ENVIRONMENTAL PRODUCT DECLARATION

as per *ISO 14025* and *EN 15804+A2*

Owner of the Declaration	ArcelorMittal Europe – Flat Products
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
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Valid to	15.11.2027

XCarb® Recycled and Renewably produced hot dip galvanized steel with Magnelis® Coating

ArcelorMittal

Institut Bauen und Umwelt e.V.

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General Information

ArcelorMittal

XCarb® Recycled and Renewably Produced Hot dip galvanized steel with Magnelis® Coating

Programme holder
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ArcelorMittal Europe – Flat Products
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Declaration number
EPD-ARC-20220236-CBA1-EN

Declared product / declared unit
The declared unit is 1 metric ton of XCarb® Recycled and Renewably Produced Magnelis® coated steel (1.5 mm steel thickness with 310 g/m² Magnelis® coating)

This declaration is based on the product category rules:
Structural steels, 11.2017
(PCR checked and approved by the SVR)

Scope:
This declaration applies to 1 metric tonne of XCarb® Recycled and Renewably Produced Magnelis® coated steel produced at ArcelorMittal.

Issue date
16.11.2022

The Life Cycle Assessment is based on the LCA model and data for ArcelorMittal XCarb® Recycled and Renewably Produced Hot Rolled Coils, coupled with downstream processes at ArcelorMittal plants, covering 100% of the production of the declared product.

Valid to
15.11.2027

The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.

The EPD was created according to the specifications of *EN 15804+A2*. In the following, the standard will be simplified as *EN 15804*.

Verification

The standard *EN 15804* serves as the core PCR
Independent verification of the declaration and data according to *ISO 14025:2011*
☐ internally ☒ externally

Dipl. Ing. Hans Peters
(chairman of Institut Bauen und Umwelt e.V.)

Dr. Alexander Röder
(Managing Director Institut Bauen und Umwelt e.V.))

Matthias Klingler
(Independent verifier)

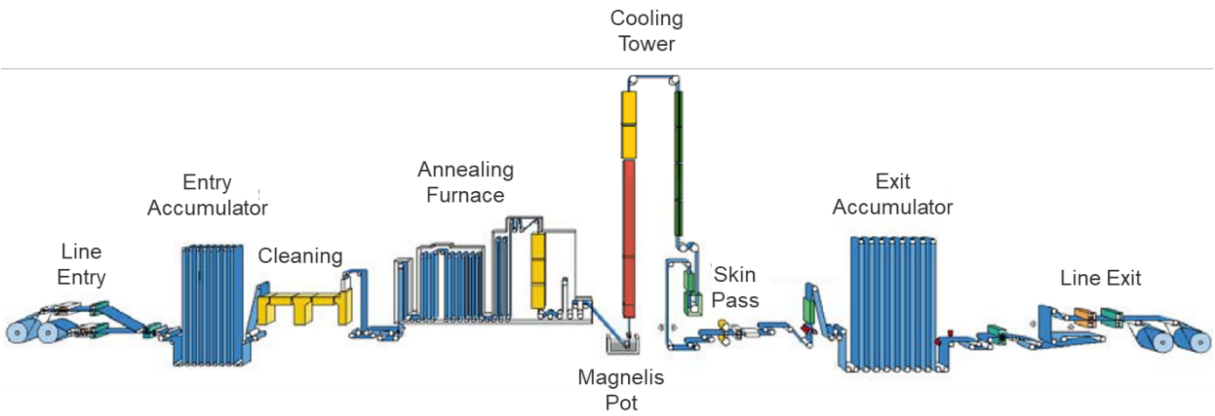
Product

Product description/Product definition
This Environmental Product Declaration refers to XCarb® Recycled and Renewably Produced hot dip galvanized steel with Magnelis® Coating. The product is a double-sided hot-dip galvanized carbon steel coated on both sides with a zinc-aluminium-magnesium alloy. This alloy, composed of 93.5 % zinc, 3.5 % aluminium and 3 % magnesium, is applied by means of a continuous hot dip galvanizing process. A post-treatment (passivation, thin organic coating and/or oiling) can also be applied on the product.

This chemical composition has been selected to provide an excellent corrosion resistance.

XCarb® Recycled and Renewably Produced hot dip galvanized steel with Magnelis® Coating is compliant with *EN 10346*.

The coated steel is available in a very wide range of steel grades (steels for cold forming and deep drawing applications, structural steels and High Strength Low Alloy steels), and coating masses (from 70 to 800 g/m²). ZM is the symbol used in *EN 10346* to refer to Zinc Aluminium Magnesium coatings to which Magnelis® coated steel belongs.



