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ENVIRONMENTAL PRODUCT DECLARATION

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OMNEO

The *BOMBARDIER OMNEO* product platform reflects our dedication to developing products and services for sustainable mobility.

BOMBARDIER
the evolution of mobility

OMNEO

Designed for Sustainable Mobility



The **BOMBARDIER* OMNEO*** product platform sets a high standard for environmentally sustainable rail transportation. This Environmental Product Declaration provides a detailed insight into the environmental impact of the **OMNEO** product family 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 Rolling Stock (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).

OMNEO - Highlighted facts and figures	
Number of cars	6
Weight (empty)	190 018 kg
Capacity	380 seats / 304 standing
Max speed	160 km/h
Energy consumption	13,2 kWh/km
Recoverability / Recyclability	95% / 92%



The Regio 2N** 6 car configuration of the **OMNEO** product family forms the basis of the specific environmental information of this EPD.

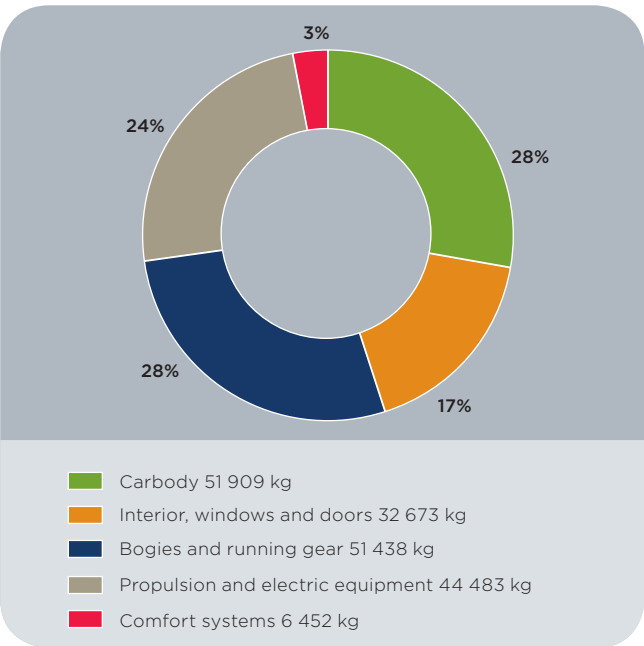
Material Content

The *OMNEO* product family 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 products.

Material [kg]	Manufacturing	Maintenance	Total
Metals	156 575	9 4018	250 593
Polymers	6 684	1145	7 829
Elastomers	4 564	2 663	7 227
Glass	4 134	242	4 376
Fluids	2 576	5 902	8 478
MONM*	581	0	581
Others	11 841	19 773	31 614
Total (kg)	186 955	123 743	310 698

The *OMNEO* product family material composition and all material required for maintenance during a 40 year operation. Materials are classified according to ISO 22628:2002.
*Modified organic natural materials

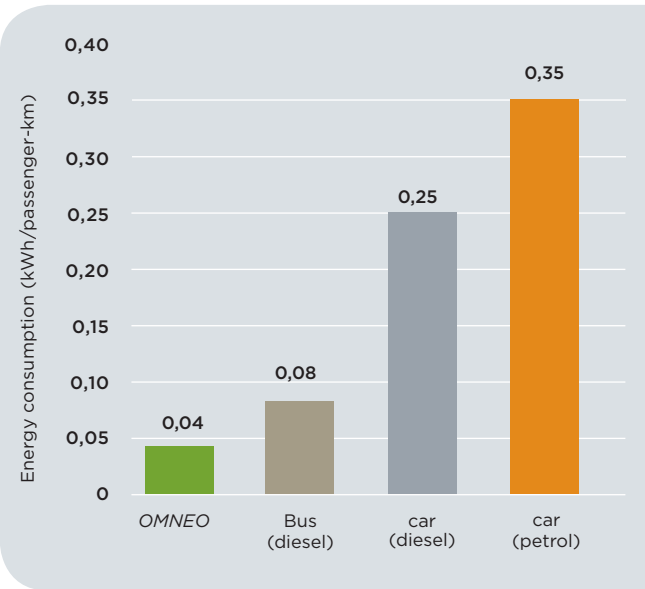
The following chart shows an allocation of the *OMNEO* total vehicle mass to the five main product groups identified in PCR 2009:05, version 2.0¹.



