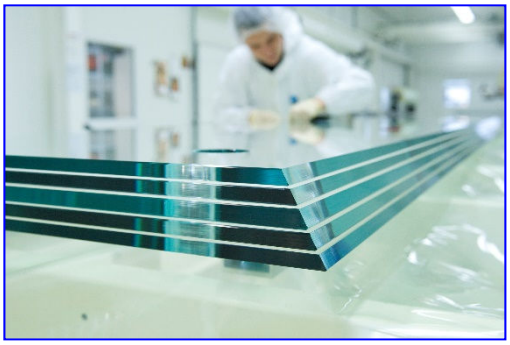
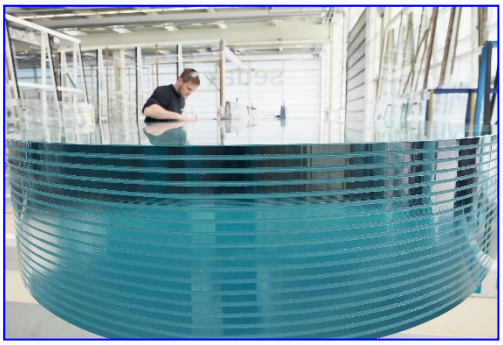
Environmental Product Declaration (EPD)

Declaration code EPD-SSG-GB-71.0



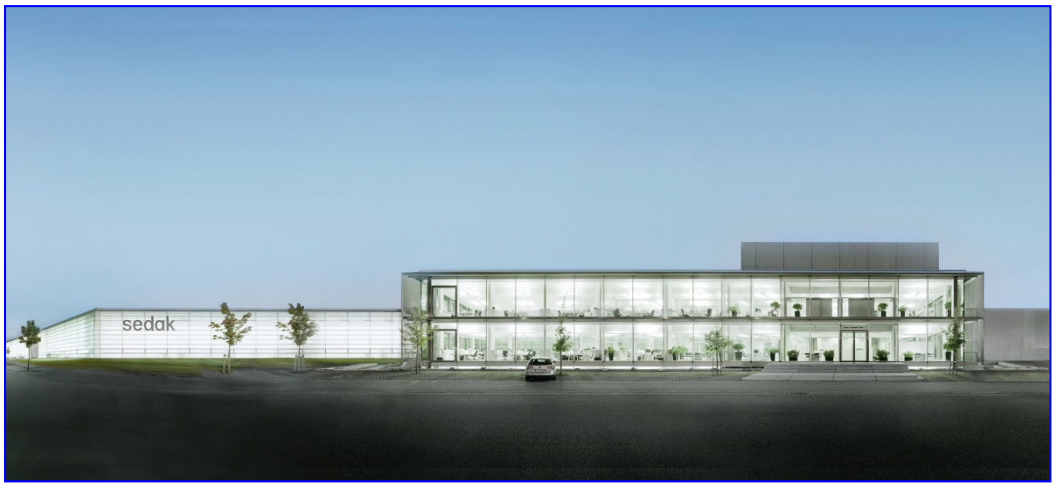


sedak

sedak GmbH & Co. KG

flat glass

GlasCobond® (with SG Interlayer) as well as sedak safety glass (with PVB or mixed interlayer)



Basis:

DIN EN ISO 14025
EN 15804 + A2

Company EPD **E**nvironmental **P**roduct **D**eclaration

Publication date:
24.10.2023

Valid until:
24.10.2028

www.ift-rosenheim.de/
published EPDs

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Testing and Calibration – EN ISO/IEC 17025
Inspection – EN ISO/IEC 17020
Product Certification – EN ISO/IEC 17065
Certification of Management Systems – EN ISO/IEC 17021

Notified Body 0757
PÜZ-Stelle: BAY 18

DAkkS Deutsche Akkreditierungsstelle D-ZE-11349-01-00

Environmental Product Declaration (EPD)

