ENVIRONMENTAL PRODUCT DECLARATION

TALENT 2

The *BOMBARDIER* TALENT** 2 train reflects our dedication to developing products and services for sustainable mobility.

EMAS
VERIFIED ENVIRONMENTAL MANAGEMENT
DE-183-00020
Hennigsdorf

BOMBARDIER
the evolution of mobility

TALENT 2

Designed for Sustainable Mobility

The TALENT 2 train sets a high standard for environmentally sustainable rail transportation. This Environmental Product Declaration provides a detailed insight into the environmental impact of the TALENT 2 train throughout its complete life cycle.

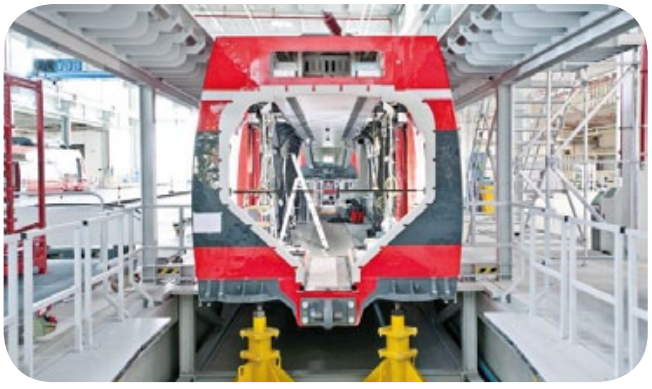
Communicating Environmental Performance – ISO 14025

We communicate the environmental performance of our products through Environmental Product Declarations (EPDs) following the international EPD® system. Our EPDs are developed in line with the UNIFE Product Category Rules for Rail Vehicles (PCR 2009:05) as well as the principles and procedures of ISO 14025:2006. EPDs are part of the *BOMBARDIER* ECO4** product portfolio. They are based on Life Cycle Assessment methodology and function as an externally validated communication tool, providing complete transparency to the benefit of our customers and other stakeholders. The external validation is carried out by independent verifiers approved by the technical committee of the international EPD® system and/or the EU Eco-management and Audit Scheme (EMAS).

The Nuremberg 4-car trainset configuration of the *TALENT* 2 train forms the basis of the specific environmental information of this EPD (*TALENT* 2 NUE).

TALENT 2 - Highlighted facts and figures	
Number of cars	4
Weight	136 855 kg
Capacity	221 seats
Max speed	160 km/h
Energy consumption	6,35 kWh/km
Recoverability/ Recyclability	96%/ 92%

Data is based on the TALENT 2 Nuremberg configuration.



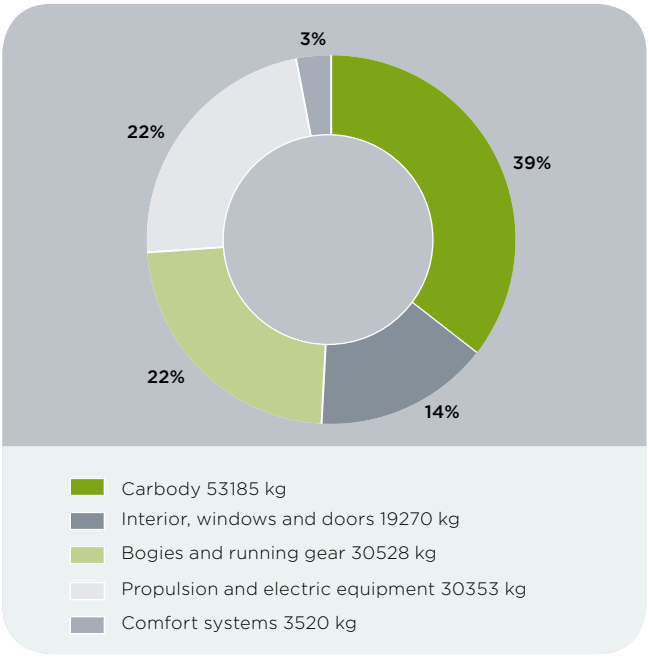
Material Content

The *TALENT* 2 train is developed with a strong emphasis on our commitment to eliminating hazardous substances and related toxic emissions, providing a safer environment for our customers, passengers and employees. The Bombardier Controlled Substances list enables product designers to screen out such substances by identifying them throughout our supply chain and actively working towards eliminating them from our vehicles.

