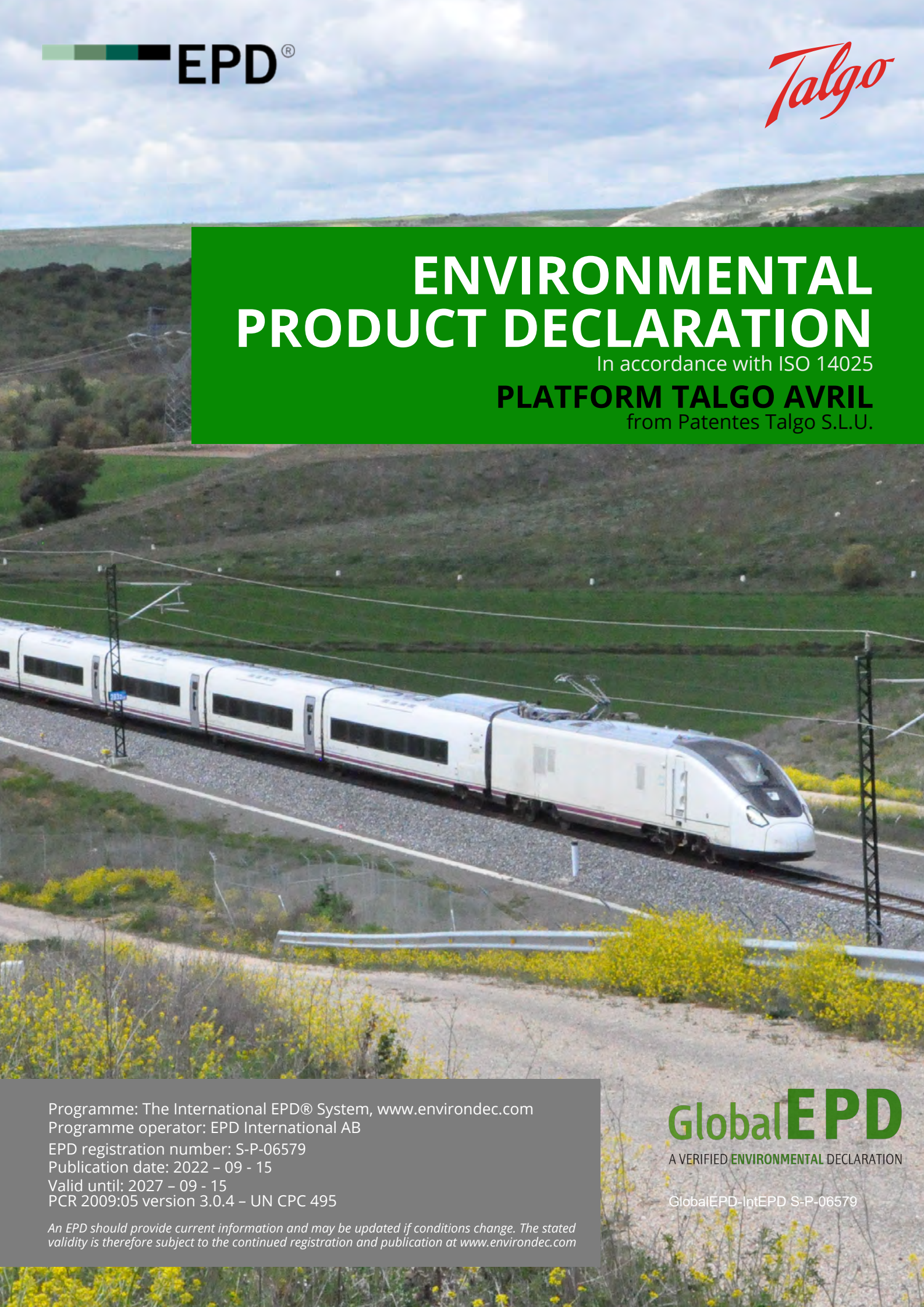


ENVIRONMENTAL PRODUCT DECLARATION

In accordance with ISO 14025

PLATFORM TALGO AVRIL

from Patentes Talgo S.L.U.

