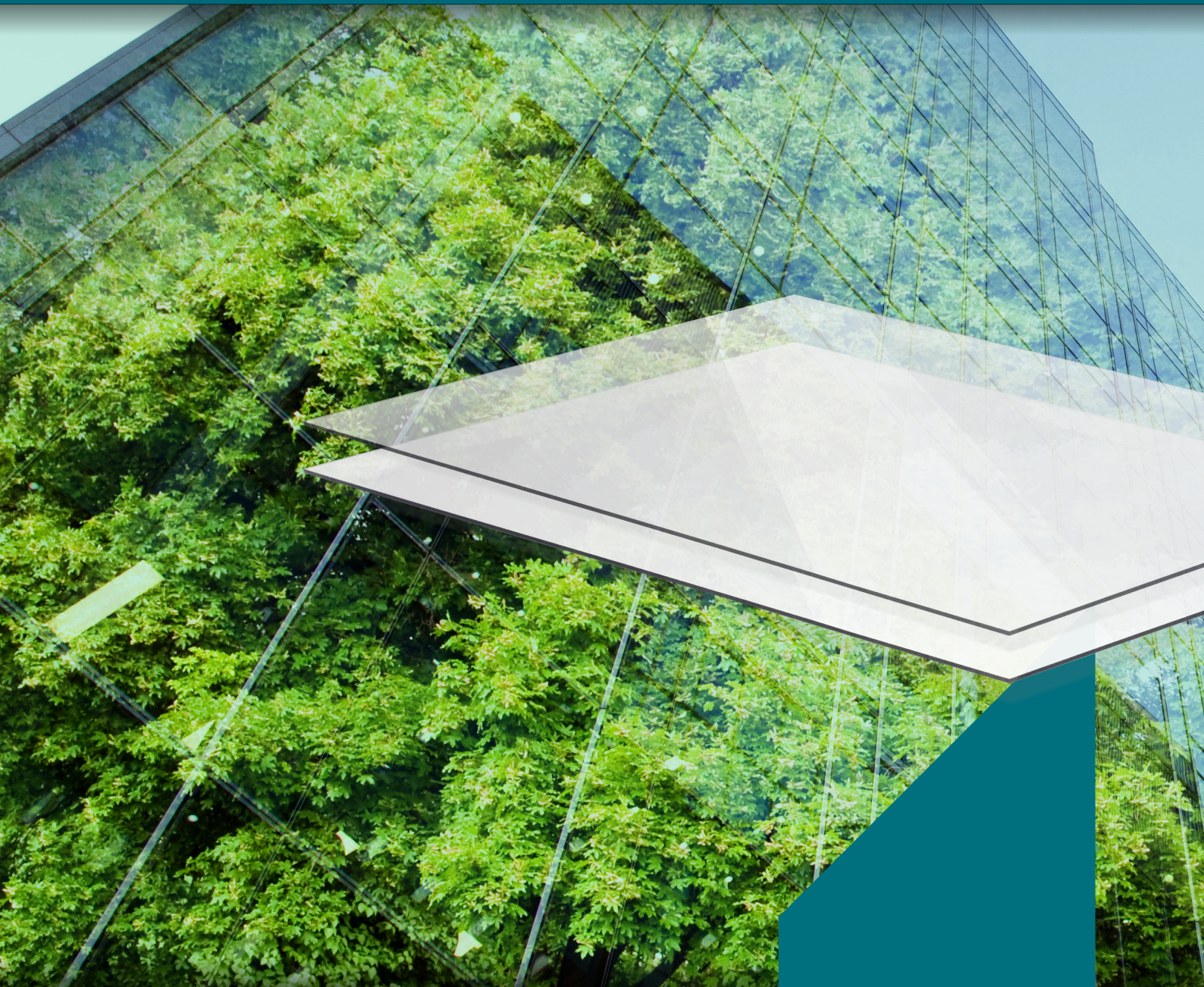


LEXAN™ SOLID SHEET

ENVIRONMENTAL PRODUCT DECLARATION (EPD)



LEXAN™ SHEET

POLYVANTIS

ABOUT THIS EPD

Declared Product:	LEXAN™ Solid Sheet
Issue Date:	July 2022
Validity:	5 years from the date of publication
PCR (Product Category Rule):	EN 15804:2012 + A2:2019
Owner of EPD:	European Polycarbonate Sheet Extruders (EPSE), average self-declaration EPD for the members of EPSE producing Multiwall Polycarbonate sheet
Third Party Verification:	In accordance to EN ISO 14025 and relevant PCR Conforms to EN15804+A2 Verifier: Bernd Brandt, bernd@brandtconsulting.eu

DESCRIPTION

An Environmental Product Declaration (EPD) is a document, which transparently communicates the environmental performance or impact of any product or material over its lifetime.