Material [kg]	Manufacturing	Maintenance	Total
Metals	119 020,6	20 184,5	139 207,7
Polymers	5 120,5	5 423,6	10 544,1
Elastomers	1 826,6	258,9	2 085,5
Glass	2 527,0	419,7	2 946,8
Fluids	1 716,7	1 616,0	3 332,7
MONM	2 691,3	380,6	3 071,9
Others	3 952,7	7 570,7	11 523,4
Total	**136 855,3**	**35 854,2**	**172 712,1**

The TALENT 2 NUE material composition and all material required for maintenance during a 32 year operation. Materials are classified according to ISO 22628:2002.

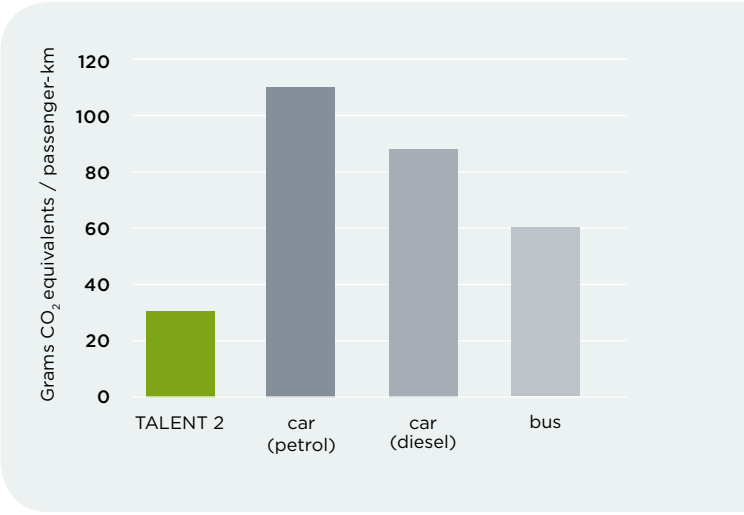
The following chart shows an allocation of the *TALENT* 2 NUE total vehicle mass to the five main product groups identified in PCR 2009:05, version 1.1[1].



The TALENT 2 NUE modular structure according to PCR 2009:05, version 1.1.

Energy Efficiency

Regenerative braking, an energy-optimized parking concept and an optional electronic support of the driver for energy saving operation contribute to maximizing the energy efficiency of the *TALENT* 2 NUE train at 6,35 kWh/km. Track energy consumption data is based on a test run on the Deutsche Bahn track between Nauen and Neustadt/Dosse in typical suburban traffic with 3 stops. Assumptions on vehicle auxiliary systems load is based on EC Contract No. FP6-031458. The passenger load is at 50% giving 111 passengers per trainset.



When compared to travelling by car or bus up to 71% of the resulting fossil CO_2 emissions per passenger/km could be avoided[2].

Noise

The *TALENT* 2 train is homologated according to TSI CR Noise (2006), see limits shown in the table below. The limits for noise are defined at a distance of 7,5 m from the center of the track and 1,2 m above the top of the rail.

Noise	dB(A)
Standstill noise	< 68
Starting noise	< 82
Pass-by noise at 80 km/h	< 81
Pass-by noise at 160 km/h	< 90

[1] Product Category Rules (PCR) for preparing an Environmental Product Declaration (EPD) for Rail Vehicles, UNCPC CODE: 495, PCR 2009:05, version 1.1, International EPD Consortium (IEC).

[2] UmweltMobilCheck: Internet tool to compare the emissions and energy consumption of different transport modes for passenger transport in Germany - Scientific Report; commissioned by Deutsche Bahn AG, 2008.