Programme: The International EPD® System, www.environdec.com
Programme operator: EPD International AB
EPD registration number: S-P-06579
Publication date: 2022 – 09 - 15
Valid until: 2027 – 09 - 15
PCR 2009:05 version 3.0.4 – UN CPC 495

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

GlobalEPD
A VERIFIED ENVIRONMENTAL DECLARATION

GlobalEPD-IntEPD S-P-06579

Talgo is a mid-sized company, with 80 years of experience, obsessed about quality and with the right costs-capabilities balanceone of the most important companies of the railway sector. Talgo **designs** and **manufactures** rolling stock, such as **maintenance** tasks for different applications, including high-speed trains, long-distance trains, locomotives, and passenger cars.
Talgo excels in the very high-speed segment, with a >50% share in the highly competitive Spanish market but..., isalso a global provider of passenger rail vehicles in every other segment: mainline, regional and suburban.
Each year our trains service a distance of 430 million km. This is like going from the Sun to Mars... and back!
Maintenance & overhaul services are also in our DNA: complete and tailored solutions, coming soon to mass transit systems.
Talgo has a clear commitment: create better societies by excelling in the development of innovative and adaptive rail solutions ready to maximize passengers and taxpayers return, and to make a transition to a green economy feasible.
For more information about Talgo, visit www.talgo.com

THE COMPANY

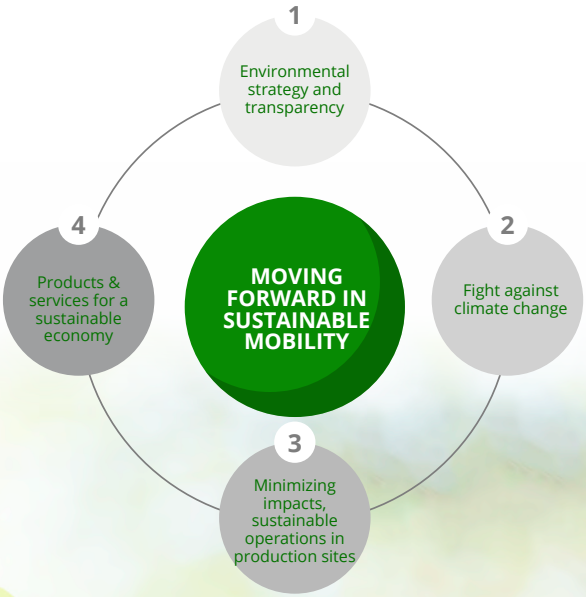
ENVIRONMENTAL SUSTAINABILITY- TALGO

The Talgo Group includes environmental protection and improvement among its corporate strategies and is committed to make it one of the fundamental pillars of its reputation in the medium term, as is currently the case with innovation and internationalization. For this reason, it is certified and verified in Environmental Management Systems by the ISO 14001:2015 standard for all its activities.

Talgo has also defined the "Advancing environmental sustainability and sustainable mobility" strategy.

Within this strategy, plans and projects are developed into 4 major vectors:

- **Vector 1:** Reinforcing environmental strategy and transparency.
- **Vector 2:** Transition to a carbon neutral economy. Fighting against climate change.
- **Vector 3:** Minimizing impacts through sustainable operations at production sites.
- **Vector 4:** Offering rail products, services, and solutions for the transition to a sustainable economy.



With all these actions, Talgo aims to respond to society's main environmental challenges: energy efficiency, climate change, consumption of natural resources and raw materials, waste management and recycling, pollution, biodiversity, eco-designand circular economy.

