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ETR1000

Environmental Product Declaration

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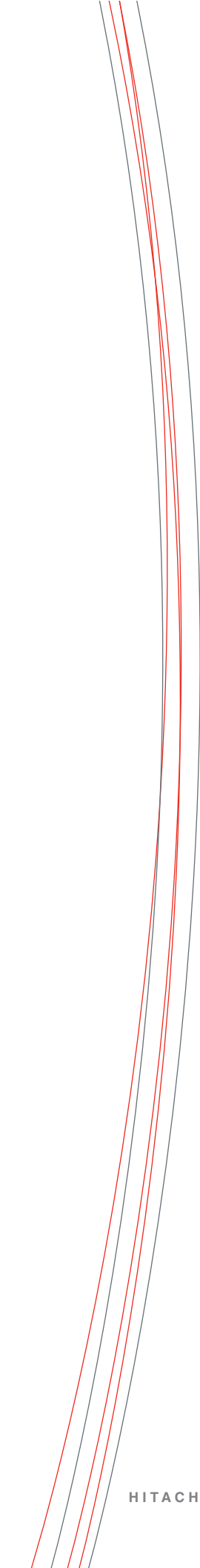
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The Company

Hitachi Rail Italy, created by the evolution of AnsaldoBreda which is the most important Italian brand with more than 160 years of history in the rail and metro sector, has a wide range of products, ranging from high speed to driverless metros. HRI is present in many countries of the world, among which - beyond Italy of course - in the Far East and in USA.

Today Hitachi Rail Italy is organized in three Italian plants: Napoli, Pistoia and Reggio Calabria; furthermore, it can rely on some operating plants abroad, achieving an overall number of about 2,400 employees. ETR1000 is produced in Pistoia, where the body components are assembled and carpentry, painting and assembly operations are performed.

The company has developed and certified an Environmental Management System in compliance with ISO 14001 standard.

The Product

ETR 1000 is a “very high speed” train for passengers’ transport, EMU (Electric Multiple Units) type, designed and produced in collaboration with Bombardier Transportation to improve the link between greater cities.

The train consists of eight car bodies with seven articulations. The traction is supplied by sixteen electric engines, coupled on eight of the sixteen bogies; other trucks are only trailers.

Technical informations

- Length 404 m (to coupler)
 - Width 2.924 m (external)
 - Height from railway plan 4.080 m
 - Net weight C0 453,580 kg
 - Weight with different loads
 - C1 454,060 kg – C0 + staff/drivers
 - C2 484,204 kg – C1 + 80% passengers
 - C3 487,200 kg – C2 + supporting people
 - Maximum speed 360 km/h
 - Maximum number of passengers 471 whereof:
 - seat 469
 - wheelchair 2
 - Power supply Electric
 - Available power 9,800 kW
- C3 is the configuration used for environmental impacts assessment.





Following table shows the distribution of materials which ETR1000 is made of, due to EN 15380-2 indications.

Product group	Vehicle materials (kg)							
	Metals	Polymers	Elastomers	Glass	Fluids	MONM	Other	Total
1 - Car body	112,020	928	1,809	245	1	86	1,767	116,856
2 - Interior, windows and doors	46,952	7,054	6,071	9,320	3	5,682	12,699	87,780
3 - Bogies and running gears	140,639	387	1,632	21	316	-	440	143,435
4 - Propulsion and electric equipment	74,655	5,375	2,985	520	3,133	683	1,116	88,465
5 - Comfort systems	10,999	350	39	-	180	-	5,476	17,044
Total	385,264	14,093	12,536	10,106	3,633	6,451	21,497	453,580
	84.9%	3.1%	2.8%	2.2%	0.8%	1.4%	4.7%	100.0%

MONM = Modified Organic Natural Materials (i.e.: leather, wood, cardboard, etc.)

Following table shows the distribution of materials which ETR1000 is made of, referred to the functional unit.

Product group	F.U. materials (g)							
	Metals	Polymers	Elastomers	Glass	Fluids	MONM	Other	Total
1 - Car body	0.0237708	0.0001968	0.0003839	0.0000521	0.0000001	0.0000182	0.0003751	0.0247971
2 - Interior, windows and doors	0.0099632	0.0014968	0.0012882	0.0019777	0.0000007	0.0012058	0.0026947	0.0186271
3 - Bogies and running gears	0.0298437	0.0000821	0.0003463	0.0000044	0.0000671	-	0.0000934	0.0304370
4 - Propulsion and electric equipment	0.0158419	0.0011406	0.0006334	0.0001103	0.0006648	0.0001449	0.0002367	0.0187725
5 - Comfort systems	0.0023341	0.0000743	0.0000083	-	0.0000382	-	0.0011619	0.0036168
Total	0.0817537	0.0029906	0.0026602	0.0021445	0.0007709	0.0013689	0.0045618	0.0962505
	84.9%	3.1%	2.8%	2.2%	0.8%	1.4%	2.4%	100.0%

MONM = Modified Organic Natural Materials (i.e.: leather, wood, cardboard, etc.)

