Reducing the environmental impact of PV mounting structures

10 February 2022


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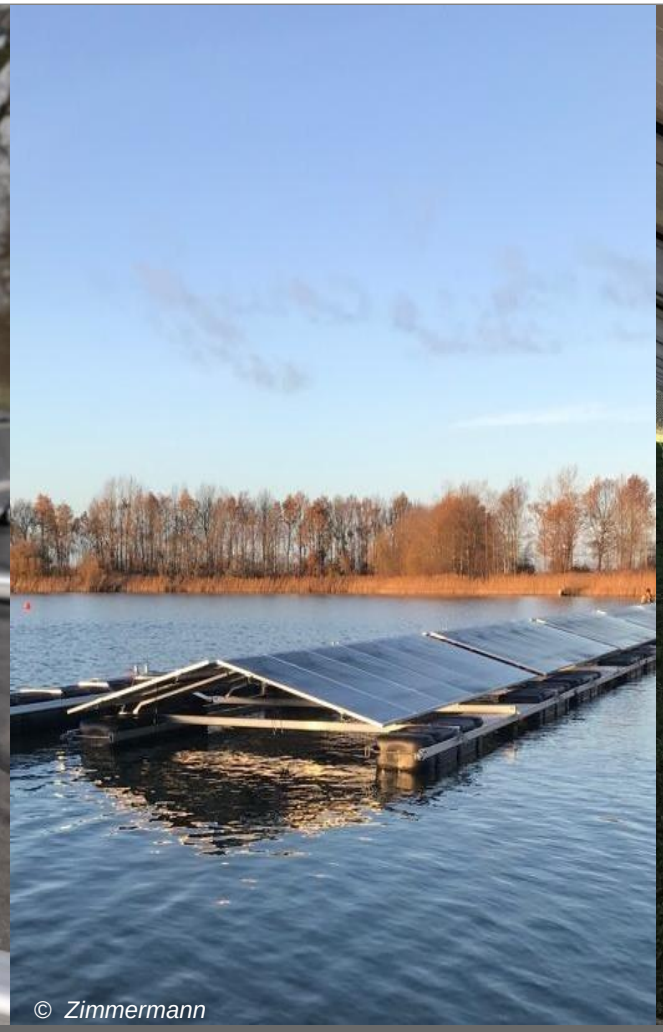
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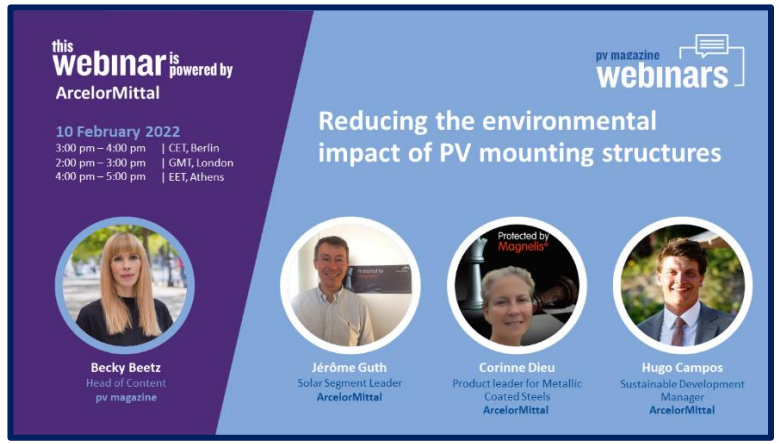
Webinars with pv magazine focusing on Magnelis® steel

2019: Increase the **durability** of solar structures with the latest generation of steels

Download the presentation here

2021: Meeting the expectation of a 30+ PV project operation **lifetime**, from the ground up

Download the presentation here



2022: Reducing the **environmental** impact of PV mounting structures

Download the presentation here

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Main concerns about sustainability are raised about PV panels recycling

ArcelorMittal

NREL model shows current incentives for PV module recycling are insufficient

Analysts at the US research institite modeled PV recycling strategies and found that current incentives are not well-aligned to drive recycling.

SEPTEMBER 17, 2021 RYAN KENNEDY

MODULES & UPSTREAM MANUFACTURING

Recycling solar panels: Making the numbers work

NREL researchers said a profitable and sustainable solar panel recycling industry could establish itself by 2032. Here's how the numbers work.

SEPTEMBER 22, 2021 JOHN FITZGERALD WEAVER

MODULES & UPSTREAM MANUFACTURING TECHNOLOGY AND R&D UNITED STATES

Establishing a solar module recycling system in India

Ankit Kapasi and Kishore Ganesan from SOFIES India are working on the Solar Waste Action Plan (SWAP) project in India, which is looking to investigate both the technical and economic feasibility of a PV module recycling system in the country. The pilot has been funded by Signify Foundation and Doen Foundation. The team at S partner Poseidon Solar and established

pv magazine

Canberra moves forward with new PV module recycling rules

The Australian federal government's call for the solar industry to address the issue of PV module waste has coincided with new plans by the Australian Capital Territory government to look at new panel recycling options.

JUNE 25, 2021 DAVID CARROLL

Sustainable PV goes beyond recycling

Despite significant progress on material and energy efficiency in solar PV manufacturing over th decades, terawatt-scale manufacturing mandates further innovation and improvement along al the value chain – especially on material circularity and supply chain decarbonization, according to sustainability director at First Solar. Ensuring these objectives are met will be key to to the global carbon budget for 1.5 C.

BER 7, 2020 PV MAGAZINE

South Korea to introduce new rules for PV recycling

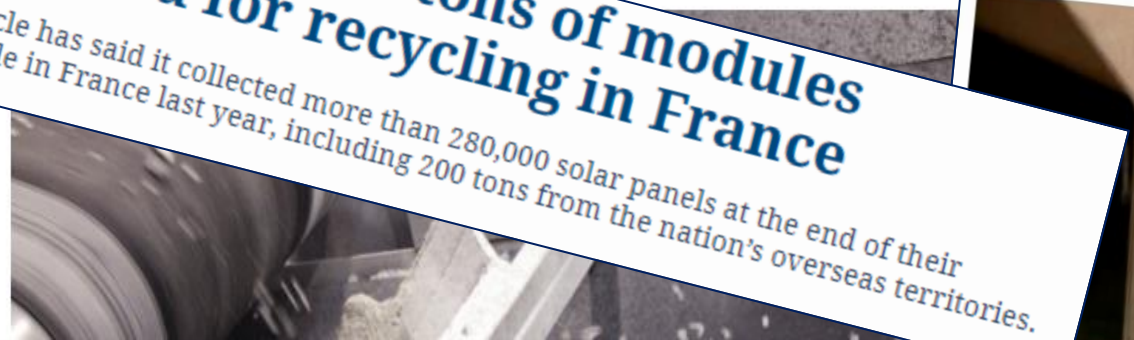
The South Korean authorities plan to introduce 2023. Several recycling facilities are government, with a combi

OCTOBER 8, 2020 P

MODULES & UPSTREAM MAN

More than 5,000 tons of modules collected for recycling in France

PV Cycle has said it collected more than 280,000 solar panels at the end of their lifecycle in France last year, including 200 tons from the nation's overseas territories.



Solar panel recycling: Turning ticking time bombs into opportunities

Australia has certainly demonstrated its appetite for solar power. Now, with the average lifespan of a solar panel being approximately 20 years, many installations from the early 2000's are set to reach end-of-life. Will they end up in landfill or be recycled? The cost of recycling is higher than landfill, and the value of recovered materials is smaller than the original, so there's limited interest in recycling. But given the presence of heavy metals, such as lead and tin, if waste is managed poorly, we're on track for another recycling crisis. A potential time bomb could present itself as an opportunity, however, if the global EV industry showed an interest in the recovered solar products.

