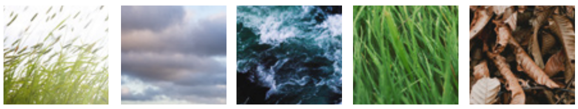
Environmental Product Declaration according to ISO 14025

CAF



URBOS 100
for the city of **Lund, Sweden**

Technological innovation in support of the **environment** to reach further with **less power consumption**. **Urbos 100** conforms to the strictest **environmental requirements**, for perfect integration in architectural environments while maintaining **high running performance**.

A new generation of trams that guarantees maximum power-efficiency and full passenger ride comfort. **Versatile, with personality and environmentally friendly.**

EPD®

www.caf.net

Environmental Product Declarations Programme:
The international EPD® System
operated by EPD International AB
www.environdec.com

Product category rules (PCR):
Rolling stock, Product Category Classification: UN CPC 495, 2009:05, version 3.03

PCR review was conducted by:
The Technical Committee of the International EPD® System
Chair: Gorka Benito
Contact via info@environdec.com

Independent third party verification of the declaration and data, according to ISO 14025:2006:
☐EPD process certification ☒EPD verification

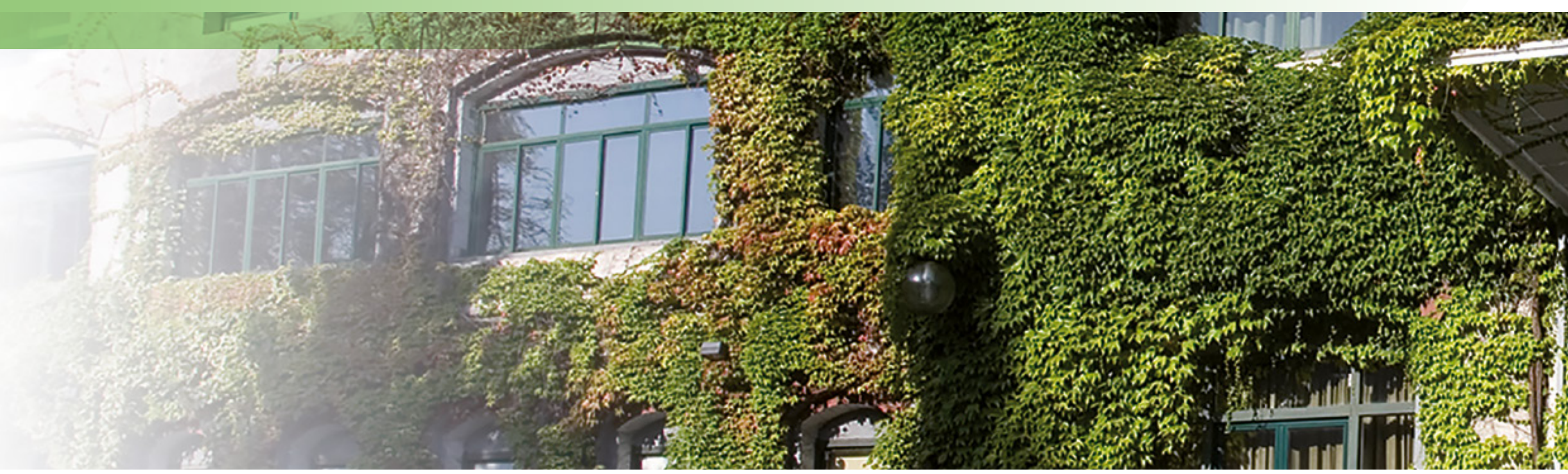
Third party verifier:
Marcel Gómez Ferrer / www.marcelgomez.com
Approved by: The International EPD® System Technical committee, supported by the Secretariat

Procedure for follow up of data during EPD validity involves third party verifier:
☐Yes ☒No

LCA study:
Instituto tecnológico de Aragón / www.itainnova.es

Registration number
S-P-02833 / Date: 02.26.2020

EPDs within the same product category but from different programmes may not be comparable.



