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ENVIRONMENTAL PRODUCT DECLARATION

In accordance with

ISO 14025:2006 and **EN 15804:2012+ A2:2019/AC:2021**

WHITE STAY PIPE

FOR STAY CABLE SYSTEMS

From VSL International, Ltd.

Programme: **The International EPD® System, www.environdec.com**
Programme operator: **EPD International AB**
EPD registration number: **EPD-IES-0024277:001**
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VSL A member of **Bouygues Construction**

VSL International, Ltd. Wankdorfallee 5, 3014 BERN – Switzerland . **www.vsl.com**

General information

Programme information

Programme:	The International EPD® System
Address:	EPD International AB Box 210 60 SE-100 31 Stockholm Sweden
Website:	www.environdec.com
E-mail:	info@environdec.com

CEN standard EN 15804 serves as the Core Product Category Rules (PCR)
Product category rules (PCR): PCR 2019:14 Construction products (EN 15804:A2) Version 1.3.4
PCR review was conducted by: PCR review was conducted by: The Technical Committee of the International EPD®System. See www.environdec.com/TCfor a list of members. Review chair: Claudia A. Peña, University of Concepción, Chile. The review panel may be contacted via the Secretariat www.environdec.com/contact.
Independent third-party verification of the declaration and data, according to ISO 14025:2006: ☒ External ☐ Internal Covering ☐ EPD process certification ☒ EPD verification
Third party verifier: Elisabet Amat, GREENIZE Approved by: The International EPD© System
Procedure for follow-up of data during EPD validity involves third party verifier: ☐ Yes ☒ No

The EPD owner has the sole ownership, liability, and responsibility for the EPD.

EPDs within the same product category but registered in different EPD programmes, or not compliant with EN 15804, may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same version number) or be based on fully-aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g. identical declared/functional units); have equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterisation factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see EN 15804 and ISO 14025.

Company information

Owner of the EPD: VSL International, Ltd.
Description of the organisation:

VSL is a leading global specialist in engineered structures and geotechnical solutions, operating as one of the two civil works subsidiaries of Bouygues Construction, a major French global player in construction with a presence in over 60 countries and a workforce of 32,400 employees worldwide.

As part of the Bouygues Construction group, VSL operates with a dedicated team of 4,000 employees across 25 countries, with a significant presence in Asia, Oceania, the Middle East, Europe, Canada, and Latin America.

Understanding that every structure constantly carries loads and is subject to various forces that can lead to material deformation or failure, VSL plays a crucial role in enabling the construction of ever-bigger, ever-longer, and ever-stronger structures. The company achieves this by strengthening critical areas and controlling the behaviour of the ground on which these structures stand.

As a specialist in post-tensioned and cable-stayed structures, foundations, and ground engineering, VSL contributes significantly to the design and construction of major engineered structures. Furthermore, VSL maintains, repairs, and upgrades existing structural systems, ensuring their long-term performance, safety, and durability throughout their lifecycle.

VSL's expertise encompasses four key domains:

- Civil Works: Partnering with clients from the initial design phase through to the construction of complex engineered structures.
- Ground Engineering and Foundations: Providing comprehensive involvement in all geotechnical aspects of a construction project, including thorough ground investigation and analysis.
- Asset Preservation, Structural Repairs, and Upgrade: Offering tailored services and innovative solutions to optimize and extend the lifespan of various structures.
- Post-Tensioning, Stay-Cable, and Other Structural Systems and Technologies: VSL is a recognized world leader in the design and installation of stay-cable systems, having developed and continuously expanded its proprietary systems to offer exceptional versatility for a wide array of applications.

Our strength stems from our comprehensive 360° approach, which seamlessly integrates engineering and construction methodologies, advanced structural systems and technologies, and efficient project execution. VSL's core purpose lies in understanding a structure holistically, considering its environment and intended use, to propose and deliver the most effective technical solutions that transform even the most complex schemes into reality.
VSL is a world leader in the design and installation of stay-cable systems. The company has developed and expanded its proprietary systems, providing a high degree of versatility for a wide range of applications.

VSL SSI 2000 is the company’s well-proven and widely used state-of-the-art stay-cable system. It exceeds the highest standards of fatigue performance and includes a high level of corrosion protection.