Following hazardous materials are included inside the products that constitute ETR1000.

Hazardous materials	kg	Where
Cadmium	0.48	Batteries
Lubricants/oil/grease	488.51	Coupler, brakes, electric engines, HVAC
Antimony trioxide	43.6	Toilet

The train doesn't contain SVHC (Substances of Very High Concern), as defined by the Regulation 1907/2006/EC (REACH).



Environmental Performance Declaration

Methodology

The environmental performances of the product have been quantified by Life Cycle Assessment (LCA) approach in accordance with ISO 14040 and ISO 14044.

Data used for the study refers to year 2012 and are related to Pistoia site plant.

Specific and generic data fulfil General Program Instruction criteria for EPD as well as PCR for rail vehicles. Contribution given by generic data is less than 1% of the total. The use phase has been modelled using computation simulations that take into account the following issues:

- Maximum speed
- Average speed (commercial)
- Average slope of the run
- Maximum acceleration on horizontal rectilinear railway step
- Jerk in traction
- Maximum deceleration on horizontal rectilinear railway step
- Deceleration normally used for station stop
- Jerk in deceleration
- Normal load
- Length of the route
- Number of stations along the run and distance between one station and the next one

The adopted model is coherent with “*Specification and verification of energy consumption for railway rolling stock – Railenergy WP 2.2: Input to future UIC/UNIFE Technical Recommendation*” (EC contract N°FP6-031458)

For computation has been considered the mission profile on Milan-Naples route, taking into account the following assumptions:

- Route length 789.8 km
- Life span of the train 25 years
- Number of passengers 377 (C3)
- Load factor 80% (C3)

The Ecoinvent database has been used for all processes, for base materials production, for waste treatment processes, for electronic parts production and as a source for the Italian electric mix.

The characterization factors used are the default ones available on www.environdec.com site.

Functional Unit

According to related PCR, the functional unit is the transport of 1 passenger for 1 km.

System boundaries

UPSTREAM

RAW MATERIALS EXTRACTION

SUPPLIERS

MANUFACTURING ACTIVITIES



CORE MODULE

HITACHI RAIL ITALY
MANUFACTURING PLANTS



DOWNSTREAM MODULE

USE AND MAINTENANCE

END OF LIFE

EPD

The considered system is split into three phases according to the following hypothesis.

UPSTREAM MODULE

- Extraction of raw materials and production of base materials
- Production of auxiliary materials for rail vehicle assembly/manufacturing
- Transportation of products from suppliers' manufacturing facilities to Hitachi Rail Italy plants

CORE MODULE

- Electricity, heat, steam, fuels and auxiliary materials produced and used for rail vehicle assembly/manufacturing
- Production and use of auxiliary materials for vehicle assembly
- Transportation of the rail vehicle to the customer (Naples) by railway
- Waste generation and treatment for included core processes

DOWNSTREAM MODULE

- Electricity consumption for rail vehicle operation
- Production of maintenance materials and spare parts
- Waste from maintenance materials and spare parts
- Direct disposal of materials
- Incineration of materials with no energy recover



Environmental Results

Consumption of material and energy resources

Non-renewable resources data for transport of 1 passenger for 1 km	Life Cycle Modules				Total life cycle
	Upstream	Core	Downstream		
			Use phase	End of life	
Materials (kg)					
Gravel	0.0001526	0.0000093	0.0008545	0.0000007	0.0010171
Limestone	0.0000827	0.0000013	0.0002580	-	0.0003420
Iron	0.0000418	0.0000008	0.0001509	-	0.0001935
Other	0.0000969	0.0000020	0.0004630	-	0.0005619
<i>Total</i>	<i>0.0003740</i>	<i>0.0000133</i>	<i>0.0017264</i>	<i>0.0000007</i>	<i>0.0021144</i>
Energy (MJ)					
Natural Gas	0.0023411	0.0029339	0.2232635	0.0000001	0.2285385
Coal	0.0063191	0.0006102	0.1364662	0.0000001	0.1433956
Oil	0.0026514	0.0003506	0.0807412	0.0000011	0.0837442
Other	0.0019188	0.0001975	0.0411758	-	0.0432921
<i>Total</i>	<i>0.0132303</i>	<i>0.0040922</i>	<i>0.4816468</i>	<i>0.0000012</i>	<i>0.4989705</i>