CAF COMMITMENT

Railways and the environment.
On track to efficiency.

CAF is an international leader in the design, manufacture, maintenance and supply of equipment and components for railway systems across the globe. The company was founded at the beginning of the 20th century and initially served primary industries in Northern Spain. Since then, the company has grown into the international company it is today with over 13,000 qualified professionals, over 30% of whom are degree qualified.

The company holds onto its roots with the company headquarters still being in the original site at Beasain. This education level combined with a commitment to R+D+I and the know-how built up from over 100 years of experience has meant that CAF has continued to lead and innovate their own state-of-the-art technology, which has significantly improved efficiency, safety and comfort of its products and of the sector itself. This technology includes solutions such as the Greentech energy efficiency family with the Evodrive kinetic energy recovery system and the Freedrive for catenary-free running. Also solutions for the control of fleets and their maintenance such as AURA, NAOS for traffic and energy control, together with AURIGA the ERTMS wayside and onboard system of the CAFs group.

CAF integrates Corporate Social Responsibility into the company's general policy and is fully aware of the potential impact of industrial activities on the environment. For this reason the organisation includes Environmental protection as one of its primary objectives. CAF's environmental management is aimed at controlling and minimizing environmental impact from emissions into the atmosphere, residues and energy consumption, with the principle aim of preserving natural resources.

To achieve this CAF has implemented a sustainability function into the production processes, making the most of natural resources and generating energy via renewable methods. The CAF Group operates photovoltaic solar, small scale wind and sustainable mobility business; with a hydro-electric plant and photovoltaic panels at their facilities to meet the energy requirements.

The implemented environmental management system has been certified in accordance with ISO 14001 since 2001. In order to provide more efficient and more environmentally friendly means of transport, CAF is currently implementing the "Product Sustainability Function", introducing eco design methods in the engineering processes to optimise and control the environmental impact of products throughout their entire operating cycle.

New initiatives for sustainable mobility

The European Green Deal sets out the key elements that should structure climate action so that the European Union can become a carbon-neutral and competitive economy by 2050. Rail transport is the mode of public transport with the lowest emissions per passenger and therefore has a decisive role to play in the fight against climate change.
The Fuel Cells and Hydrogen Joint Undertaking (FCH JU) of the European Commission has selected the project FCH2RAIL.

FCH2RAIL would be technically led by CAF and would benefit from the European funding under the H2020 Program to work on the development of a railway vehicle prototype powered by hydrogen.

URBOS 100
TRAMS

For the city of Lund in Sweden

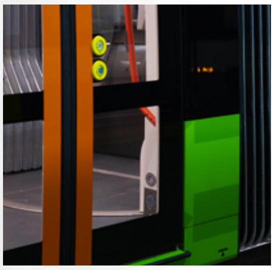
This is an international gauge, bidirectional tram vehicle with two driver cabs, made up of 5 articulated modules resting on two motor bogies and one trailer bogie under the central module.

Technical Datasheet

Composition:	Mc-S-T-S-Mc
Power supply voltage:	750 Vdc
Track gauge:	1,435 mm
Max. speed:	70 km/h
Length:	32,966 mm
Exterior width:	2,650 mm
Vestibule area floor height:	345-365 mm
Total capacity:	218
Places for wheelchairs:	4

Equipment

- Saloon and cab air conditioning
- Passenger Audio and Visual Information: loudspeakers, LED indicators, TFT displays, intercoms
- Event recorder and driver surveillance system
- Interior video surveillance (CCTV)
- Sanders and Flange lubrication
- Train control and diagnostic system using programmed logic
- People Counting System (APC)
- Radio communication system
- Signalling system



URBOS

Versatile, with personality and environmentally friendly

Urban design

Environmentally sustainable CAF's long-standing experience in the production and implementation of urban transport systems has led to the creation of the Urbos solution, a range of trams with the potential to respond to the most demanding requirements of users and operators alike. The Urbos family includes trams, LRVs and tram-trains, a whole range of innovative, high-quality products, specifically designed to offer the end user a unique traveling experience.