As a result of this strategy comes this EPD report of one of the most important projects of the organization

PRODUCT DESCRIPTION

Talgo trains are designed to be adaptable to the individual needs of every operator. With maximum reliability, high interior comfort and low operating costs as baselines, the client can decide which solution suits him.The Talgo AVRIL product platform combines maximum speed, low energy consumption and a high capacity in an extremely lightweight single-deck train. It is the widest very high-speed train available on the European market today, and it offers various seating arrangements. The platform includes several variants. The train included in this analysis is the 581 seats composition manufactured in Las Matas (Madrid) and Rivabellosa (Alava).

CHARACTERISTICS

MASS (kg)	327.210,7*
LENGTH (mm)	202.000
CAPACITY (seats)	579 + 2 PRM
DOORS (per side)	10 - 1 per car
MAX SPEED (Km/h)	363
INTERIOR WIDTH (mm)	3.100
POWER SUPPLY VOLTAGE (kv)	25
POWER (kW)	8.000
ENERGY CONSUMPTION (kWh/km)	< 13,7
RECOVERABILITY/RECYCLABILITY (%)	96,9% / 93,8%
LIFE CYCLE (year)	40

**Dead mass (MU) of the train. For the calculation, the initial theoretical calculation has been used as a starting point and has been complemented with real data on the weight of some train components/-sub-assemblies.*

LIGHWEIGHT DESIGN

Coach bodies are manufactured with aluminium profile in a very efficient and lightweight design to accomplish with homologation axle load limitations.

Moreover, Talgo's coaches have lower number of axles due to its unique architecture (articulated train and single axle running gear), thus Talgo trainset is the lightest train in the market (between 20%-30% of weight reduction if compared to conventional technology).

Geographical scope: Spain.

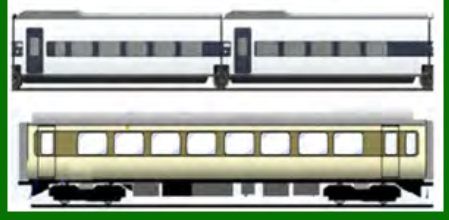
The selected variant is planned to have a 40-year life cycle and will travel along 16.666.680km on Spanish railways.

Data related to consumption and waste during manufacturing as well as maintenance waste are based on 2020 references.

SHORT COACHES CONFIGURATION

The train has a length of 202m.To have this length with a total of 14 coachesIs really complicated. Talgo´s technology based onshorter coaches compared with a typical conventional coach of 25-26 meter long makes it possible.

Talgo single coach length is about 13,3 m (almost half of conventional coach, in 26 m Talgo has 2 axless, while conventional technology has 4 axles). This configuration of shorter coaches optimizes the width of the coaches, since for the same reference standard profile (G1) Talgo coaches can be wider than conventional coaches.



HIGH CAPACITY = MAXIMUM EFFICIENCY

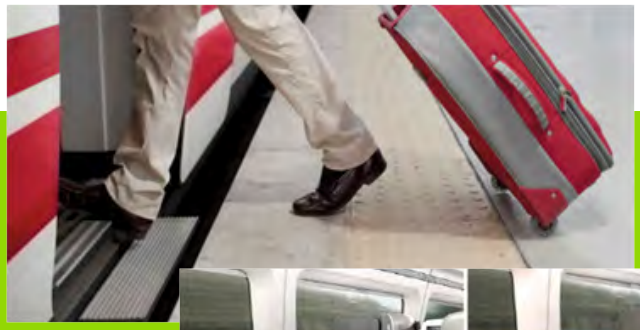
The wide body structure allows to increase the occupancy level by the 3+2 seating arrangement for the tourist coaches.

INNOVATIVE MANUFACTURING

One of the innovative design features of the **Avril Platform** is the use of carbon fiber for the front of the driving parts manufacture. This innovation has never been used before,optimizes the overall weight of the structure and improves aerodynamic.

UNLIMITED ACCESSIBILITY

The design based on the technology of a carriage that allows the carriages to be at the same height as the platforms.
This allows people with reduced mobility (PRM) to access the entire train independently, without complications or steps.
The continuous low floor also allows passenger loading and unloading up to 20% faster than on comparable trains, reducing the time the train is stationary in the station and reducing operating costs.