In line with Bouygues Construction ´s objectives, VSL is strongly committed to reducing its greenhouse gas emissions. Bouygues Construction has set the goal of achieving the following targets for reducing greenhouse gas emissions by 2030 compared to 2021:

- **A 40% reduction on scopes 1 & 2** (direct & indirect emissions produced by the company's own activity).
- **A 20% reduction on scope 3 upstream civil works** in absolute value

Those targets are validated by the SBTi as being aligned with the Paris agreement.

One of the actions of VSL to reduce its own carbon footprint, is to evaluate the products with the Environmental Product Declaration (EPD). This information allows VSL to make strategic decision for its system products manufacture and supply chain.

Name and location of production site for the white stay pipe:
VSL SYSTEMS MANUFACTURER
20230, Laem Chabang, Thailand.

Contact :
Guillermo RAMÍREZ
Email : guillermo.ramirez@vsl.com
More information : https://vsl.com

VSL Thailand is certified ISO 9001, ISO 14001 and ISO 45001.

Figure 1.*ISO 9001, ISO 14001, ISO 45001 Certifications*

Product information

Product name: White stay pipe for stay cable systems.

Product description: This EPD covers the life-cycle analysis of the White stay pipe. The Stay pipe structure is made of two coextruded HDPE layers and an helicoidal rib welded over the external layer. The standard product has black HDPE in the internal layer and white colour in the external layer and rib. Other colour combinations, mainly for external layer, tailor made, according with customer and design requirements are considered as coloured stay pipe and are not included in this LCA and EPD.

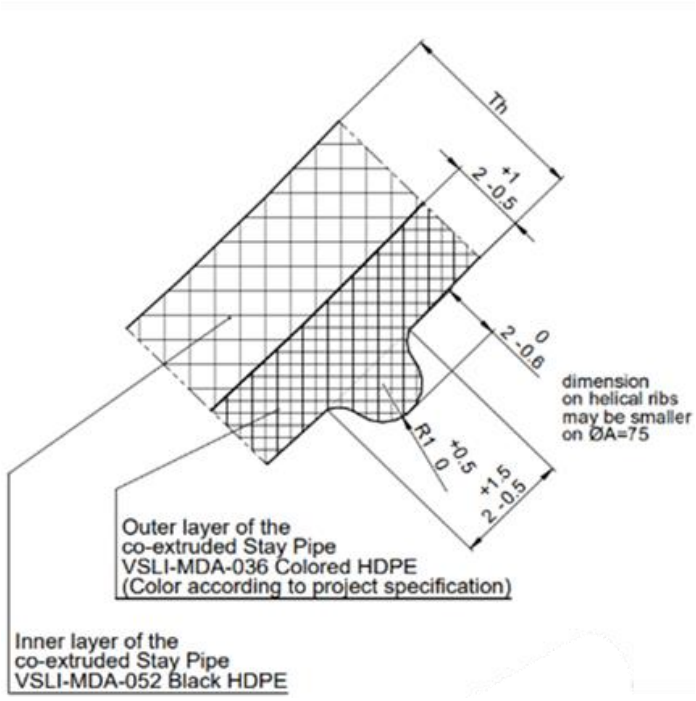


Figure 2. ***Structure of the White stay pipe***

The stay pipe provides the stay cable system with an external protection against environmental and mechanical effects by fully encasing tension elements over the complete stay cable free length.
VSL Stay cable technology has, following, mainly systems, that use stay pipe to protect tension elements:

- SSI 2000. VSL standard system.
- SSI 2000C. A compact stay cable system with reduced cable diameter and therefore reduced wind drag.
- SSI 2000D. Extra-Protected against corrosion by dehumidification techniques.
- SSI 2000 Saddle. A patented design facilitating simplified pylon layouts resulting in enhanced bridge aesthetics and increased structural efficiency.
- MSI 2000, a patented heavy duty stay cable system particularly developed for hangers of arch bridges and stay of suspended roofs.