Declaration code EPD-SSG-GB-71.0

Programme operator	ift Rosenheim GmbH Theodor-Gietl-Straße 7-9 83026 Rosenheim, Germany		
Practitioner of the LCA	ift Rosenheim GmbH Theodor-Gietl-Straße 7-9 83026 Rosenheim, Germany		
Declaration holder	sedak GmbH & Co. KG Einsteinring 1 86368 Gersthofen, Germany www.sedak.com		
Declaration code	EPD-SSG-GB-71.0		
Designation of declared product	GlasCobond® (with SG Interlayer) as well as sedak safety glass (with PVB or mixed interlayer)		
Scope	sedak safety glass finds applications in the building industry, in the marine sector or is further processed to insulating glass unit.		
Basis	This EPD was prepared on the basis of EN ISO 14025:2011 and DIN EN 15804:2012+A2:2019. In addition, the "Allgemeiner Leitfaden zur Erstellung von Typ III Umweltproduktdeklarationen" (General guideline for preparation of Type III Environmental Product Declarations) applies. The declaration is based on PCR documents EN 17074 „PCR for flat glass products", "PCR Part A" PCR-A-0.3:2018 and "Flat glass in building industry" PCR-FG-2.0:2021.		
Validity	Publication date: 24.10.2023	Last revision: 24.10.2023	Valid until: 24.10.2028
	This verified Company Environmental Product Declaration (company EPD) applies solely to the specified products and is valid for a period of five years from the date of publication in accordance with DIN EN 15804.		
LCA Basis	The LCA was prepared in accordance with DIN EN ISO 14040 and DIN EN ISO 14044. The data are based on both the data compiled from the production site of sedak GmbH & Co. KG and the generic data derived from the "LCA for Experts 10" database. LCA calculations were carried out for the included "cradle to grave" including all upstream chains (e.g. raw material extraction, etc.).		
Notes	The ift-Guidance Sheet "Conditions and Guidance for the Use of ift Test Documents" applies. The declaration holder assumes full liability for the underlying data, certificates and verifications.		

Christian Kehrer Head of Certification and Surveillance Body	Dr. Torsten Mielecke Chairman of Expert Committee ift-EPD and PCR	Benedikt Dellawalle Independent verifier

1 General Product Information

Product definition

The EPD belongs to the product group flat glass and applies to

1 m² Laminated safety glass
of company sedak GmbH & Co. KG

The functional unit is obtained by summing up:

Assessed product	Declared unit	Weight per unit area	Density
Laminated safety glass double (LSG 10-10)	1 m²	51.44 kg/m²	2.39 g/cm³
Laminated safety glass triple (LSG 6-10-6)	1 m²	60.78 kg/m²	2.16 g/cm³
Laminated safety glass **printed** 3 times (LSG 6-6-6)	1 m²	24.08 kg/m²	2.13 g/cm³

Table 1 Product groups

For the calculation of the density, the thickness and density of the films used are taken into account:

Assessed product	Foil used and foil thickness	Foil thickness	Laminate thickness
LSG 10-10	one layer of Sentryglass foil à 1.52 mm	0.95 g/cm³	21.52 mm
LSG 6-10-6	two layers of Sentryglass foil à 3.04 mm	0.95 g/cm³	28.08 mm
LSG 6-6-6 **printed**	one layer of Sentryglass foil à 3.04 mm one layer of polyvinyl butyral foil à 3.04 mm*	1.065 g/cm³	24.08 mm

Table 2 Laminate structure - foil use per declared unit

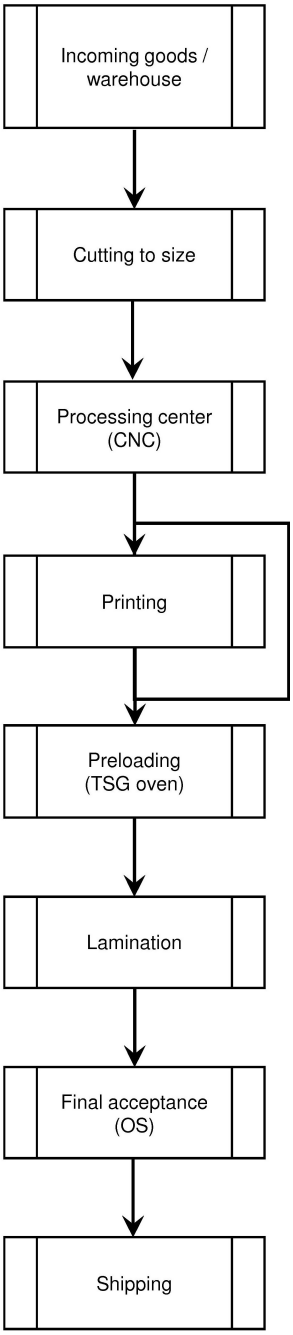
The average unit is declared as follows:
Directly used material flows are determined using the manufactured areas (m²) and allocated to the declared unit. All other inputs and outputs in the manufacture were scaled to the declared unit as a whole, since no direct assignment to the average size is possible. In the case of thickness-dependent inputs and outputs, the thickness is taken into account in the apportionment. The reference period refers to the period between 01.04.2022 and 30.03.2023.

