



# pv magazine Webinar

powered by ArcelorMittal

Increase the durability of solar structures with the latest generation of steels



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Forming AG

## Content

- ✓ Why durability of solar structures is key
- ✓ How steels for structures are selected
- ✓ Magnelis®: a breakthrough galvanised steel for corrosion protection
- ✓ Field test results
- ✓ Applications for ground mounted structures
- ✓ Experience and projects: from France to US and Middle East

**Magnelis®**  
Essential for the durability,  
robustness and sustainability of  
solar projects



**Jérôme Guth**  
Solar Segment Leader, ArcelorMittal Europe – Flat Products  
**Eric Lauer**  
Strategic Development Manager, Forming

# Who are we ?

- Number 1 steel producer
- Present in 60 countries
- 209,000 employees
- 92.5 million tonnes of steel
- Steel for wind and solar energies, construction, transport, appliances...
- 1500 researchers



ArcelorMittal



- Jérôme Guth
- Solar Segment Leader,
- ArcelorMittal Europe – Flat Products

## Who are we ?



- Eric Lauer,
- Strategic Development Manager
- Forming AG



- 55 years of experience
- Innovation in roll forming
- Cold-rolled profiles for the solar industry
- 120 000 tons of steel processed
- Supplier of the largest solar plant in the world 1177MW

# Contents

- Why durability of solar structures is key
- How steels for structures are selected
- Magnelis®: a breakthrough pre-coated steel for corrosion protection
- Field test results
- Experience and projects: from France to US and Middle East
- Applications for ground mounted structures
- Conclusion

# Why durability of solar structures is key



Expectations: up to 25,  
and even 40 years



Various environments

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LemonyPo, Thaweesak Tripphamon  
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© Forming AG

Reduced CAPEX



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Reduced OPEX

# How steels for structures are selected

Page 8  
EN ISO 12944-2:1998

|  |   |
|--|---|
| <p>EUROPEAN STANDARD<br/>NORME EUROPÉENNE<br/>EUROPÄISCHE NORM</p>   | <p><b>EN 1993-1-3</b></p> <p>October 2006</p>   |
| <p>ICS 91.010.30</p>   | <p>Supersedes ENV 1993-1-3:1996<br/>Incorporating corrigendum November 2009</p>   |
| <p>English Version</p>   |   |
| <p><b>Eurocode 3 - Design of steel structures - Part 1-3: General rules - Supplementary rules for cold-formed members and sheeting</b></p>                             |   |
| <p>Eurocode 3 - Calcul des structures en acier - Partie 1-3: Règles générales - Règles supplémentaires pour les profilés et plaques à parois minces formés à froid</p> | <p>Eurocode 3 - Bemessung und Konstruktion von Stahlbauten - Teil 1-3: Allgemeine Regeln - Ergänzende Regeln für kaltgeformte dünnwandige Bauteile und Bleche</p> |

2006

1998

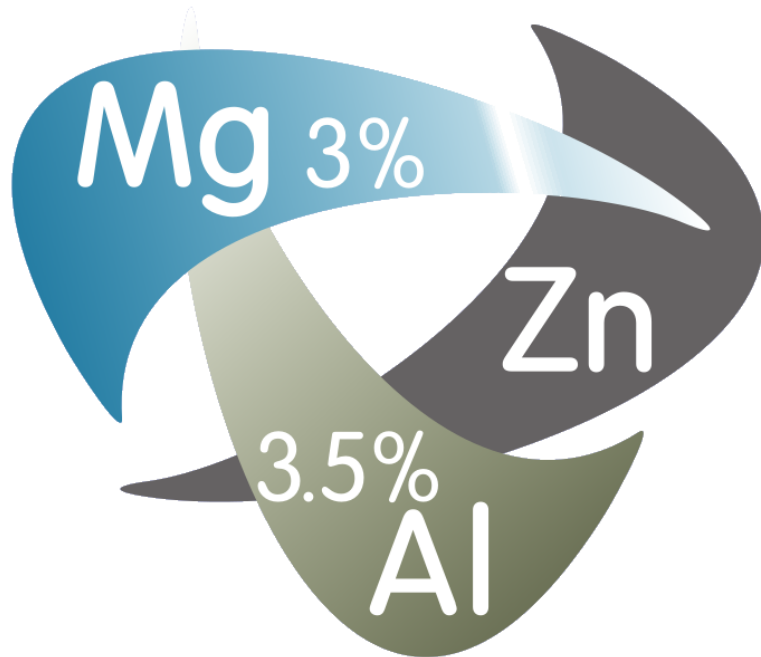
Table 1 — Atmospheric-corrosivity categories and examples of typical environments

