MIIRA
A CAF GROUP COMPANY

EPD®

Environmental Product Declaration

In accordance with **ISO 14025:2006** for:

Monobloc wheels

From:

CAF MIIRA MIIRA A CAF GROUP COMPANY

Programme:	The International EPD® System, www.environdec.com
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Programme information

Programme:

The International EPD® System

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Accountabilities for PCR, LCA and independent, third-party verification

Product Category Rules (PCR)

PCR: Fabricated Metal Products, Except Construction Products, 2023:01, version 1.0.1

Product category classification: UN CPC 412

PCR review was conducted by: The Technical Committee of the International EPD® System. A full list of members is available at www.environdec.com. The review panel may be contacted via info@environdec.com

Chair of the PCR review: Hüdai Kara

Life Cycle Assessment (LCA)

LCA accountability: IK-Ingenieria

Independent third-party verification

Independent third-party verification of the declaration and data, according to ISO 14025:2006, via:

☒ EPD verification by accredited certification body

Third-party verification: Tecnalia R&I Certification, SL

Auditor: Eva Larzabal Aperribay

info@tecnaliacertificacion.com

Accredited by: ENAC n°125/C-PR283 accreditation

OR

Procedure for follow-up of data during EPD validity involves third-party verifier:

☒ Yes ☐ No

EPDs within the same product category but from different programmes may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same version number) or be based on fully aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g. identical declared/functional units); have equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterisation factors); have equivalent content declarations; and be valid at the time of comparison.

Company information

Owner of the EPD: CAF MiiRA

CONTACT DETAILS

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Description of the organisation:

CAF MiiRA is a global reference in providing comprehensive solutions for rolling gear in the railway sector. We offer state-of-the-art engineering, manufacturing, and maintenance solutions for complete wheelsets and portal axles, including gearboxes, for all types of trains. We also provide services such as technological evaluation, inspections, and life cycle optimization analysis.

CAF MiiRA's history dates back to 1929, when it manufactured components for casting, forging, and various assemblies such as wheels, axles, wheelsets, brake blocks, crane wheels, etc. In 1990, it specialized to offer more competitive products by focusing on wheels, axles, and wheelsets. From 2006 to 2016, CAF MiiRA was established as a separate business unit of the CAF Group. New capabilities were developed to improve the product catalogue (e.g., resilient wheels).

CAF MiiRA creates solutions that provide quick and clear ad-hoc responses to each client and project. We offer high-tech products and high-quality engineering services that observe and manage "State of the art" design, manufacturing, testing, maintenance, and management processes from the perspective of innovation, cutting-edge technology, and efficiency for our clients. The company has a Technological Plan aimed at providing quality and efficiency.

The forging and heat treatment facilities assisted by computer simulations, minimize material usage and optimize costs. For the machining process, there are cutting lathes and CNC programs that use advanced dimensional simulation technologies to ensure compliance with the highest standards. For the assembly process, there is an automatic hydraulic press for wheels as well as the necessary facilities to carry out shrink fitting processes. The final quality control operations take place on an automated verification line, in order to assure that the characteristics of the products, meet customer requirements and applicable standards.

CAF MiiRA is fully committed with the environment. The company stands out as a manufacturer of complete wheelsets and axle assemblies, that covers the entire product life cycle, from conception to the end-of-life. The steel used complies with all applicable European standards.

We focus on smart design by creating lightweight, energy-efficient, low-maintenance solutions, in order to minimize the environmental impact of all products. Higher strength materials are used to reduce product volume combined with surface treatments like cold rolling to increase fatigue limits and overall safety. 100% renewable electricity is used in the manufacturing process. Additionally, the company is part of SBTI (Science based targets initiative) and Race to Zero 2050. Several standards and recognitions obtained in this field include: ISO 14001; ISO 26000; EMAS; Ecovadis Platinum Category; CPD B rating, among others.

CAF MiiRA's quality systems are rigorously tested and currently comply with major international standards and regulations: ISO 9001; IRIS Certification; ASSOCIATION OF AMERICAN RAILROADS; RISAS...