A Life Cycle Perspective

Environmental Profile of the TALENT 2

At Bombardier life cycle thinking is integrated to the design process, highlighting the significance of different design choices and the true overall environmental impact these choices have.

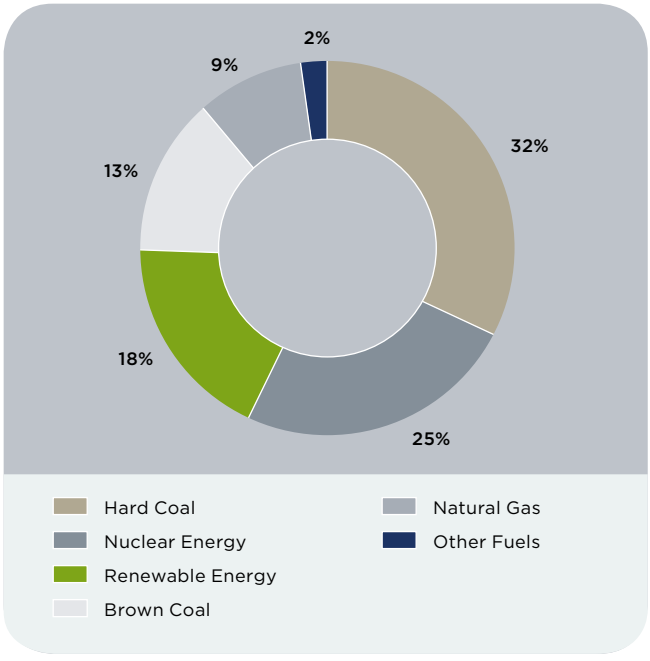
Life Cycle Assessment

Resource efficiency, waste generation and overall environmental impact are estimated throughout all life cycle phases of the *TALENT* 2 NUE train, following ISO 14040:2006 methodology.[3] The results are based on a 4-car *TALENT* 2 train in service for 32 years, with an average running distance of 250 000 km per year. All assumptions on vehicle auxiliary systems load are based on EC Contract No. FP6-031458, following the methodology and operational profiles used for the energy consumption simulation. The simulated operational scenarios features 80% energy recovery from regenerative braking. The end of life phase of the life cycle is modeled according to technology available today. The potential benefit from material recycling and energy recovery is not included in the environmental impact tables.

[3] Bombardier document: 3EST7-3295 Life Cycle Assessment of the TALENT 2 train for Nürnberg suburban electrical multiple unit train.

Power supply

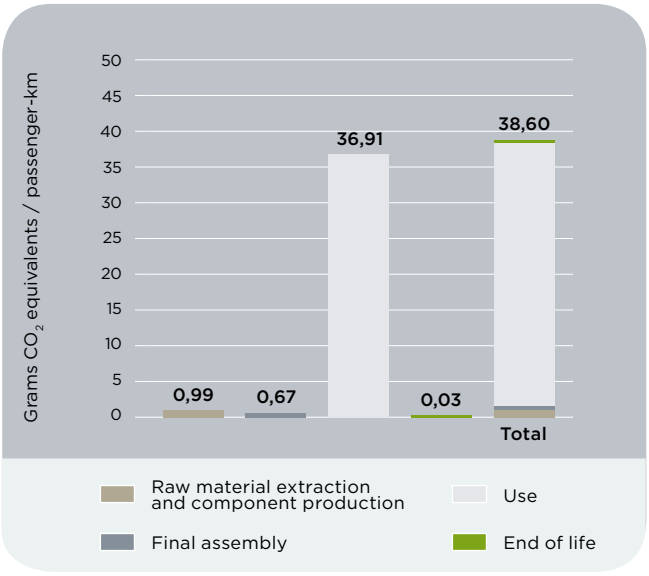
Electric power to Deutsche Bahn AG rail vehicles is sourced primarily from hard coal and nuclear energy. The Deutsche Bahn AG power supply mix for 2009 was used to model the operation phase of the *TALENT* 2 train life cycle.