The *OMNEO* product family modular structure according to PCR 2009:05, version 2.0.

Energy Efficiency

BOMBARDIER ECO4 solutions have been extensively applied to the design of the *OMNEO* product family. Using lightweight materials and increasing capacity has reduced the mass per passenger by approximately 9%, while the use of new aerodynamic solutions has reduced energy consumption by almost 5% compared to conventional double-deck trains. The use of high efficiency gear boxes and permanent magnet motors reduces energy consumption by a further 5%.



When compared to travelling by car or by bus the *BOMBARDIER OMNEO* product family provides a far more energy efficient transportation solution. The figures represent energy consumption at operation at a 50% passenger load.

Noise

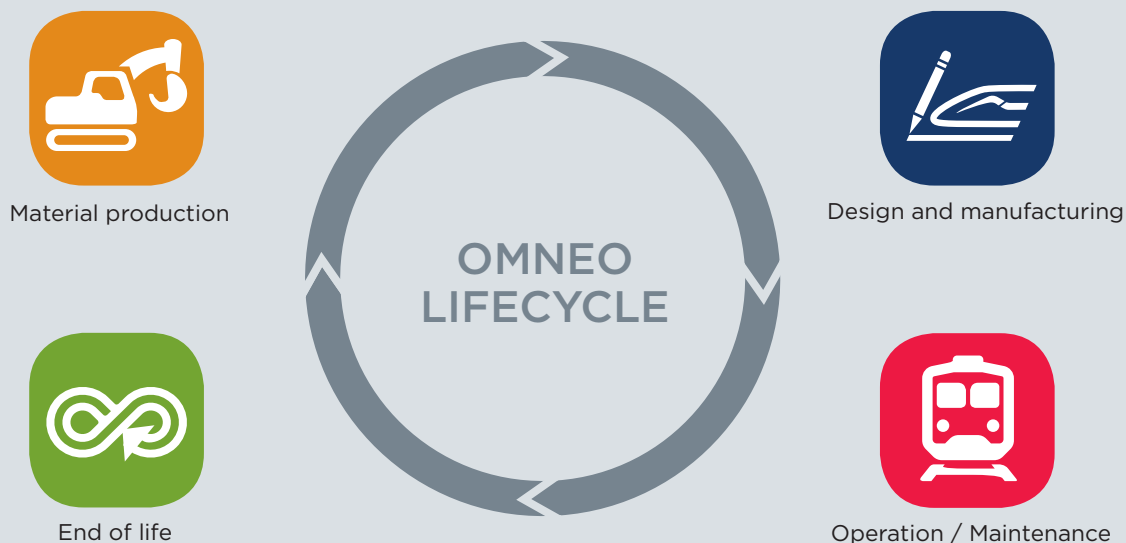
The *OMNEO* product family is homologated according to CR Noise TSI (Decision 2011/229/EU), see limits shown in the table below. The limits for noise are defined at a distance of 7,5 m from the center of the track and 1,2 m above the top of the rail. Pass-by noise has been measured on a Noise TSI reference track.

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

¹ Product Category Rules (PCR) for preparing an Environmental Product Declaration (EPD) for Rolling Stock, UNCPC CODE: 495, PCR 2009:05, version 2.0, International EPD Consortium (IEC).

A Life Cycle Perspective

Environmental Profile of the OMNEO product family



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.