CAF MiiRA's headquarters are in Beasain (Basque Country), Spain. In addition to its headquarters in Spain, CAF MiiRA also has a plant in Italy dedicated to integral wheelsets maintenance. If you need more information about CAF MiiRA or the CAF Group, you can visit their websites at www.cafmiira.com and www.caf.net, respectively.

Name and location of production site:

Beasain, Gipuzkoa (Spain)

Product information

Product name:

Monobloc wheels

Product description:

Forged and rolled Monobloc steel wheels for railway applications.

The calculations presented are applicable only to the following products:

"Monobloc" type wheels
- Manufactured from carbon steel blooms or ingots
- Whose primary shaping has been carried out through a forging process, or forging and rolling.
- Subjected to a quenching and tempering heat treatment process
- Forged and treated at the CAF facilities in Beasain
- With a final weight that is between 200 and 780 Kg
- With an external diameter that is between 400-1350 mm
-

UN CPC code:

412 – finished products of iron or steel

Geographical scope:

The wheels are manufactured in Spain, and most of their suppliers are located in Europe. The product is sold internationally.

LCA information

Declared unit:

The declared unit is "1 kg of fabricated wheel"

The declared unit of "1 kg of fabricated wheel" has been calculated having into account all the annual inputs and outputs of the manufacturing process in the CAF MiiRA plant in Beasain. This production represents a group of monobloc wheels, with different weights and diameters, which share all the manufacturing steps inventoried in the Core of the present study. Therefore, the declared unit covers a group of wheels affected by the manufacturing data inventoried for this study.

In addition, different steel quality compositions have been analysed in the present LCA study, including the following compositions according to ISO 683-1:2016: C45, C50, C55 and C60. For each of these steels, the chemical compositions at the minimum (Min.), maximum (Max.) and average content of elements were analysed.

The composition of these steels corresponds to the composition of the ER6, ER7, ER8 and ER9 steel wheels listed in EN 13262:2021.

Among these compositions, the steel with the highest impact on the Global Warming Potential (C60 Max.) was chosen to be used as the input steel in the Upstream phase, and therefore, the scope of this study and the EPD covers these steels, using the worst-case scenario.

Time representativeness:

Primary data originated by CAF Miira, corresponds to the year 2022.

Database(s) and LCA software used:

The databases used were Ecoinvent 3.8 and the software used was SIMAPRO 9.3.0.3.

Description of system boundaries:

The system boundaries established in this study have been defined following the guidelines of the PCR 2023:01 version 1.0.1 Fabricated metal products, except construction products, applying the "cradle-to-gate" criterion.

System diagram:

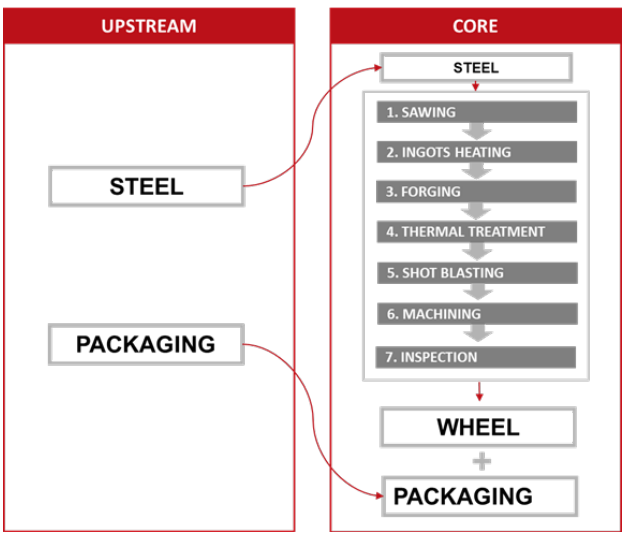
The scope of life cycle of assessment (LCA) is cradle-to-gate, and therefore, this study includes the information from the Upstream and Core stages.

