

**15**

countries

Customers in

**140**

countries

Employees in 2023

**126.756**

Nationalities:

**142**

Commitment:

**35%**

Europe Co<sub>2</sub> reductions by 2030

## Smarter steels for people and planet

Steel  
shipments in 2023

**55.6**

million tonnes

Research sites

**14**

Full-time researchers

**1700**

R&D programmes

**100+**

in progress

Trademark products

**200+**

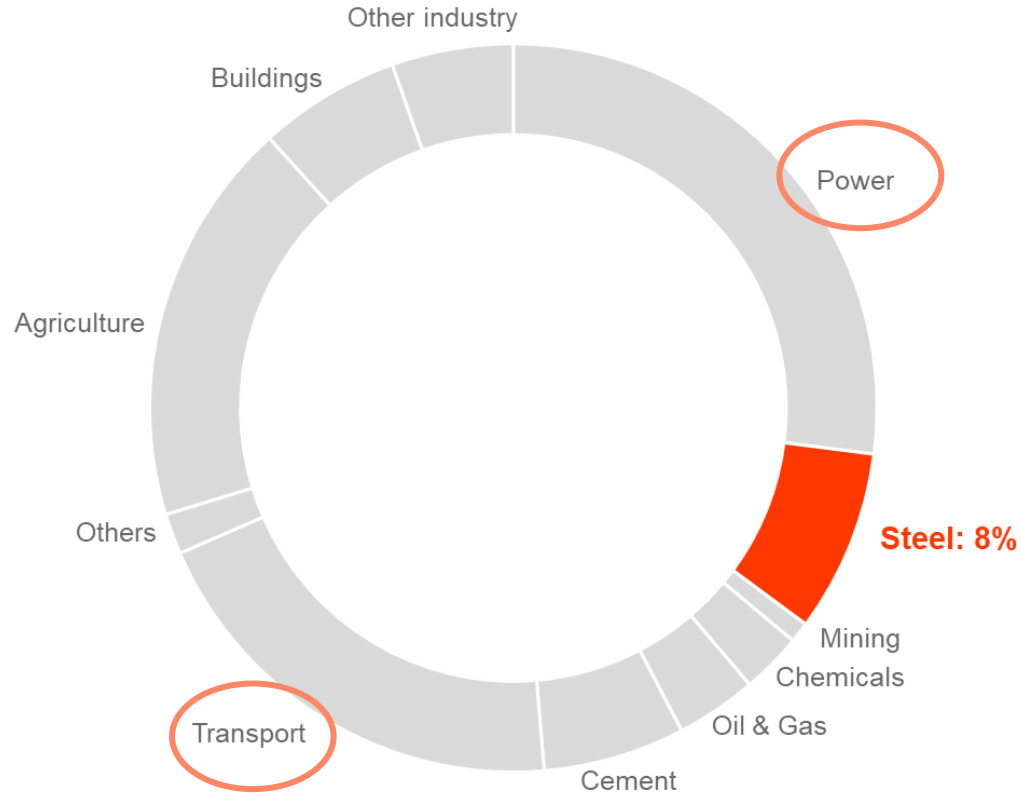
**Magnelis®**

For more info visit: <https://corporate.arcelormittal.com/>

# 1. Cleaner energy sources deserve cleaner solutions

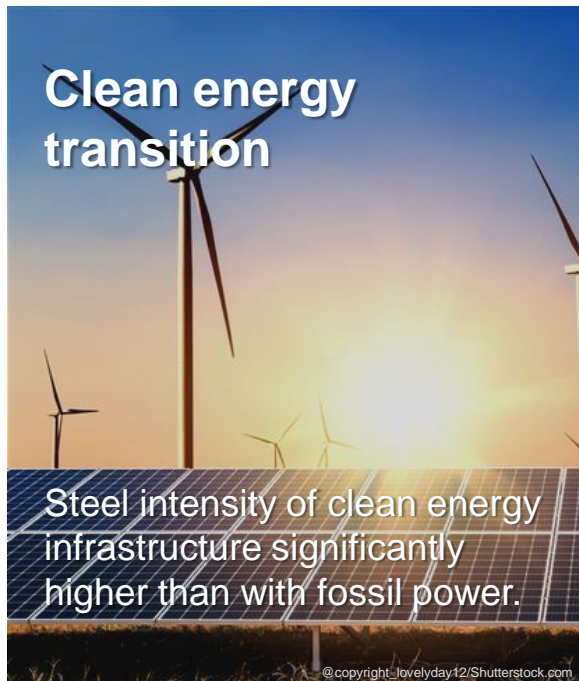
Jean-Louis Remlinger

# Manufacturing steel around the globe accounts for 8% of total CO<sub>2</sub> emissions



Source: McKinsey & Company, 2020

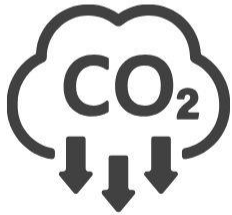
## A low carbon-emissions world also needs steel.



<sup>1</sup> Based on Steligence® design with XCarb® recycled and renewably produced



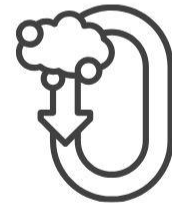
# Smarter steels for people and planet



Group target:  
**25% reduction**  
in carbon emissions  
intensity by 2030



**- 35%**  
scope 1 and 2  
CO<sub>2</sub> emissions by 2030  
across Europe



**Net zero**  
CO<sub>2</sub> emissions by 2050  
across the group

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**

## 2. XCarb<sup>®</sup> as a response and a solution

**Luca Marioni**





# Sustainability: Big steps on a long journey

Sometimes the big things count most. And when it comes to the carbon footprint of a utility-scale solar array, it is the mounting structures and trackers that are responsible for a large component of carbon emissions. It's heavy metal, after all.