| Corrosivity category           | Mass loss per unit surface/thickness loss (after first year of exposure) |                      |                               |                      | Examples of typical environments in a temperate climate (informative only)                            |   |
|--------------------------------|--|----------------------|-------------------------------|----------------------|---|---|
|                                | Low-carbon steel   |                      | Zinc                          |                      | Exterior  | Interior  |
|                                | Mass loss<br>g/m <sup>2</sup>  | Thickness loss<br>µm | Mass loss<br>g/m <sup>2</sup> | Thickness loss<br>µm |   |   |
| C1<br>very low                 | ≤ 10   | ≤ 1,3                | ≤ 0,7                         | ≤ 0,1                | —   | Heated buildings with clean atmospheres, e.g. offices, shops, schools, hotels.  |
| C2<br>low                      | > 10 to 200  | > 1,3 to 25          | > 0,7 to 5                    | > 0,1 to 0,7         | Atmospheres with low level of pollution. Mostly rural areas.  | Unheated buildings where condensation may occur, e.g. depots, sports halls.   |
| C3<br>medium                   | > 200 to 400   | > 25 to 50           | > 5 to 15                     | > 0,7 to 2,1         | Urban and industrial atmospheres, moderate sulfur dioxide pollution. Coastal areas with low salinity. | Production rooms with high humidity and some air pollution, e.g. food-processing plants, laundries, breweries, dairies. |
| C4<br>high                     | > 400 to 650   | > 50 to 80           | > 15 to 30                    | > 2,1 to 4,2         | Industrial areas and coastal areas with moderate salinity.  | Chemical plants, swimming pools, coastal ship- and boatyards.   |
| C5-I<br>very high (industrial) | > 650 to 1 500   | > 80 to 200          | > 30 to 60                    | > 4,2 to 8,4         | Industrial areas with high humidity and aggressive atmosphere.  | Buildings or areas with almost permanent condensation and with high pollution.  |
| C5-M<br>very high (marine)     | > 650 to 1 500   | > 80 to 200          | > 30 to 60                    | > 4,2 to 8,4         | Coastal and offshore areas with high salinity.  | Buildings or areas with almost permanent condensation and with high pollution.  |

NOTES

- The loss values used for the corrosivity categories are identical to those given in ISO 9223.
- In coastal areas in hot, humid zones, the mass or thickness losses can exceed the limits of category C5-M. Special precautions must therefore be taken when selecting protective paint systems for structures in such areas.

# Magnelis®: a breakthrough pre-coated steel for corrosion protection



- High capacity available
- 100% continuous product control
- Quality at “ppm” level
- Traceability