PRODUCT INFORMATION

PRODUCT DESCRIPTION	PRODUCT COMPOSITION AND CONTENT															
LEXAN™ Solid polycarbonate sheets combine a high level of mechanical, optical and thermal properties, which can be used for a wide range of applications.	The product does not contain materials listed in the “Candidate list of Substances of Very High Concern for authorization” in a concentration over 0.1% (w/w).															
PRODUCTION PROCESS AND TECHNOLOGY	<div>Table 1 Composition of the product in percentages</div> <table><tr><td>Components</td><td>Composition/content/ ingredients</td><td>Quantity (range)</td></tr><tr><td>Product</td><td>Polycarbonate granulates</td><td>80 - 90%</td></tr><tr><td></td><td>Regrinded polycarbonate granulates</td><td>10 - 15%</td></tr><tr><td></td><td>UV-additives</td><td>1 - 15%</td></tr><tr><td></td><td>Pigments (white, grey, brown/bronze, blue, violet, red)</td><td>0.02 - 1.1%</td></tr></table>	Components	Composition/content/ ingredients	Quantity (range)	Product	Polycarbonate granulates	80 - 90%		Regrinded polycarbonate granulates	10 - 15%		UV-additives	1 - 15%		Pigments (white, grey, brown/bronze, blue, violet, red)	0.02 - 1.1%
Components		Composition/content/ ingredients	Quantity (range)													
Product		Polycarbonate granulates	80 - 90%													
		Regrinded polycarbonate granulates	10 - 15%													
		UV-additives	1 - 15%													
	Pigments (white, grey, brown/bronze, blue, violet, red)	0.02 - 1.1%														
LEXAN™ Solid Polycarbonate sheets are produced via an extrusion process.																
Polycarbonate powder and/or pellets are compounded to a melt, which is transformed to a sheet shape through a calendaring process.																



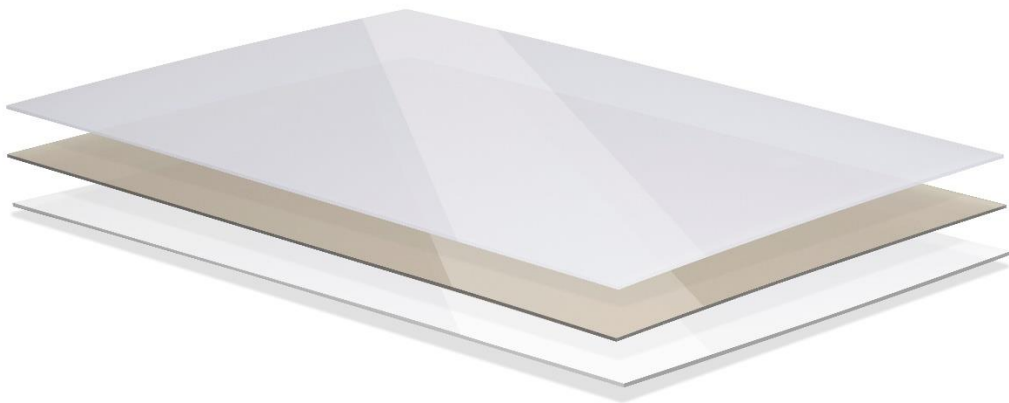
TECHNICAL DATA / PHYSICAL CHARACTERISTICS

Table 2 Technical properties of the product

Technical property	Standard	Value/unit	Comment
Reaction to fire	EN 13501-1	B-s1, d0	Test according EN 13823 up to 6mm
Dimensional tolerances	EN 16240	Pass/Fail	
Light transmittance “ τ_v ”	EN 14500	%	Up to 87%
Linear thermal expansion	ISO 11359-2	$65.10^{-6} \text{ K}^{-1}$	Coefficient
Durability	EN 16240	ΔA clear, ΔD colored	Test according to EN ISO 4892-2
Thermal transmittance (U value)	EN ISO 6946	3.5 – 5.8 W/m ² K	Depending on thickness

LIFE CYCLE STAGE AND MODULES

Description of the system boundary (X = Included in LCA; MND = Module not declared)																
Product stage			Construction installation stage		Use stage							End of life stage				Beyond the system boundaries
Raw materials	Transport	Manufacturing	Transport	Construction installation stage	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	disposal	Reuse-recovery - Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	X	X	X	X	X



LCA (LIFE CYCLE ASSESSMENT)

The LCA study was performed by EPSE and ENPERAS/VITO according to the ISO 14040 and ISO 14044 (data inventory) standards (ISO, 2006). The specific data utilized in this analysis was collected and provided by EPSE. It represents the weighted average data for the year 2019, as reported by the member companies of EPSE. Generic data have been used for the processes EPSE member companies cannot influence. The European electricity mix (consumption mix + import) has been used to model electricity use in the life cycle stages. Ecoinvent 3.6 database (June 2019, Wernet et al., 2016) was used for this study.