Upstream

- Extraction and production of raw material for all main parts of the product
- Recycling process of recycled material used in the product
- Production of consumer packaging
- Transportation of raw material to the upstream process (default information included in the indicators used)
- Generation of electricity and production of fuel (default information included in the indicators used)

Core

- Manufacturing process; including the inflow of auxiliary materials and energy consumptions needed for the manufacturing of the product
- Transportation of the steel and other materials and components to the core process where the final manufacturing takes place
- End-of-life treatment of manufacturing waste
- Generation of electricity and production fuels, steam and other energy carries used



Excluded lifecycle stages:

The Downstream phase was not included as the scope used for the study is "cradle-to-gate"; therefore, the transportation to the retailer/consumer, the use and the end-of-life of the product have not been included.

Cut-off criteria:

For the manufacturing process, 99,34% of the mass was included in the data inventory**.**

The included inventory data together accounted for more than the 99% of the results in all the environmental impact categories calculated. A sensitivity analysis was conducted in order to assess the relevance of the missing data. For this study, the missing data do not contribute more than 1% for the considered impact categories, therefore, no additional effort has been done.

Data quality:

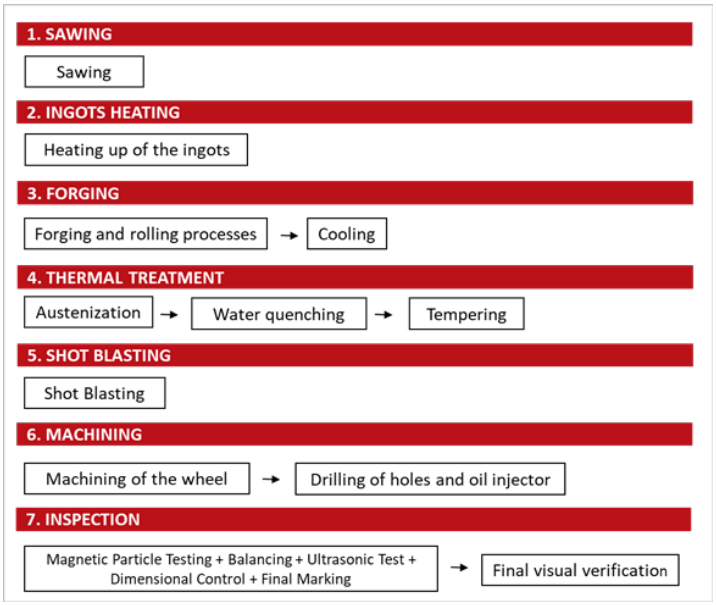
All the data related to the inputs and outputs to each of the production processes of the CAF MiiRA plant in Beasain were obtained during the year 2022.

In those cases, for which there were no data available concerning specific processes and/or materials, theoretical calculations have been made, estimates done or even data from internationally recognized databases of life cycle inventories have been used.

This data is valid as it represents the real manufacturing year of the product assessed and supplied to the customer.

Additional technical information:

Different processes are involved in the manufacturing process of the wheels. The following working diagram shows these processes:



For the electricity consumption during the manufacturing stage, the corresponding 2022 energy mix was obtained from the data published by the CNMC, which is a public body that oversees the Spanish economic sectors, including electricity (https://gdo.cnmc.es/CNE/accesoEtiquetado.do).

The manufacturing plant of CAF MIIRA uses energy 100% renewable, generated by wind power and certified by the CNMC with Guarantee of Origin. The electricity is supplied by the electricity company Acciona-Energía.

Content declaration

Product

For the 1 kg of wheel, its composition is 100% steel with 72% of recycled content.

The chemical composition of the final wheel is the same composition as the input steel because the manufacturing process does not alter the original composition.

This EPD covers the composition of the ER6, ER7, ER8 and ER9 steel wheels listed in EN 13262:2021. The data from steel C60 was taken for the calculation, because it corresponds to the worst-case scenario.

The chemical composition of C60 Max. according to ISO 683-1:2016 is:

Steel quality composition (according to ISO 683-1:2016)

C60	Mass fraction
C	0,57 - 0,65
Si	0,10 - 0,40
Mn	0,60 - 0,90
P	0,045
S	0,045
Cr	0,40
Mo	0,10
Ni	0,40
Cu	0,30

None of the components are classified as dangerous.