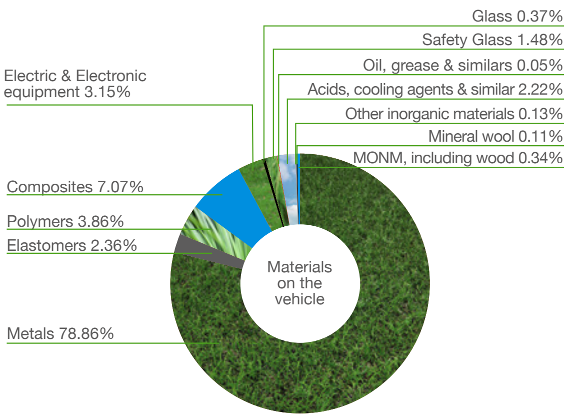
Own personality
Flexible design and configuration
Maximum level of comfort
Best accessibility conditions for passengers
High reliability / optimised life cycle cost

LIST OF **MATERIALS**

In the design of the Urbos 100 for the City of Lund, materials have been selected according to the functional, technical and regulatory requirements, as well as considering their recyclability and ease of dismantling at the end of their operating life.

In accordance with their policy, CAF meets the environmental requirements right from the very first stages of their projects. When designing the Lund tram units, CAF has observed and demanded that their suppliers apply the “Railway Industry Substance List” (www.unifedatabase.org) to reject the content of regulated materials that could affect the environment or people’s health.

Disassembling is foreseen right from the design stage to enhance material separation and recycling of the vehicle when its end of life is reached. The following figures show the summarised inventory of the tram materials.



Hazardous substances	Weight (%)	Location
Nickel	0,054%	Electronic componets
Lubricant oil and grease	0,050%	Mechanical components
Cooling agents	0,036%	HVAC

Commitment with clean energy

The CAF Group owns two hydroelectric plants, preserved heritage of the origins of the company for over 100 years, which were subject to a comprehensive modernization a decade and a half ago.

CAF has also undertaken an ambitious project to install solar panels on the roofs of its plant in Beasain offering optimum utilization conditions.

PRODUCT
ENVIRONMENTAL IMPACT

Noise

The main sources of noise emission involve the effects of the rolling gear, the HVAC unit and the vehicle's traction equipment. In accordance with standard ISO 3095, the unit's exterior contractual noise emission is as follows:

Noise	dB(A)
Stationary noise	≤ 54
Acceleration sound pressure level	≤ 71
Pass-by noise (60 km/h)	≤ 78

Energy Consumption

Energy consumption during the use stage takes into account the route and timetables of the line the vehicle has been designed for and it has been calculated based on a simulation coherent with the reference document TecRec 100:001 -Specification and verification of energy consumption for railway rolling stock. A vehicle occupation capacity of 214 passengers (all seated and 5 passengers per sqr-meter standing) has been considered in accordance with the operational mass defined in standard EN 15663.

Electrical Energy Consumption [kWh/pass.km]

Manufacturing	1.43E-04	
	0% receptivity	100% receptivity
Average use: service	0,02559	0,01915
Average use: service + standby	0,02630	0,02048

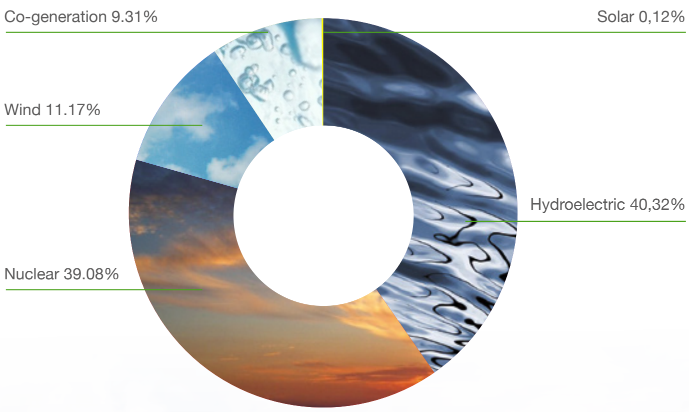
(*) Data valid according to established simulation criteria. On real operation, depending on operational conditions, these values may vary.