## Tests performed by Magnelis®

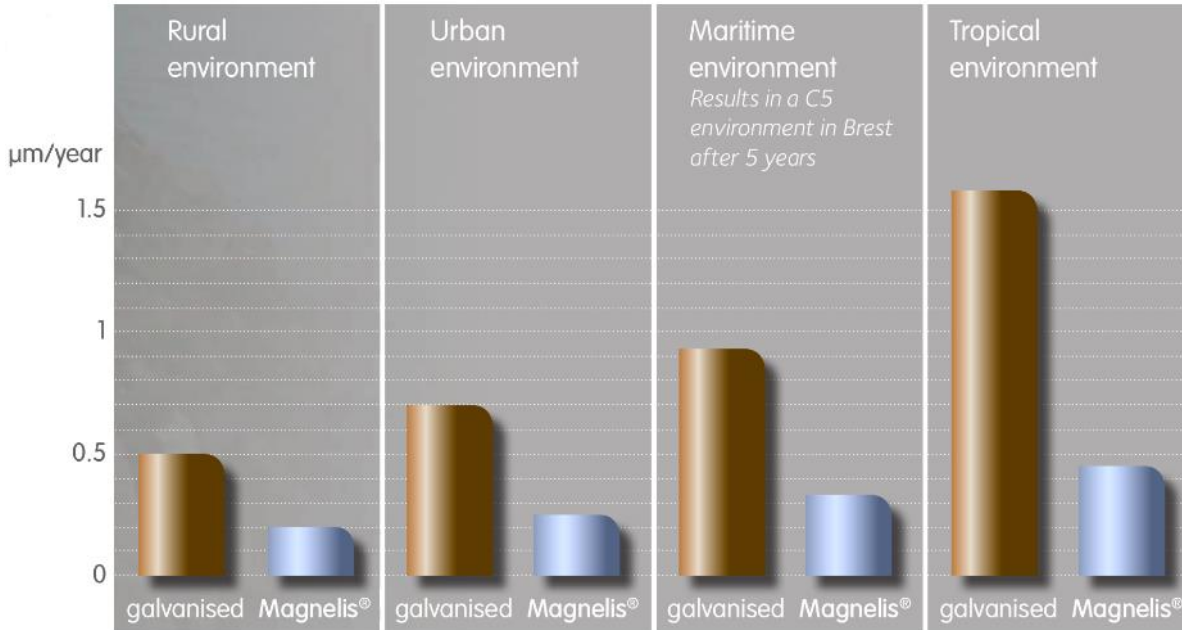
### Laboratory tests

- Salt-spray tests
- Cyclic auto VDA
- Cyclic auto ECC 1
- Kesternich
- ArcelorMittal soil tests

### Field tests

- Marine: Brest
- Industrial: Dunkerque
- Tropical: Florida
- Urban: Chicago
- Desert: Dubai
- Rural: Maizières, France

# Magnelis<sup>®</sup> outperforms whatever the environment



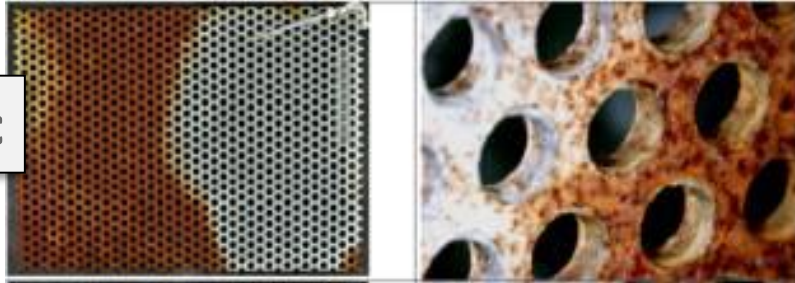
Mean yearly consumed thickness in different environments in microns/year (after 2 years)

The measured weight loss is not dependent of the initial coating thickness of the samples

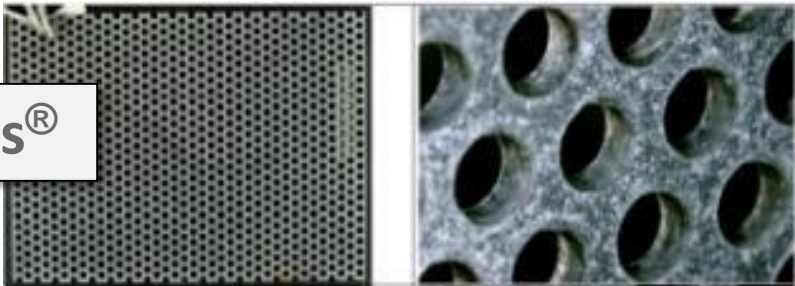
Classical galvanised steel corrodes at least 3 times faster than **Magnelis<sup>®</sup>**

# Magnelis<sup>®</sup> self-healing effect

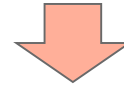
Pure zinc



Magnelis<sup>®</sup>



- ✓ Samples (2mm) perforated after galvanization
- ✓ exposed 4 years in marine environment (Brest, France)



- 1<sup>st</sup> step: cut edges of galvanised material rust
- 2<sup>nd</sup> step: cut edges of Magnelis<sup>®</sup> coated steel are reprotected

