

ENVIRONMENTAL PRODUCT DECLARATION



INNOVIA APM 300



The *BOMBARDIER** *INNOVIA** APM 300 automated people mover reflects our dedication to developing products and services for sustainable mobility.

BOMBARDIER
the evolution of mobility

INNOVIA APM 300

Designed for Sustainable Mobility



The **INNOVIA APM 300** vehicle sets a high standard for environmentally sustainable rail transportation. This **Environmental Product Declaration** provides a detailed insight into the environmental impact of the **INNOVIA APM 300** vehicle 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.

INNOVIA APM 300 - Highlighted facts and figures

Number of cars	1
Weight	15 500 kg
Capacity	103 passengers
Max speed	80 km/h
Energy consumption	2,56 kWh/km
Recoverability/ Recyclability	98%/ 95%

Data is based on a standard INNOVIA APM 300 configuration.

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).

A standard configuration of the **INNOVIA APM 300** vehicle with average grid mix power supply in Europe forms the basis of the specific environmental information in this EPD.



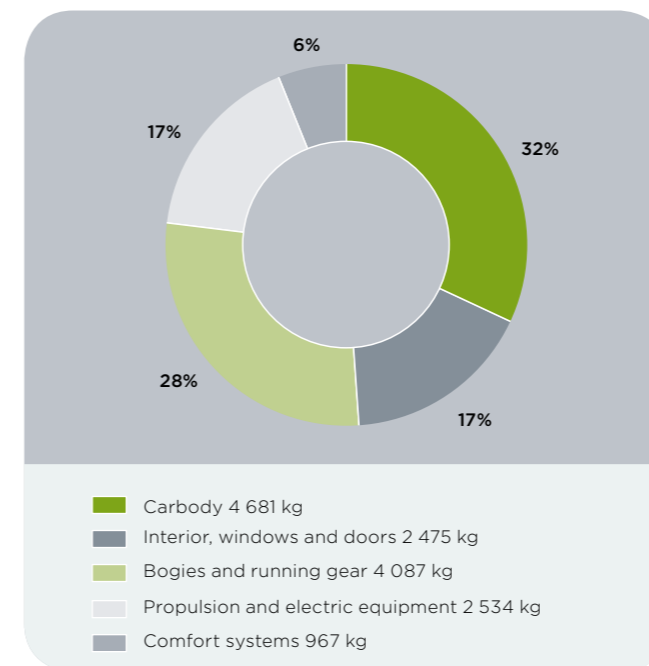
Material Content

The **INNOVIA APM 300** vehicle 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	11 594,4	215,8	11 810,2
Polymers	1 287,1	748,1	2 035,3
Elastomers	598,4	9 612,0	10 210,4
Fluids	37,2	-	37,2
MONM	211,1	1 320,9	1 532,0
Glass	548,6	-	548,6
Others	466,1	2,8	468,9
Total	14 742,9	11 899,6	26 642,6

The **INNOVIA APM 300** material composition and all material required for maintenance during a 30 year operation. Materials are classified according to ISO 22628:2002.

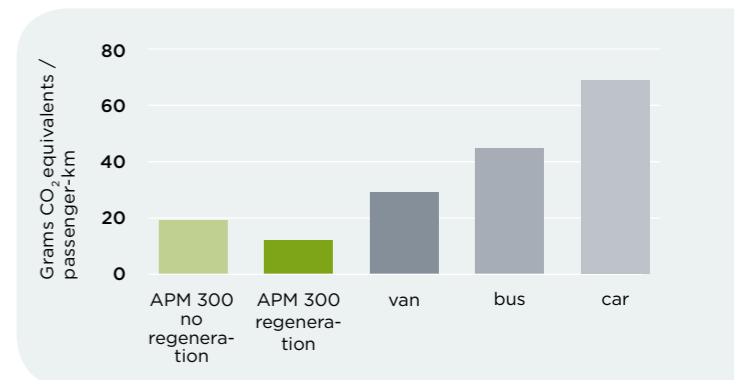
The following chart shows an allocation of the **INNOVIA APM 300** vehicle total mass to the five main product groups identified in PCR 2009:05, version 1.1¹.



The **INNOVIA APM 300** modular structure according to PCR 2009:05, version 1.1.

Energy Efficiency

The **INNOVIA APM 300** Vehicle features high energy efficiency at an average of 2,56 kWh/km, based on 100% receptivity and regeneration into the auxiliary systems. Track energy consumption data includes HVAC and auxiliary systems operation and is based on simulation runs for a standard operational profile of the vehicle. The simulations are carried out at nominal passenger load, giving a total of 103 passengers per vehicle based on EN 15663-2012-05. Specifications for the **INNOVIA APM 300** vehicle comfort systems load when out of service are based on TecRec 100:001: Specification and verification of energy consumption for railway rolling stock.