Risorse rinnovabili data for transport of 1 passenger for 1 km	Life Cycle Modules				Total life cycle
	Upstream	Core	Downstream		
			Use phase	End of life	
Materials (kg)					
Wood	0.0000053	0.0000003	0.0000575	-	0.0000631
Biomass	-	-	-	-	-
<i>Total</i>	<i>0.0000053</i>	<i>0.0000003</i>	<i>0.0000575</i>	<i>-</i>	<i>0.0000631</i>
Energy (MJ)					
Hydropower	0.0010387	0.0001451	0.0361229	-	0.0373067
Biomass	0.0001294	0.0000087	0.0017194	-	0.0018575
Wind power	0.0000307	0.0000056	0.0012180	-	0.0012543
Other	0.0000006	-	0.0000069	-	0.0000075
<i>Total</i>	<i>0.0011994</i>	<i>0.0001593</i>	<i>0.0390672</i>	<i>-</i>	<i>0.0404259</i>
Water (l) except the use for turbines	0.0217724	0.0051210	1.0204914	-	1.0473848
Electricity consumption during manufacturing (kWh)	-	0.0001831	-	-	0.0001831
Use of recycled resources (kg)	-	-	-	-	-

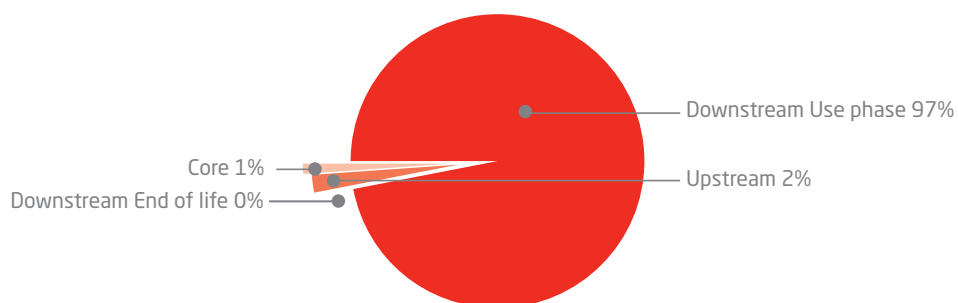
Additional informations

WASTE (kg) data for transport of 1 passenger for 1 km	Life Cycle Modules				Total life cycle
	Upstream	Core	Downstream		
			Use phase	End of Life	
Hazardous	-	0.0001825	-	0.0042585	0.0044410
Non Hazardous	-	0.0022883	-	0.2257434	0.2280317
<i>Total</i>	-	<i>0.0024708</i>	-	<i>0.2300019</i>	<i>0.2324727</i>

Pollutant emissions expressed in terms of potential environmental impacts

ENVIRONMENTAL IMPACT data for transport of 1 passenger for 1 km	Life Cycle Modules				Total life cycle
	Upstream	Core	Downstream		
			Use phase	End of life	
GWP (kg CO2eq)	0.0007169	0.0002314	0.0282474	-	0.0291957
ODP (kg CFC-11eq)	-	-	-	-	-
AP (kg SO2eq)	0.0000054	0.0000006	0.0001210	-	0.0001270
EP (kg PO4eq)	0.0000006	-	0.0000087	-	0.0000093
POCP (kg C2H4eq)	0.0000005	0.0000001	0.0000092	-	0.0000098

GWP



About 97% of GWP is caused by the “Downstream Use Phase” of the train.



Additional Informations

Energy consumption

On the strength of the results obtained by the simulation on the mission route, due to TS 50591_2013, ETR 1000 electricity consumption is around 18 kWh/km.