## Winner

### ArcelorMittal, XCarb and Magnelis

While there is still a very long way to go for all or even the majority of steel production to be produced without carbon emissions, multinational steel producer ArcelorMittal is offering solar developers a low-carbon option. The company's XCarb steel is a certified low-carbon material, which it says is both long-lasting and sustainable.

ArcelorMittal reports that its XCarb is produced via an electric arc furnace (EAF), using predominantly scrap steel, and with 100% renewable energy. "The electricity used is independently verified and has a 'Guarantee of Origin' ensured by purchasing Renewable Energy Certificates," the company reports.

Alongside its clean production, ArcelorMittal says its Magnelis steel is also long-lived, making it suitable for solar installations in challenging environments. The Magnelis steel is a double-sided hot-dip galvanized carbon steel, coated on both sides with a zinc-aluminum magnesium alloy. "Anything you can do to make a solar asset last longer is a positive climate impact," says Jenny Chase, solar analyst and Sustainability juror.

At a high level, ArcelorMittal has a target of achieving a 25% reduction in CO<sub>2</sub> emissions intensity, per ton of crude steel, by 2030. The company notes that steel is 100% recyclable and with a CO<sub>2</sub> footprint as low as approximately 300 kg of CO<sub>2</sub> per ton of finished steel when the metallic feedstock is 100% scrap.

#### Jury comments

**Jenny Chase:** To me, ArcelorMittal is interesting because it is one of the innovators among the large steel companies for sustainability, reducing emissions, and decarbonizing this enormously carbon-intensive part of the economy. The fact that it is specifically offering a low carbon racking and mounting solution to the solar industry is a step forward. Steel is a fairly major part of solar's carbon emissions and will probably remain so in the coming years.

**Karolina Attspodina:** The company's way of reducing carbon in steel is very credible and I really hope that this goes beyond and gets adopted with other companies that are working with steel. This is a huge carbon footprint they are minimizing.



# Decarbonisation is a long journey, already started!



ArcelorMittal

Magnelis<sup>®</sup>  
for solar applications

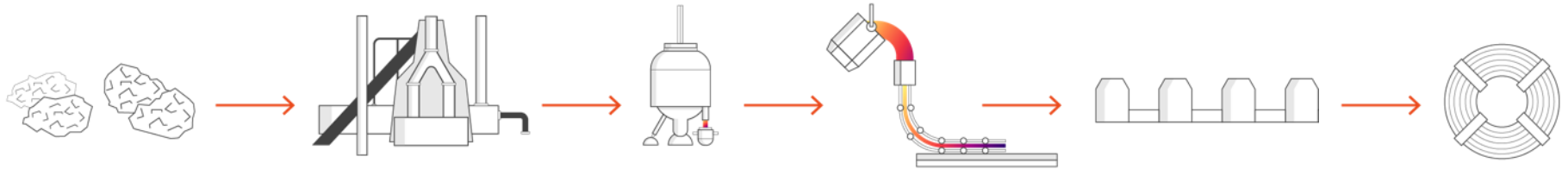


XCarb<sup>®</sup>  
ArcelorMittal Recycled  
and renewably produced

#### Jury comments

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# 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.**

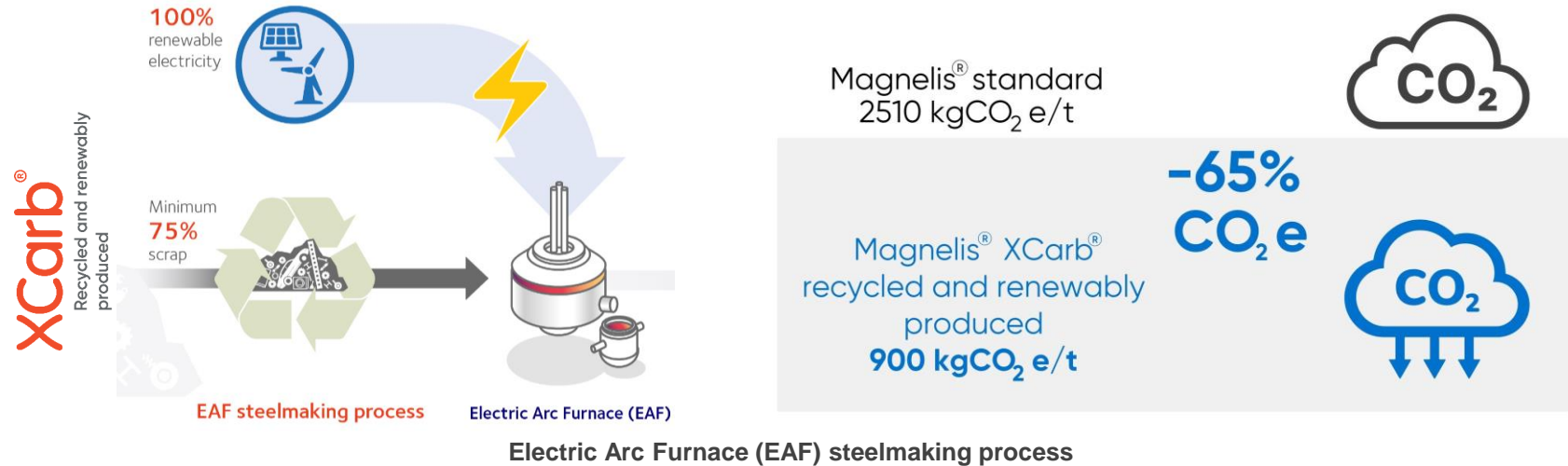
## Hot strip mill and cold mill

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)**.