For the use and application of the product, the respective national provisions at the place of use apply.

Application
XCarb® Recycled and Renewably Produced hot dip galvanized steel with Magnelis® coating can be used in various industrial applications, such as:

- Construction: structural or non-structural profiles, roofing & cladding, decking, cable trays, expanded metal, gratings, composite flooring, concrete moulds
- Road and railway infrastructure: safety barriers, protection equipment, sound
- insulation wall panels, walls providing protection against hail
- Agriculture and farming: barns, greenhouse structures, agricultural equipment
- Solar energy generation: structures for photovoltaic plants
- Tubular applications: structural tubes for scaffolding, road signals, poles.

The coated steel is delivered in wide coils, slit coils, blanks or sheets. It can be processed by all conventional processing operations used for hot dip galvanized steel: bending, drawing, clinching, profiling, stamping, welding etc.

The friction coefficient of XCarb® Recycled and Renewably Produced hot dip galvanized steel with Magnelis® coating is lower than the one of standard hot dip galvanized steel and is stable during cold forming operations.

Technical Data
Due to its 3 % magnesium content, XCarb® Recycled and Renewably Produced hot dig galvanized with Magnelis® coating offers self-healing on cut edges and corrosion resistance in chloride and ammonia atmospheres. This high corrosion resistance means that less metallic coating is required to ensure an equivalent corrosion protection than with standard hot dip galvanized steels.

The coating process can apply various thickness of the Zinc Aluminium Magnesium layer, up to 800 g/m² (total of both sides).

Specific mechanical properties are defined for each steel grade used as substrate and measured according to *EN ISO 6892*. The corrosion resistance performance can be evaluated with different indoor and outdoor tests. One of the most common tests is the 'Salt Spray Test' defined according to *EN ISO 9227/ASTM B-117*.

Constructional data
The following table refers to steel properties without the coating. Properties with coating differ according to thickness. If necessary, specific characteristics can be obtained at http://industry.arcelormittal.com/catalogue/E35/EN.

Name	Value	Unit
Density	7850	kg/m^3
Modulus of elasticity	210000	N/mm^2
Coefficient of thermal expansion	12	$10^{-6}K^{-1}$
Thermal conductivity	48	W/(mK)
Melting point	1536	°C

Performance data of the product with respect to its characteristics in accordance with the relevant technical provision (no CE-marking).

Base materials/Ancillary materials
The base material of XCarb® Recycled and Renewably Produced hot dip galvanized with Magnelis® coating is iron. Alloying elements are added on the form of ferroalloys or metals. The metallic coating includes only zinc, aluminium and magnesium.

This product comes from a production process flow which only uses XCarb® Recycled and Renewably Produced Hot Rolled Coil. This pre-material will only be transported by sea or train to the ArcelorMittal finishing mills outside Spain.

The substrates can be made of different steel grades (DX51D to DX57D, S220GD to S550GD, HX260LAD to HX500LAD, *EN 10346*) with steel thicknesses ranging between 0.36 mm and 6.0 mm.

Detailed steel and coating properties and chemical compositions are available at: http://industry.arcelormittal.com/catalogue/E35/EN.

This product contains substances listed in the *candidate list (*date 02.06.2022) above 0.1 mass percent: **No.**

Reference service life
Hot dip galvanized coated steels are used in construction with many different application purposes. The service life therefore will be limited by the

application and corresponding service. At the end of life, they will be recovered and recycled into a new steel product.

LCA: Calculation rules

Declared Unit
The declaration refers to the functional unit of 1 metric ton of double-sided XCarb® Recycled and Renewably Produced hot dip galvanized steel with Magnelis® coating, packed and ready to be transported from ArcelorMittal to its clients as specified in Part B requirements on the EPD.

The results are calculated based on a 1.5mm steel thickness with 310 g/m² Magnelis® coating. The steel substrate has been elaborated from an XCarb® Recycled and Renewably Produced Hot Rolled Coil.

Declared unit

Name	Value	Unit
Declared unit	1	t
Thickness	1.5	mm
Density	7828	kg/m³

The product described refers to the average annual production at ArcelorMittal in Europe for the reference year of 2021. The results are within a 10 % variation.

System boundary
Type of EPD: cradle to gate with modules C1–C4 and module D (A1-A3, C and D)

Modules A1-A3 of the XCarb® Recycled and Renewably Produced hot dip galvanized steel with Magnelis® coating production include:

- The provision of resources, additives, and energy
- Transport of resources and additives to the production site
- Transport of intermediate products within ArcelorMittal sites
- Production processes on site include energy, production of additives, disposal of production residues, and consideration of related emissions.
- Recycling of production/manufacturing scrap. Steel scrap is assumed to reach the end-of-waste status once is shredded and sorted, thus becoming input to the product system in the inventory.