Thanks to the self healing effect,  
cut edges are re-protected by the **Magnelis<sup>®</sup>** coating

# Magnelis®: first metallic coating certified for C5 environment



**CSTB**  
Le Centre de Recherches  
ENVELOPPE ET REVÊTEMENTS  
Construction Légères et Couvertures

## Evaluation Technique Préalable de Matériau

Revêtement métallique sur tôle d'acier  
cathodique

### Magnelis®

**ZM120 equivalent with Z275  
Magnelis® ZM310  
in severe environments**

Commission chargée de formuler des Avis Techniques  
Groupe Spécialisé n° 2  
....., Faculté et Classes Légères

Date de validité: 21 mars 2012

CSTB  
France

Deutsches Institut für Bautechnik **DIBt**

Zulassungsgesicht für Bauelemente und Bauteile  
Bauteiltechnisches Prüfamt  
Eine vom Bundesrat und den Ländern  
gemeinsam getragene Anstalt des öffentlichen Rechts  
Möglertstr. 63/7A, 10585 Berlin, Deutschland

Datum: 23.07.2013  
Geschäftszeichen: I 36-1-30.11-1210

Zulassungsnummer:  
**Z-30.11-61**

Geltungsdauer:  
vom **25. Juli 2013**  
bis **25. Juli 2018**

Antragsteller:  
ArcelorMittal  
19 Avenue de la Liberté  
2000 LUXEMBOURG  
LUXEMBOURG

Zulassungsgegenstand:  
Mit dem Beschichtungssysteme Magnelis korrosionsschutzgeschützte Stahlbleche (Coils) für die  
Herstellung dinnwandiger kaltgeformter Bauteile

**Magnelis® ZM120 is K11  
Magnelis® ZM250 is K111**

DIBT  
Germany

RISE  
Sweden

SP  
Swedish Technical Approval  
SC0559-13  
and decision on protection control, in accordance with chapter 6, 22 and 23 of Planning and  
Building Act (2010:860), etc.

### Magnelis ZM310, Corrosion protection coating

Model:  
ArcelorMittal Global Research & Development, CL / Chavenet 6, 4830 Sartois, Ecluse, Spain  
VAT number: ES 62064320  
Internet: [www.arcelormittal.com](http://www.arcelormittal.com)

Information supplied by:  
ArcelorMittal Global Research & Development, Rue de la Digue, 22, BE-4830 Sartois, Belgium  
Tel: +32 4 236 21 95, E-mail: [info\\_risec@arcelormittal.com](mailto:info_risec@arcelormittal.com)

Product:  
Corrosion protection coating, Magnelis ZM310, is a special coating composed by an alloy of zinc,  
aluminium and magnesium. Coating thickness 20 µm per side.

Intended use:  
intended as corrosion protection of steel sheet for interior- and outdoor applications. The  
corrosion protection is suitable for corrosivity class C5, according to EN ISO 12944-2  
described steel, based on a meaner expected lifetime of 12 years.

Trade name:  
Magnelis ZM310

Approval:  
The product fully fulfills the requirements set forth in chapter 6, 4 § 5, P.B.I., in respect to the end user  
conditions stated in this certificate, and has received approval in accordance with the  
European construction standards (Eurocodes), (EN) issued by the National Board of Housing,  
Building and Planning.

ENX  
Durability  
Durability

Associated documents:  
Section A, 7 §  
Section 6, EN 12944-2, clause 2.1.1

Section:  
Section A, 7 §  
Section 6, EN 12944-2, clause 2.1.1

**Magnelis® ZM310 is C5**

# Magnelis® guaranteed durability for solar applications



Up to 25 years in atmospheric conditions

ArcelorMittal

**Magnelis®**

**25 years guarantee in Solar Applications**

ArcelorMittal Commercial Spain S.L. provides this guarantee to

hereafter referred to as the "Client" relating to the quality of its Magnelis® ZM310-type coated flat carbon steel. Subject to the conditions of this document, this guarantee covers the non-perforation and non-rupture due to corrosion of Magnelis® steel sheet coated with 310 g/m<sup>2</sup> on both sides according to European standard EN 10346, used for solar applications, for a period of 25 years, from the date of shipping by ArcelorMittal.