Power supply for the TALENT 2 NUE train resulting in emissions of 500 g of CO_2 equivalents per kWh.

Carbon Footprint

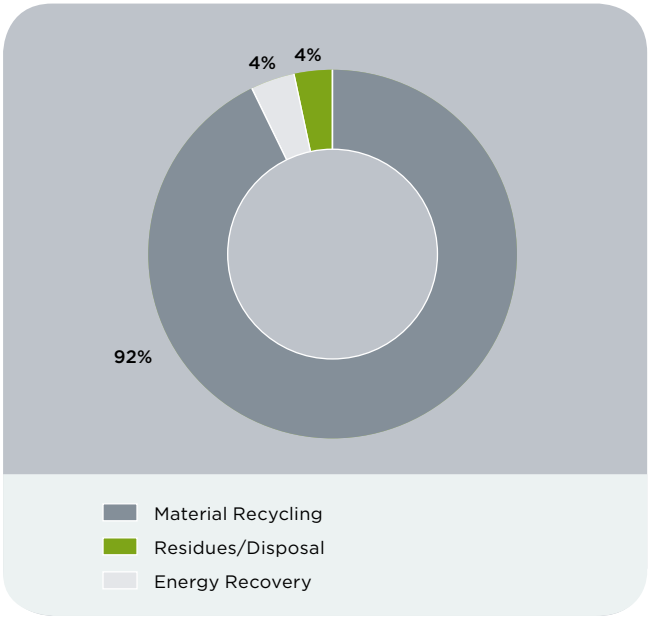
Greenhouse gas (GHG) emissions throughout the *TALENT* 2 NUE train life cycle are as low as 38,60 g of CO_2 equivalents when allocated to one passenger travelling for one km.



Contribution of each life cycle phase to the total mass of CO_2 equivalents.

Recyclability and Recoverability

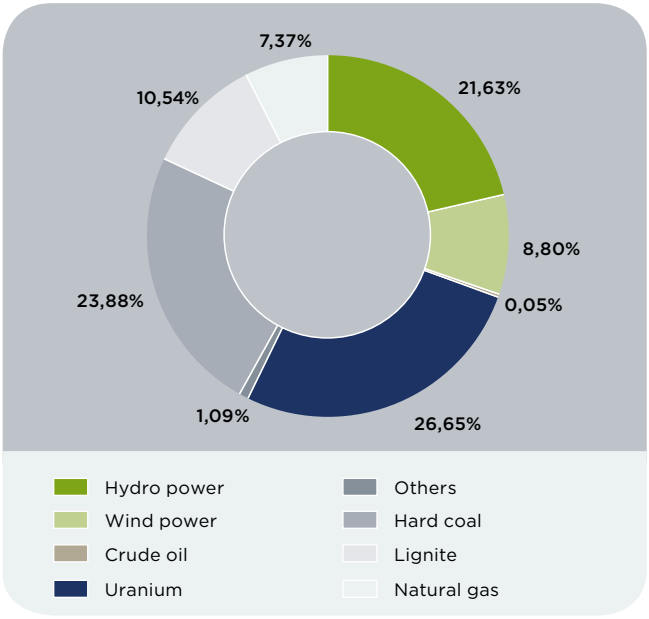
Using materials featuring high recyclability and considering disassembly early in the design phase maximise the overall recoverability of the *TALENT* 2 train. Material recycling and energy recovery aggregate to give a 96% recoverability rate.