The technical characteristics of the products of the White stay pipe duct-system family are the following ones:

Figure 3.VSL STAY PIPE

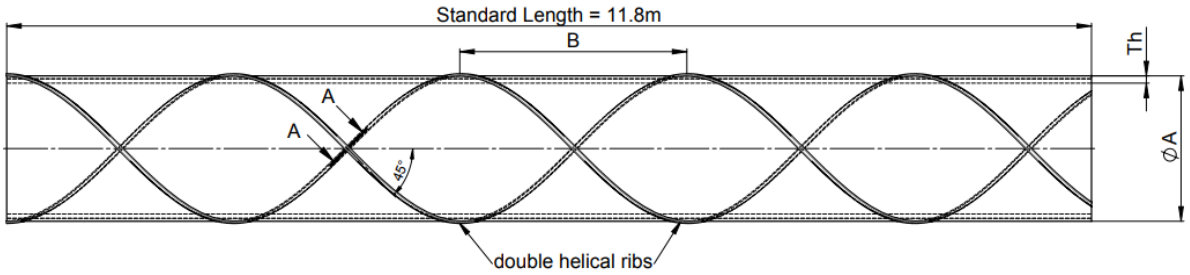


Figure 4. *VSL Stay pipe dimensions*

TYPE	ØA ext.	Th	PITCH
STAY PIPE 75	75	4,3	118
STAY PIPE 90	90	4,3	141
STAY PIPE 110	110	4,3	173
STAY PIPE 125	125	4,9	196
STAY PIPE 140	140	5,4	220
STAY PIPE 160	160	6,2	251
STAY PIPE 180	180	5,6	283
STAY PIPE 200	200	6,2	314
STAY PIPE 210	210	6,6	330
STAY PIPE 225	225	7	353
STAY PIPE 250	250	7,8	393
STAY PIPE 280	280	8,7	440
STAY PIPE 315	315	9,8	495
STAY PIPE 355	355	11,1	557
STAY PIPE 400	400	12,3	628
STAY PIPE 450	450	13,8	707

Table 1: *Dimensions of the White stay pipe system*

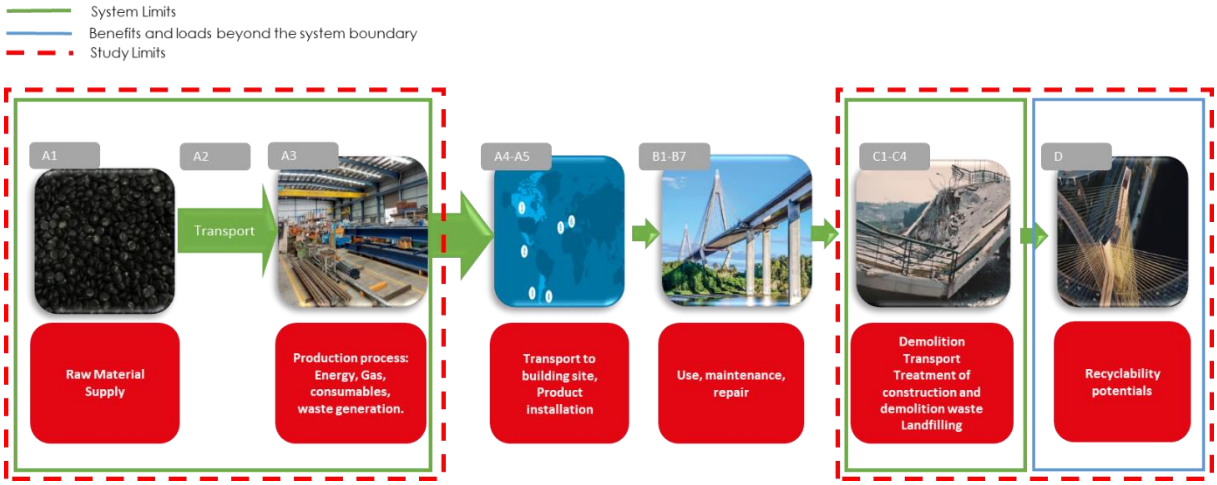
UN CPC code: I4219 - Other structures (except prefabricated buildings) and parts of structures, of iron, steel or aluminium; plates, rods, angles, shapes, sections, profiles, tubes and the like, prepared for use in structures, of iron, steel or aluminium; props and similar equipment for scaffolding, shuttering or pit propping.