Several levers and domains to act on sustainability from the early design stage to the end-of-life

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Engineering Construction Procurement

- Eco-Design & Engineering:
  → **Selection of materials** with reduced footprint alu-steel
  → **Optimal use of materials**
- Eco-Construction:
  → Minimize waste on-site
  → Reduce energy & resources
- Sustainable Procurement:
  → **Selection of suppliers** upon how they operate

Operation Maintenance

- Limited maintenance thanks to **long durable** materials
- Limited water consumption for PV panel cleaning
- **Durable & robust** mounting structures, able for retrofitting
- Reduced **run-off** or pollutions (e.g. cleaning agents) in nature

End of life

- Total or partial **reuse** of some components or…
- Dismantle, evacuate, sort & **recycle** materials at the end of life (e.g rammed poles versus concrete foundations)

CO_2 footprint reduction by substitution of aluminum by steel
→ Case of PV panels frames

ArcelorMittal

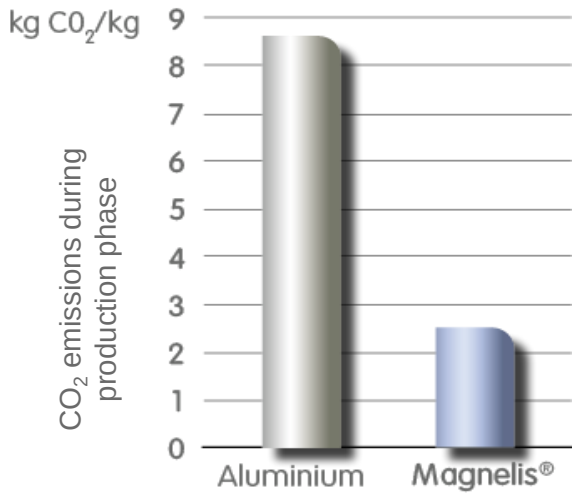
Huge aluminum demand expected in solar industry, concerns arise on emissions

Researchers from the University of New South Wales (UNSW) predict that growth to 60TW of photovoltaics needed to rapidly reduce emissions to 'net zero' and limit global warming to <2 °C could require up to 486 Mt of aluminium by 2050. A key concern for this large aluminium demand is its large global warming potential.

JANUARY 25, 2022 MARIJA MAISCH

Example of carbon footprint reduction (-15%)
By substituting aluminium PV panel frame by
Magnelis® coated high strength steel

2017 Intersolar Award
Recognized the strong sustainability focus
of this innovation by Q-Cell / Hanwha
(-60% installation time and -80% mounting material)



Sources: European Aluminium and World Steel Associations, Eurofer and ArcelorMittal Global R&D

For **rooftop mounting structures**, Magnelis® steel and aluminium are used → Potential for CO_2 footprint reduction by redesigning with Magnelis® steel

Already several companies offer roof top systems in Europe, fully or partly designed with Magnelis® steel components: rail, wind deflector, hooks or attachments. *(list is not exhaustive)*:

ADIWATT
AVASCO
BAKS
CORAB
DOME SOLAR
ENECO
ESDEC
ETANCO
K2 SYSTEM
R.BRINK
SMARTVOLT
SUNBEAM
SUN SUPPORT
VAN VEEN METAL
...

On top of environmental footprint, using Magnelis® steel is also an opportunity to reduce cost.

Weight constraints can be solved with thin gauges and high strength steels

For **ground mounting structures**, (Magnelis®) steel is the material of choice
→ Growing awareness to reduce CO_2 footprint
→ Importance to integrate sustainability at engineering, procurement and construction stages

Safely meeting demand for renewable energy with innovative material design for health and sustainability

Clean energy is critical to solving our climate crisis. But we need to consider the full environmental and human health impacts of solar energy generation across its entire lifecycle, including mining, manufacturing, use, decommissioning and recycling. This requires us to identify critical stages in the production process, and how choices in materials and chemicals at different stages of production influence each other.

OCTOBER 5, 2020

KRISHNA RAJAN, DEPARTMENT OF MATERIALS DESIGN AND INNOVATION, THE UNIVERSITY AT BUFFALO; MARK ROSSI, CLEAN PRODUCTION ACTION; ALEXANDRA MCPHERSON, NIAGARA SHARE; AND CHITRA RAJAN, UNIVERSITY AT BUFFALO

OPINION & ANALYSIS | SUSTAINABILITY | WORLD

Solar Steel
Gonvarri Industries

January 13, 2022

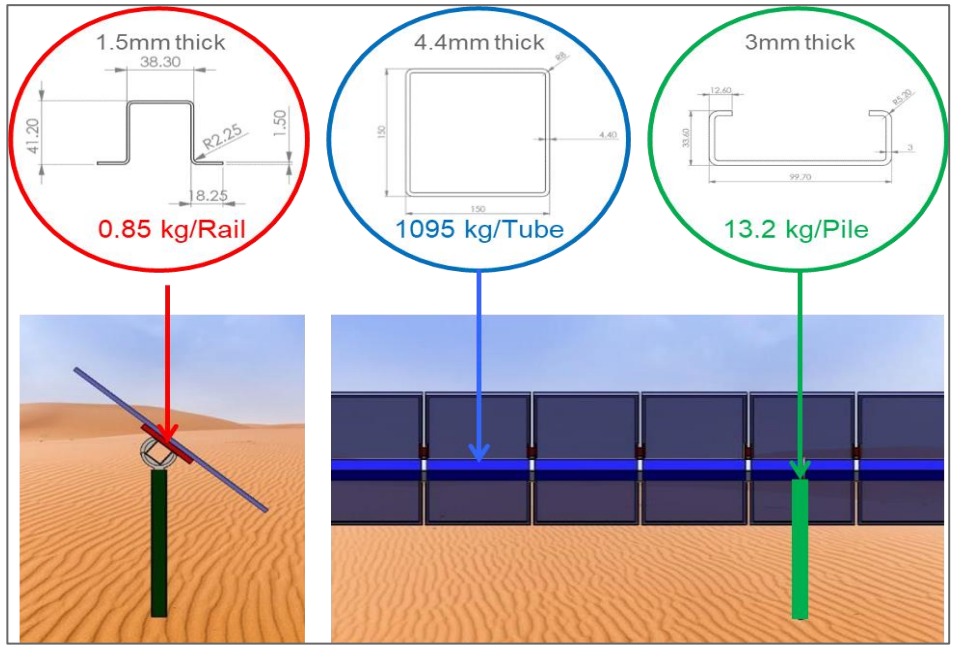
Gonvarri Solar Steel has received the Ecovadis Gold Medal for its performance in environment, labor practices and human rights, ethics and sustainable procurement

Read full article here

The sustainability challenge is now and urgent: it is the differentiation of the future!
→ Low impacting materials & designs are needed
→ Responsible suppliers

ArcelorMittal

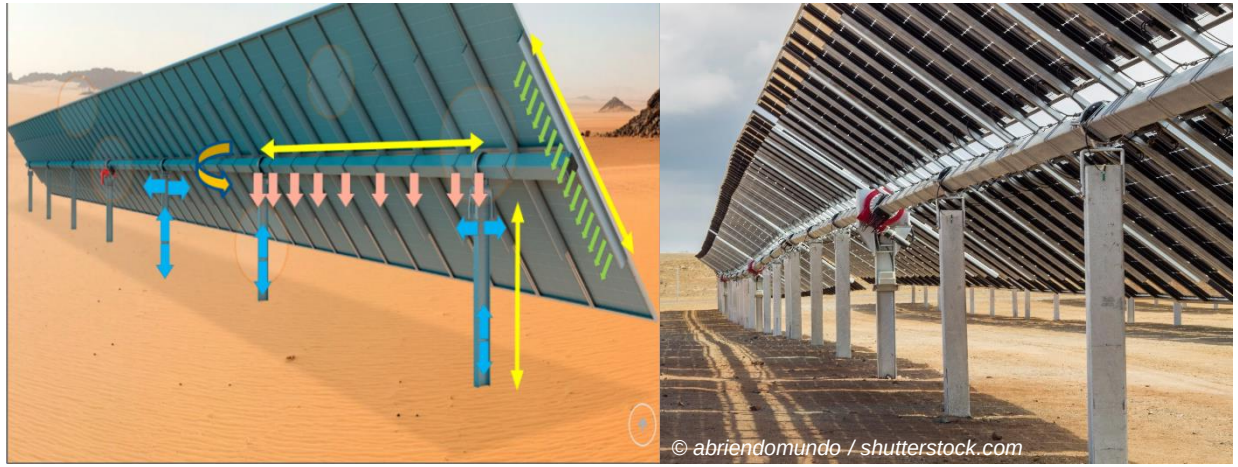
Redesign with higher strength steels allow immediate weight & CO_2 footprint reduction (1/2) → Generic system description & loads