The validity of the EPD is restricted to the laminates presented.

Product description

sedak safety glass consists of several panes of glass in different thicknesses, which are tempered according to specifications. Lamination foil of various thicknesses is used between the panes. In some cases, printed panes of glass are used. The focus is on meeting the highest technical requirements and quality.
For a detailed product description refer to the manufacturer specifications or the product specifications of the respective offer/quotation.

Product manufacture



Application

sedak safety glass is used, among other things, in high-quality architectural applications such as facade glass, glass balustrades and railings, as well as glass staircases, and in marine applications such as ships, yachts, and pools.

Management systems

The following management systems are held:

- Quality management system as per DIN EN ISO 9001:2015
- Energy management system as per DIN EN ISO 50001:2018

Additional information

For additional verifications of applicability or conformity refer to the CE marking and the documents accompanying the product, if applicable.

GlasCobond® (with SG Interlayer) as well as sedak safety glass (with PVB or mixed interlayer) meet the following building-physical performance characteristics according to EN 1279-5:2018-10:

Characteristics	LSG 10-10	LSG 6-10-6	LSG 6-6-6	Unit
Resistance against wind, snow, permanent and/or live loads	45/45	45/45/45	45/45/45	
Thermal transmittance (U_g value)	5.1	4.6	4.6	W/(m²*K)
Light transmittance (τ_V)	0.90	0.89	0.01	%
External light reflectance (ρ_V)	0.08	0.08	0.04	
Total energy transmittance (g value)	0.82	0.79	0.23	%
Solar direct transmittance (τ_e)	0.78	0.74	0.01	
ρ_e	0.07	0.07	0.04	

2 Materials used

Primary materials

The raw materials used can be found in Section 6.2 Inventory analysis (Inputs).
The primary materials used are listed in the LCA (see Section 7).

Declarable substances

The product contains no substances from the REACH candidate list (declaration dated 09.08.2023).

All relevant safety data sheets are available from sedak GmbH & Co. KG.

3 Construction process stage

Processing recommendations, installation

Observe the instructions for assembly/installation, operation, maintenance and disassembly, provided by the manufacturer. For this, see www.sedak.com

4 Use stage

Emissions to the environment

No emissions to indoor air, water and soil are known. There may be VOC emissions.

Reference service life (RSL)

The RSL information was provided by the manufacturer. The RSL must be established under specified reference conditions of use and relate to the declared technical and functional performance of the product within the building. It must be determined according to all specific rules given in European product standards or, if none are available, according to a c-PCR. It must also take into account ISO 15686-1, -2, -7 and -8. If there is guidance on deriving RSLs from European Product Standards or a c-PCR, then such guidance must take precedence.

If it is not possible to determine the service life as the RSL in accordance with ISO 15686, the BBSR table “Nutzungsdauer von Bauteilen zur Lebenszyklusanalyse nach BNB” (service life of building components for life cycle assessment in accordance with the sustainable construction evaluation system) can be used. For further information and explanations refer to www.nachhaltigesbauen.de.

For this EPD the following applies:
For a "cradle to grave" EPD and Module D (A + B + C + D), a reference service life (RSL) must be specified.
The service life of GlasCobond® (with SG Interlayer) as well as sedak safety glass (with PVB or mixed interlayer) of company sedak GmbH & Co. KG is specified as 30 years according to EN 17074.

The service life is dependent on the characteristics of the product and in-use conditions.

The service life solely applies to the characteristics specified in this EPD or the corresponding references.
The RSL does not reflect the actual life time, which is usually determined by the service life and the redevelopment of a building. It does not give any information on the useful life, warranty referring to performance characteristics or guarantees.

5 End-of-life stage

Possible end-of-life stages

GlasCobond® (with SG Interlayer) as well as sedak safety glass (with PVB or mixed interlayer) are sent to central collection points. There the products are usually shredded and sorted into their constituents. The end-of-life stage depends on the site where the products are used and is therefore subject to the local regulations. Observe the locally applicable regulatory requirements.