When compared to travelling by car, van or bus in Europe up to 81% of the resulting fossil CO₂ emissions per passenger/km could be avoided².

Noise

The **INNOVIA APM 300** vehicle features rubber tyres reducing noise and vibration levels and is compliant to ASCE 21 requirements.

Interior Noise	dB(A)
Stationary	<=74
Cruise at speed <= 30 miles/hr	<=76
Cruise at speed > 30 miles/hr	<=79
Exterior Noise	dB(A)
Train entering/leaving	<=76
Train stopped	<=74
Noise at all speeds	<=76

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 U.S. Department of Transportation, Federal Transit Administration, Public Transportation's Role in Responding to Climate Change, www.fta.dot.gov/documents/PublicTransportationsRoleInRespondingToClimateChange.pdf

A Life Cycle Perspective

Environmental Profile of the INNOVIA APM 300



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

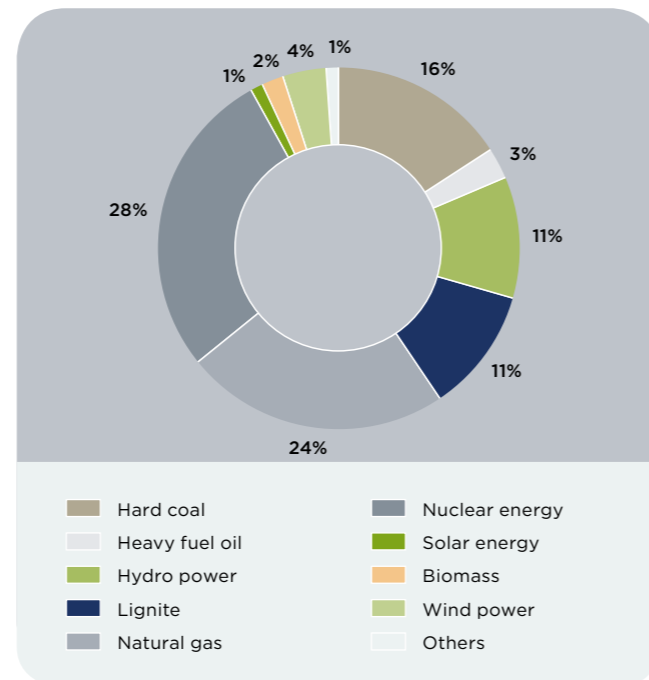
Resource efficiency, waste generation and overall environmental impact are estimated throughout all life cycle phases of the INNOVIA APM 300 vehicle, based on ISO 14040:2006 methodology.³

The results are based on a standard configuration INNOVIA APM 300 vehicle in service for 30 years with an average running distance of 107 710 km per year, following the methodology and operational profiles used for the energy consumption simulations. Specifications on vehicle comfort systems load when out of service are based on TecRec 100:001: Specification and verification of energy consumption for railway rolling stock. Electricity consumption at manufacturing is 89 000 kWh per vehicle. The end of life phase of the life cycle is modelled 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: MLM_TAVE120047 Life Cycle Assessment of the INNOVIA APM 300.

Power supply

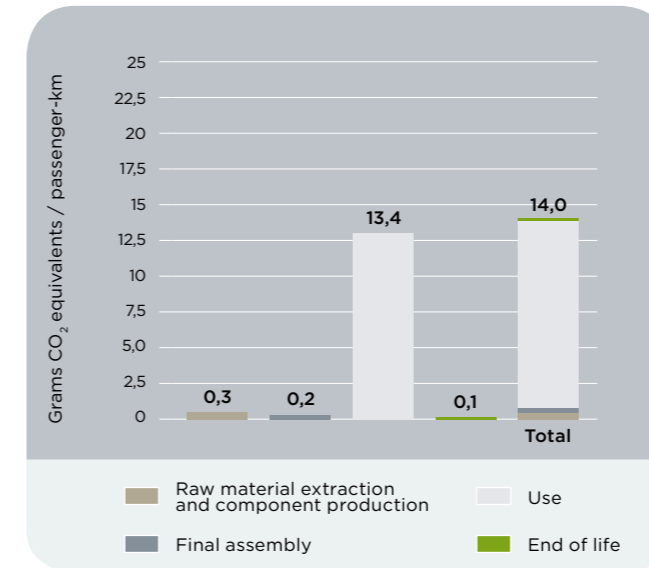
The European average power supply mix was used to model the operation phase of the INNOVIA APM 300 vehicle life cycle. A specific operator in Europe was not considered. The power supply represents an average of the EU-27 energy grid (reference year: 2008).



Power supply for the INNOVIA APM 300 resulting in emissions of 534 g of CO₂ equivalents per kWh.