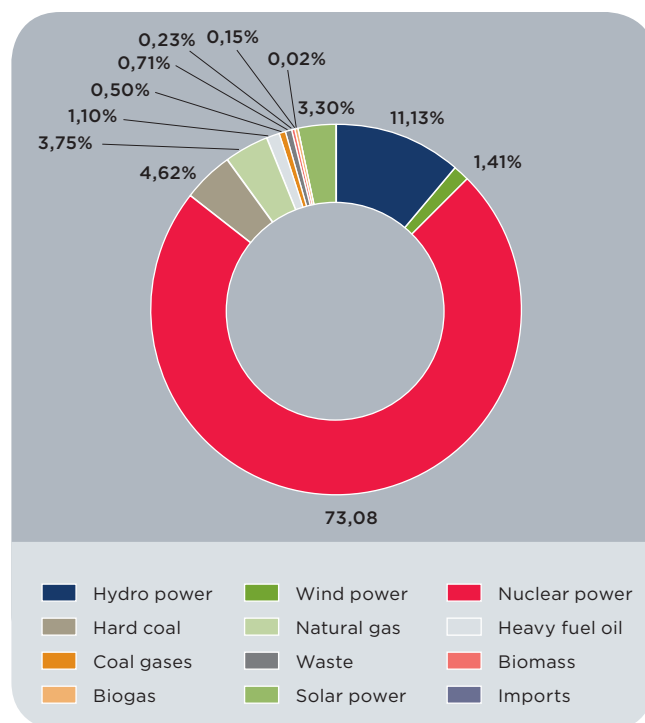
Life Cycle Assessment

Resource efficiency, waste generation and overall environmental impact are estimated throughout all life cycle phases of the OMNEO product family, following ISO 14040:2006.² The results are based on the *Regio 2N 6 car configuration of the OMNEO* product family in service for 40 years in the Cannes – Ventimiglia route, with an average running distance of 150 000 km per year. All assumptions on vehicle comfort systems load are based on TecRec 100:001: Specification and verification of energy consumption for railway rolling stock. The passenger load is CN4 - all seats occupied + 4 standing/m², resulting in 684 passengers per 6-car train set.

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 charts and tables.

Power supply

Electric power to the Regio 2N is primarily sourced from nuclear power and hydro power. The French average power supply mix was used to model the operation phase of the OMNEO product family life cycle.

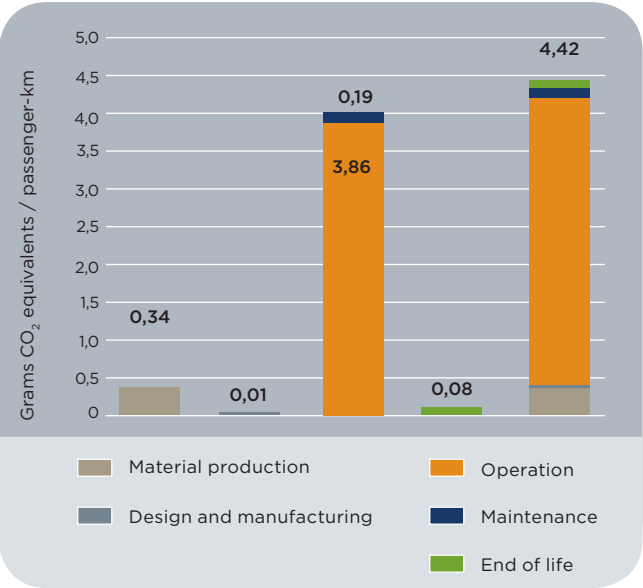


Power supply for the OMNEO product family resulting in emissions of 114 g of CO₂ equivalents per kWh.

² Bombardier document: 580019750, Analyse du cycle de vie Regio 2N

Carbon Footprint

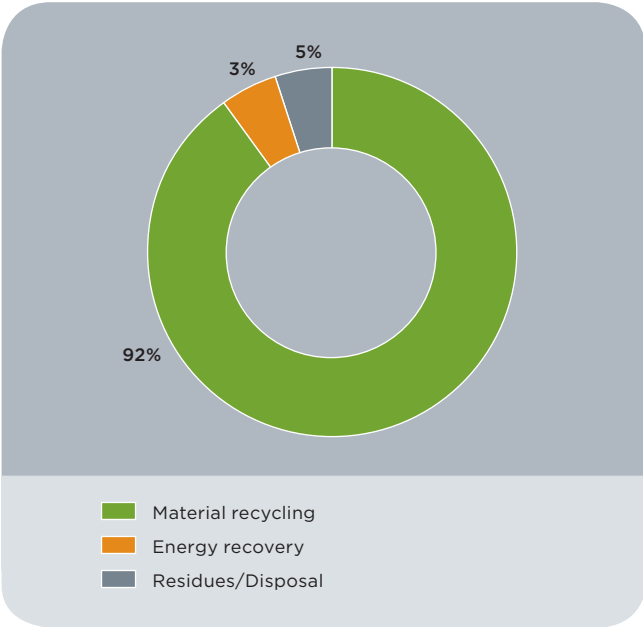
Greenhouse gas (GHG) emissions throughout the rail vehicle life cycle are 4,42 g of CO₂ equivalents per passenger travelling one km.