Date July 2nd 2018 The Client

ArcelorMittal Commercial Spain S.L. (s) .....

(s) Sandeep Arora (s) .....

Represented by Juan Marin

Sandeep Arora Head of Product Marketing 4  
 Juan Marin Head of Finance

The terms and conditions of this Guarantee will enter into force as follows: (i) the Client shall return this document duly dated, initialed and signed by the authorized person(s) within thirty (30) days of the date of its receipt; or (ii) the document shall be deemed to have been tacitly accepted in full by the Client upon expiry of the period of thirty (30) days from the date of its receipt.

ArcelorMittal may cancel the Guarantee if it does not receive payment for coils within three (3) months of delivery.

ArcelorMittal Commercial Spain S.L. - Carretera de Toledo N° 402, km 8.2 - 28023 Villaverde (Madrid), Spain  
 los.technicalassistance@arcormittal.com  
 Region Mercantíl de Madrid, Tomo 4.353, Sección 16, Hoja 16-7886

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Magnelis® guarantee N° 0462219

Up to 20 years in soils

ArcelorMittal

**Magnelis®**

**20 years guarantee in Applications in Soil**

ArcelorMittal Belgium N.V. provides this guarantee to

hereafter referred to as the "Client" relating to the quality of its Magnelis® ZM430-type coated flat carbon steel. Subject to the conditions of this document, this guarantee covers the non-perforation and non-rupture due to corrosion of Magnelis® steel sheet in a minimum nominal sheet thickness of 3.0 mm and coated with 430 g/m<sup>2</sup> on both sides according to European standard EN 10346, used for applications in which the surface of the coated steel gets in contact with the soil, for a period of 20 years, from the date of shipping by ArcelorMittal.

Date July 2nd 2018 The Client

ArcelorMittal Belgium N.V. (s) .....

(s) Sandeep Arora (s) .....

Represented by Juan Marin

Sandeep Arora Head of Product Marketing 4  
 Juan Marin Head of Finance

The terms and conditions of this Guarantee will enter into force as follows: (i) the Client shall return this document duly dated, initialed and signed by the authorized person(s) within thirty (30) days of the date of its receipt; or (ii) the document shall be deemed to have been tacitly accepted in full by the Client upon expiry of the period of thirty (30) days from the date of its receipt.

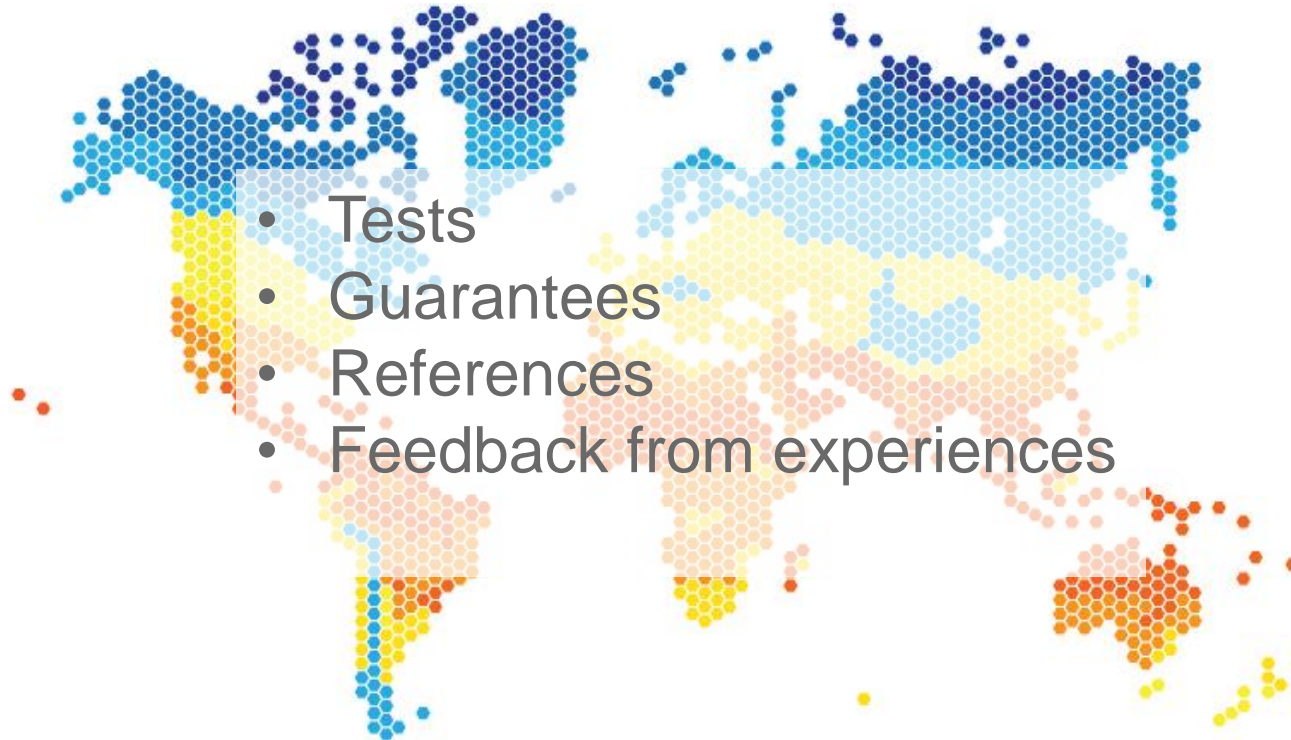
ArcelorMittal may cancel the Guarantee if it does not receive payment for coils within three (3) months of delivery.