Carbon Footprint

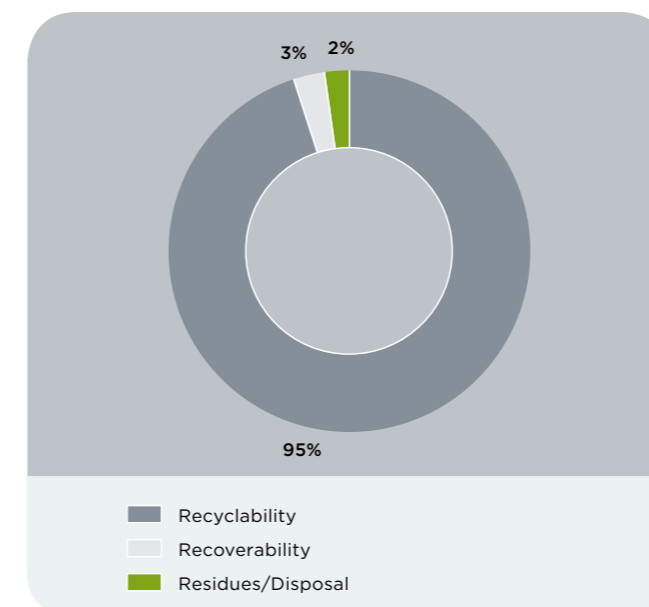
Greenhouse gas (GHG) emissions throughout the INNOVIA APM 300 vehicle life cycle are as low as 14,0 g of CO₂ equivalents when allocated to one passenger travelling for one km.



Contribution of each life cycle phase to the total mass of CO₂ equivalents.

Recyclability and Recoverability

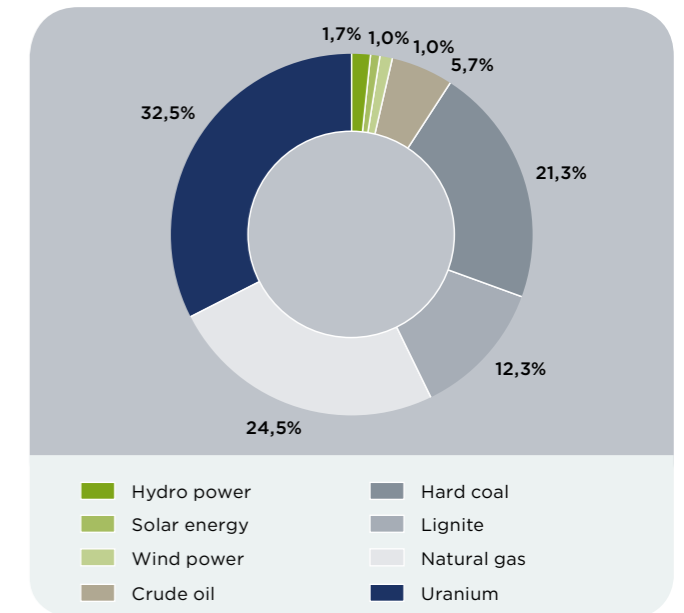
Using materials featuring high recyclability and considering disassembly early in the design phase maximise the overall recoverability of the INNOVIA APM 300 vehicle. Material recycling and energy recovery aggregate to give a 98% recoverability rate.



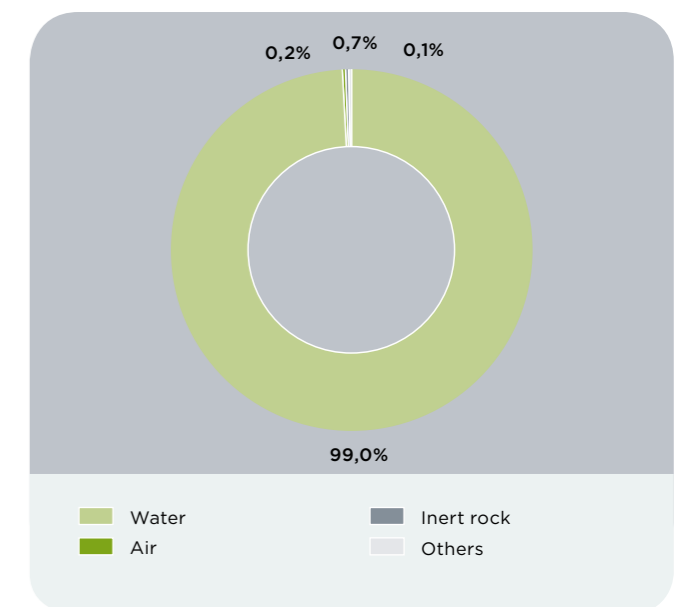
Projected recoverability at the end of life phase of the INNOVIA APM 300, following ISO 22628 methodology.