# Continuous incremental improvements to reduce residual CO<sub>2</sub>e impact of our material

## Transport

- Only low train and boat transportation are used between plants for XCarb® recycled and renewably produced
- Electric and hydrotreated vegetable oil (HVO) truck for customer delivery



© ArcelorMittal Distribution Solutions



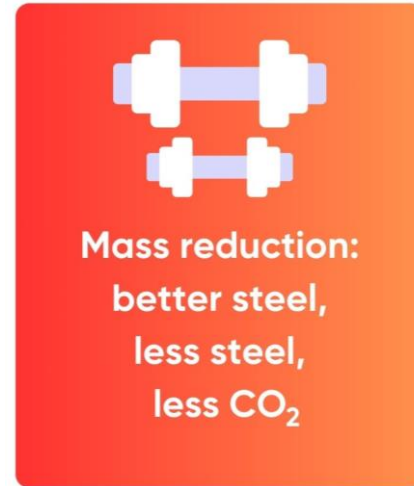
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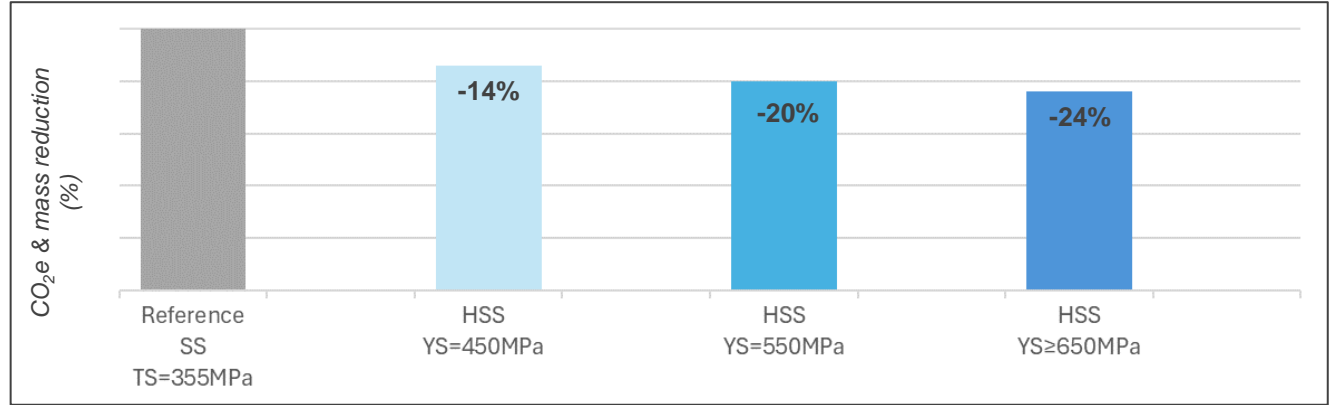
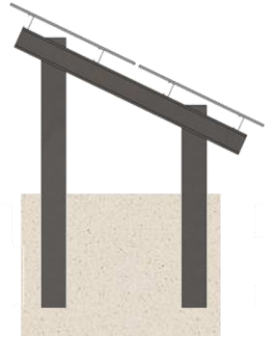


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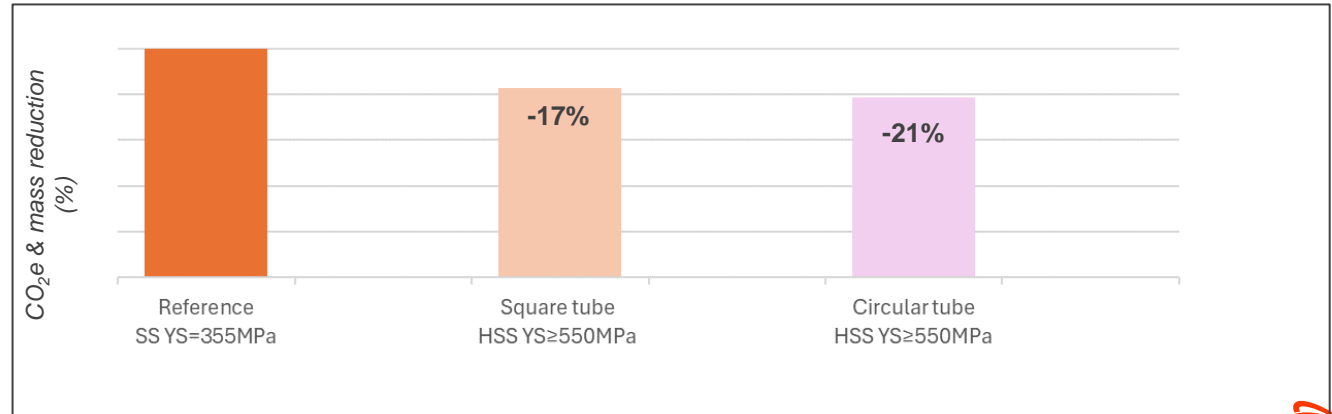
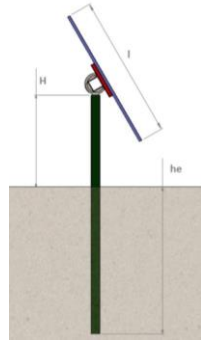