GHG emissions in g CO₂ equivalents/passenger-km

Recyclability and Recoverability

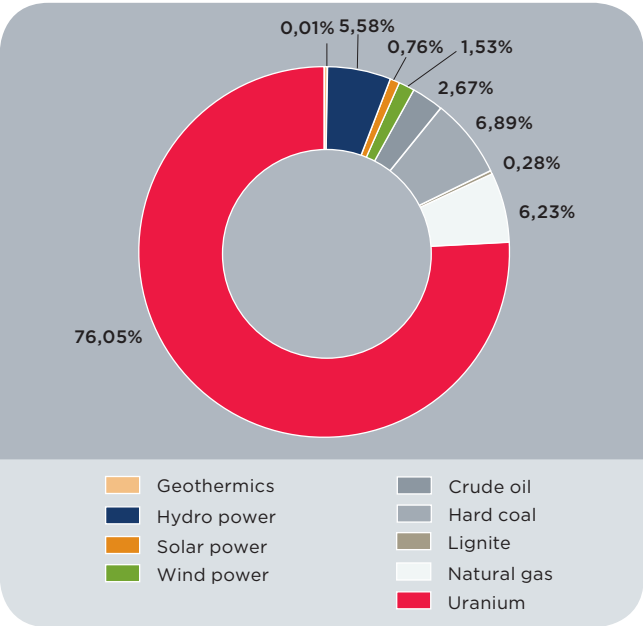
Using materials featuring high recyclability and considering disassembly early in the design phase maximise the overall recoverability of the OMNEO product family. Material recycling and energy recovery aggregate to a 95% recoverability rate.



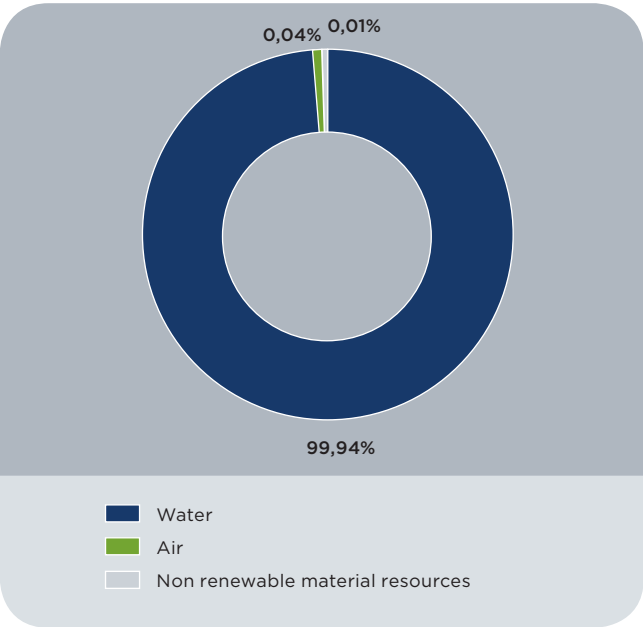
Projected recoverability at the end of life phase of the OMNEO product family, following ISO 22628 methodology.

Energy and Material Resource Use

Renewable and non-renewable energy and material resource use throughout the rail vehicle 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/blue/orange shades representing renewable resources and grey/brown/red shades representing non-renewable resources.



Energy resource use throughout the rail vehicle life cycle shown as a percentage of the total calorific value.



Material resource use throughout the rail vehicle life cycle shown as a percentage of the total material resource mass.