Energy and Material Resource Use

Renewable and non-renewable energy and material resource use throughout the INNOVIA APM 300 vehicle life cycle is detailed in the following charts as a percentage of the total resource use 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 INNOVIA APM 300 life cycle shown as a percentage of the total calorific value.



Material resource use throughout the INNOVIA APM 300 life cycle shown as a percentage of the total material resource mass.

Environmental Impact in Detail

	Upstream module	Core module	Downstream module		Total
	Raw material extraction and component production	Final assembly	Use	End of life	
Renewable resources					
Material (kg/pass.km)	3,46E-01	1,29E-02	1,20E+01	4,43E-04	1,23E+01
Water	3,45E-01	1,25E-02	1,20E+01	3,54E-04	1,23E+01
Air	8,49E-04	4,18E-04	1,86E-02	8,90E-05	1,99E-02
Carbon dioxide	2,01E-06	8,02E-06	3,09E-04	1,48E-08	3,19E-04
Nitrogen	5,08E-08	1,44E-15	1,16E-09	1,42E-15	5,19E-08
Energy (MJ/pass.km)	2,01E-04	8,96E-05	8,41E-03	9,36E-07	8,70E-03
Geothermics	5,68E-07	9,00E-08	2,03E-04	3,71E-09	2,04E-04
Hydro power	1,76E-04	1,02E-05	3,71E-03	3,81E-07	3,90E-03
Solar energy	1,66E-05	7,62E-05	2,18E-03	1,27E-07	2,27E-03
Wind power	8,32E-06	3,06E-06	2,31E-03	4,25E-07	2,33E-03
Others	3,16E-09	0,00E+00	5,60E-11	1,04E-10	3,32E-09
Non-renewable resources					
Material (kg/pass.km)	2,48E-03	3,17E-04	4,57E-02	2,05E-05	4,86E-02
Inert rock	2,35E-03	3,12E-04	4,53E-02	1,93E-05	4,80E-02
Metal ores	6,21E-05	7,62E-09	2,13E-06	2,21E-09	6,42E-05
Non renewable elements	3,17E-05	1,37E-08	6,38E-06	8,00E-09	2,54E-05
Other minerals	3,88E-05	5,05E-06	4,46E-04	1,13E-06	4,91E-04
Energy (MJ/pass.km)	4,24E-03	2,69E-03	2,15E-01	6,49E-05	2,22E-01
Crude oil (resource)	8,45E-04	1,28E-04	1,22E-02	4,92E-06	1,31E-02
Hard coal (resource)	1,84E-03	1,54E-03	4,56E-02	1,35E-05	4,90E-02
Lignite (resource)	1,54E-04	4,61E-05	2,81E-02	1,42E-05	2,84E-02
Natural gas (resource)	8,50E-04	4,64E-04	5,51E-02	1,11E-05	5,64E-02
Uranium (resource)	5,57E-04	5,07E-04	7,38E-02	2,13E-05	7,48E-02
Waste					
Waste (kg/pass.km)	3,22E-03	3,15E-04	4,56E-02	2,79E-05	4,91E-02
Hazardous waste	4,06E-07	2,10E-07	3,04E-05	7,25E-07	3,17E-05
Non-hazardous waste	3,22E-03	3,15E-04	4,55E-02	2,72E-05	4,91E-02
Environmental impact categories (pass.km)					
Acidification Potential (AP) [kg SO ₂ -Equiv.]	1,88E-06	1,08E-06	5,21E-05	1,34E-08	5,51E-05
Eutrophication Potential (EP) [kg Phosphate-Equiv.]	1,52E-07	4,70E-08	2,81E-06	1,85E-09	3,02E-06
Global Warming Potential (GWP 100 years) [kg CO ₂ -Equiv.]	3,30E-04	2,23E-04	1,34E-02	5,95E-05	1,40E-02
Ozone Layer Depletion Potential (ODP, steady state) [kg R11-Equiv.]	3,61E-12	6,01E-12	7,93E-10	5,67E-13	8,04E-10
Ozone Creation Potential (POCP) [kg Ethene-Equiv.]	1,36E-07	6,29E-08	3,22E-06	1,07E-09	3,42E-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 (SO₂ equivalents).

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 CO₂ 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 NH₃) 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

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PCR review was conducted by the technical committee of the international EPD® system:

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Independent verification of the declaration and data, in accordance to ISO 14025:2006.

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Environmental Product Declarations within the same product category but from different programs may not be comparable. Geographical scope: Europe, data reference year: 2008-2011. This EPD is valid until 2015-10-12 Registration No. S-P-00193 UN CPC 49520
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More information on the international EPD® system is available at www.environdec.com

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