# Up to 24% reduction of material usage and CO<sub>2</sub> footprint by material optimisation...

Fixed tilt

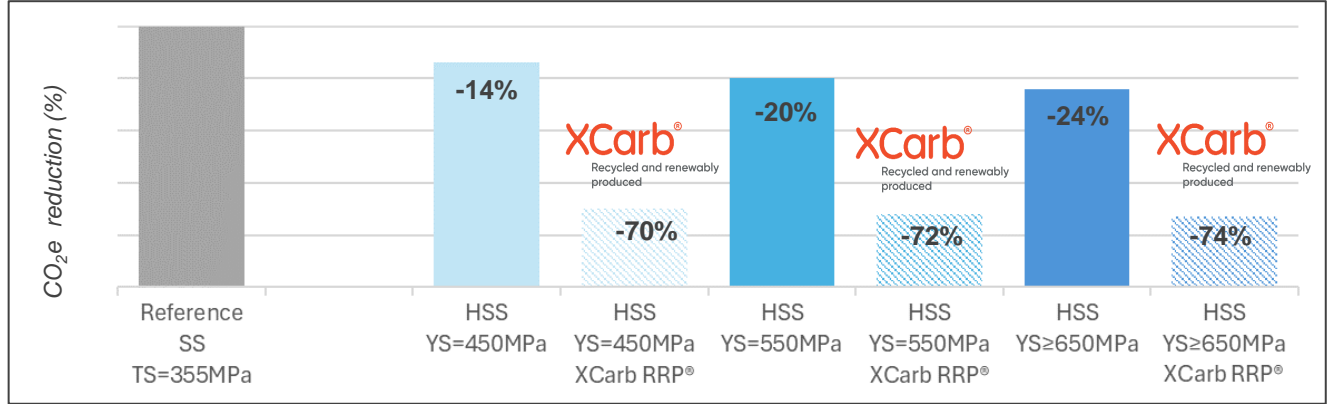
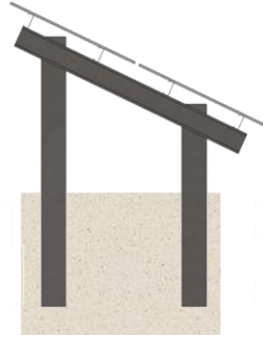


Horizontal Single Axis Tracker

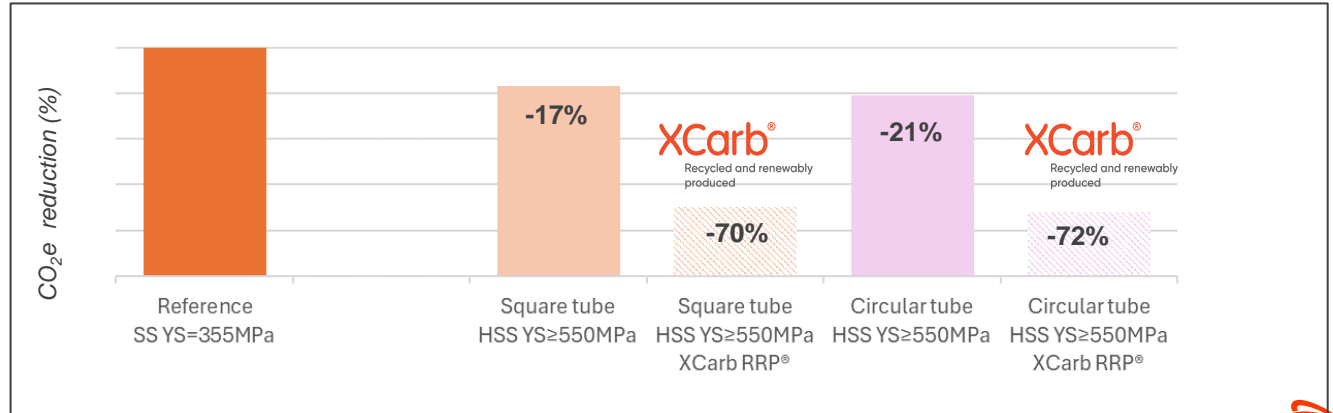
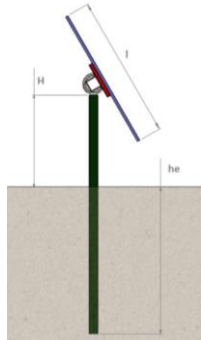


... and up to 74% when material optimisation is coupled with low CO<sub>2</sub> emissions material

Fixed tilt



Horizontal Single Axis Tracker



## Our solutions available for you

High Strength Steels (HSS) offer applied to solar:

**Current available XCarb<sup>®</sup> recycled and renewably produced for solar market**

Structural steels S220GD-S450GD +ZM

High Strength Steels (HSS) up to S450GD-HyPer<sup>®</sup> +ZM



[Check out our product document centre!](#)