Declared Functional Unit (FU) is the production of 1 kg of a "Solid Polycarbonate sheet". Gross weight per square meter of 1mm thick Solid polycarbonate sheet is 1.2 kg/m²/mm. LEXAN™ Solid polycarbonate sheets are typically available in thicknesses between 2 and 15mm.

GWP TOTAL - POTENTIAL ENVIRONMENTAL IMPACT

Global Warming Potential (GWP) represents the unit for measuring carbon footprint. GWP values for producing the declared FU is given in Table 3. GWP values to produce 1m² of Solid Polycarbonate sheet in typically available thicknesses is provided in Table 4.

Table 3 **Global Warming Potential** (unit for measuring carbon footprint) for the FU

	Unit	Value
Functional Unit (FU)	kg	1
Impact category	-	-
GWP-Total*	kg CO ₂ equiv./FU	5.48
GWP (A1, A2, A3) Product Stage	kg CO ₂ equiv./FU	4.18

Table 4 GWP values for 1m² of Solid Polycarbonate (PC) Sheet in available thicknesses.

Thickness (mm)	Nominal weight (kg/m ²)	Conversion factor to FU	GWP Total* for 1m ² (kg CO ₂ equiv.)	GWP (A1, A2, A3) for 1m ² (kg CO ₂ equiv.)
2	2.4	0.417	13.14	10.02
3	3.6	0.278	19.71	15.04
4	4.8	0.208	26.35	20.10
5	6.0	0.167	32.81	25.03
6	7.2	0.139	39.42	30.07
8	9.6	0.104	52.69	40.19
10	12.0	0.083	66.02	50.36
12	14.4	0.069	79.42	60.58
15	18.0	0.056	97.86	74.64

***Included is:**

Product Stage: A1, A2, A3

Installation stage: A4

End of life Stage: C1, C2, C3, C4

LCA RESULTS

The following tables show the results of the potential environmental impacts per reference flow, resource use, waste categories & output flows. The results presented here refer to the Declared Functional Unit (FU) of 1 kg of a "Solid Polycarbonate sheet".

POTENTIAL ENVIRONMENTAL IMPACTS PER REFERENCE FLOW

	Production			Construction process stage		End-of-life stage				D Reuse, recovery, recycling	Total excl module D
	A1 Raw material	A2 Transport	A3 Manufacturing	A4 Transport	A5 Installation	C1 Deconstruction / demolition	C2 Transport	C3 Waste processing	C4 Disposal		
GWP - total (kg CO ₂ equiv/FU)	3,42E+00	1,05E-01	6,51E-01	2,36E-01	2,06E-01	1,04E-02	4,98E-02	8,19E-04	8,02E-01	-8,67E-01	5,48E+00
GWP - fossil (kg CO ₂ equiv/FU)	3,43E+00	1,05E-01	6,99E-01	2,36E-01	3,70E-02	1,03E-02	4,98E-02	8,08E-04	8,02E-01	-8,65E-01	5,37E+00
GWP - biogenic (kg CO ₂ equiv/FU)	-9,11E-03	6,15E-05	-4,99E-02	9,96E-05	1,69E-01	7,20E-05	2,03E-05	1,04E-05	5,92E-05	-1,51E-03	1,11E-01
GWP - luluc (kg CO ₂ equiv/FU)	1,44E-03	4,57E-05	1,52E-03	8,76E-05	2,43E-06	2,39E-05	1,74E-05	7,62E-07	1,56E-05	-6,40E-04	3,15E-03
ODP (kg CFC 11)	1,14E-07	2,28E-08	5,81E-08	5,35E-08	1,53E-09	8,67E-10	1,13E-08	6,47E-11	6,53E-09	-5,51E-08	2,69E-07
AP (kg mol H ⁺)	7,28E-03	5,48E-04	6,56E-03	1,01E-03	5,19E-05	6,01E-05	2,03E-04	3,78E-06	2,35E-04	-2,10E-03	1,59E-02
EP - freshwater (kg P equiv/FU)	3,11E-05	1,14E-06	6,60E-05	1,93E-06	1,04E-07	1,10E-06	3,91E-07	9,42E-08	7,85E-07	-2,12E-05	1,03E-04
EP - marine (kg N - equiv/FU)	1,82E-03	1,57E-04	6,91E-04	2,89E-04	2,22E-05	7,62E-06	6,03E-05	1,14E-06	1,41E-04	-4,32E-04	3,19E-03
EP - terrestrial (mol N - equiv/FU)	1,86E-02	1,74E-03	1,43E-02	3,20E-03	2,24E-04	9,39E-05	6,67E-04	1,39E-05	1,03E-03	-4,79E-03	3,99E-02
POCP (kg NM VOC equiv/FU)	6,00E-03	5,15E-04	2,39E-03	9,83E-04	6,43E-05	2,38E-05	2,04E-04	3,46E-06	2,76E-04	-1,48E-03	1,05E-02
ADP - minerals&metals (kg Sb equiv/FU)	2,24E-06	1,92E-07	4,57E-06	4,87E-07	1,20E-08	1,40E-08	9,69E-08	1,10E-09	4,41E-08	-3,63E-07	7,65E-06
ADP fossil (MJ/FU)	8,86E+01	1,57E+00	1,32E+01	3,56E+00	1,07E-01	2,12E-01	7,50E-01	1,10E-02	2,63E-01	-1,97E+01	1,08E+02
WDP (m ³ world eq. deprived/FU)	4,28E+00	5,16E-03	2,48E-01	1,03E-02	5,67E-04	2,37E-03	2,09E-03	3,66E-05	9,52E-03	-6,55E-01	4,56E+00