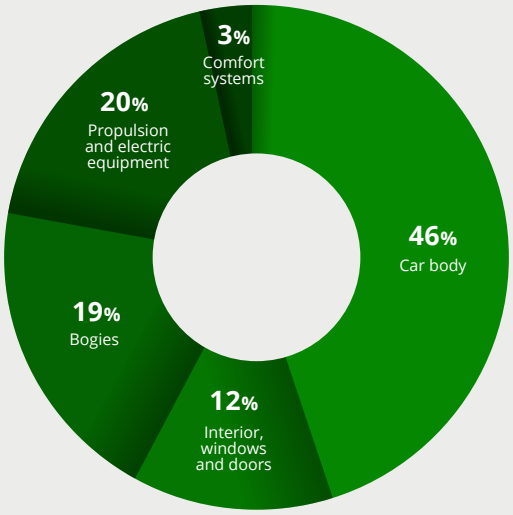
	MATERIAL	PERCENTAGE
1	FE metals	48,68%
2	Non-FE metals	31,37%
3	Elastomers (unfilled)	1,33%
4	Thermoplastics (unfilled)	2,95%
5	Thermoplastics (glass unfilled)	0,25%
6	Thermosets (unfilled)	1,99%
7	Thermosets (glass unfilled)	1,81%
8	Carbon or natural fiber reinforced polymers	1,46%
9	Glass	0,87%
10	Safety Glass (Shatterproof glass)	0,59%
11	Oil, grase or similar	0,16%
12	Acids and Cooling agents or similar	0,16%
13	MONM (leather, wood, cotton fleece...)	0,34%
14	Electric/Electronics	6,81%
15	Ceramics	0,44%
16	Mineral wool	0,79%

Material content classification according to UNI-LCA-001.00

The materials used for the manufacturing of the train have been selected according to the previous eco-design of the product. In accordance with Regulation (EC) Nº 1907/2006 (REACH) and RISL (Railway Industry Substances List), Talgo certifies that the train Talgo-Avril does not contain any prohibited substance or listed on the Candidate List of Substances of Very High Concern (SVHC).

The materials are classified in these 16 different categories according UNIFE Methodology - UNI-LCA-001.00.

GROUP PRODUCTS:



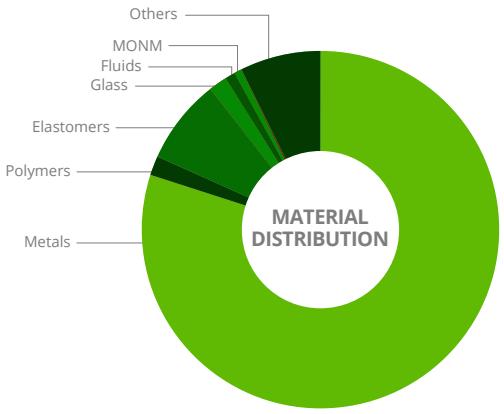
Group products according to PCR-RS 2009:05 v.3.04

The materials classified above are divided into these groups:

- **Metals:** FE metals and Non-FE Metals.
- **Elastomers**
- **Polymers:** thermoplastics, thermosets and carbon or natural fiber.
- **Glass**
- **Fluids:** oil, grease or similar and acids or cooling agents.
- **MONM** (Modified Organic Natural Materials).
- **Others:** including electric/electronic, ceramics and mineral wool.

MATERIAL	
Metals	80,05%
Elastomers	1,33%
Polymers	8,46%
Glass	1,46%
Fluids	0,32%
MONM	0,34%
Others	8,03%

Material group distribution according to ISO 22628

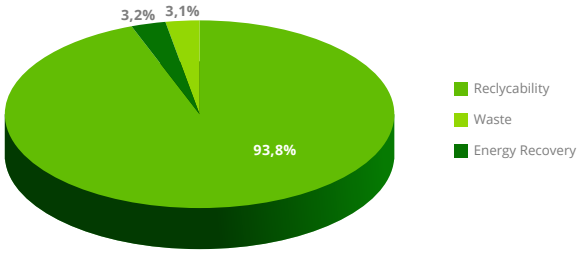


Material group distribution according to ISO 22628

RECYCLABILITY AND RECOVERABILITY

Following the Recyclability and Recoverability Calculation Method Railway Rolling Stock of UNIFE - UNI-LCA-001.00 standard,the train has a 96.9% recoverability and only a 3.1% of waste.