Module C1 assumes a generic multi-story building demolition scenario. **Module C2** includes impacts of assumed distances of 100 km from the demolition site of a scrap processing plant and 200 km from this plant to the disposal. In both cases, empty returns of transport were assumed.

Module C3 takes into account the sorting and shredding of after-use steel to allow its orientation towards the recycling solutions. This process will also produce losses due to efficiency that will be oriented towards landfill sites. A conservative value of 2 % landfill is then considered in C4.

Module C4 takes into account the waste disposal including physical pre-treatment and management of the disposal site. Steel is an inert material which does not require any specific treatment on disposal site.

Module D refers to the end of life of the structural steel, including reuse and recycling

Comparability
Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to *EN 15804* and the building context, respectively the product-specific characteristics of performance, are taken into account.

For life cycle modelling of the considered products, *GaBi ts software* version 10.6.1.35 was used with GaBi database 2022.2. This database contains consistent and documented datasets available in *Gabi Documentation*

LCA: Scenarios and additional technical information

Characteristic product properties
Information on biogenic carbon
The declared product does not contain any biogenic carbon.

Product packaging is adapted to the way the product will be transported, its intended use, its thickness and width, and the customer's request.

For modelling, a conservative scenario was employed, considering the following amounts of packaging materials.

- Steel – 0.796 kg
- Plastic – 0.075 kg
- Timber – 1.5 kg
- Cardboard – 1.73 kg.

Information on describing the biogenic Carbon Content at factory gate

Name	Value	Unit
Biogenic carbon content in product	0	kg C
Biogenic carbon content in accompanying packaging	1.46	kg C

End of life (C1 - C4)
Current practice for the average hot dip galvanized steel consists of 98 % recycling and 2 % landfill

according to the *European Commission Technical Steel Research*.

Name	Value	Unit
Recycling	980	kg
Landfilling	20	kg

Reuse, recovery and/or recycling potentials (D), relevant scenario information

Name	Value	Unit
Recycling	98	%

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LCA: Results

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; ND = MODULE OR INDICATOR NOT DECLARED; MNR = MODULE NOT RELEVANT)

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	ND	ND	ND	ND	MNR	MNR	MNR	ND	ND	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 ton XCarb® Recycled and Renewably Produced hot dip galvanized steel with Magnelis® coating

Core Indicator	Unit	A1-A3	C1	C2	C3	C4	D
Global warming potential - total	[kg CO_2-Eq.]	7.97E+2	4.35E+1	2.13E+1	1.53E+0	2.90E-1	-5.42E+1
Global warming potential - fossil fuels	[kg CO_2-Eq.]	7.94E+2	4.32E+1	2.11E+1	1.52E+0	2.98E-1	-5.43E+1
Global warming potential - biogenic	[kg CO_2-Eq.]	2.43E+0	1.83E-3	1.53E-2	5.40E-3	-8.84E-3	8.68E-2
GWP from land use and land use change	[kg CO_2-Eq.]	1.60E-1	2.82E-1	1.45E-1	9.36E-4	5.51E-4	-1.45E-2
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	8.93E-8	1.33E-11	2.12E-12	1.99E-11	7.01E-13	1.50E-10
Acidification potential, accumulated exceedance	[mol H^+-Eq.]	2.51E+0	2.46E-1	1.27E-1	3.75E-3	2.12E-3	-1.49E-1
Eutrophication, fraction of nutrients reaching freshwater end compartment	[kg P-Eq.]	2.17E-3	1.52E-4	7.70E-5	4.31E-6	5.06E-7	-9.69E-6
Eutrophication, fraction of nutrients reaching marine end compartment	[kg N-Eq.]	5.64E-1	1.19E-1	6.20E-2	1.03E-3	5.41E-4	-3.10E-2
Eutrophication, accumulated exceedance	[mol N-Eq.]	6.08E+0	1.32E+0	6.87E-1	1.10E-2	5.94E-3	-3.36E-1
Formation potential of tropospheric ozone photochemical oxidants	[kg NMVOC-Eq.]	1.66E+0	2.31E-1	1.20E-1	2.82E-3	1.64E-3	-1.04E-1
Abiotic depletion potential for non-fossil resources	[kg Sb-Eq.]	9.13E-2	4.45E-6	2.17E-6	3.84E-7	3.06E-8	1.19E-6
Abiotic depletion potential for fossil resources	[MJ]	9.26E+3	5.82E+2	2.83E+2	2.68E+1	3.91E+0	-4.03E+2
Water (user) deprivation potential, deprivation-weighted water consumption (WDP)	[m^3 world-Eq deprived]	1.75E+2	6.26E-1	2.41E-1	3.11E-1	3.27E-2	1.14E+0

RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A2: 1 ton XCarb® Recycled and Renewably Produced hot dip galvanized steel with Magnelis® coating

Indicator	Unit	A1-A3	C1	C2	C3	C4	D
Renewable primary energy as energy carrier	[MJ]	2.06E+4	4.44E+1	1.96E+1	1.38E+1	5.86E-1	5.87E+1
Renewable primary energy resources as material utilization	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Total use of renewable primary energy resources	[MJ]	2.06E+4	4.44E+1	1.96E+1	1.38E+1	5.86E-1	5.87E+1
Non-renewable primary energy as energy carrier	[MJ]	9.27E+3	5.85E+2	2.84E+2	2.68E+1	3.91E+0	-4.08E+2
Non-renewable primary energy as material utilization	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Total use of non-renewable primary energy resources	[MJ]	9.27E+3	5.85E+2	2.84E+2	2.68E+1	3.91E+0	-4.08E+2
Use of secondary material	[kg]	9.52E+2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	2.76E+1
Use of renewable secondary fuels	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of non-renewable secondary fuels	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of net fresh water	[m^3]	4.26E+0	5.04E-2	2.27E-2	1.32E-2	9.93E-4	-3.52E-2

RESULTS OF THE LCA – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A2: 1 ton XCarb® Recycled and Renewably Produced hot dip galvanized steel with Magnelis® coating

Indicator	Unit	A1-A3	C1	C2	C3	C4	D
Hazardous waste disposed	[kg]	3.00E-6	4.07E-9	1.50E-9	7.90E-8	0.00E+0	2.02E-8
Non-hazardous waste disposed	[kg]	2.06E+1	1.03E-1	4.63E-2	1.90E-2	2.00E+1	-7.70E-1
Radioactive waste disposed	[kg]	2.87E-1	2.86E-3	5.27E-4	3.95E-3	4.35E-5	6.74E-3
Components for re-use	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Materials for recycling	[kg]	0.00E+0	0.00E+0	0.00E+0	9.80E+2	0.00E+0	0.00E+0
Materials for energy recovery	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Exported electrical energy	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Exported thermal energy	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0

RESULTS OF THE LCA – additional impact categories according to EN 15804+A2-optional: 1 ton XCarb® Recycled and Renewably Produced hot dip galvanized steel with Magnelis® coating

Indicator	Unit	A1-A3	C1	C2	C3	C4	D
Potential incidence of disease due to PM emissions	[Disease Incidence]	ND	ND	ND	ND	ND	ND
Potential Human exposure efficiency relative to U235	[kBq U235-Eq.]	ND	ND	ND	ND	ND	ND
Potential comparative toxic unit for ecosystems	[CTUe]	ND	ND	ND	ND	ND	ND
Potential comparative toxic unit for humans - cancerogenic	[CTUh]	ND	ND	ND	ND	ND	ND
Potential comparative toxic unit for humans - not cancerogenic	[CTUh]	ND	ND	ND	ND	ND	ND
Potential soil quality index	[-]	ND	ND	ND	ND	ND	ND

Note: 952 kg of scrap are used in the manufacturing of 1 metric ton of XCarb® RRP hot dip galvanized steel with Magnelis® coating. After use, 980 kg steel are recycled, and 20 kg are landfilled. The potential environmental impact calculated for module D depends on the net amount of scrap left in the system, which is 980-952 = 28 kg. This means that the system has a net output of 28 kg of scrap, which is shown in module D as an environmental credit or burden depending on the impact category.

The additional and optional impact categories in accordance with *EN 15804-A2* have not been declared, as this is not required in accordance with *PCR Part A*.

Disclaimer 1 – for the indicator "Potential Human exposure efficiency relative to U235".
This impact category deals mainly with the eventual impact of low-dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure or radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

Disclaimer 2 – for the indicators "abiotic depletion potential for nonfossil resources", "abiotic depletion potential for fossil resources", "water (user) deprivation potential, deprivation-weighted water consumption", "potential comparative toxic unit for ecosystems", "potential comparative toxic unit for humans – cancerogenic", "Potential comparative toxic unit for humans not cancerogenic", "potential soil quality index".
The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high as there is limited experienced with the indicator.

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ASTM B-117
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EN 1993-1-3
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EN 10346
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EN 15804
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EN ISO 6892
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EN ISO 9227
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