Packaging

The distribution packaging of the wheels considered for this calculation is a wooden pallet:

Packaging composition

Wooden pallet	%
Wood	99,17%
Steel, low allowed	0,83%
Total	100%

Recycled material

The steel used for the manufacturing of the wheels is 72% recycled since is mostly produced from Scrap iron (pre- and post-consumer), while the packaging is 0% recycled.

Results of the environmental performance indicators

Impact category indicators

Results for the life cycle assessment of 1kg of fabricated wheel (declared unit)

ENVIRONMENTAL IMPACT 1 kg of fabricated wheel	UNIT	UPSTREAM	CORE	TOTAL
Global warming potential (GWP) - Fossil	kg CO2 eq	1,88E+00	6,06E-01	2,48E+00
Global Warming Potential (GWP) - Biogenic	kg CO2 eq	-6,38E-02	1,48E-03	-6,24E-02
Global warming potential (GWP) - Land use	kg CO2 eq	1,72E-03	8,50E-04	2,57E-03
Global warming potential (GWP) - Total	**kg CO2 eq**	**1,81E+00**	**6,08E-01**	**2,42E+00**
Acidification (AP)	mol H+ eq	1,21E-02	1,66E-03	1,38E-02
Eutrophication (EP), freshwater	kg P eq	1,14E-04	6,73E-06	1,21E-04
Eutrophication (EP), marine	kg N eq	1,72E-03	4,53E-04	2,17E-03
Eutrophication (EP), terrestrial	mol N eq	2,06E-02	4,97E-03	2,56E-02
Photochemical ozone creation potential (POCP)	kg NMVOC eq	7,79E-03	1,59E-03	9,38E-03
Ozone depletion (ODP)	kg CFC-11 eq	9,47E-08	1,05E-07	1,99E-07
Abiotic depletion potential (ADP) - minerals and metals	kg Sb eq	1,89E-04	1,61E-06	1,91E-04
Abiotic depletion potential (ADP)- fossil fuels	MJ	2,30E+01	9,67E+00	3,26E+01
Water deprivation potential (WDP)	m3 eq depriv.	6,43E-01	8,80E-01	1,52E+00

The results for the Total Global Warming Potential (GWP) impact for 1 kg of fabricated wheel are:

ENVIRONMENTAL IMPACT 1 kg of fabricated wheel	UPSTREAM	CORE	TOTAL
Global warming potential (GWP) - Total (Kg CO2 eq)	**1,81**	**0,61**	**2,42**
Climate warming potential (GWP) - Total (%)	74,89%	25,11%	100%

The total Global warming potential of 1 kg of fabricated wheel is 2,42 kg CO2 eq.

Resource use indicators

The results for the primary energy resources (renewable and non-renewable) declared unit are included below:

RESOURCES 1 kg of fabricated wheel		UNIT	UPSTREAM	CORE	TOTAL
Primary energy resources – Renewable	Used as energy carrier	MJ	2,52E+00	1,78E+00	4,29E+00
	Used as raw materials	MJ	1,06E+00	0,00E+00	1,06E+00
	TOTAL	**MJ**	**3,58E+00**	**1,78E+00**	**5,36E+00**
Primary energy resources – Non-renewable	Used as energy carrier	MJ	2,30E+01	9,68E+00	3,26E+01
	Used as raw materials	MJ	0,00E+00	0,00E+00	0,00E+00
	TOTAL	**MJ**	**2,30E+01**	**9,68E+00**	**3,26E+01**