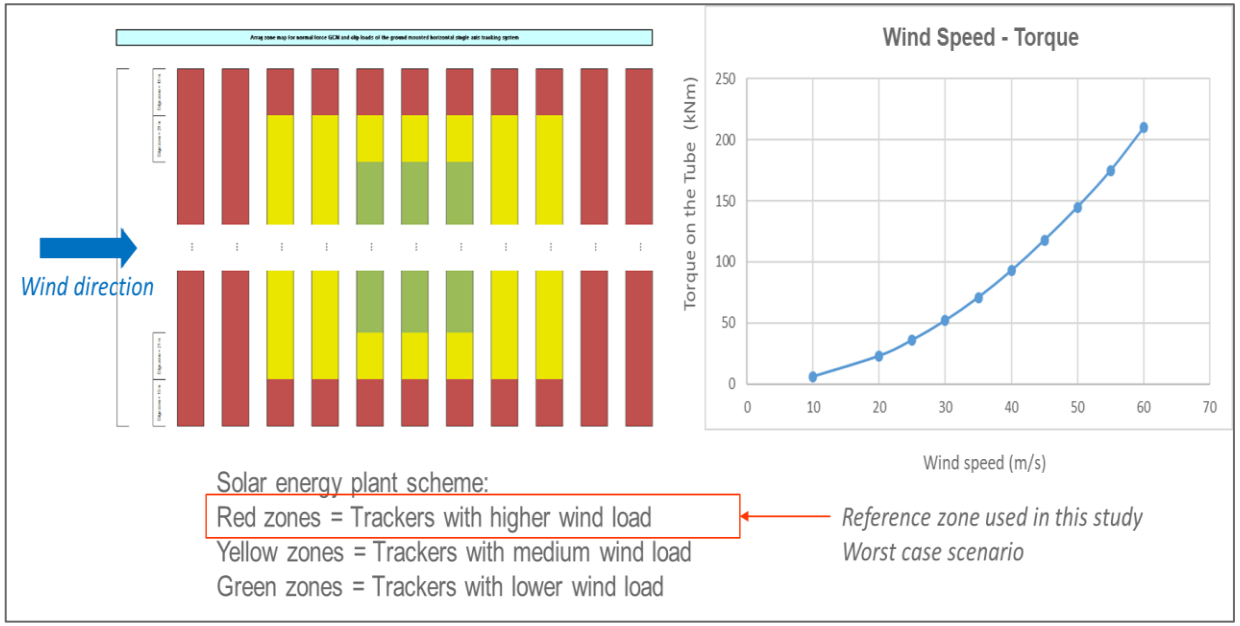


Reference steel grade = S350GD + Magnelis®

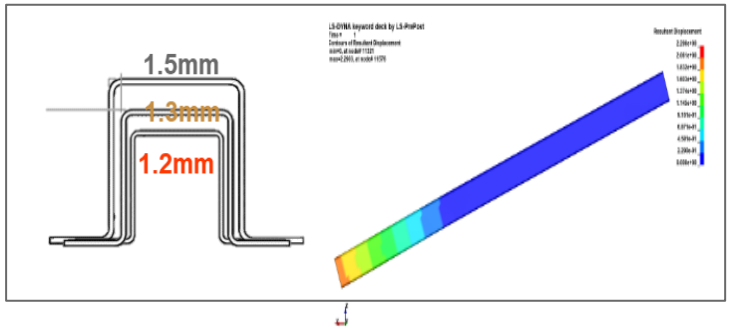
High strength grades =

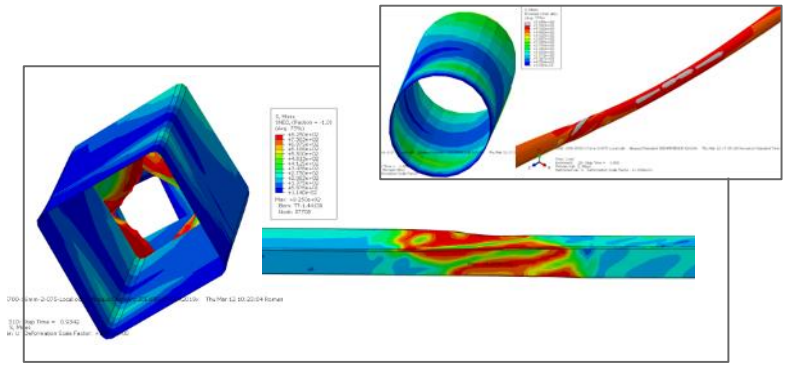
- S450GD HyPer® + Magnelis®
- S550GD HyPer® + Magnelis®
- S700GD HyPer® + Magnelis®
- Eurocode-compliant (EN1993-1-1 / 3 / 12)

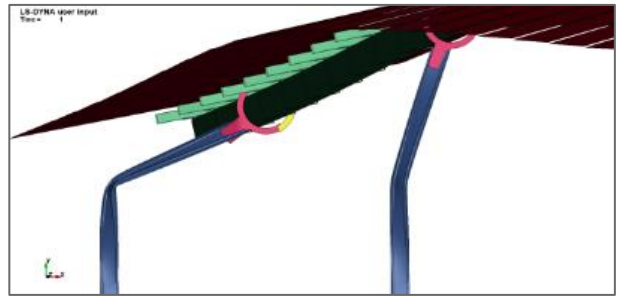


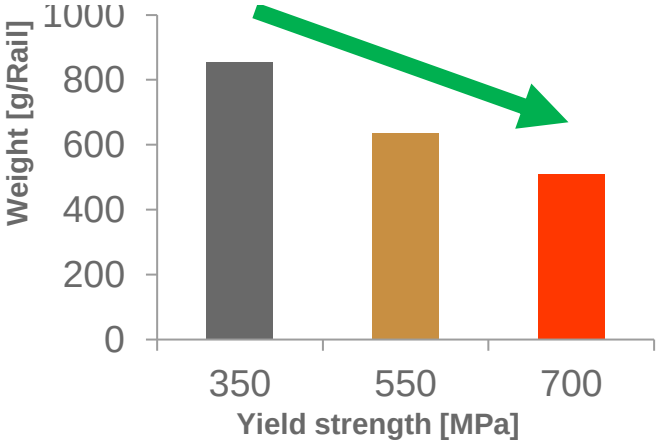


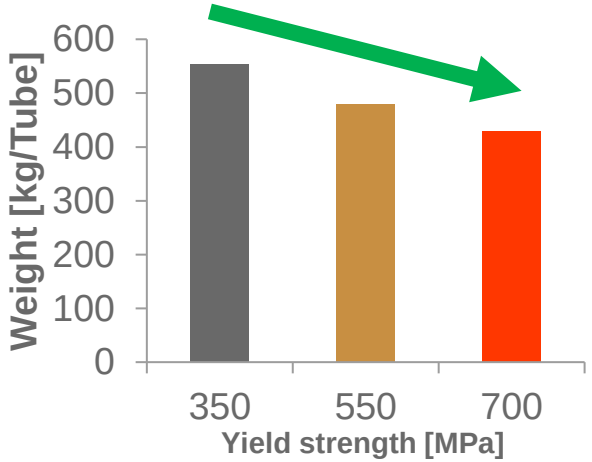
Redesign with higher strength steels allow immediate weight & CO_2 footprint reduction (2/2) → Validated for rails / purlins, torque tubes & poles

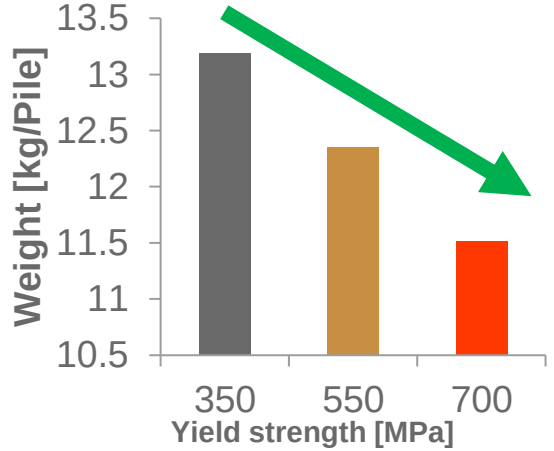












25.5% to 40.5% weight and CO_2 footprint reduction

13.5% and 22.5% weight and CO_2 footprint reduction

6.3% to 13.3% weight and CO_2 footprint reduction

→ Upgrade with high strength steels also provides cost reduction

When & how to act on sustainability ?
→ Several steps to improve sustainability of solar mounting structures

Engineering Construction Procurement

- Eco-Design:
  → **Selection of materials** with reduced footprint alu-steel
  → **Optimal use of materials**
- Eco- Construction:
  → Minimise waste on-site
  → Reduce energy & resources
- Sustainable Procurement:
  → **Selection of suppliers** how they operate integrating:
  - Climate change and greenhouse gas emissions
  - Water stewardship and biodiversity
  - Human rights and labour rights
  - Community relations and business integrity

Operation Maintenance

- Limited maintenance thanks to **long lifetime** materials
- Limited water consumption for PV panel cleaning
- **Durable & robust** mounting structures, able for retrofitting
- Reduced **run-off** or pollutions (e.g. cleaning agents in nature)

Durabilily of structures made of Magnelis® steel:
- In atmospheric conditions
- **In soils for rammed poles**
- In water for floating
- Magnelis® vs post galvanised

Responsible Steel™ standards & certification

E.g: ArcelorMittal plants in Belgium & Germany producing Magnelis® are certified since July 2021, about how they operate in their local and social environments

ArcelorMittal

Durability is a key feature of sustainability
→ Magnelis® excellent protection even in harsh atmospheric conditions

Corrosion category ISO 9223	Galva Z275	Galva Z600	Magnelis® ZM310	Magnelis® ZM430
C2	5 y to 15 y	> 15 y	> 50 y	> 50 y
C3	2 y to 5 y	> 15 y	**30 y to > 50 y**	40 y to > 50 y
C4	--	5 y to 15 y	15 y to 30 y	**20 y to 40 y**
C5	--	2 y to 5 y	≤ 15 y	10 y to 20 y

C3 = the most frequent case temperate / urban...