Recoverability and recyclability potential profile

As a result of the studied design and modularity used during assembly and dismounting, high recyclability and recoverability potential ratios are achieved at the end of the tram operating life.

Recoverability and Recyclability Potential according to ISO 22628	
Recyclability Rate	93.2%
Recoverability Rate	97.5%

Swedish Electricity Mix



Source: http://www.swedishernergyagency.se

ENVIRONMENTAL PROFILE OF THE **PRODUCT LIFE CYCLE**

Environmental Profile Of The Product Life Cycle

Environmental profile for the functional unit [1 pass. 1 km]			Material and Component Production [UPSTREAM]	Transport and vehicle assembly [CORE]	Vehicle use [DOWNSTREAM]			TOTAL	
					Use energy consumption & consumables		Maintenance & End of Life		
					0% recept.	100% recept.		0% recept.	100% recept.
Primary energy resources – Renewable	Use as energy carrier	MJ, net calorific value	7,96E-5	5,59E-4	7,95E-2	6,19E-2	1,02E-6	8,02E-2	6,26E-2
	Used as raw materials	MJ, net calorific value	1,41E-3	2,87E-5	1,40E-5	1,40E-5	7,10E-5	1,53E-3	1,53E-3
	TOTAL	MJ, net calorific value	1,49E-3	5,88E-4	7,96E-2	6,19E-2	7,20E-5	8,17E-2	6,41E-2
Primary energy resources – Non Renewable	Use as energy carrier	MJ, net calorific value	6,94E-4	3,02E-3	1,45E-1	1,13E-1	6,65E-5	1,48E-1	1,16E-1
	Used as raw materials	MJ, net calorific value	6,32E-3	4,10E-4	1,99E-4	1,99E-4	1,12E-3	8,05E-3	8,05E-3
	TOTAL	MJ, net calorific value	7,01E-3	3,43E-3	1,45E-1	1,13E-1	1,19E-3	1,56E-1	1,24E-1
Secondary material (*)		Kg	-	-	-	-	-	-	-
Renewable secondary fuels		MJ, net calorific value	0	0	0	0	0	0	0
Non-renewable secondary fuels		MJ, net calorific value	0	0	0	0	0	0	0
Net use of fresh water m3		m3	3,36E-7	7,27E-7	7,76E-6	6,05E-6	3,03E-7	9,12E-6	7,41E-6

* Secondary material is known as used as a fraction of material inputs, but documented and consistent data from the supply chain are not available, so this indicator is not determined.