ArcelorMittal Belgium N.V. - Kazembuisen 66 - 1206 Brussels, Belgium - for technical assistance@arcormittal.com  
 BE040010291, 1974 Brussels

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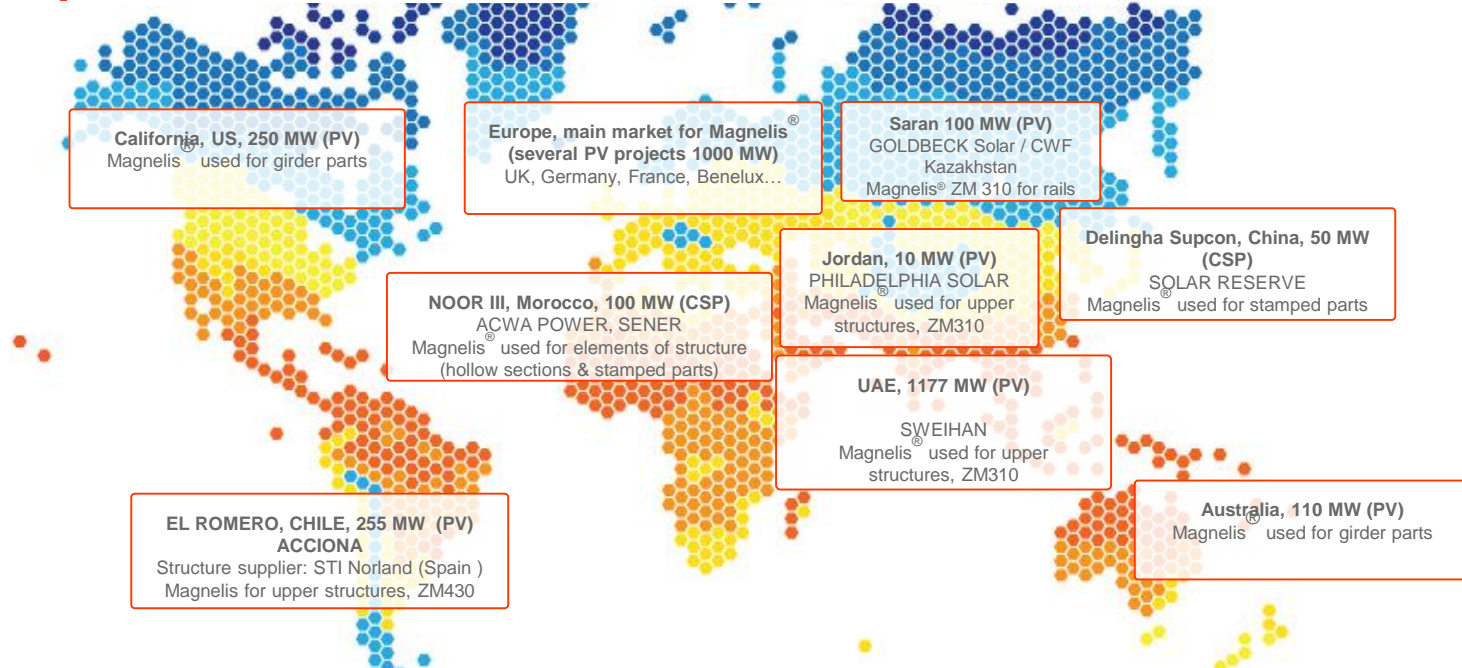
Magnelis® guarantee N° 0462219