### 3. XCarb<sup>®</sup> versus standard steel: LCA benefits in PV farm structures



ArcelorMittal

Dr. Anna Heimsath, Fraunhofer ISE,  
Freiburg, Germany



Fraunhofer

# Life Cycle Assessment (LCA) of Steel Structures of PV Power Plants

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**ArcelorMittal**

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**06.11.2024**

Irmak Öztürk, Mathew Berwind

Contact: Anna Heimsath

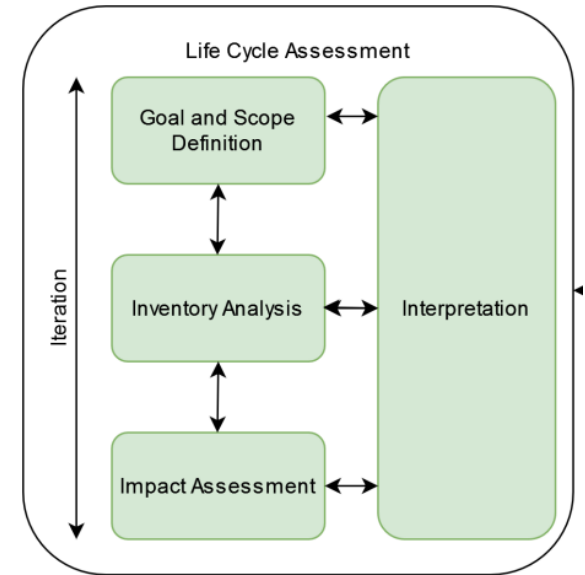
[anna.heimsath@ise.fraunhofer.de](mailto:anna.heimsath@ise.fraunhofer.de)

[www.ise.fraunhofer.de](http://www.ise.fraunhofer.de)

# Methodology

## Life Cycle Assessment

- **Goal:** To analyze the environmental impacts of steel variants from ArcelorMittal in **mounting structures for Fixed Tilt and Horizontal Single Axis Tracker PV systems** located in Germany and Spain respectively.
- **Scope:** Focuses on fundamental PV system components (module manufacturing, **mounting structure**, inverters, transportation, installation, operation, and maintenance),
- Material production, manufacturing, transportation, installation and use phases are considered, while excluding the end-of-life phase of the plant.
- **Functional Unit:** **1 MWp** of a PV plant.
- **Plant Lifetime:** **30 years**.
- **Guidelines:** **ISO 14040, 14044, and IEA PVPS guidelines**.
- **Data Sources:** **Fraunhofer ISE, EPDs from ArcelorMittal**, manufacturers for foreground data (AM), Ecoinvent-v3.8 for background data.



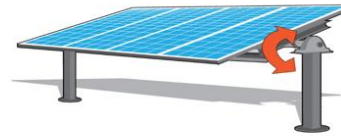
**LCA-Framework**

# LCA of a Fixed-Tilt (FT) and Horizontal Single Axis Solar Tracker (HSAT) PV Power Plant

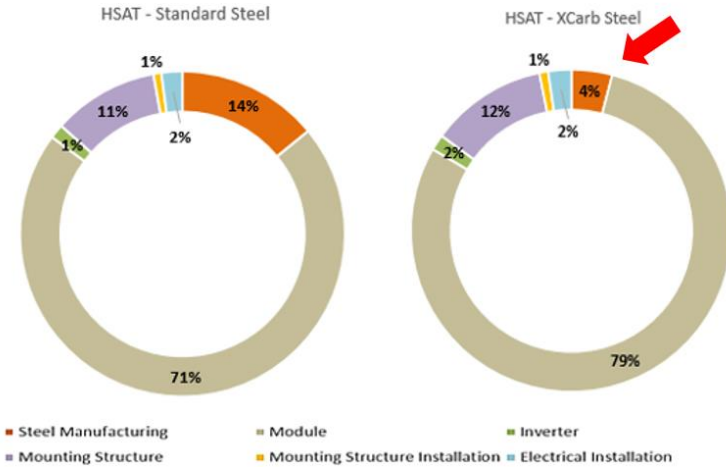
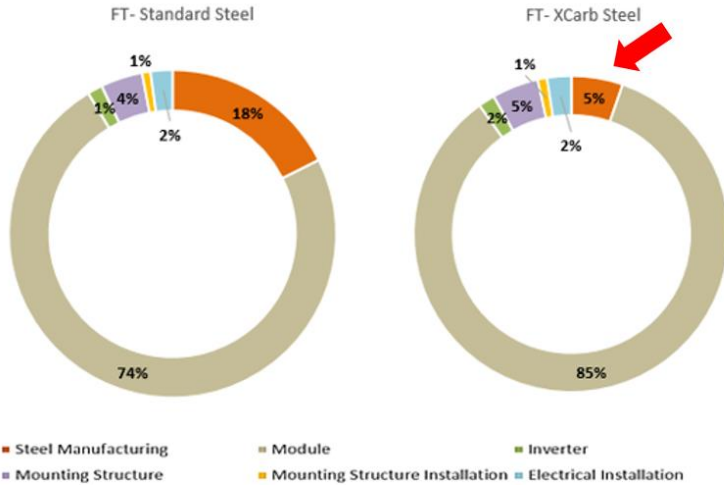
## Steel Mounting Structure Focused Results



Germany



Spain



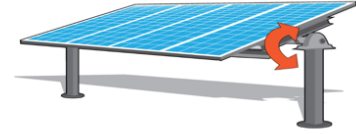
GWP of 1 MWh Fixed Tilt Power Plant with Standard and XCarb Steel Mounting Structure