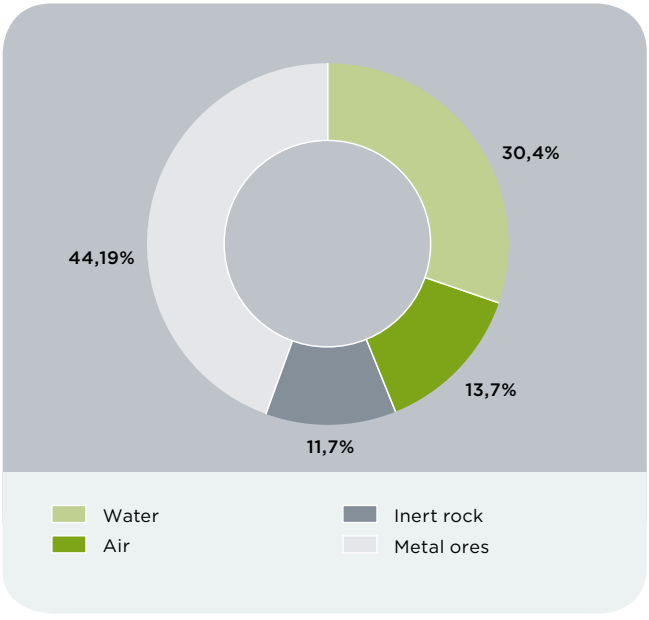
Projected recoverability at the end of life phase of the TALENT 2 NUE, following ISO 22628 methodology.

Energy and Material Resource Use

Renewable and non-renewable energy and material resource use throughout the *TALENT* 2 train life cycle is detailed in the following charts as a percentage of the total for the entire life cycle of the vehicle. The distinction between renewable and non-renewable energy and material resources is shown with green shades representing renewable resources and grey shades representing non-renewable resources.



Energy resource use throughout the TALENT 2 NUE life cycle shown as a percentage of the total calorific value.



Material resource use throughout the TALENT 2 NUE life cycle shown as a percentage of the total material resource mass.

Environmental Impact in Detail

	Upstream module	Core module	Downstream
Renewable resources	Raw material extraction and component production	Final assembly	Use
Material (kg/pass. km)	1,59E-02	1,03E-02	5,63E-01
Water	1,04E-02	7,36E-03	3,89E-01
Air	5,53E-03	2,94E-03	1,74E-01
Carbon dioxide	1,32E-05	1,46E-06	1,27E-05
Others	2,71E-07	6,70E-12	4,61E-07
Energy (MJ/pass.km)	1,22E-03	5,14E-04	1,04E-01
Hydropower	8,97E-04	2,24E-04	2,07E-02
Biomass	1,08E-06	0,00E+00	2,15E-06
Wind power	7,10E-05	2,53E-04	8,34E-02
Solar energy	1,30E-04	2,24E-05	1,26E-04
Others	1,17E-04	1,47E-05	2,85E-05
Non-renewable resources			
Material (kg/pass.km)	2,31E-02	1,37E-02	7,14E-01
Inert rock	5,01E-03	3,40E-03	1,49E-01
Natural aggregate	4,93E-06	4,70E-06	2,36E-04
Copper ores	1,49E-03	1,32E-07	5,63E-04
Metal ores	1,66E-02	1,03E-02	5,64E-01
Energy (MJ/pass.km)	1,23E-02	9,78E-03	6,39E-01
Uranium	1,87E-03	3,85E-03	2,48E-01
Crude oil	2,74E-03	1,66E-04	7,49E-03
Hard coal	4,18E-03	2,26E-03	2,21E-01
Lignite	7,77E-04	2,55E-03	9,69E-02
Natural gas	2,69E-03	9,49E-04	6,65E-02
Waste			
Waste (kg/pass.km)	7,72E-03	3,43E-03	1,50E-01
Hazardous waste	3,34E-05	4,09E-06	9,79E-05
Non-hazardous waste	7,68E-03	3,43E-03	1,50E-01
Environmental impact categories (pass.km)			
Acidification Potential (AP) [kg SO_2-Equiv.]	5,00E-06	1,08E-06	5,72E-05
Eutrophication Potential (EP) [kg Phosphate-Equiv.]	4,40E-07	1,36E-07	5,29E-06
Global Warming Potential (GWP 100 years) [kg CO_2-Equiv.]	9,87E-04	6,67E-04	3,69E-02
Ozone Layer Depletion Potential (ODP, steady state) [kg	5,23E-11	1,03E-10	6,69E-09
Ozone Creation Potential (POCP) [kg Ethene-Equiv.]	4,32E-07	1,56E-07	4,32E-06