GWP total = Total Global Warming Potential (Climate Change); GWP - fossil = Global Warming Potential (Climate Change) fossil; GWP-biogenic = Global Warming Potential (Climate change) biogenic; GWP-luluc = Global Warming Potential (Climate Change) land use and land use change; ODP = Ozone Depletion Potential; AP = Acidification Potential for Soil and Water; EP = Eutrophication Potential; EP-marine = Eutrophication Potential, marine; EP-terrestrial = Eutrophication Potential, terrestrial; POCP = Photochemical Ozone Creation; ADP-minerals&metals = Abiotic Depletion Potential - minerals and metals; ADP fossil = Abiotic Depletion Potential - Fossil Fuels; WDP = water use (Water (user) deprivation potential, deprivation- weighted water consumption

RESOURCE USE

	Production			Construction process stage		End-of-life stage				D Reuse, recovery, recycling	Total excl module D
	A1 Raw material	A2 Transport	A3 Manufacturing	A4 Transport	A5 Installation	C1 Deconstruction / demolition	C2 Transport	C3 Waste processing	C4 Disposal		
PERE (M J equiv/FU)	9,89E-01	3,12E-02	3,11E+00	5,13E-02	3,61E-01	3,96E-02	1,04E-02	1,53E-03	2,09E-02	-2,85E+00	4,61E+00
PERM (M J equiv/FU)	1,18E-01	0,00E+00	1,37E+00	0,00E+00	-3,59E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,13E+00
PERT (M J equiv/FU)	1,11E+00	3,12E-02	4,48E+00	5,13E-02	2,75E-03	3,96E-02	1,04E-02	1,53E-03	2,09E-02	-2,85E+00	5,74E+00
PENRE (M J equiv/FU)	8,48E+01	1,59E+00	1,42E+01	3,59E+00	4,60E-01	2,54E-01	7,55E-01	1,39E-02	3,05E-01	-2,01E+01	1,06E+02
PENRM (M J equiv/FU)	4,62E-02	0,00E+00	1,29E+00	0,00E+00	-3,51E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	9,85E-01
PENRT (M J equiv/FU)	8,48E+01	1,59E+00	1,55E+01	3,59E+00	1,10E-01	2,54E-01	7,55E-01	1,39E-02	3,05E-01	-2,01E+01	1,07E+02
SM (kg/FU)	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	4,01E-01	0,00E+00
RSF (M J equiv/FU)	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
NRSF (M J equiv/FU)	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
FW (m³ water eq/FU)	1,08E-01	1,55E-04	9,83E-03	2,67E-04	6,43E-05	1,56E-04	5,42E-05	2,59E-06	4,70E-04	-1,79E-02	1,19E-01

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 resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Net use of fresh water