Environmental Impact in Detail

	Upstream module	Core module		
	Material production	Design and manufacturing	Operation	
Renewable material resources (kg/pass.km)	5,99E-01	1,37E-01	6,94E+01	
Water	5,95E-01	1,37E-01	6,94E+01	
Air	3,22E-03	1,80E-04	1,97E-02	
Carbon dioxide	8,02E-06	1,00E-06	4,85E-04	
Nitrogen	9,31E-08	9,43E-16	3,02E-13	
Others	3,94E-09	2,98E-08		
Renewable energy resources (MJ/pass.km)	4,60E-04	4,40E-05	2,20E-02	
Biomass	5,63E-13	0,00E+00	5,22E-14	
Geothermics	9,11E-06	2,61E-08	1,04E-05	
Hydro power	3,51E-04	3,07E-05	1,56E-02	
Solar power	6,95E-05	4,46E-06	2,06E-03	
Wind power	3,04E-05	8,81E-06	4,34E-03	
Others	1,92E-08	1,20E-16	2,34E-09	
Non-renewable material resources (kg/pass.km)	2,21E-03	1,36E-05	6,09E-03	
Inert rock	4,19E-05	1,94E-09	5,75E-03	
Metal ores	2,15E-03	1,31E-05	3,28E-04	
Non renewable elements	1,59E-05	2,68E-07	1,06E-06	
Other minerals	1,04E-06	2,39E-07	1,69E-05	
Non-renewable energy resources (MJ/pass.km)	3,93E-03	7,24E-04	2,59E-01	
Crude oil	6,88E-04	1,64E-05	6,62E-03	
Hard coal	2,07E-03	3,42E-05	1,66E-02	
Lignite	1,40E-04	2,41E-06	5,46E-04	
Natural gas	7,25E-04	2,41E-04	1,66E-02	
Uranium	3,00E-04	4,29E-04	2,19E-01	
Others	3,94E-07	6,25E-09	7,26E-07	
Waste (kg/pass.km)	2,27E-03	1,43E-05	2,16E+02	
Hazardous waste	1,94E-06	1,77E-07	2,30E-05	
Non-hazardous waste	2,26E-03	1,42E-05	2,16E+02	
Environmental impact categories (pass.km)				
Acidification Potential (AP) [kg SO ₂ -Equiv.]	1,99E-06	3,21E-08	1,26E-05	
Eutrophication Potential (EP) [kg Phosphate-Equiv.]	1,69E-07	4,51E-09	1,08E-06	
Global Warming Potential (GWP 100 years) [kg CO ₂ -Equiv.]	3,39E-04	1,43E-05	3,86E-03	
Ozone Layer Depletion Potential (ODP, steady state) [kg R11-Equiv.]	7,91E-13	8,66E-14	4,41E-11	
Ozone Creation Potential (POCP) [kg Ethene-Equiv.]	1,55E-07	4,80E-08	8,68E-07	

Downstream module		Total
Maintenance	End of life	
2,48E-01	2,71E-04	7,05E+01
2,53E-01	2,32E-04	7,05E+01
2,06E-03	3,83E-05	2,67E-02
6,10E-06	1,95E-08	5,01E-04
1,76E-08	2,73E-15	1,11E-07
2,56E-11	0,00E+00	3,38E-08
2,26E-04	2,30E-06	2,27E-02
3,66E-11	0,00E+00	3,72E-11
5,37E-06	2,49E-09	2,49E-05
1,47E-04	9,74E-07	1,61E-02
4,67E-05	2,07E-07	2,18E-03
2,68E-05	1,12E-06	4,40E-03
0,00E+00	3,24E-10	2,18E-08

1,01E-03	1,53E-05	9,34E-03
1,17E-03	-8,74E-09	7,20E-05
6,80E-06	1,50E-05	9,10E-03
2,90E-05	1,73E-07	7,80E-05
1,60E-05	1,21E-07	9,61E-05
2,35E-03	4,50E-05	2,66E-01
3,99E-04	1,79E-06	7,72E-03
1,21E-03	1,01E-05	1,99E-02
1,07E-04	1,12E-05	8,07E-04
4,40E-04	5,35E-06	1,80E-02
1,94E-04	1,66E-05	2,20E-01
1,99E-07	9,33E-10	1,33E-06

6,33E+02	1,91E-05	9,64E-03
6,76E-05	6,12E-07	9,33E-05
6,33E+02	1,85E-05	9,55E-03

1,06E-06	6,14E-09	1,57E-05
9,64E-08	1,61E-09	1,35E-06
1,93E-04	8,47E-06	4,42E-03
1,84E-13	4,67E-13	4,56E-11
9,05E-08	6,52E-10	1,16E-06

Definitions

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).

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).

Global warming potential and Carbon footprint

The Global warming potential (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 product 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.

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

* Trademark(s) of Bombardier Inc. or its subsidiaries.

** Trademark of the ARF (Association des Régions de France).

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 products.

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/mobility-solutions/product-responsibility-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

☐ Internal ☒ External

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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 2017-06-16. Registration No. S-P-00518

UN CPC 49520

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

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