In this EPD, the modules of after-use are presented according to the market situation.
Glass as well as plastics are recycled to certain parts. Residual fractions are sent to landfill or thermally recycled.

Disposal routes

The LCA includes the average disposal routes.

All life cycle scenarios are detailed in the Annex.

6 Life Cycle Assessment (LCA)

Environmental product declarations are based on life cycle assessments (LCAs) which use material and energy flows for the calculation and subsequent representation of environmental impacts.

As a basis for this, life cycle assessments were prepared for GlasCobond® (with SG Interlayer) as well as sedak safety glass (with PVB or mixed interlayer). These LCAs are in conformity with the requirements set out in DIN EN 15804 and the international standards DIN EN ISO 14040, DIN EN ISO 14044, ISO 21930 and EN ISO 14025.

The LCA is representative of the products presented in the Declaration and the specified reference period.

6.1 Definition of goal and scope

Aim

The goal of the LCA is to demonstrate the environmental impacts of the products. In accordance with DIN EN 15804, the environmental impacts covered by this Environmental Product Declaration are presented for the entire product life cycle in the form of basic information. No other additional environmental impacts are specified.

Data quality, data availability and geographical and time-related system boundaries

The specific data originate exclusively from the period under review between 01.04.2022 and 30.03.2023. They were collected on-site at the plant located in Gersthofen and originate in parts from company records and partly from values directly obtained by measurement. Validity of the data was checked by the ift Rosenheim.

The generic data originates from the professional database and building materials database software “LCA for Experts 10”. The last update of both databases was in 2023. Data from before this date originate also from these databases and are not more than eleven years old. No other generic data were used for the calculation.

Generic data are selected as accurately as possible in terms of geographic reference. If no country-specific data sets are available or if the regional reference cannot be determined, European or globally valid data sets are used.

Data gaps were either filled with comparable data or conservative assumptions, or the data were cut off in compliance with the 1% rule.

The life cycle was modelled using the sustainability software tool “LCA for Experts” for the development of life cycle assessments.

The data quality complies with the requirements of prEN 15941:2022.

Scope / system boundaries

The system boundaries refer to the supply of raw materials and purchased parts, manufacture/production, use and end-of-life stage of GlasCobond® (with SG Interlayer) as well as sedak safety glass (with PVB or mixed interlayer).
No additional data from pre-suppliers/subcontractors or other sites were taken into consideration.

Cut-off criteria

All company data collected, i.e. all commodities/input and raw materials used, the thermal energy and electricity consumption, were taken into consideration.

The boundaries cover only the product-relevant data. Building sections/parts of facilities that are not relevant to the manufacture of the products, were excluded.

The transport distances of the pre-products used were taken into consideration as a function of 100% of the mass of the products.

A truck-trailer (34-40 t total weight, 27 t payload) with Euro 0-6 mix is used for the determined transport routes. 61% capacity of the truck-trailer was used (according to the standard data set). The Euro standard mix and capacities used are representative of the usual supply chain situations and can therefore be applied.

In addition to the transport distances for pre-products, transport distances for waste were also taken into account. The transport of generated waste in A3 was mapped with the following scenario according to the manufacturer:

- Transport to collection point with 27 t truck (Euro 0-6 Mix), diesel, 27 t payload, 50 % capacity used, transport kilometers per waste material recorded individually.

The criteria for the exclusion of inputs and outputs as set out in DIN EN 15804 are fulfilled. From the data analysis it can be assumed that the total of negligible processes per life cycle stage does not exceed 1% of the mass/primary energy. This way the total of negligible processes does not exceed 5% of the energy and mass input. The life cycle calculation also includes material and energy flows that account for less than 1%.

6.2 Inventory analysis

Aim

All material and energy flows are described below. The processes covered are presented as input and output parameters and refer to the declared/functional units.

Life cycle stages

The complete life cycle of GlasCobond® (with SG Interlayer) as well as sedak safety glass (with PVB or mixed interlayer) is shown in the annex. The product stage "A1 – A3", construction process stage "A4 – A5", use stage "B1 – B7", end-of-life stage "C1 – C4" and the benefits and loads beyond the system boundaries "D" are considered.