GWP of 1 MWh HSAT Power Plant with Standard and XCarb Steel Mounting Structure



# Balance of System (BoS) Results

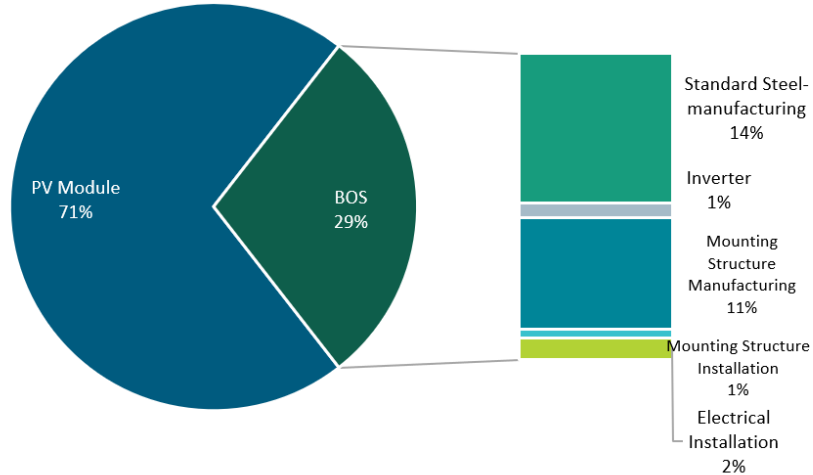
## Horizontal Single Axis Tracker PV Plant



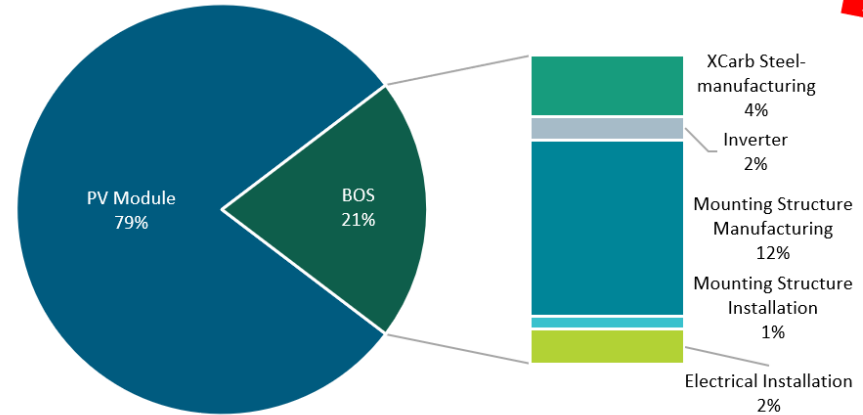
### Standard Steel

### XCarb® Steel

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

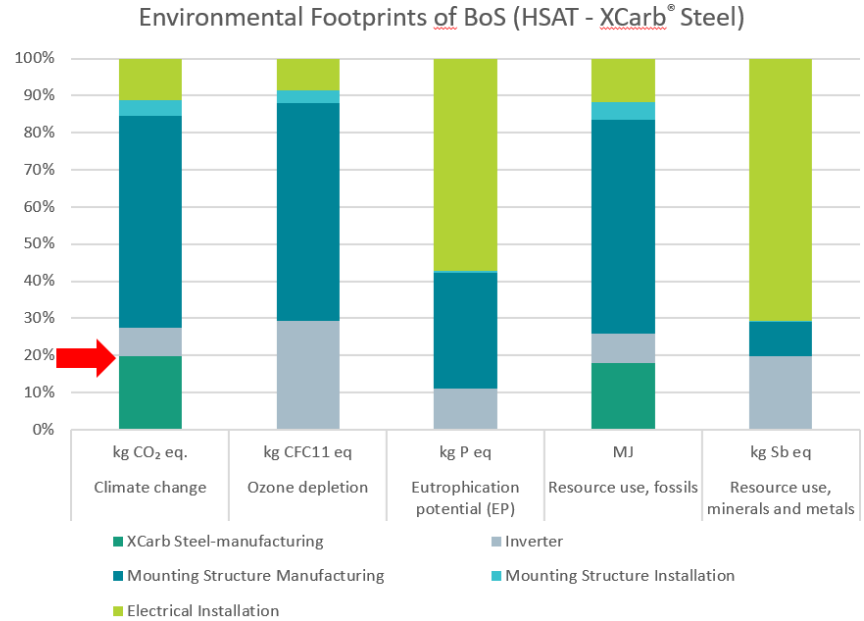
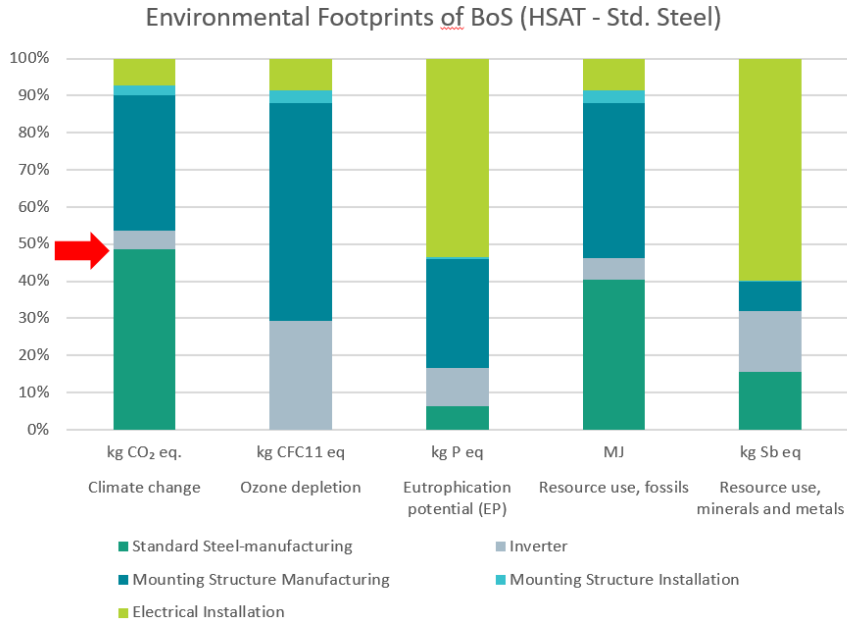


Climate Change kg CO<sub>2</sub> eq.