The recyclability rate is a 93,8% by using materials with high recyclability.



Recyclability, energy recovery and waste values according to UNI-LCA-001.00

GWP EMISSIONS

Low energy consumption of Talgo Avril, contributes to achieve emissions with a Global Warming Potential of 8,56g CO2eq/pass km during operation phase (downstream), the total GWP emissions taking into account upstream, core, and downstream phases is 8,80 g CO2eq/pass km.

ENERGY CONSUMPTION

Train energy consumption calculations during operation are based on standard UNE-EN 50591:2020 Railway applications and have been calculated by numeric simulation.
The number of passengers used for the calculation is 581.

With an average consumption lower than 13,70 kWh/km and 16.666.680 km the energy consumption associate to the vehicle operation for the 40 years life cycle is lower than 228.333,516 MWh.

Spanish national energy mix named in the analysis software as Electricity, high voltage {ES}| market for | Cut-off, U" (ecoinvent v3.6), has been taken as a reference for the environmental impact study.

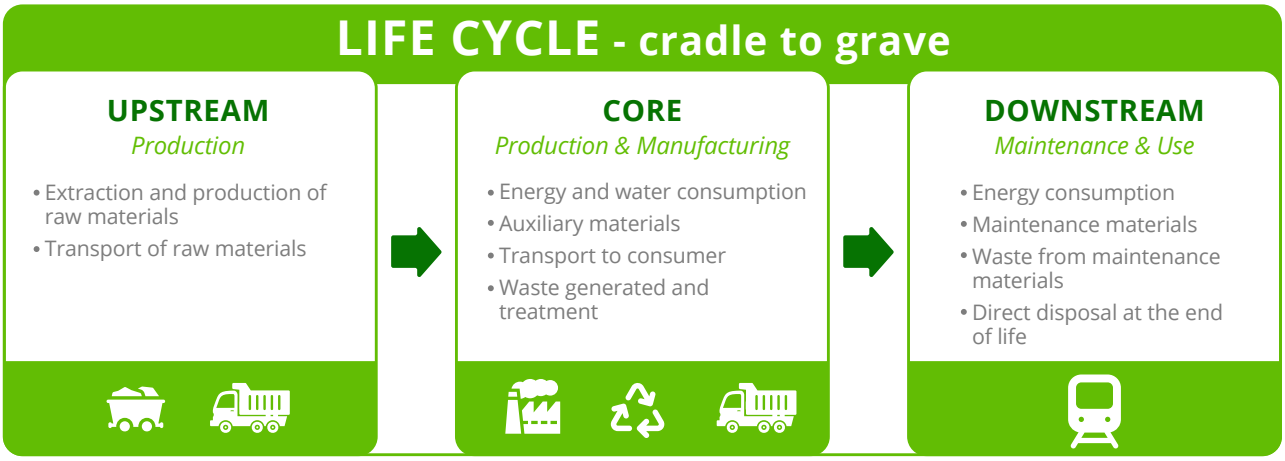
NOISE

The noise analysis has been carried out according to UNE-EN-ISO 3095:2014.

OUTSIDE NOISE EMITED	dB (A)
Stationary noise	64
Starting noise	79
Pass-by noise (320 km/h)	92

LIFE CYCLE ANALYSIS (LCA)

The LCA is from cradle to grave. It means that we evaluate environmental impact linked to all the phases in the life of the product from obtaining of raw materials, processing of these materials, manufacturing, dissemination, usage, maintenance, and repair, and selling or reusing.