C4 = Coastal / industrial tropical / desert…

Unreliable protections for expected lifetime of solar plant

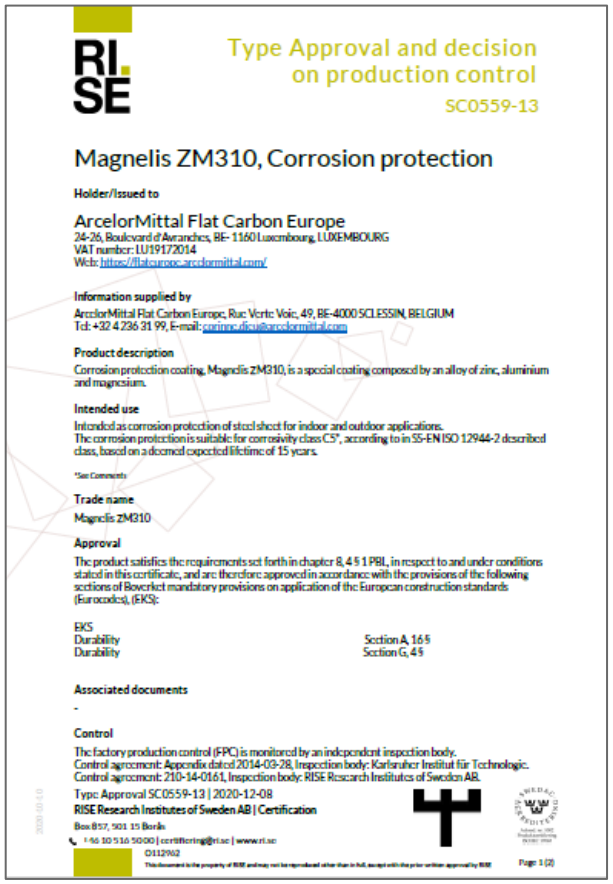
Magnelis® offers robust protection for expected lifetimes of solar structures ….with retro-fitting potential

Based on German standard DIN 55634-1: 2018

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

ArcelorMittal

Durability is a key feature of sustainability
→ Long durability of Magnelis® is certified by third parties



RI. SE

Type Approval and decision on production control

SC0559-13

Magnelis ZM310, Corrosion protection

Holder/Issued to

ArcelorMittal Flat Carbon Europe
24-26, Boulevard d'Avranches, BE- 1160 Luxembourg, LUXEMBOURG
VAT number: LU19172014
Web: https://flateurope-arcelormittal.com/

Information supplied by

ArcelorMittal Flat Carbon Europe, Rue Verte Voie, 49, BE-4000 SCLESSIN, BELGIUM
Tel: +32 4 236 31 99, E-mail: coatings.flat@arcelormittal.com

Product description

Corrosion protection coating, Magnelis ZM310, is a special coating composed by an alloy of zinc, aluminium and magnesium.

Intended use

Intended as corrosion protection of steel sheet for indoor and outdoor applications.
The corrosion protection is suitable for corrosivity class C5*, according to in SS-EN ISO 12944-2 described class, based on a deemed expected lifetime of 15 years.

*See Comments

Trade name

Magnelis ZM310

Approval

The product satisfies the requirements set forth in chapter 8, 4 § 1 PBL, in respect to and under conditions stated in this certificate, and are therefore approved in accordance with the provisions of the following sections of Boverket mandatory provisions on application of the European construction standards (Eurocodes), (EKS):

EKS	
Durability	Section A, 16 §
Durability	Section G, 4 §

Associated documents

-

Control

The factory production control (FPC) is monitored by an independent inspection body.
Control agreement: Appendix dated 2014-03-28, Inspection body: Karlsruher Institut für Technologie.
Control agreement: 210-14-0161, Inspection body: RISE Research Institutes of Sweden AB.

Type Approval SC0559-13 | 2020-12-08
RISE Research Institutes of Sweden AB | Certification
Box 857, 501 15 Borås
+46 10 516 50 00 | certifiering@ri.se | www.ri.se

D112902

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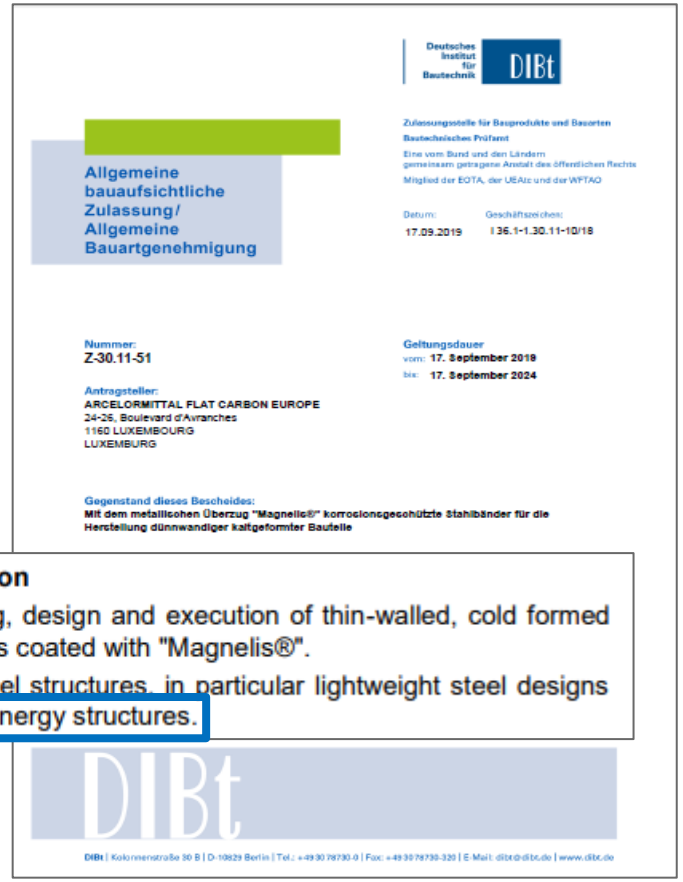


Deutsches Institut für Bautechnik DIBt

Zulassungsstelle für Bauprodukte und Bauarten
Bautechnisches Prüfamt
Eine vom Bund und den Ländern gemeinsam getragene Anstalt des öffentlichen Rechts
Mitglied der EOTA, der UEAtc und der WFTAO

Allgemeine bauaufsichtliche Zulassung/ Allgemeine Bauartgenehmigung

Datum: 17.09.2019
Geschäftszeichen: I 36.1-1.30.11-10/18

Nummer: Z-30.11-51

Geltungsdauer
vom: 17. September 2019
bis: 17. September 2024

Antragsteller:
ARCELORMITTAL FLAT CARBON EUROPE
24-26, Boulevard d'Avranches
1160 LUXEMBOURG
LUXEMBURG

Gegenstand dieses Bescheides:
Mit dem metallischen Überzug "Magnelis®" korrosionsgeschützte Stahlbänder für die Herstellung dünnwandiger kaltgeformter Bauteile

1.2 Subject of permit and field of application

The subject of the permit is the planning, design and execution of thin-walled, cold formed members manufactured from flat products coated with "Magnelis®".

The field of application is as follows: steel structures, in particular lightweight steel designs such as roof and wall elements o solar energy structures.