Environmental profile for the functional unit [1 pass. 1 km]		Material and Component Production [UPSTREAM]	Transport and vehicle assembly [CORE]	Vehicle use [DOWNSTREAM]				TOTAL	
				Use energy consumption & consumables		Maintenance	End of Life		
WASTE* [kg/ pass.km]				0% recept.	100% recept.			0% recept.	100% recept.
Hazardous waste disposed	Kg	1,50E-7	1,99E-8	7,53E-8	5,86E-8	5,87E-9	3,07E-11	2,51E-7	2,34E-7
Non Hazardous disposed	Kg	1,68E-4	1,75E-5	4,96E-4	3,87E-4	1,62E-5	3,70E-6	7,02E-4	5,92E-4
Radioactive waste disposed	Kg	2,25E-8	10,00E-9	2,20E-6	1,72E-6	2,72E-9	2,55E-10	2,24E-6	1,75E-6
*(EDIP 2003 method)									
OUTPUT FLOWS [kg/ pass.km]									
Components for reuse	Kg	N/A	0	N/A	N/A	0	0	0	0
Material for recycling	Kg	N/A	2,37E-6	N/A	N/A	1,79E-5	9,91E-5	1,19E-4	1,19E-4
Materials for energy recovery	Kg	N/A	4,01E-6	N/A	N/A	2,45E-6	2,08E-6	8,54E-6	8,54E-6
Exported energy, electricity	Kg	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Exported energy, thermal	Kg	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Environmental profile for the functional unit [1 pass. 1 km]		Material and Component Production [UPSTREAM]	Transport and vehicle assembly [CORE]	Vehicle use [DOWNSTREAM]				TOTAL	
				Use energy consumption & consumables		Maintenance	End of Life		
ENVIRONMENTAL IMPACT [/pass.km]				0% recept.	100% recept.			0% recept.	100% recept.
Global Warming potential	kg CO2-Eq	5,61E-4	1,39E-4	9,49E-4	7,40E-4	8,79E-5	3,44E-6	1,74E-3	1,532E-3
Acidification potential	kg SO2-Eq	3,89E-6	8,90E-7	4,53E-6	3,53E-6	9,06E-7	7,96E-9	1,02E-5	9,226E-6
Eutrophication potential	kg PO4-Eq	3,77E-6	1,90E-7	2,12E-6	1,65E-6	3,30E-7	9,16E-9	6,42E-6	5,951E-6
Tropospheric Ozone potential	kg C2H4-Eq	3,29E-7	4,40E-8	2,73E-7	2,13E-7	5,40E-8	7,48E-10	7,00E-7	6,408E-7
Ozone depletion potential	kg CFC-11-Eq	1,43E-10	3,61E-11	1,20E-9	9,36E-10	2,44E-10	4,52E-13	1,63E-9	1,359E-9
Abiotic depletion	kg Sb-eq	7,64E-8	2,15E-10	4,63E-9	3,60E-9	2,90E-9	9,22E-12	8,42E-8	8,317E-8
Abiotic depletion (fossil fuels)	MJ	6,45E-3	2,87E-3	8,95E-3	7,00E-3	1,03E-3	4,08E-5	1,93E-2	1,740E-2

Low Energy Consumption

Under a Life Cycle approach, cost and environmental impacts reduction of the operation use have been core targets of the Urbos platform design process. Low specific energy consumption per passenger has been achieved, thanks to the lightness and large capacity of the train, together with a low consumption of maintenance materials, as a result of the reliability and durability of the components, and the modularity and standardisation of the solutions employed.

INFORMATION ABOUT THE **ENVIRONMENTAL DECLARATION**

This environmental declaration was made following the requirements of the reference document “PCR 2009:05 v.3.03 - UN CPC 495 Rolling Stock” published by Environdec (www.environdec.com) and is based on the data of the URBOS 100 tram units for the City of Lund, for all the stages of the product’s life cycle (production of raw materials and components, assembly of the vehicle, distribution, use and end of life).

The functional unit in this study is the transport of 1 passenger over 1km and the operating life of the vehicle analysed has been set at 30 years.

The Urbos 100 environmental impact study has been quantified by means of a Life Cycle Analysis in accordance with standards ISO 14040 and ISO 14044. The methods of the characterization of the environmental impact of the compiled operating life inventory are CML-IA and EDIP 2003.

Information regarding the materials and production of the vehicle has been obtained directly from the Management Systems of CAF and the information provided by the suppliers themselves. Data from the Ecoinvent database (version 3.2) has been used for the environmental definition of the processes and materials. Those processes not available in Ecoinvent database were generated using first hand data.

For vehicle assembly, the effect of the procurement of materials and components making it up have been considered, as well as the transport of materials (over 58% of the tram weight) to the assembly plant, the assembly itself, handling of the waste from both the assembly and dismantling of the vehicle and the transport of the vehicle from CAF’s Zaragoza plant to Lund in Sweden during year 2020.

For the environmental impact of the energy consumption during assembly, the Spanish electricity production mix has been taken into account, with data provided by the Spanish Electrical Grid (Red Eléctrica Española) for the year 2017.

For environmental impact characterization of the energy consumption during use phase an average of 60.000 km per year and 2017 Swedish electricity mix (Swedish Energy Agency - www.swedishernergyagency.se) has been considered.

In the end of life, and vehicle dismantling stage, has been modelled according to ISO 21106. The potential advantage of recycling and recovery of the energy from incineration processes has not been accounted for in the study.