Benefits

The below benefits have been defined as per DIN EN 15804:

- Benefits from recycling
- Benefits (thermal and electrical) from incineration

Allocation of co-products

No allocations occur during production.

Allocations for re-use, recycling and recovery

If the products are reused/recycled and recovered during the product stage (rejects), the elements are shredded, if necessary and then sorted into their constituents. This is done by various process plants, e.g. magnetic separators.
The system boundaries were set following their disposal, reaching the end-of-waste status.

Allocations beyond life cycle boundaries

The use of recycled materials in the manufacturing process was based on the current market-specific situation. In parallel to this, a recycling potential was taken into consideration that reflects the economic value of the product after recycling (recyclate).
The system boundary set for the recycled material refers to collection.

Secondary material

The use of secondary material by sedak GmbH & Co. KG was considered in Module A3. Secondary material is not used.

Inputs

The LCA includes the following production-relevant inputs per 1 m² Laminated safety glass:

Energy
For the input material natural gas, "Natural gas mix (DE)" was assumed and for the input material liquefied petroleum gas "Liquefied petroleum gas (LPG) (DE)". The German electricity mix is used for the electricity mix at the plant, and electricity from the company's own PV system is also included under "Electricity from photovoltaics (DE)".
A portion of the process heat is used for space heating. This can, however, not be quantified, hence a “worst case” figure was taken into account for the product.

Water
The water consumed by the individual process steps for the manufacture amounts to a total of 212 l (LSG 10-10), 318 l (LSG 6-10-6) as well as 493 l (LSG 6-6-6) l per m² element.
The consumption of fresh water specified in Section 6.3 originates (among others) from the process chain of the pre-products.

Raw material/Pre-products
The chart below shows the share of raw materials/pre-products in percent.

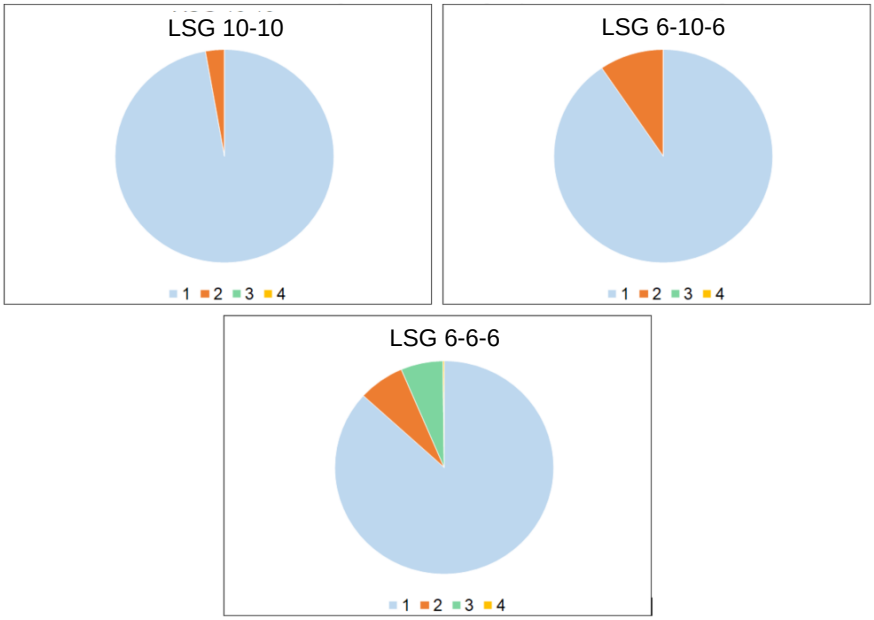


Illustration 1 Percentage of individual materials per declared unit

No.	Material	Mass in % per m² LSG		
		10-10	6-10-6	6-6-6
1	Float glass	97.2	90.5	87.8
2	Sentryglass foil	2.8	9.5	5.64
3	PVB-interlayer	0.0	0.0	6.3
4	Ceramic ink	0.0	0.0	0.2

Table 3 Percentage of individual materials per declared unit

Ancillary materials and consumables
There are 1.42 kg (LSG 10-10), 1.60 kg (LSG 6-10-6) and 1.67 kg (LSG 6-6-6) of ancillary materials and consumables.