DIBt

DIBt | Kolonnenstraße 30 B | D-10829 Berlin | Tel.: +49 30 78730-0 | Fax: +49 30 78730-320 | E-Mail: dibt@dibt.de | www.dibt.de

The only metallic coated steel certified in C5
Currently under renewal for the 3rd time

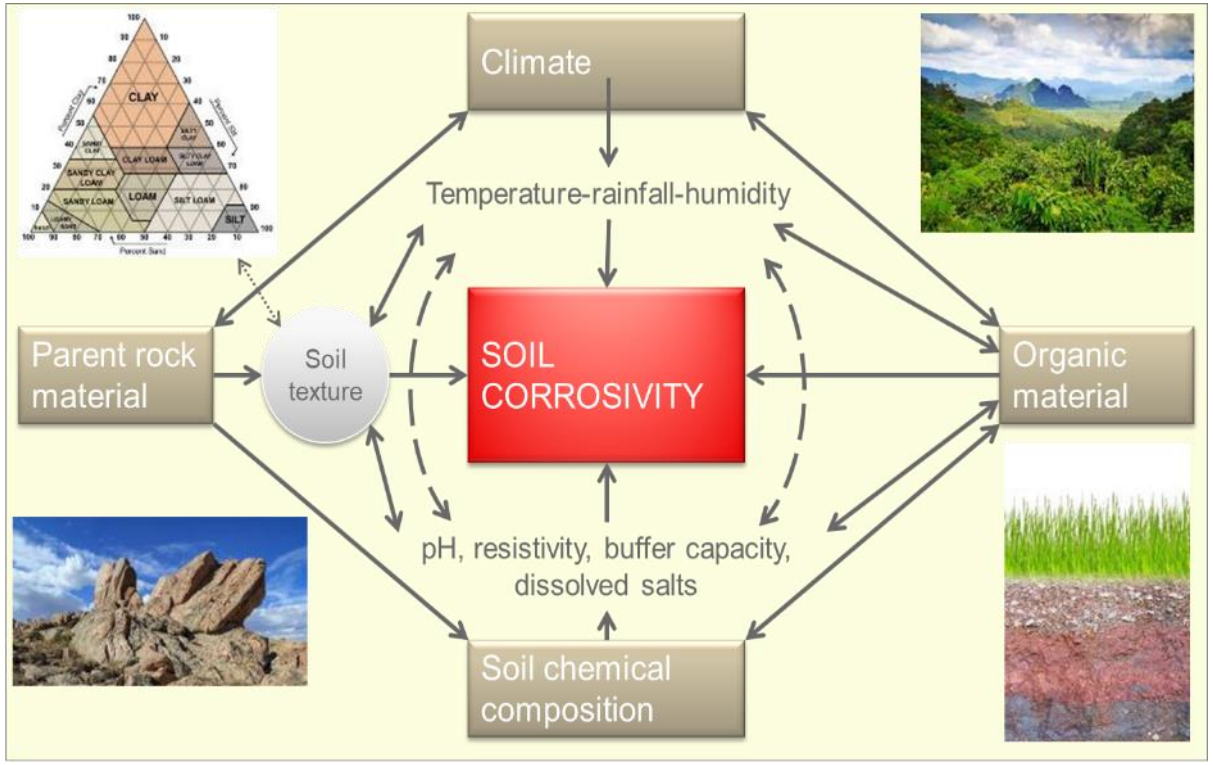
Solar mounting structures now explicitly included in the scope of the certificate

All certificates are available at industry.arcelormittal.com/magnelis

Durability is a key feature of sustainability
→ Magnelis® protection in soil evaluated in field & accelerated tests

Due to limited scientific knowledge and few quantitative norms, expertise developed in soils since 2006

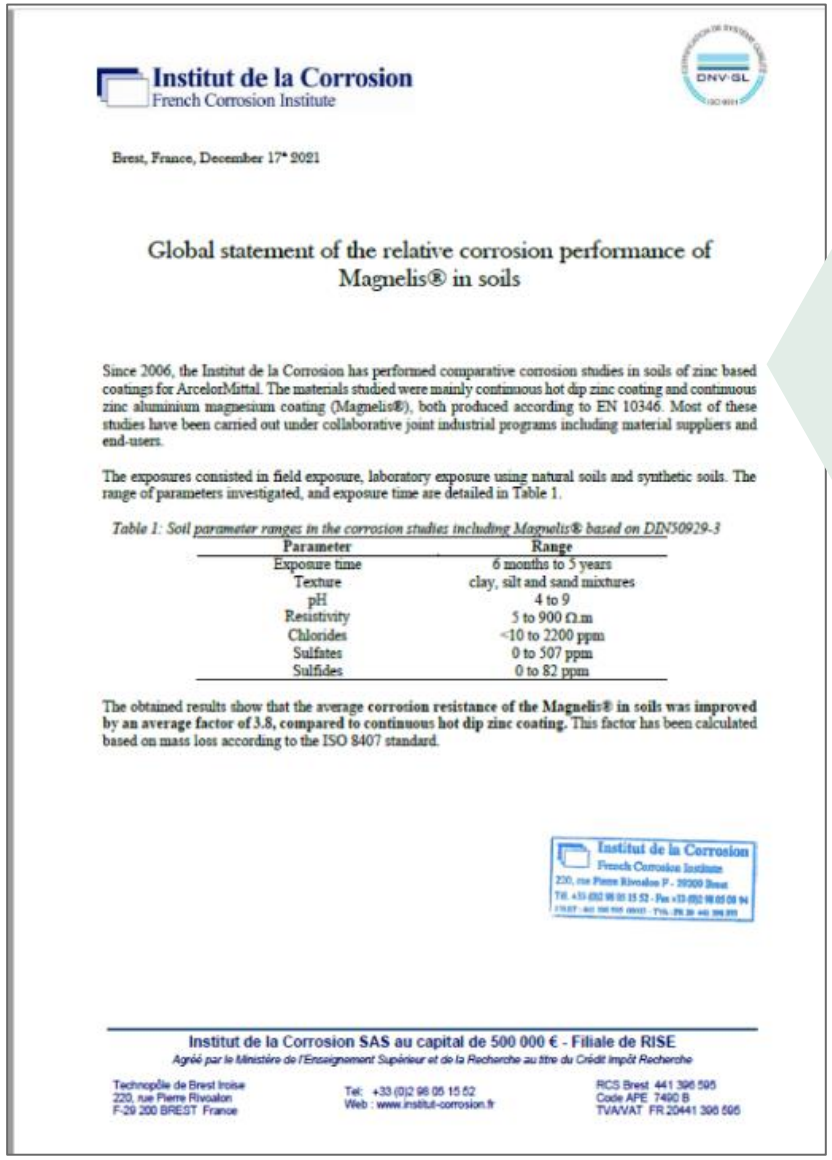
- ArcelorMittal's, and in collaboration with independent bodies
- Accelerated lab tests and field exposures tests



Complex interactions in soils

Testing sites to acquire deep proprietary knowledge

Durability is a key feature of sustainability
→ **Improved protection of Magnelis® in soils was assessed by third party**



Institut de la Corrosion
French Corrosion Institute

Brest, France, December 17th 2021

Global statement of the relative corrosion performance of Magnelis® in soils

Since 2006, the Institut de la Corrosion has performed comparative corrosion studies in soils of zinc based coatings for ArcelorMittal. The materials studied were mainly continuous hot dip zinc coating and continuous zinc aluminium magnesium coating (Magnelis®), both produced according to EN 10346. Most of these studies have been carried out under collaborative joint industrial programs including material suppliers and end-users.

The exposures consisted in field exposure, laboratory exposure using natural soils and synthetic soils. The range of parameters investigated, and exposure time are detailed in Table 1.

Table 1: Soil parameter ranges in the corrosion studies including Magnelis® based on DIN50929-3

Parameter	Range
Exposure time	6 months to 5 years
Texture	clay, silt and sand mixtures
pH	4 to 9
Resistivity	5 to 900 Ω.m
Chlorides	<10 to 2200 ppm
Sulfates	0 to 507 ppm
Sulfides	0 to 82 ppm

The obtained results show that the average **corrosion resistance of the Magnelis® in soils was improved by an average factor of 3.8, compared to continuous hot dip zinc coating.** This factor has been calculated based on mass loss according to the ISO 8407 standard.