The Life Cycle of the train is divided in 3 processes according to the PCR-RS 3.04 2009:05*:

**Cut-off rules for the LCA according to PCR-RS v3.04 2009:05.*

Database(s) and LCA software used: the software for the LCA analysis is SimaPRO version 9.1.1 and the database Ecoinvent version 3.6, cut-off system model. The methodology for assessing environmental impacts during the life cycle is the EN 15804:2012+A2:2019/AC:2021 (Default list of environmental performance indicators Version 2.0). Information regarding the indicators and factors of this methodology are available on www.environdec.com site.

FUNCTIONAL UNIT

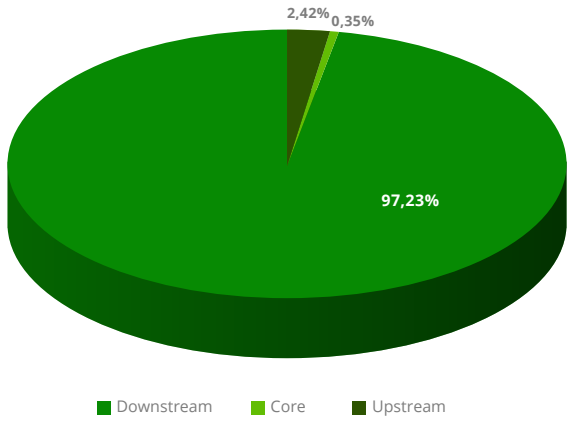
The functional unit chosen to quantify the environmental impact of the product is the transport of 1 passenger for 1 km.

ENVIRONMENTAL PERFORMANCE

ENVIRONMENTAL IMPACT INDICATORS		UNIT	UPSTREAM	CORE	DOWNSTREAM	TOTAL
Global warming potential (GWP)	Fossil	Kg CO2 eq	2,11E-04	2,70E-05	8,42E-03	**8,66E-03**
	Biogenic	Kg CO2 eq	1,99E-06	3,18E-06	5,76E-05	**6,28E-05**
	Land use and land transformation	Kg CO2 eq	2,47E-07	9,03E-07	7,87E-05	**7,99E-05**
	Total	Kg CO2 eq	2,13E-04	3,11E-05	8,56E-03	**8,80E-03**
Ozone layer Depletion (ODP)		Kg CFC11 eq	7,51E-11	2,96E-12	9,45E-10	**1,02E-09**
Acidification potential (AP)		mol H+ eq	1,37E-06	1,72E-07	7,42E-05	**7,58E-05**
Eutrophication potential (EP)	Aquatic freshwater	Kg P eq	2,41E-08	8,83E-10	3,92E-07	**4,17E-07**
	Aquatic marine	Kg N eq	2,27E-07	2,90E-08	1,07E-05	**1,09E-05**
	Aquatic terrestrial	mol N eq	2,58E-06	2,75E-07	1,20E-04	**1,22E-04**
Photochemical oxidant creation potential (POCP)		Kg NMVOC eq	8,18E-07	7,98E-08	3,21E-05	**3,30E-05**
Abiotic depletion potential (ADP)	Metals and minerals	Kg Sb eq	1,05E-07	2,58E-11	4,08E-08	**1,46E-07**
	Fossil resources	MJ	2,69E-03	4,83E-04	2,02E-01	**2,06E-01**
Water deprivation potential (WDP)		m3	6,05E-05	1,95E-06	5,58E-03	**5,64E-03**

GLOBAL WARMING POTENTIAL (GWP)

The 97% of GWP is caused by the module "DOWNSTREAM" due to emissions caused by energy production necessary for the vehicle operation during his life cycle.