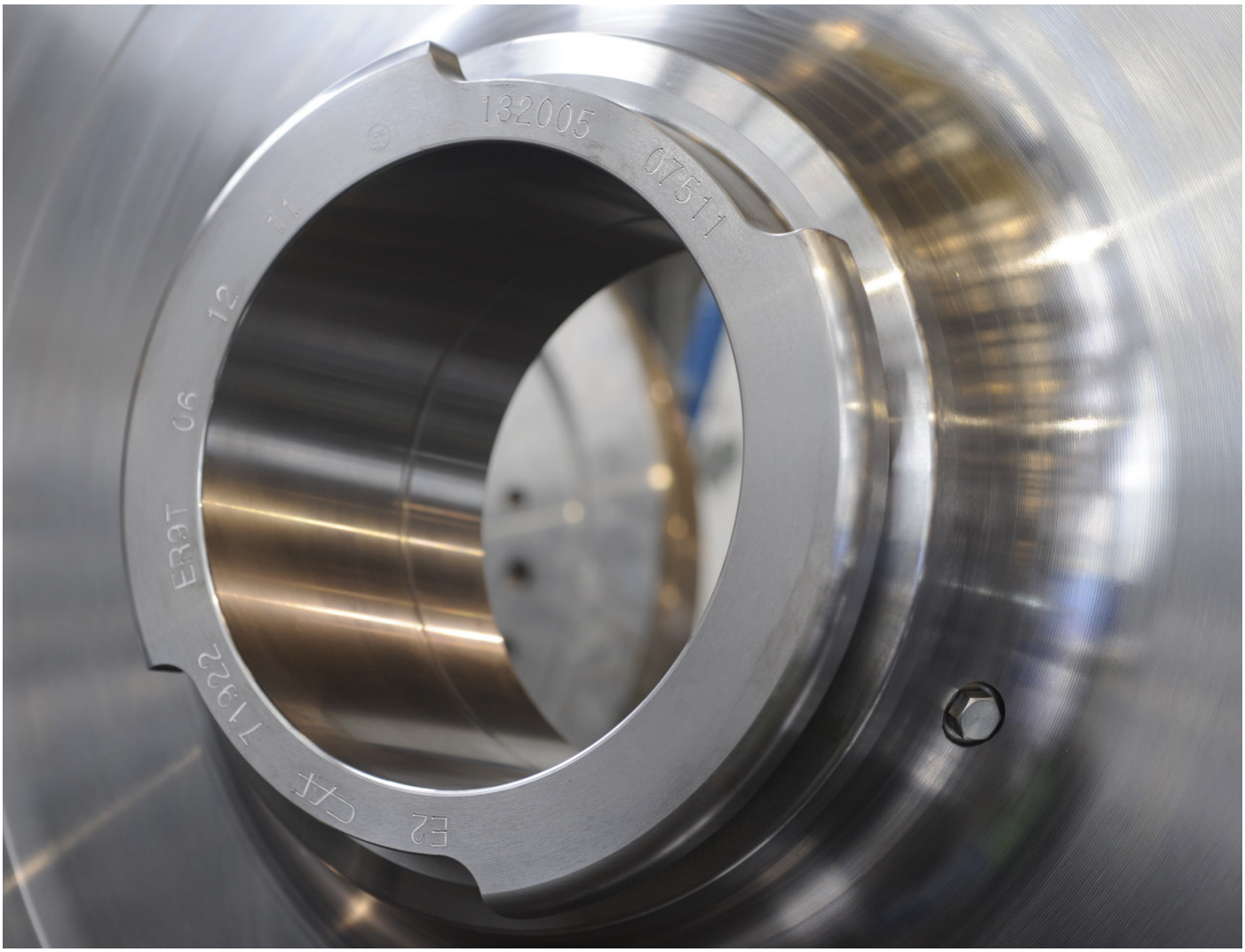
Additional environmental information

Global Warming Potential of typical monobloc wheels

As stated before, the declared unit of this study is "1 kg of fabricated wheel" and this unit represents a group of monobloc wheels that undergo the same manufacturing process analysed in this study.