# Balance of System (BoS) Results

## Focus on Balance of System and Impact Categories

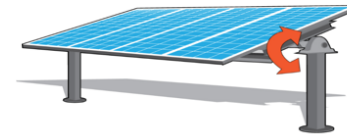


## Summary - Carbon PayBack Time and Carbon Reduction

### Mounting Structure Focused Results



Germany



Spain

#### 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

# Life Cycle Assessment and Sustainability of PV Power Plants and Integrated PV

**Contact: Anna Heimsath** [anna.heimsath@ise.fraunhofer.de](mailto:anna.heimsath@ise.fraunhofer.de)

**WWW:** [Solar Power Plants and Integrated Photovoltaics - Fraunhofer ISE](#)

**4. Magnelis®: reduce, reuse and recycle,  
backed by Environmental Product  
Declarations (EPD)**

**Walter Perez Villa**



# Magnelis® as a way to REDUCE the consumption of resources

Available in  
**XCarb®**  
Recycled and renewably  
produced

Coating designation		ZM310	ZM430	ZM620	ZM800
Coating mass (total both sides)	g/m <sup>2</sup>	310	430	620	800
Coating thickness	µm/per side	25	35	50	65



Magnelis® ZM310 ~ Continuous galvanised Z600 (600 g/m<sup>2</sup>)

Magnelis® ZM430 ~ Batch galvanised 610 g/m<sup>2</sup> (85 µm)

# Magnelis® outperforms the corrosion protection of other alternatives

Atmospheric classification for upper structures according to EN ISO 9223:2021

Corrosivity category ISO 9223	Magnelis® ZM310 Expected lifetime	Magnelis® ZM430 Expected lifetime	Magnelis® ZM620 Expected lifetime
C2	> 50 years	> 50 years	> 50 years
C3	30 to > 50 years	40 to > 50 years	> 50 years
C4	15 to 30 years	20 to 40 years	30 to > 50 years
C5	8 to 15 years	10 to 20 years	15 to 30 years

Based on extensive field exposure tests in 20 sites around the world. Indicative and non-binding durations.

Soil classification for foundations according to DIN 50929-3:2018

Soil category DIN 50929-3	Magnelis® ZM430 Expected lifetime <sup>1</sup>	Magnelis® ZM620 <sup>2</sup> Expected lifetime <sup>1</sup>	Magnelis® ZM800 <sup>2</sup> Expected lifetime <sup>1</sup>
Ia	25 to 30 years	30 to 35 years	35 to 40 years
Ib	20 to 25 years	25 to 30 years	30 to 35 years
II	15 to 20 years	20 to 25 years	25 to 30 years
III	< 15 years	< 20 years	< 25 years

<sup>1</sup> The expected lifetime = duration until the perforation of the coated steel, exposed to soil conditions corresponding to the mentioned DIN 50929-3 category. At this point in time, due to the risk of rupture, a major maintenance is necessary.

<sup>2</sup> Feasibility on request. Magnelis® ZM620 & ZM800 definitions are in line with EN 10346:2015

## Magnelis® supports REUSE of PV structures - Retrofitting

### REVAMPING



Replacement of damaged or underperforming PV components. New components are more efficient and improve energy production.

### REPOWERING



PV redesign to maximise the total system capacity within the limits of the land area of the original PV plant. Additional power that can be added after a revamping by implementing additional technologies.



# XCarb<sup>®</sup> recycled and renewably grades are available with Magnelis<sup>®</sup>

Environmental Product Declarations are available for Magnelis<sup>®</sup> coating according to the latest EPD standard (EN15804+A2)

## EPD for Magnelis<sup>®</sup> conventional route

2510 kg CO<sub>2</sub> eq/T using the conventional Blast Furnace route

## EPD for Magnelis<sup>®</sup> XCarb<sup>®</sup> recycled and renewably produced

900 kg CO<sub>2</sub> eq/T using XCarb<sup>®</sup> recycled and renewably produced Magnelis<sup>®</sup>

# Environmental Product Declaration



In accordance with ISO 14025:2006 and EN 15804:2012+A2:2019/AC:2021 for:

## XCarb<sup>®</sup> recycled and renewably produced Hot Dip Galvanised steel coils with Magnelis<sup>®</sup> coating

from

**ArcelorMittal Europe – Flat Products**



Programme:	The International EPD <sup>®</sup> System, <a href="http://www.environdec.com">www.environdec.com</a>
Programme operator:	EPD International AB
EPD registration number:	S-P-11914
Publication date:	2023-12-15
Revision Date:	2024-02-19 (Version 1.1)
Valid until:	2028-12-14

An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at [www.environdec.com](http://www.environdec.com)