Rolling Stock System Boundaries

Upstream
- Material & Energy Production
- Transport of Materal & Parts

Core
- Vehicle Manufacturing (including energy and auxiliary materials and waste)
- Transport of Vehicle to Use Location

Downstream
- Vehicle Energy & Maintenance Materials
- Vehicle Dismantling and Disposal

Definitions:

Acidification (potential):
Acidification results from the emission of sulphur dioxide and nitrogen oxides. In the atmosphere, these oxides react with the existing steam, forming acids which fall back to the earth in the form of rain or snow, or as dry deposits. Its
effect on the earth generally shows itself in the form of reduced forest development and in aquifer ecosystems, such as lakes, acidification is apparent in the disappearance of some living organisms. Other objects such as constructions, monuments and buildings may also be damaged as a result of the effects of acid rain. Acidification potential measures an emitting substance's contribution to acidification expressed in sulphur dioxide equivalents (SO2).

Eutrophication (potential):
Eutrophication results in the enrichment of water ecosystems with organic compounds and nutrients, which give rise to an increased production of plankton, algae and other water plants with the resulting reduction in water quality. In this case the main sources related to this phenomenon are nitrogen and phosphorous.
A secondary effect is the decomposition of dead organic material, a process which consumes oxygen and may result in anaerobic environments. The eutrophication potential, expressing in equivalent PO-43, quantifies nutrient enrichment via the release of a substance in water or land.

Global Warming (potential):
Greenhouse effect emissions into the atmosphere absorb some of the infrared solar radiation reflected on the earth's surface resulting in a troposphere temperature increase. The global warming potential is an index, in equivalent kg of CO2, to measure the global warming contribution of a substance released into the atmosphere in a span of 100 years.

Ozone depletion (potential):
The ozone layer in the atmosphere protects the flora and fauna from harmful ultraviolet radiation from the sun. Some substances emitted into the atmosphere deplete this layer resulting in a higher level of UV radiation on the earth. The ozone layer depletion potential is the contribution of a substance compared with the impact caused by CFC-11.

Ozone photochemical formation/ Photochemical oxidation (potential):
The photo-chemical formation of the ozone in the troposphere is mainly provoked by the decomposition of volatile organic compounds (VOCs) in the presence of nitrogen oxides (Nox) and light. The formation of ozone by means of this process can be quantified by using the so-called ozone photo-chemical formation potentials (POCPs) expressed in equivalent kg of ethane (C 2H4).

Abiotic depletion (includding fossil fuels) (potential):
Characterization of the scarcity of resources and hence the limitations in its availability to current and future generations. The Abiotic Depletion Potential of a resource is defined as the ratio of the annual production and the square of the ultimate Earth reserve for the resource divided by the same ratio for a reference resource, antimony (Sb).

Reference Documentation:

- ISO14040:2006. Environmental management. Life cycle assessment. Principles and framework.
- ISO14044:2006. Environmental management. Life cycle assessment. Requirements and guidelines.
- ISO 14025:2006 Environmental labels and declarations. Type III environmental declarations. Principles and procedures.
- Product Category Rules 2009:05 version 3.03 - UN CPC 495 Rolling Stock
- General Programme Instructions for environmental product declarations, EPD, version 3.0
- ISO 22628:2002. Road vehicles. Recyclability and recoverability. Calculation method.
- TecRec 100:001. Specification and verification of energy consumption for railway Rolling stock.
- EN 15663:2009. Railway applications. Definition of vehicle reference masses.
- ISO 3085. Railway applications - Acoustics - Measurement of noise emitted by railbound vehicles.
- Railway Industry Substance List, (www.unife-database.org).
- UNI-LCA-001:00 Railway Rolling Stock - Recyclability and Recoverability Calculation Method.
- ISO 21106:2019, Railway applications — Recyclability and recoverability calculation method for rolling stock.

Headquarters

J.M. Iturrioz 26
20200 Beasain, Gipuzkoa
Spain

Versión impresa: en papel Cyclus Offset