# Magnelis®



- Tests
- Guarantees
- References
- Feedback from experiences

# Experience and projects: from Europe to US and Middle East



Many projects around the world with Magnelis®:  
PV & CSP, racking & foundations, fix & trackers

# Applications of Magnelis®



© STI Norland & Acciona Energia

Fixed structures



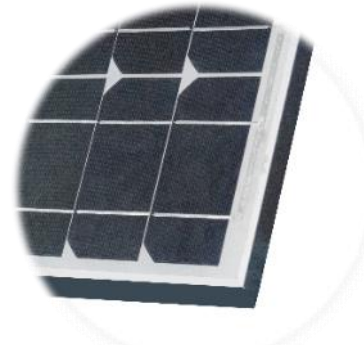
© Laszlo66 / shutterstock.com

Roof top



© ariendomundo / shutterstock.com

Trackers



© M.Somchai / shutterstock.com

PV frames



© Forming AG

Car-port




© Thaweesak Thippamon / shutterstock.com

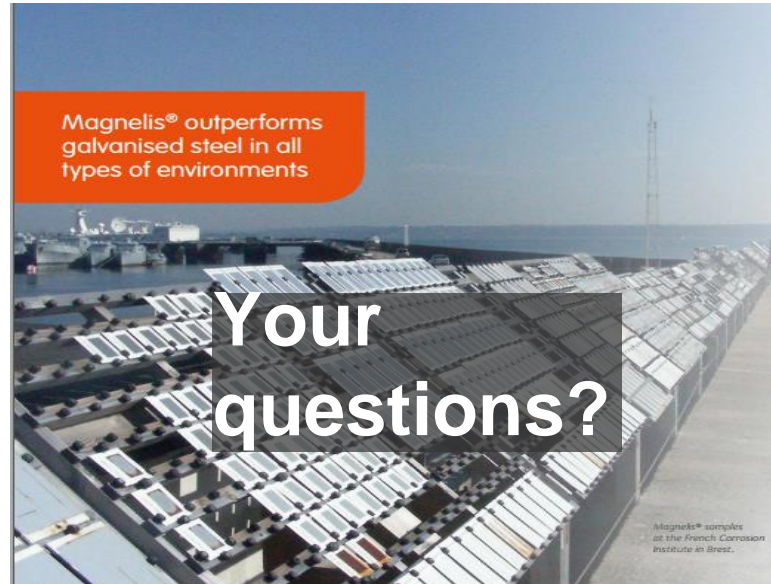
Floating



## Conclusion

- 
- Mega successes
  - Recent mega GW projects
  - Extending the tests
  - Enlarging the Magnelis® range

Thank you !



**More info** <https://industry.arcelormittal.com/magnelis>

**Watch the video** <https://www.youtube.com/watch?v=ER0R8K3nLXY>

**Order free samples** <https://industry.arcelormittal.com/samplewebshop>



# Questions and discussion



## Upcoming Events

### **pV magazine upcoming webinars**

#### **Minimizing the dynamic effects of wind in solar plants through tracker wind design**

Thursday 4 April 2019, 5pm - 6pm (CEST)

### **@ Intersolar Europe 2019**

#### **Roundtables Europe 2019**

May 16, 2019

##### **Subsidy-free PV: Transforming the energy landscape**

**Future PV Roundtable – 12:00 – 13:30**

**Register for free:**

<https://www.pv-magazine.com/upcoming-future-pv-roundtables/registration/>

**Quality Roundtable – 14:30 – 17:00**

**Register for free:**

<https://www.pv-magazine.com/quality-roundtables/registration/>