## **5. Success stories along the value chain**

**Jean-Louis Remlinger**

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

## Example of PV plant & solar trackers in Portugal

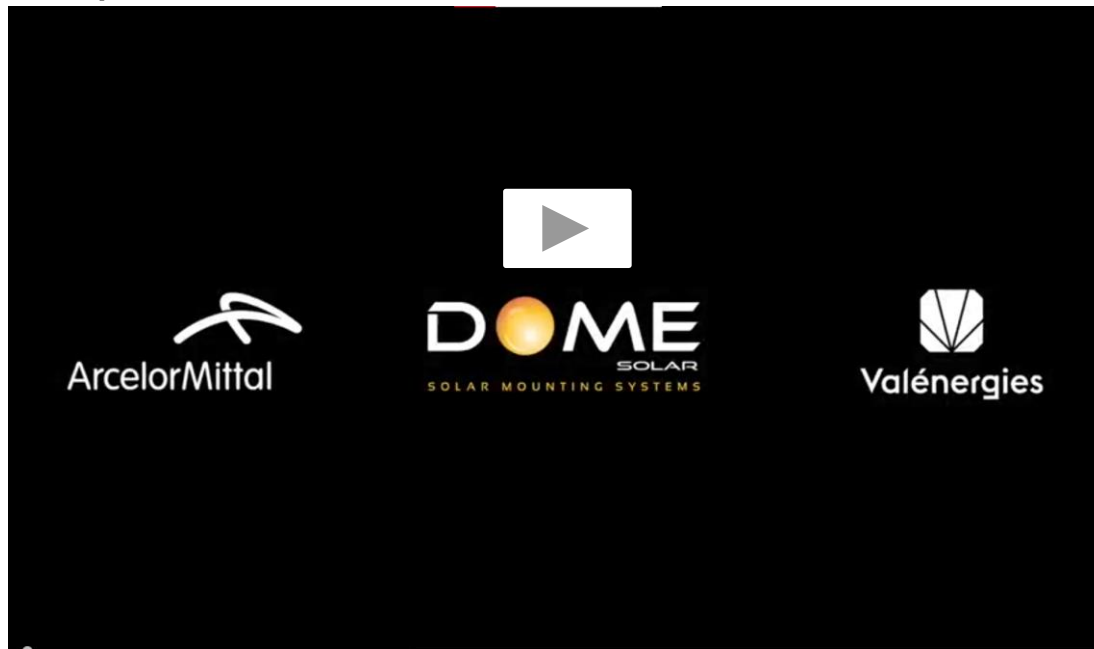
Gonvarri Solar Steel and Iberdrola will install 41 MWp of solar trackers made from ArcelorMittal's recycled and renewably produced Magnelis® XCarb® for a project in Portugal



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

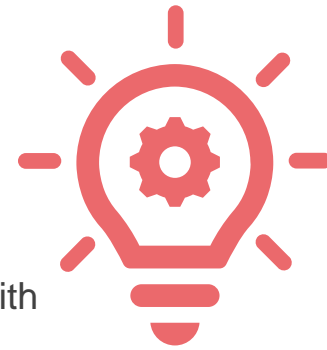
# Combining Magnelis® coating and XCarb® recycled and renewably produced steel to build sustainable solar infrastructures

Example of Dome Solar



[View more: Magnelis® - Industry](#)

## Key takeaways



1. ArcelorMittal is a solid and innovative partner for your 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!

# We are happy to answer your questions!



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# Thank you



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13 November 2024

8:00 am -9:00 am EST | New York City

2:00 pm – 3:00 pm CET | Berlin

| 6:30 pm – 7:30 pm CST | Delhi

pv magazine  
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# Mitigating the CO2 footprint in solar: low-carbon steel for PV

## Q&A



**Marian Willuhn**

Senior Editor

pv magazine



**Jean-Louis Remlinger**

Segment Leader Solar

ArcelorMittal



**Walter Pérez Villa**

Product coordinator,  
Metallic Coated

ArcelorMittal



**Luca Marioni**

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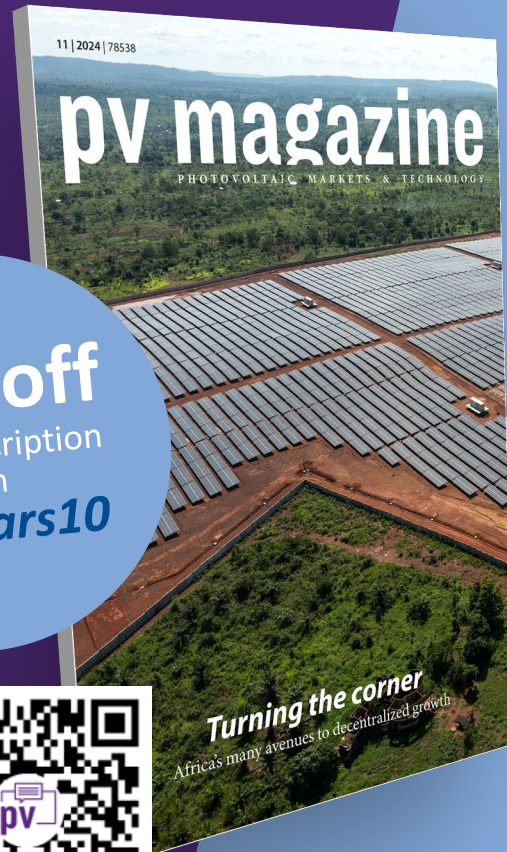
**Anna Heimsath**

Head of Analysis Modules  
and PV Power Plants

Fraunhofer ISE



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## Research shows tilt angles over 30 degrees delay solar module thermal failures

by Lior Kahana



**Most-read online!**

## Italian startup offers green hydrogen generation, storage system for homes

by Emiliano Bellini



# Coming up next...

## Thursday, 14 November 2024

11:00 am – 12:00 pm EST, New York  
5:00 pm – 6:00 pm CET, berlin

## Monday, 18 November 2024

11:00 am – 12:00 pm EST, New York City  
5:00 pm – 6:00 pm CET, Berlin

Many more to come!

**One-stop-software for  
scalable, efficient, and  
accurate PV project  
development**

**Securing supply in  
extreme  
environments:  
designing solar-and-  
storage solutions for  
harsh climates and  
weak grids**

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group

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