Institut de la Corrosion
French Corrosion Institute

Institut de la Corrosion SAS au capital de 500 000 € - Filiale de RISE
Agréé par le Ministère de l'Enseignement Supérieur et de la Recherche au titre du Crédit Impôt Recherche

Technopôle de Brest Iroise
220, rue Pierre Rivoalon
F-29 200 BREST France

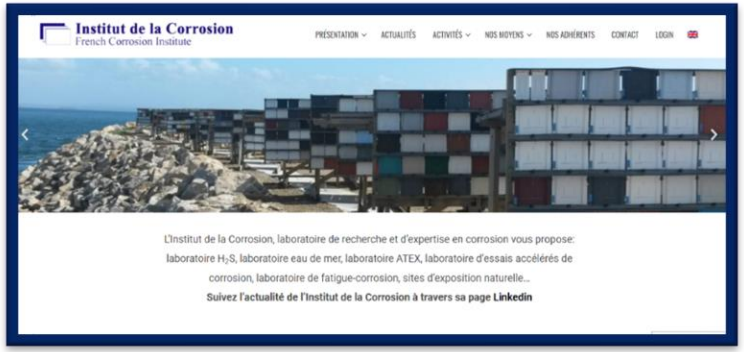
Tel: +33 (0)2 98 05 15 52
Web : www.institut-corrosion.fr

RCS Brest 441 396 595
Code APE 7490 B
TVA/VAT FR 20441 396 595

*"Corrosion resistance of Magnelis® in soils was improved by an **average factor of 3.8** compared to continuous hot dip zinc coating"*

Statement from French Corrosion Institute. This lab, subsidiary of RISE Research Institutes of Sweden AB, is among the largest laboratories in the field of corrosion and corrosion protection of materials in the world. https://www.institut-corrosion.fr/?lang=en

Details including data and types of soils are specified in the French Corrosion Institute's statement
Download here



Durability is a key feature of sustainability

→ Recent German standard for quantitative categorisation of soils

→ Adjust Magnelis® protection accordingly

March 2018

DIN 50929-3

DIN

ICS 77.060

Supersedes
DIN 50929-3:1985-09

Corrosion of metals –
Corrosion likelihood of metallic materials when subject to corrosion from the outside –
Part 3: Buried and underwater pipelines and structural components,
English translation of DIN 50929-3:2018-03

Korrosion der Metalle –
Korrosionswahrscheinlichkeit metalle
Teil 3: Rohrleitungen und Bauteile in
Englische Übersetzung von DIN 5092

Corrosion des métaux –
Probabilité de corrosion des matériau
Partie 3: Conduites et éléments de cor
Traduction anglaise de DIN 50929-3:2

Table 2 — Information relating to the assessment of soil

Z	Parameters/ Measurands	Requirement or criterion	Test	Unit	Measurement range	Rating
	Soil samples					
Z_1	type of soil — cohesion	proportion of elutriable matter	method as in DVGW GW 9: 2011-09, Annex B, Module 5	mass fractions in %	< 10 10 to 30 30 to 50 50 to 80 > 80	+4 +2 0 −2 −4
	— contamination	DIN EN 12501-2:2003-08, Table 1				−12
Z_2	specific electrical soil resistivity	lowest resistivity after addition of water, measured in the cell	method as in DVGW GW 9: 2011-09, Annex B, Module 2	Ω m	> 500 200 to 500 200 to 50 20 to 50 10 to 20 < 10	+4 +2 0 −2 −4 −6
Z_3	moisture content of soil and reference for Z_6 to Z_{10}	water content after drying at 105 °C	method as in DVGW GW 9: 2011-09, Annex B, Module 1	mass fractions in %	< 20 > 20	0 −1
Z_4	pH value	pH value for 50 % water content	method as in DVGW GW 9: 2011-09, Annex B, Module 2	—	> 9 6 to 9 4 to 6 < 4	+2[a] 0 −1 −3

Recent German standard, also available in English, defines 4 types of soil category based on soils parameters

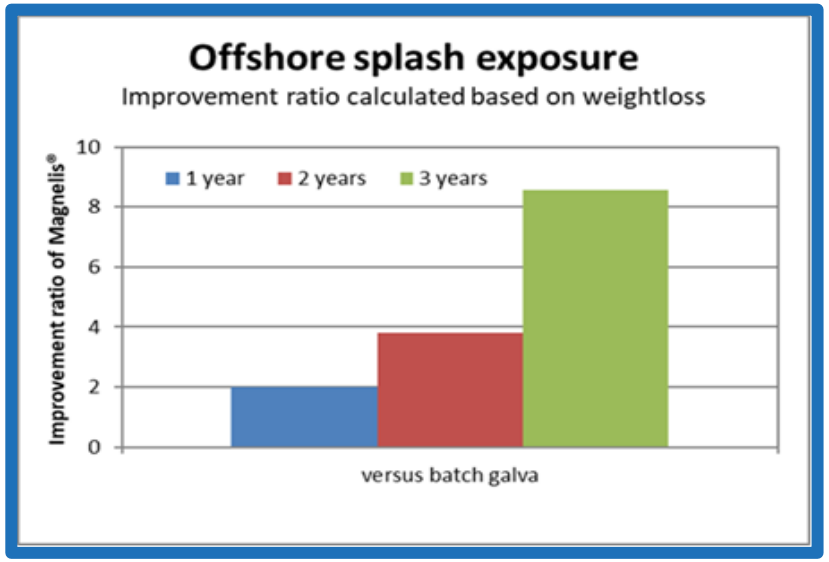
Table 3 — Classification of soils, corrosion load and likelihood of free corrosion of unalloyed and low-alloy ferrous materials

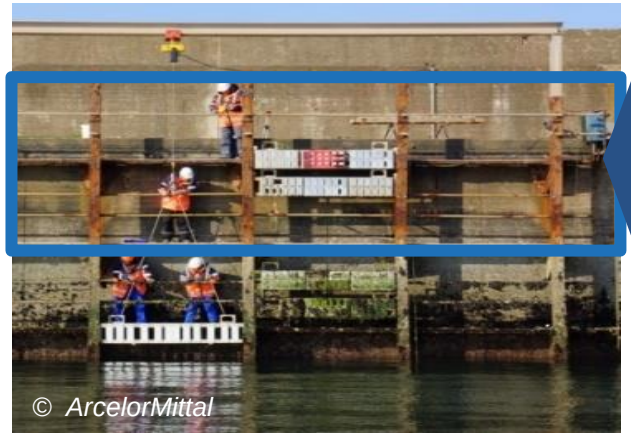
B_0 or B_1 values	Soil category	Corrosion load[a]	Likelihood of corrosion based on the B_1 value	
	based on the B_0 value		Pitting corrosion	Uniform corrosion
≥ 0	Ia	very low	very low	very low
−1 to −4	Ib	low	low	very low
−5 to −10	II	medium	medium	low
< −10	III	high	high	medium
The order of magnitude of the corrosion rate to be expected is specified in Table 1. In the case of pipes and tanks, priority shall be given to the assessment of permanent leak tightness. In this case, the rate of pitting corrosion is to be considered. In the case of structural components, priority shall be given to the assessment of permanent strength. In this case, the rate of uniform corrosion is to be considered.				
[a] The corrosion load corresponds to the likelihood of free corrosion in the absence of extensive concentration cells (see 6.1.2).				

Magnelis® ZM430 and ZM620 or above are recommended for poles rammed in soils

Possible use of Magnelis® also in concrete

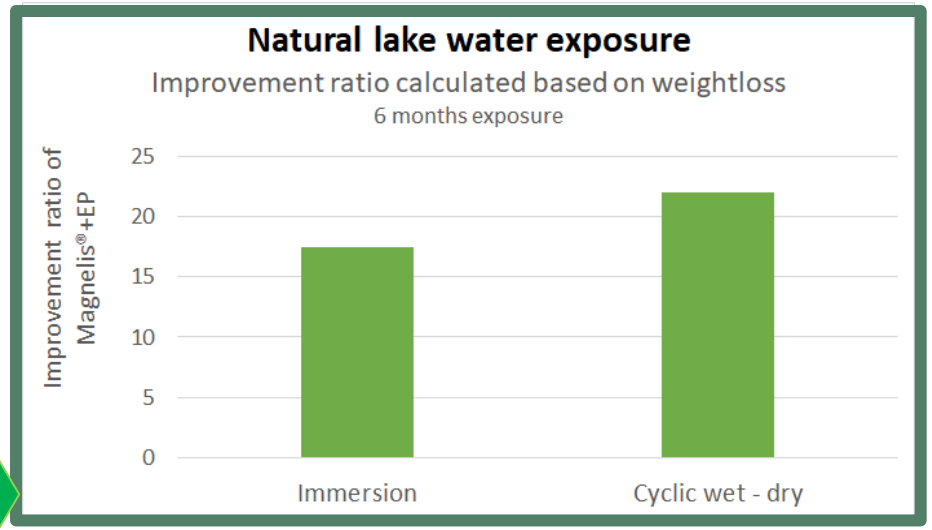
Durability is a key feature of sustainability
→ Improved protection of Magnelis® in contact with water





Magnelis® performs significantly better **(improvement ratio up to 8)** compared with batch galvanised steels.

Efficient solution for floating structures in brackish waters.



Magnelis® performs significantly better **(improvement ratio up to 22)** compared with batch galvanised steels

Efficient solution for floating structures in fresh/sweet water.