WASTE CATEGORIES & OUTPUT FLOWS

	Production			Construction process stage		End-of-life stage				D Reuse, recovery, recycling	Total excl module D
	A1 Raw material	A2 Transport	A3 Manufacturing	A4 Transport	A5 Installation	C1 Deconstruction / demolition	C2 Transport	C3 Waste processing	C4 Disposal		
Hazardous waste disposed (kg/FU)	2,68E-06	3,94E-06	1,49E-05	9,31E-06	2,54E-07	1,41E-07	1,97E-06	1,80E-08	6,93E-07	-7,43E-06	3,39E-05
Non-hazardous waste disposed (kg/FU)	6,24E-02	6,89E-02	1,74E-01	1,71E-01	9,02E-02	7,48E-04	3,59E-02	4,09E-05	4,02E-01	-2,17E-02	1,01E+00
Radioactive waste disposed (kg/FU)	1,49E-05	1,06E-05	6,85E-05	2,42E-05	6,87E-07	1,50E-06	5,12E-06	5,17E-08	1,20E-06	-2,67E-05	1,27E-04
Components for re-use (kg/FU)	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Materials for recycling (kg/FU)	0,00E+00	0,00E+00	5,48E-02	0,00E+00	5,81E-02	0,00E+00	0,00E+00	2,88E-01	0,00E+00	-4,01E-01	4,01E-01
Materials for energy recovery (kg/FU)	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Exported energy (M J/FU)	0,00E+00	0,00E+00	1,43E-02	0,00E+00	2,56E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-2,70E-01	2,70E-01

IMPACT CATEGORIES ADDITIONAL TO EN15804+A2

	Production			Construction process stage		End-of-life stage				D Reuse, recovery, recycling	Total excl module D
	A1 Raw material	A2 Transport	A3 Manufacturing	A4 Transport	A5 Installation	C1 Deconstruction / demolition	C2 Transport	C3 Waste processing	C4 Disposal		
PM (disease incidence eq/FU)	5,56E-08	7,12E-09	3,81E-08	1,62E-08	7,20E-10	1,57E-10	3,46E-09	5,91E-11	2,06E-09	-1,12E-08	1,23E-07
IRP (kg U235 eq/FU)	1,83E-01	7,01E-03	8,38E-02	1,56E-02	4,55E-04	1,83E-03	3,28E-03	3,74E-05	1,07E-03	-5,54E-02	2,96E-01
ETP - fw (CTUe/FU)	4,60E+01	1,29E+00	2,42E+01	2,89E+00	1,03E-01	1,45E-01	6,01E-01	8,83E-03	2,26E+00	-8,21E+00	7,75E+01
HTP - c (CTUh/FU)	5,06E-09	4,21E-11	1,07E-09	8,34E-11	2,39E-11	3,75E-12	1,69E-11	2,81E-13	1,53E-10	-4,22E-10	6,45E-09
HTP - nc (CTUh/FU)	3,87E-08	1,39E-09	2,62E-08	3,13E-09	1,72E-10	1,28E-10	6,55E-10	8,03E-12	1,53E-09	-6,92E-09	7,19E-08
SQP (/)	3,67E+00	1,06E+00	2,56E+01	2,47E+00	1,07E-01	5,17E-02	5,17E-01	6,66E-03	2,89E-01	-1,74E+01	3,38E+01

PM = Particulate Matter (Potential incidence of disease due to PM emissions); IRP = Ionizing Radiation Potential – human health effects (Potential Human exposure efficiency relative to U235); ETP-fw = Ecotoxicity – freshwater; (potential comparative toxic unit); HTP- c = Human Toxicity – cancer effects; HTP-nc = Human Toxicity – non cancer effects; SQP = Soil Quality Index, land use related impacts

INFORMATION ON BIOGENIC CARBON CONTENT

There is no biogenic carbon content in the product. Uptake of biogenic CO₂ within the pallets and the carton is reported in module A3, release in module A5.

	Biogenic carbon content (kg C / FU)
Biogenic carbon content in product (at the gate)	0,00E+00
Biogenic carbon content in accompanying packaging	4.82E-02

This EPD, a self-declaration of the Environmental Impacts, is valid for products sold globally, produced in Europe.

REFERENCES

- Datasheets www.polyvantis.com
- ISO 14040:2006: Environmental Management-Life Cycle Assessment-Principles and framework.
- ISO 14044:2006: Environmental Management-Life Cycle Assessment-Requirements and guidelines.
- ISO 14025:2006: Environmental labels and Declarations-Type III Environmental Declarations principles.
- EN 15804+A2:2019. CEN TC350. Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products. European standard.
- European Commission, PEFCR Guidance document, – Guidance for the development of Product Environmental Footprint Category Rules (PEFCRs), version 6.3, December 2017.
- Life cycle assessment and EPDs (average, self-declaration) for solid and multiwall polycarbonate sheets produced by the European Polycarbonate Sheet Extruders (EPSE); December 2021.

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