LCA information

Declared unit: The declared unit is the baseline reference for which all information is collected. In this study, the declared unit is **"1 kg of White stay pipe".**
Reference service life: Not relevant for this EPD.
Geographical scope: The geographical scope of this EPD is global.
Time representativeness: The data collection from factory (primary data) and electricity mixes are from 2024. In this study, no datasets older than 10 years were used.
Database(s) and LCA software used: All the data used to model the process and obtain the Life Cycle Inventory are specific data and have been obtained by measurements made during the period from 2024. They are representative of the different processes implemented during the manufacturing process. The data has been measured directly at the company's own premises. In addition, the most complete and highest quality European life cycle inventory database, Ecoinvent 3.10, has been used, as this database contains the most extensive and updated information, and its scope coincides with the geographical, technological and temporal area of the project. The LCA was modelled with Simapro 9.6.0.1.

Description of system boundaries: According to the standard UNE-EN 15804:2012+A2:2020/AC:2021 (SEPTEMBER 2021) and PCR 2019:14 CONSTRUCTION PRODUCTS (version 1.3.4) the system boundary is cradle to gate with modules C1–C4 and module D (A1–A3 + C + D). The life cycle stages A4-A5, B1-B7 were excluded from the LCA study.

System diagram:



Manufacturing process:
The manufacture of the White stay pipe duct system begins with the reception of the material. The ducts are subjected several times to the process of extrusion and shaped to the desired precision in successive individual extrusion steps. The different parts are classified depending on the unit of anchorage requested.

Author of the Life Cycle Assessment:
IK ingeniería
Av. Cervantes 51,Edif. 10, panta 5, dpto.
48970 Basauri, Bizkaia (Spain)

Data quality

The environmental impact of the White stay pipe duct system has been calculated. It is based on the international standards established for the development of environmental product declarations, such as ISO 14025 for the preparation of the environmental product declaration, ISO 14040 and ISO 14044 for the preparation of the life cycle analysis, UNE-EN 15804:2012+A2:2019 (SEPTEMBER 2021) and the Product Category Rules PCR - "2019:14 Construction products " (Version 1.3.4).

Data has been collected from 2024 and is representative of that year. Data for raw material supply, transport to fabrication plant and production (A1-A3) is based on specific consumption data for the factory at Laem Chabang. Generic background datasets were used for the downstream processes. SimaPro v9.6.0.1. software was used to prepare the life cycle analysis together with the Ecoinvent 3.10 database. Characterization factors from EN15804: 2012 + A2:2019. The geographical coverage is global. Technological coverage is typical or average. The Characterization Factors correspond to those set out in "EN 15804 Reference Package EF 3.1.

Assumptions

The modularity principle, as well as the polluter-payer principle have been followed. The following assumptions have been made in this EPD:

- ✓ It does not include the manufacturing processes of the capital goods or spare parts and/or maintenance with a life of more than three years.
- ✓ The environmental impact of infrastructure for general management, office, and headquarters operations is not included.
- ✓ The impact caused by people (common activities, travel for work...) will not be considered.
- ✓ It does not include the consumption of natural gas for sanitary hot water from showers and heating system for the comfort of people.
- ✓ The processes associated with fuel production are intrinsically included in the indicators in ECOINVENT's database used in carrying out the LCA.
- ✓ The environmental impact of external transport has been calculated using lorries from the ECOINVENT 3.10 database, EURO 5. These lorries have been selected to reflect the most realistic scenario possible.

Cut-off rules

The standard ISO 14025 and the PCR -"2019:14 CONSTRUCTION PRODUCTS" indicate that the life cycle inventory data should include a minimum of 95% of the total inputs (materials and energy) for each stage. This cut-off rule does not apply for hazardous materials and substances. No such cut-off criteria have been taken into account in this study.

Allocation

Where necessary, such us waste generation and energy consumption, an allocation based in mass has been used.

Greenhous gas emission from the use of electricity in the manufacturing phase

Medium voltage (direct emissions and losses in grid) electricity is considered for the manufacturing process.

Electricity mix	Amount	Units
Specific electricity mix (supplier 1)	2,00E-02	Kg CO2-eqv/kWh

LCA Scenarios and additional technical information

Dismantling/demolition (module C1):
The consumption of energy (diesel) of dismantling machinery is considered. 9,00E-03 kg of diesel.