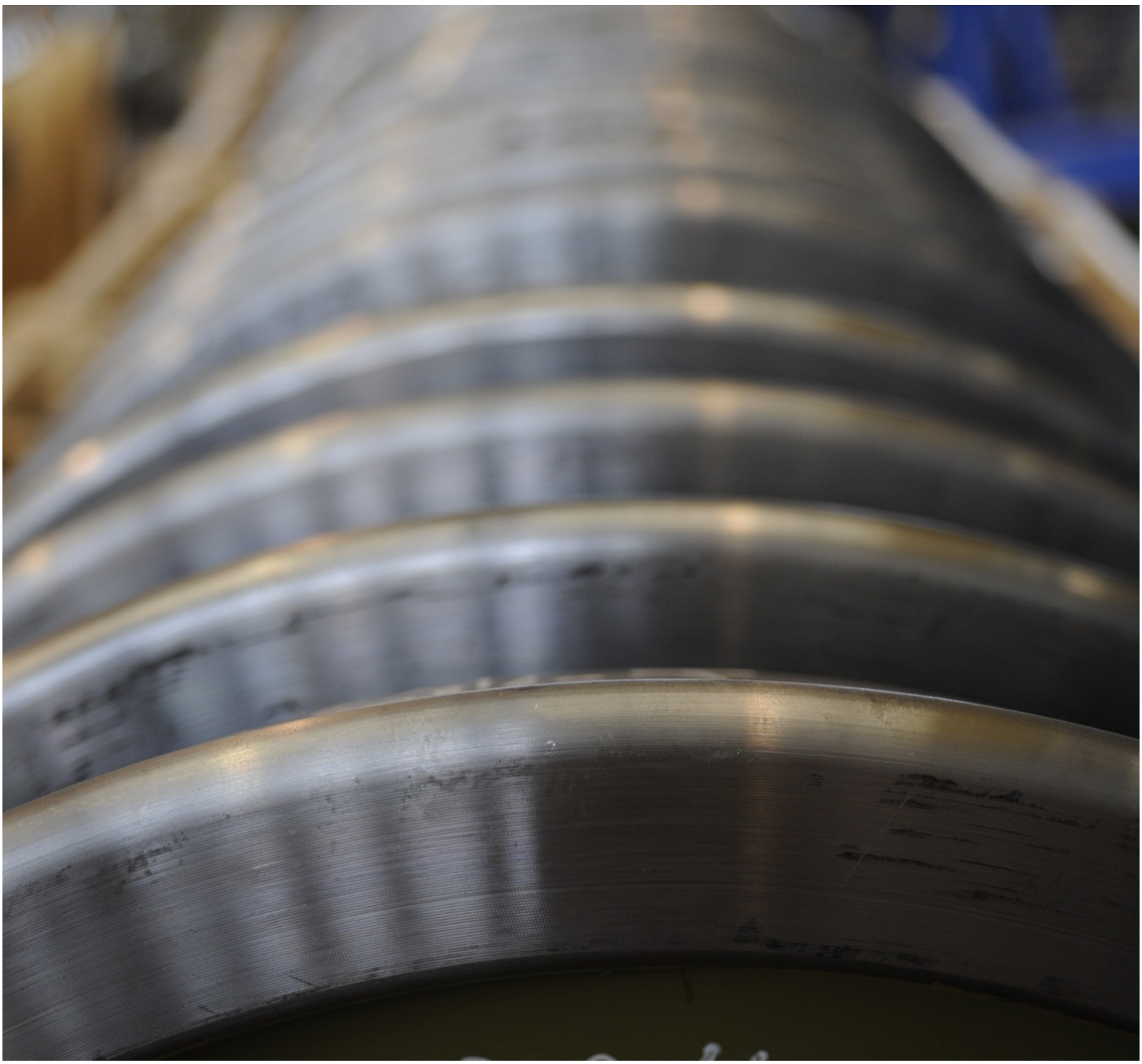
The Global Warming Potential of the typical wheels represented by this declared unit are shown below:

Weight of the monobloc wheel (Kg)	Global warming potential (GWP) - Total (Kg CO2 eq)		
	Upstream	Core	Total
250	453,45	152,05	605,50
300	544,14	182,46	726,60
350	634,83	212,87	847,70
400	725,52	243,28	968,80
450	816,21	273,69	1.089,90
500	906,90	304,10	1.211,00
550	997,59	334,50	1.332,10



References

- CAF MiiRA: http://www.cafmiira.com/
- ISO 14040:2006. Environmental management — Life cycle assessment — Principles and framework.
- ISO 14044:2006. Environmental management — Life cycle assessment — Requirements and guidelines.
- ISO 14025:2006: Environmental labels and declarations. Type III environmental declarations. Principles and procedures.
- General Programme Instructions of the International EPD® System. Version 4.0.
- Product Category Rules PCR 2023:01 version 1.0.1 Fabricated metal products, except construction products: UN CPC 412 – finished products of iron or steel



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