module	Total
End of life	
2,56E-04	5,90E-01
1,02E-04	4,07E-01
1,54E-04	1,83E-01
2,66E-08	2,74E-05
1,65E-14	7,32E-07
5,99E-06	1,06E-01
2,65E-06	2,18E-02
0,00E+00	3,23E-06
2,98E-06	8,37E-02
3,62E-07	2,79E-04
2,18E-09	1,60E-04
3,00E-04	7,51E-01
4,14E-05	1,57E-01
3,41E-07	2,46E-04
1,56E-09	2,05E-03
2,58E-04	5,91E-01
1,31E-04	6,62E-01
4,61E-05	2,54E-01
1,15E-05	1,04E-02
2,80E-05	2,27E-01
3,11E-05	1,00E-01
1,44E-05	7,01E-02
5,46E-05	1,61E-01
2,67E-06	1,38E-04
5,19E-05	1,61E-01
2,39E-08	6,34E-05
2,96E-09	5,87E-06
3,08E-05	3,86E-02
1,24E-12	6,85E-09
1,65E-09	4,91E-06

Definitions

Acidification potential

The aggregate measure of the acidifying potential of some substances, calculated through the conversion factor of sulphur oxides and nitrogen and ammonia into acidification equivalents (H^+ ion).

Carbon footprint

The carbon footprint of a passenger travelling for one km is the result of an allocation of the total amount of greenhouse gases (GHG) emitted over all phases of the vehicle life cycle. The total mass of emitted GHGs is allocated to CO_2 equivalents.

Eutrophication potential

The aggregate measure of the inland water eutrophication potential of some substances, calculated through the conversion factor of phosphorous and nitrogen compounds (waste water discharges and air emissions of NO_x and NH_3) into phosphorous equivalents.

Global warming potential

The aggregate measure of the contribution to the greenhouse effect of some gases through their conversion into carbon dioxide equivalents.

Life cycle assessment

Life cycle assessment (LCA) is a technique assessing the environmental impact associated with all stages of a product's life from-cradle-to-grave (i.e., from raw material extraction through materials processing, manufacturing, distribution, use, repair and maintenance, and disposal or recycling).

Ozone layer depletion potential

The aggregate measure of the ozone layer depleting potential of some substances, calculated through the conversion factor of halogenated hydrocarbons that contribute to the depletion of the ozone layer into CFC -11 equivalents.

Photochemical ozone creation potential

The aggregate measure of the ground level ozone creation potential of some substances, calculated through the conversion factor of ethylene equivalents that contribute to the formation of photochemical oxidants.

Recyclability and recoverability

The recyclability and the recoverability rate of a new rail vehicle are expressed as a percentage by mass of the rail vehicle that can potentially be recycled, reused or both (recyclability rate), or recovered, reused or both (recoverability rate).

Design for Environment

The integration of environmental sustainability into product development is fundamental at Bombardier, where it has a core function in designing state of the art rail transportation equipment.

Applying a complete life cycle perspective to vehicle design is central to our product responsibility strategy. Maximising energy and resource efficiency, eliminating hazardous substances and related toxic emissions as well as enhancing the overall product recyclability rate is the result of a high quality working process applied to product design and cascaded down our supply chain. The Bombardier Transportation Design for Environment (DfE) Centre of Competence, together with the DfE expert network, acts as a catalyst by providing the essential tools, expertise and central coordination in projects worldwide.

More information on Design for Environment and Environmental Product Declarations at Bombardier is available at:
www.csr.bombardier.com/en/products/our-product-reponsibility-strategy

PCR review was conducted by the technical committee of the international EPD® system:
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Environmental Product Declarations within the same product category, but from different programs may not be comparable. This EPD is valid until 2013-12-20
Registration No. S-P-00190 UN CPC 49520
Date: 2010-12-01

EPD®

More information on the international EPD® system is available at www.environdec.com.

Independent verification of the declaration and data, in accordance to EMAS/Environmental Declaration, site Hennigsdorf.
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