Transport (module C2):
With a collection rate of 100%, the transports are carried out by lorry (EURO 5) over 50 km.

Waste processing (modules C3 and C4):
For the end-of-life hypothesis, statistics from the European Union's Annex C for construction waste management have been used. It was determined that 22.5% of product is recycled and 77.5% is landfilled.

Recyclability potentials (module D):
Module D contains credits from the recycling of the stay pipe in module C3. The plastic recycled is credited with the avoided production of the raw material they would be displacing in the technosphere if recycled.The loads of recycling process and the benefits of substitution of virgin raw materials have been considered.

LCA Scenarios for end of life

Processes	Per Declared unit	
Collection process specified by unit	0,00E+00	Kg collected separatelly
	1,00E+00	Kg collected with mixed construction waste
Recovery system specified by unit	0,00E+00	Kg for reuse
	7,75E-01	Kg for recycling
	0,00E+00	Kg for energy recovery
Disposal specified by unit	2,25E-01	Kg for final disposal
Assumptions for scenario transportation	Lorry 16-32 metric ton, EURO5 Consumption: 0,03kg/km Distance:50 km	

Modules declared, geographical scope, share of specific data (in GWP-GHG indicator) and data variation:

	Product stage			Construction process stage		Use stage							End of life stage				Resource recovery stage
	Raw material supply	Transport	Manufacturing	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
Module	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Modules declared	X	X	X	ND	ND	ND	ND	ND	ND	ND	ND	ND	X	X	X	X	X
Geography	TH	TH	TH	ND	ND	ND	ND	ND	ND	ND	ND	ND	GLO	GLO	GLO	GLO	GLO
Specific data	2,39%			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation – products	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation – sites	0%			-	-	-	-	-	-	-	-	-	-	-	-	-	-

ND: Not declared

Content information

The result of the most representative product involves the following product: **multi-strand post-tensioning system White stay pipe duct system unit 100.**

Product components	Per 1 kg		
	Weight, kg	Post-consumer material, weight-%	Renewable material, weight-%
Plastic components	>0,95	0,00%	0,00%
Others	<0,05	0,00%	0,00%
TOTAL	1,00	0,00%	0,00%
Packaging materials	**Weight, kg**	**Weight-% (versus the product)**	
Wood	2,96E-03	0,30%	
Plastic	3,39E-02	3,39%	
TOTAL	3,69E-02	3,69%	

Packaging: The product is transported to the construction site packed with plastic film and cardboard, in pallets.

No substances included in the Candidate List of Substances of Very High Concern for authorization under REACH Regulations are present in the analyzed White stay pipe duct systems manufactured by VSL, either above the threshold for registration with the European Chemicals Agency or above 0,1% (wt/wt).

Environmental Information

The estimated impact results are only relative statements, which do not indicate the endpoints of the impact categories, exceeding threshold values, safety margins and/or risks. Usage of results from A1-A3 without considering the results of module C is not encouraged

Potential environmental impact – mandatory indicators according to EN 15804:

Results per declared unit							
Indicator	**Unit**	**A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**
GWP-fossil	kg CO_2 eq.	3,66E+00	4,22E-02	9,78E-03	6,78E-02	9,28E-02	-6,95E-01
GWP-biogenic	kg CO_2 eq.	1,80E-02	3,70E-06	1,65E-06	7,60E-03	5,28E-05	3,33E-03
GWP-luluc	kg CO_2 eq.	1,73E-03	3,68E-06	3,89E-06	5,07E-05	4,97E-06	-2,95E-04
GWP-total	kg CO_2 eq.	3,68E+00	4,22E-02	9,79E-03	7,54E-02	9,29E-02	-6,92E-01
ODP	kg CFC 11 eq.	9,68E-08	6,44E-10	1,37E-10	1,08E-09	2,24E-10	-1,95E-08
AP	mol H^+ eq.	1,30E-02	3,81E-04	3,26E-05	2,39E-04	6,17E-05	-2,40E-03
EP-freshwater	kg P eq.	9,10E-05	1,48E-07	9,00E-08	1,65E-06	1,07E-07	-1,64E-05
EP-marine	kg N eq.	2,47E-03	1,76E-04	1,04E-05	7,62E-05	3,03E-05	-4,33E-04
EP-terrestrial	mol N eq.	2,67E-02	1,93E-03	1,15E-04	7,63E-04	2,52E-04	-4,81E-03
POCP	kg NMVOC eq.	1,62E-02	5,76E-04	4,54E-05	3,10E-04	1,09E-04	-3,09E-03
ADP-minerals&metals*	kg Sb eq.	2,51E-05	1,47E-08	3,13E-08	3,67E-07	1,90E-08	-4,81E-06
ADP-fossil*	MJ	9,08E+01	5,52E-01	1,37E-01	9,26E-01	1,93E-01	-1,80E+01
WDP	m^3 deprive	1,26E+00	1,62E-03	7,49E-04	1,37E-02	-1,23E-01	-1,85E-01
Acronyms	GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP-minerals&metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption						

** Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.*

Potential environmental impact – additional mandatory and voluntary indicators

Results per declared unit						
Indicator	**A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**
GWP-GHG[1]	3,66E+00	4,22E-02	9,78E-03	7,54E-02	9,28E-02	-6,95E-01

Use of resources

Results per declared unit							
Indicator	**Unit**	**A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**
PERE	MJ	7,66E+00	3,28E-03	1,73E-03	4,71E-02	2,78E-03	-3,64E-01
PERM	MJ	7,43E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PERT	MJ	7,73E+00	3,28E-03	1,73E-03	4,71E-02	2,78E-03	-3,64E-01
PENRE	MJ	4,52E+01	5,52E-01	1,37E-01	9,26E-01	1,93E-01	-1,80E+01
PENRM	MJ.	4,60E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PENRT	MJ	9,13E+01	5,52E-01	1,37E-01	9,26E-01	1,93E-01	-1,80E+01
SM	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
RSF	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
NRSF	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
FW	m^3	3,04E-02	3,95E-05	1,83E-05	3,88E-04	-2,87E-03	-4,51E-03

[1] The indicator includes all greenhouse gases included in GWP-total but excludes biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. This indicator is thus equal to the GWP indicator originally defined in EN 15804:2012+A1:2013.

Acronyms	PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy re-sources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water

Waste production

Results per functional or declared unit							
Indicator	**Unit**	**A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**
Hazardous waste disposed	kg	2,19E-01	1,40E-04	2,40E-04	5,74E-06	3,41E-04	-3,99E-02
Non-hazardous waste disposed	kg	1,30E+01	6,65E-04	4,52E-03	1,46E-04	3,85E+00	-2,53E+00
Radioactive waste disposed	kg	3,06E-05	0,00E+00	2,76E-08	3,18E-08	4,76E-08	-5,78E-06

Output flows

Results per functional or declared unit							
Indicator	**Unit**	**A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**
Components for re-use	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Material for recycling	kg	2,28E-01	0,00E+00	0,00E+00	1,80E-01	0,00E+00	0,00E+00
Materials for energy recovery	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Exported energy, electricity	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Exported energy, thermal	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

Information on biogenic carbon content

Results per declared unit		
BIOGENIC CARBON CONTENT	**Unit**	**QUANTITY**
Biogenic carbon content in product	kg C	0,00E+00
Biogenic carbon content in packaging	kg C	0,00E+00

The packaging of the reference product corresponds to <5% of the total weight of the reference product.

Note: 1 kg biogenic carbon is equivalent to 44/12 kg CO_2.

Additional information

More information can be found in the following webpage:

https://vsl.com

Information related to Sector EPD

This is an individual EPD®

Differences versus previous versions

This is the first version of the EPD®.

References

- General Programme Instruction of the International EPD®System. Version 4.0.
- ISO 14020:2000 Environmental labels and declarations-General principles.
- ISO 14025:2010 Environmental labels and declarations-Unit III Environmental Declarations-Principles and procedures.
- ISO 14040:2006 Environmental Management-Life Cycle Assessment-Principles and framework.
- ISO 14044:2006 Environmental Management-Life Cycle Assessment-Requirements and guidelines.
- PCR 2019:14 Construction products (EN 15804: A2) version 1.3.4
- UNE-EN 15804:2012+A2:2020/AC:2021 Sustainability of construction works-Environmental Product Declarations-Core rules for the product category of construction products
- LCA REPORT STAY PIPE STANDARD 2024

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