- Number of passengers used for calculation is 377.
- Load factor is 80%
- Configuration adopted is "C3"

Noise

	Train speed	Measurement point	Noise Level
In stationary conditions	0 km/h	X = 7,5 m Z = 1,2 m	≤ 68 dB(A)
In departure conditions	Acceleration from 0 to 30 km/h	X = 7,5 m Z = 1,2 m	≤ 85 dB(A)
In transit conditions	250 km/h	X = 25 m Z = 3,5 m	≤ 87 dB(A)
	300 km/h	X = 25 m Z = 3,5 m	≤ 91 dB(A)
	320 km/h	X = 25 m Z = 3,5 m	≤ 92 dB(A)

Potential recyclability and recoverability

Recyclability and recoverability percentages, calculated according to UNI-LCA-001.00 standard, are reported in the following table:

	Recovery		Undefined residue
Reuse (Component parts) 180	Recycling (Materials) 428,102 kg	Energy recovery (Materials) 428,282 kg	Waste (Materials) 18,895 kg
Recyclability rate 94.4%			
Recoverability rate 95.8%			
Vehicle mass 453,580 kg			

	Recyclability	Recoverability
End of life	94.4%	95.8%
Maintenance	92.2%	98.0%
Total life cycle	93.1%	97.1%

Other environmental information

Hitachi Rail Italy has developed and certified an Health and Safety at work Management System in compliance with OHSAS 18001.

Hitachi Rail Italy pursue the following strategically goals:

- satisfaction of customer's needs, both from product and service point of view
- health and safety of employees
- health, reliability and quality of the products

The use of materials that can be cause of allergic reactions has been completely avoided.



Glossary

Acidification Potential (AP): Phenomenon by which atmospheric rainfall has a pH which is lower than average. This may cause damage in forests and cultivated fields, as well as in water ecosystems and objects in general. This phenomenon is due to the emissions of SO₂, of NO_x, and NH₃, which are included in the Acidification Potential (AP) index expressed in masses of SO₂ produced.

Eutrophication Potential (EP): Enrichment of the watercourses by the addition of nutrients. This causes imbalance in water ecosystems due to the overdevelopment encouraged by the excessive presence of nourishing substances. In particular, the Eutrophication Potential (EP) includes phosphorous and nitrogen salts and it is expressed in grams of oxygen (kg O₂).

Global Warming Potential (GWP): Phenomenon by which the infrared rays emitted by the earth's surface are absorbed by the molecules in the atmosphere as a result of solar warming and then re-emitted in the form of heat. Thus giving rise to a process of global warming of the atmosphere. The indicator used for this purpose is GWP (Global Warming Potential), that includes the emissions of carbon dioxide, the main greenhouse gas, as well as other gases like methane (CH₄), nitrogen protoxide (N₂O), chlorofluorocarbons (CFC), which are expressed according to the degree of absorption of CO₂ (kg CO₂).

HVAC: Heating, Ventilating, and Air Conditioning

MONM: Modified Organic Natural Materials

Ozone Depletion Potential (ODP): Degradation and depletion of the ozone layer in the stratosphere, which has the property of blocking the ultraviolet components of sunlight thanks to its particularly reactive compounds, originated by chlorofluorocarbons (CFC) or by chlorofluoromethanes (CFM). The substance used as a point of reference for assessing the ODP (Ozone Depletion Potential) is trichlorofluoromethane, or CFC-11.

Photochemical Ozone Creation Potential (POCP): Production of compounds capable of encouraging an oxidizing reaction by the action of light. Thus lead to the production of ozone in the troposphere. The indicator POCP (Photochemical Ozone Creation Potential) includes especially VOC (volatile organic compounds) and is expressed in grams of ethylene (kg C₂H₄).

SVHC: Substances of Very High Concern

References

- LCA of ETR1000 – Final report, Altran Italia and Hitachi Rail Italy S.p.A., July 2013
- Energy calculation.docx – V 300 Zefiro. Route simulation – 05/29/2013
- Product Category Rules (PCR 2009:05) for preparing an Environmental Product Declaration (EPD) for Rolling Stocks - UNCPC CODE: 495 – version 2.0 2013-02-04
- General Programme Instructions For Environmental Product Declarations, EPD, Version 1.0, 2008-02-29
- ISO 22628:2002
- EN 15380-2:2006
- EN 15663:2009
- Database Ecoinvent, software SimaPro 7.1 and suppliers' data used for calculation, including database required by PCR
 - (1) Reference laws about hazardous substances
 - Regulation 1907/2006 "REACH" (Annex XVII)
 - Directive 94/62/EC on packaging and waste from packaging and subsequent updates
 - Regulation (CE) 1005/2009 on ozone depletion substances
 - Directive 2002/95/CE RoHS
 - Regulation (CE) n. 648/2004
 - Directive 2002/72/CE
 - Directive 2001/41/CE
 - Directive 67/548/CE

Verification information

Pcr review was conducted by Kathy Reimann, Bombardier Transportation GmbH.

Independent verification of the declaration and data, according to ISO 14025:
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Approved by International EPD System

For further information visit www.environdec.com site

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

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