ArcelorMittal

Sustainability of mounting structures
→ Magnelis® environmental benefits vs galvanised steels

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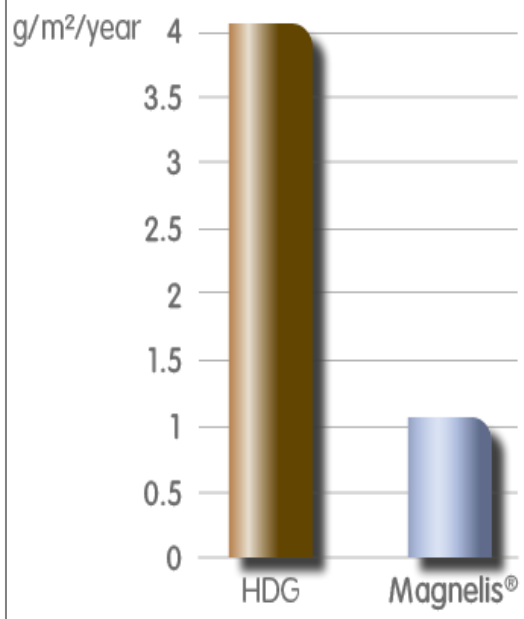
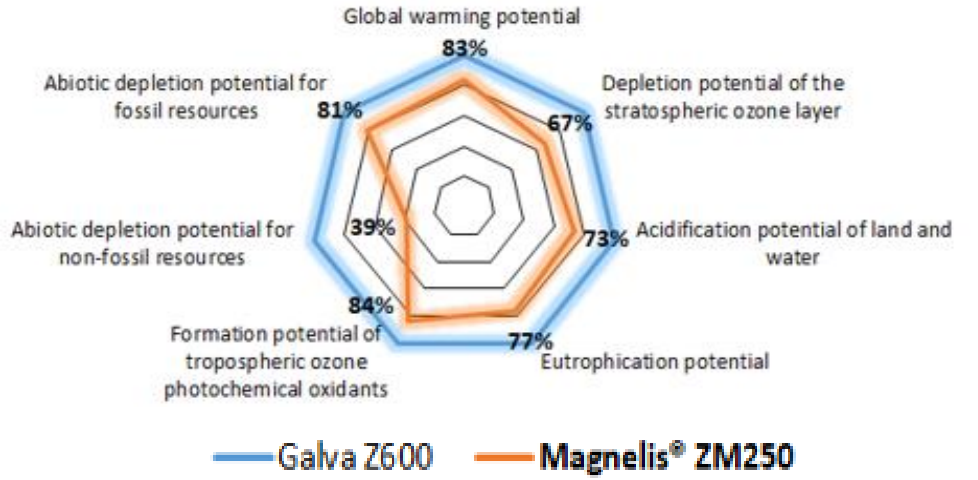
Reduced zinc run-off rate of Magnelis® in soils & waters



Dissolution rate of the material from the surface
Source: French Corrosion Institute

Reduced usage of natural resources (Environment Product Declaration)

Magnelis® ZM250 vs galva Z600 (similar in corrosion protection) - per m² - Scope: coating only from cradle-to-gate. Based on LCA model approved by IBU independent program operator, validated for the assessed products.



Positive influence on each environmental impact.
61% reduction on the consumption of scarce resources (Zn mainly).

Magnelis® is also RoHS compliant (Restriction of Hazardous Substances)

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Flat Carbon Europe

ArcelorMittal

Version 22: 12/05/2021

Legal Entity: AM Belgium (Liège, Gent, Genk), AM Bremen (Bremen, Brema), AM Eisenhüttenstadt, AM España (Avilès, Gijon, Etxebarri, Lesaka, Legasa, Sagunto), AM France (Basse Indre, Desvres, Dunkerque, Mardyck, Montataire, Florange, Mouzon), AM Méditerranée (Fos, St Chély), AM Avellino e Canossa, AM Poland (Kraków, Dąbrowa Górnicza, Świętochłowice, Sosnowiec, Chorzów), AM Sestao, AM Tailored Blanks

Declaration of compliance with European Directive 2011/65/EU on the Restriction of the use of certain Hazardous Substances in electrical and electronic equipment (RoHS) and its amendments Market Industry

Flat carbon steels and their coatings do not contain Lead, Cadmium, Mercury, Hexavalent Chromium, Polybrominated biphenyls (PBB), Polybrominated diphenyl ethers (PBDE), Bis(2-ethylHexyl) phthalate (DEHP), Butyl benzyl phthalate (BBP), Dibutyl phthalate (DBP) and Diisobutyl phthalate (DIBP) above the threshold indicated in Annex II of the European Directive 2011/65/EU as amended by Commission Delegated Directive (EU) 2015/863 of 31 March 2015.

Are therefore compliant with the RoHS directive at the above-mentioned date:

Steels and metallic coatings:
Hot rolled and cold rolled steels, Electrical steels
Metallic coatings: Hot Dip Galvanized, Electrogalvanized, Galfan, Aluzn®, Alupur®, Jetskin®, Magnelis®, Optigal®.
Those products are manufactured without intentional additions of lead, cadmium, mercury, hexavalent chromium and, in particular, are in compliance with Commission delegated Directive (EU) 2018/739 of March 1st, 2018.

Finishing treatments:
Protective Oils, Phosphatation, E-passivation®, Easyfilm® E, Easyfilm® HPE, Easyfilm® Ready-to-Enamel, Easyfilm® Ready-to-Paint and Electrical Steel Varnishes.

Organic coated Steels:
The *Nature* collection, including the *Solano®, Granite®,* and *Estetic®* products.

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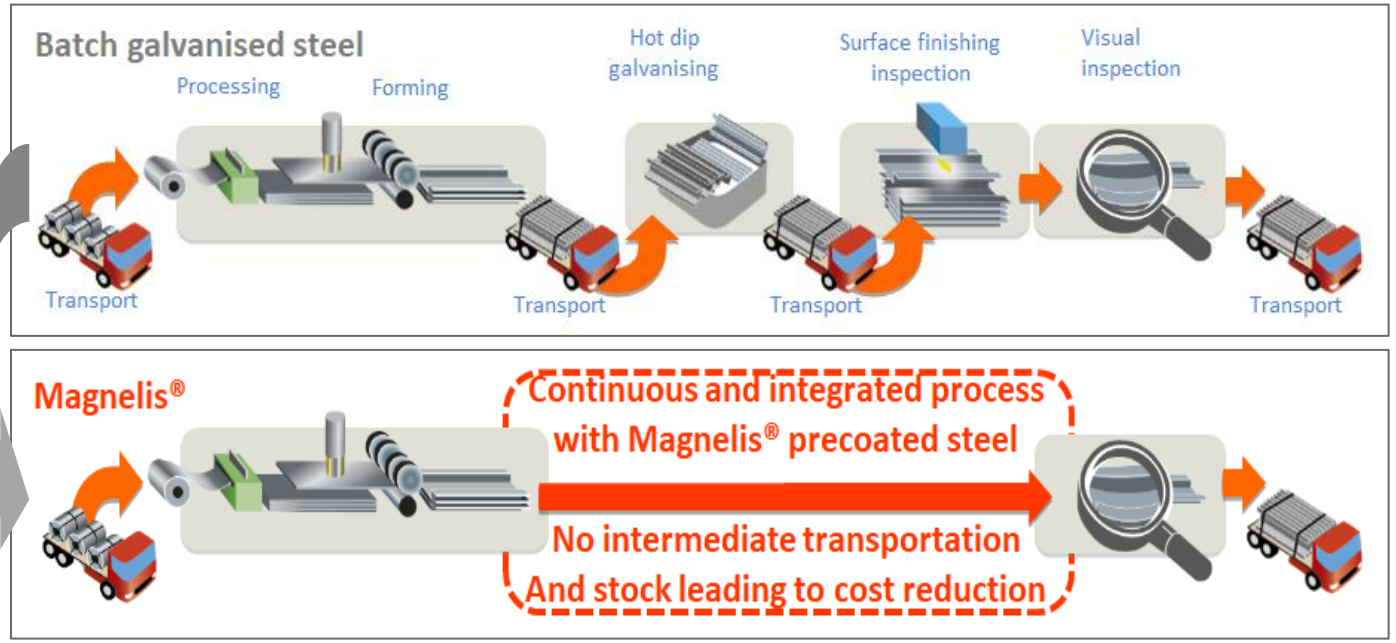
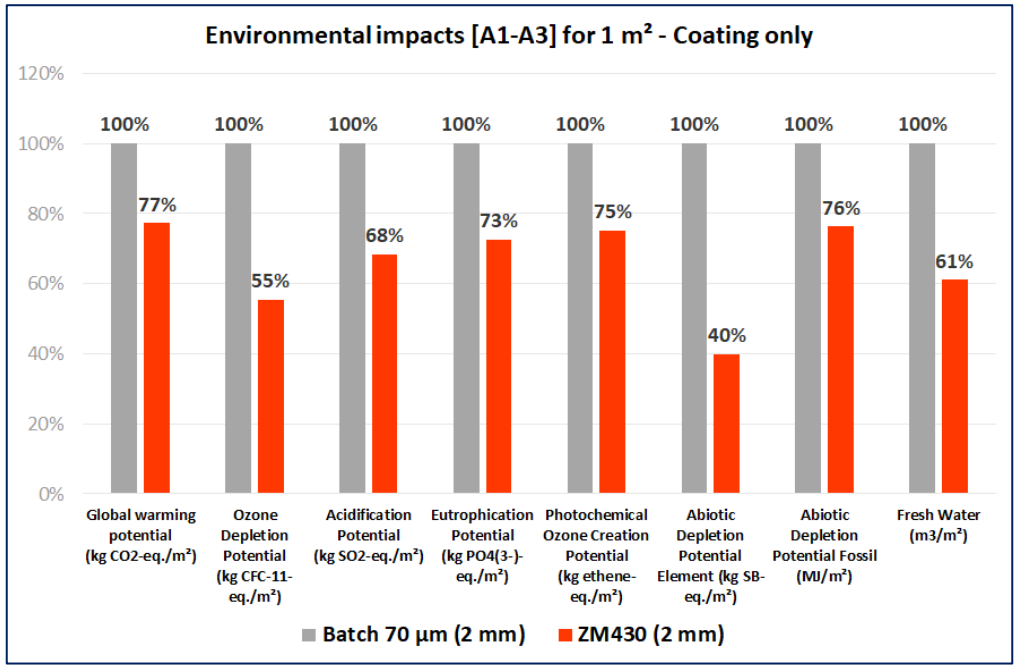
Sustainability of mounting structures
→ Magnelis® benefits vs batch galvanised steels