GWP for the Talgo Avril life cycle divided in modules

USE OF RESOURCES		UNIT	UPSTREAM	CORE	DOWNSTREAM	TOTAL
Primary energy resources - Renewable	Used as energy carrier	MJ, net calorific value	2,15E-04	8,60E-05	4,78E-02	**4,81E-02**
	Used as raw materials	MJ, net calorific value	-1,45E-04	5,46E-06	3,38E-03	**3,24E-03**
	Total	MJ, net calorific value	6,96E-05	9,14E-05	5,12E-02	**5,14E-02**
Primary energy resources - Non renewable	Used as energy carrier	MJ, net calorific value	2,86E-03	5,05E-04	2,09E-01	**2,13E-01**
	Used as raw materials	MJ, net calorific value	2,87E-03	8,05E-06	2,11E-03	**4,98E-03**
	Total	MJ, net calorific value	5,73E-03	5,13E-04	2,12E-01	**2,18E-01**

DEFINITIONS

GWP, GLOBAL WARMING POTENTIAL

Defines the time integrated warming effect produced by an instantaneous release of 1kg of greenhouse gas (GHG) compared to the caused by CO2. In this way, the radiative effects of each gas can be considered, as well as their different residence times in the atmosphere. This impact category is expressed in kg equivalent of CO2,and it is divided into 3 subgroups: fossil, biogenic and land use & transformation.

ODP, OZONE DEPLETION POTENTIAL

The ozone layer absorbs ultraviolet radiation reaching planet Earth.
Ozone depletion is caused by the emission of chlorides and bromides into the atmosphere because of human consumption of fluorocarbon compounds and other sources. This depletion leads to an increase in the amount of UV radiation on the Earth's surface, causing negative effects on human health and ecosystems, both aquatic and terrestrial. It is expressed in kg equivalent of CFC -11 (trichlorofluoromethane).

AP, ACIDIFICATION POTENTIAL

The acidification is caused by emissions of sulphur dioxide and nitrogen oxides to the atmosphere, soil, and water. This potential measure the acidification contribution by a substance. The result is expressed in kg equivalent of H+ that includes emissions of SO2, of NOX and NH3.

EP, EUTROPHICATION POTENTIAL

Eutrophication is caused by the increase of nutrient levels in water ecosystems. This potential measures the nutrient enrichment in the ecosystem. The indicator includes phosphorous and nitrogen salts and it is divided into freshwater (equivalent kg of P), terrestrial (equivalent mol of N) and aquatic marine (equivalent kg of N).

POCP/POFP, OZONE PHOTOCHEMICAL FORMATION / PHOTOCHEMICAL OXIDATION POTENTIAL

This indicator measures the decomposition of volatile organic compounds (VOCs) in the presence of nitrogen oxides (NOx) and light. It is expressed in kg equivalent of NMVOC (non-methane volatile organic compounds).

ABIOTIC DEPLETION

It is divided into 2 different subcategories: metals and minerals, decrease of natural, abiotic resources because of human activity, it is expressed in kilograms of Antimony (Sb) equivalent and fossil resources which express a decrease in natural resources, fuels, that will be used as energy, it is expressed in net MJ.

WATER DEPRIVATION POTENTIAL (WDP)

Expresses the impact of a decrease in freshwater availability. It refers to a measure of the water available after human and aquatic ecosystem demand has been met. It is expressed in equivalent m3.

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- General Programme Instructions for the International EPD® System v3.01 (2019/09/18)
- European REACH regulation (EC 1907/2006 REACH (Annex XVII)

PROGRAMME INFORMATION

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For further information visit www.environdec.com

The EPD owner has the sole ownership, liability, and responsibility for the EPD. EPDs within the same product category but from different programs may not be comparable.

Product category rules (PCR): Rolling Stock. Product Category Classification: UN CPC 495. Version 3.04. (2022-05-12).

PCR review was conducted by: The Technical Committee of the International EPD® System.

may be contacted via info@environdec.com.

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

☐ EPD process certification ☒ EPD verification

Third party verifier: CTME. Centro Tecnológico de Miranda de Ebro.
Eva Martinez Herrero (evamtz@ctme.ES)

Approved by: The International EPD® System

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

☒ Yes ☐ No

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