Benefits of Magnelis® vs batch galvanised steels:

- Cost reduction (Zinc, transport, manpower…)
- Time saving (simplified logistic & project management)
- Availability (capacities)
- 100% online surface quality control (both sides)
- Compatibility with high strength steels
- Higher geometrical tolerances (flatness, straightness)
- No design constraints

Comparative environmental impacts at equivalent corrosion protection between Magnelis® and batch galvanised



Source : EPD, hot dip galvanisation process data used as proxy for batch galvanising process.

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Several levers and domains to act on sustainability from the early design stage to the end-of-life

Engineering Construction Procurement

- Eco-Design:
  → **Selection of materials** with reduced footprint
  - alu-steel
  - **XCarb®: towards carbon neutral steel**

  → **Optimal use of materials**

- Eco- Construction:
  → Minimize waste on-site
  → Reduce energy & resources

- Sustainable Procurement:
  → **Selection of suppliers** upon how they operate

Operation Maintenance

- Limited maintenance thanks to long **durable materials**
- Limited water consumption for PV panel cleaning
- **Durable & robust** mounting structures, able for retrofitting
- Reduced **run-off** or pollutions (e.g. cleaning agents in nature)

End of life

- Total or partial **reuse** of some components or…
- Dismantle, evacuate, sort & **recycle** materials at the end of life (e.g rammed poles versus concrete foundations)

ArcelorMittal

We’re serious about climate action

Ambitious targets

- Group target to reach net zero by 2050
- Group target to reduce CO_2 by 25% by 2030
- Europe target to reduce CO_2 emissions by 35% by 2030

Major investments

- $10 billion total investment to achieve 2030 decarbonisation target

Customer focussed

XCarb®
Towards carbon neutral steel

- First to market with CO2 reduced solutions for customers
- XCarb® green steel certificates
- XCarb® recycled and renewably produced

Transparent data

THIRD-PARTY VERIFIED EPD ISO 14025 and EN 15804 Institut Bauen und Umwelt e.V.

- In-house expertise
- Product carbon footprints calculations

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We are transforming the way steel is produced

A. Steelmaking transformation

- Step change not seen in steel industry for over 100 years.
- Shift from BF (Blast Furnace) to EAF-DRI (Electric Arc Furnace-Direct Reduced Iron).
- From sinter to pellets.

DRI-EAF

B. Energy transformation

- Three options: clean electricity (green H2), fossil carbon with CCS, circular carbon.
- Green H2 needs access to renewable energy at affordable prices.
- Energy infrastructure investment required for European steel industry to shift to green H2 is €450-700bn

Green electricity | Green hydrogen | Zero emissions steel

C. Increased use of scrap

- Continue to optimise the use of recycled scrap in BF-BOF and EAF-DRI routes.
- But recognising that scrap is a limited resource, steel demand will continue to outweigh scrap availability for many decades.

D. Clean electricity

- Transition from BF-BOF to EAF-DRI will increase electricity needs of steel production process.
- This electricity must also need to come from clean sources.
- Guarantees of Origin and Power Purchase Agreements will be needed.

E. Offsetting residual emissions

- There are likely to be residual emissions where there is no technologically feasible alternative or costs will remain prohibitively high.
- We estimate this will be <5% of our emissions.
- These residual emission will be dealt with using high-quality offsets and carbon credits.

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XCarb® green steel certificates

CO_2 reduction projects

- Enabling major investments to decarbonise the blast furnace.
- Technologies include gas injection, biomass (Torero) and carbon capture and utilisation (Carbalyst).

Verified by DNV

- CO_2 savings are independently verified by DNV.

Scope 3 reduction for customers

- Enables customers to reduce their Scope 3 emissions by 2.1tCO_2 per tonne of XCarb® green steel certificates.

Available with Magnelis®

- XCarb® green steel certificates available with all steels sold by ArcelorMittal Europe – Flat Products, including Magnelis®

//EXTERFER Gestamp BETTE

ALFUN FEAG ATELIERS 3S créateurs de bardage métallique epco dedicated to perfection

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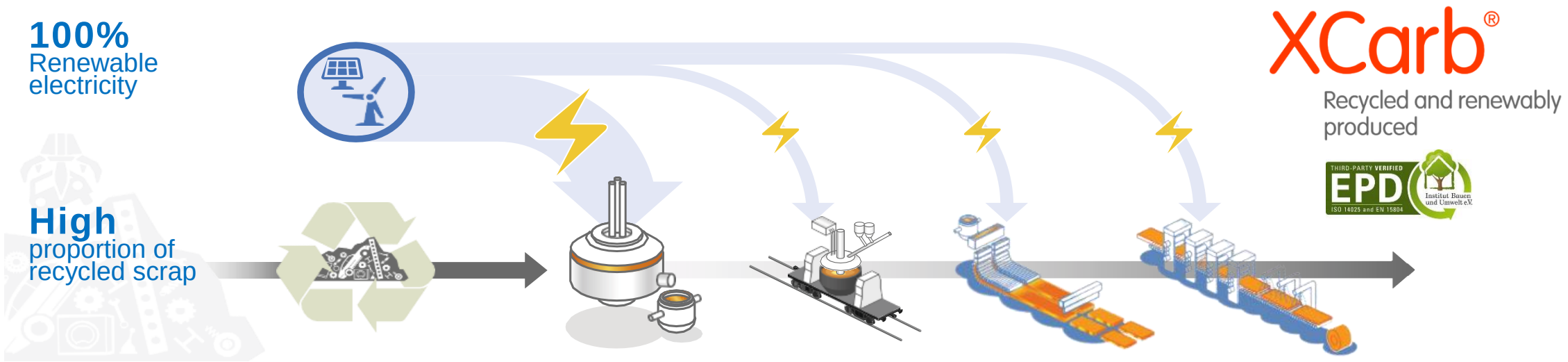
XCarb® recycled and renewably produced



- CO_2 reduced coils made in ArcelorMittal Sestao's EAF using **100% renewable energy** and a high proportion of **recycled scrap**.
- CO_2 footprint as low as **500kgCO_2 per tonne of hot rolled coil**, on a life cycle basis (cradle-to-gate).
- A variety of coatings can be offered using substrate from ArcelorMittal Sestao.
- Supplied with an **EPD** verified by third party.
- **Available soon with Magnelis®** - please ask about availability.

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At the end-of-life Magnelis® steel is infinitely recyclable

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End of life

Steel recycles forever

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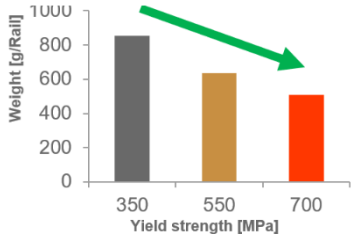
Reduce your environmental impact with ArcelorMittal steel

Magnelis® durable steel



HyPer® high strength steels

XCarb®
Towards carbon neutral steel

XCarb® Green Steel certificates
XCarb® Recycled and Renewably Produced

ArcelorMittal

Reducing the environmental impact of PV mounting structures

10 February 2022

industry.arcelormittal.com/magnelis

corporate.arcelormittal.com/climate-action/steel-s-sustainability-credentials

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