Product packaging
The amounts used for product packaging are as follows:

No.	Material	Mass in g per m² LSG		
		10-10	6-10-6	6-6-6
1	Reusable steel frame	6516.2	7698.3	6492.7
2	Padding material	8.0	8.0	8.0
3	Foil hood	25.0	25.0	25.0
4	Spacer	50.0	50.0	50.0

Table 4 Weight in g of packaging per declared unit

Biogenic carbon content
The biogenic carbon content is neglected and not reported, as the total mass of biogenic carbon-containing materials is less than 5% of the total mass of the product and associated packaging and the mass of biogenic carbon-containing materials in the packaging is less than 5 % of the total mass of the packaging.

Outputs

The following manufacturing-related outputs were included in the LCA per 1 m² laminated safety glass:

Waste
Secondary raw materials were included in the benefits.
See Section 6.3 Impact assessment.

Waste water
The production process generates 212 l (LSG 10-10), 318 l (LSG 6-10-6) and 493 l (LSG 6-6-6) l of waste water.

6.3 Impact assessment

Aim

The impact assessment covers both inputs and outputs. The impact categories applied are stated below:

Core indicators

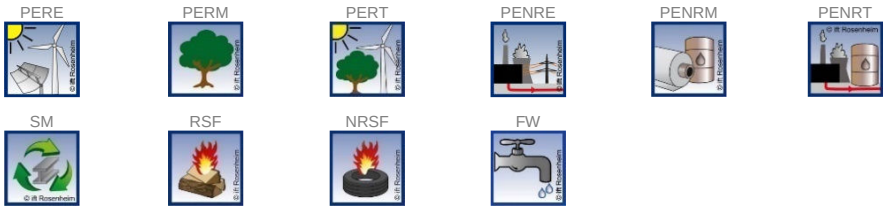
The models for impact assessment were applied as described in DIN EN 15804-A2.
The core indicators presented in the EPD are as follows:

- Climate change - total (GWP-t)
- Climate change - fossil (GWP-f)
- Climate change - biogenic (GWP-b)
- Climate change - land use & land use change (GWP-l)
- Ozone depletion (ODP)
- Acidification (AP)
- Eutrophication freshwater (EP-fw)
- Eutrophication salt water (EP-m)
- Eutrophication land (EP-t)
- Photochemical ozone creation (POCP)
- Depletion of abiotic resources - fossil fuels (ADPF)
- Depletion of abiotic resources - minerals and metals (ADPE)
- Water use (WDP)

Resource management

The models for impact assessment were applied as described in DIN EN 15804-A2.
The following resource use indicators are presented in the EPD:

- Renewable primary energy as energy source (PERE)
- Renewable primary energy for material use (PERM)
- Total use of renewable primary energy (PERT)
- Non-renewable primary energy as energy source (PENRE)
- Renewable primary energy for material use (PENRM)
- Total use of non-renewable primary energy (PENRT)
- Use of secondary materials (SM)
- Use of renewable secondary fuels (RSF)
- Use of non-renewable secondary fuels (NRSF)
- Net use of freshwater resources (FW)

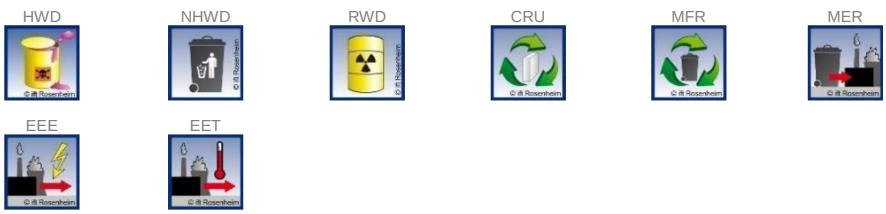


Waste

The waste generated during the production of 1 m² Laminated safety glass is evaluated and shown separately for the fractions trade wastes, special wastes and radioactive wastes. Since waste handling is modelled within the system boundaries, the amounts shown refer to the deposited wastes. A portion of the waste indicated is generated during the manufacture of the pre-products.

The models for impact assessment were applied as described in DIN EN 15804-A2.
The following waste categories and indicators for output closures are presented in the EPD:

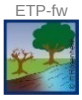
- Disposed hazardous waste (HWD)
- Non-hazardous waste disposed (NHWD)
- Radioactive waste disposed (RWD)
- Components for re-use (CRU)
- Materials for recycling (MFR)
- Materials for energy recovery (MER)
- Exported electrical energy (EEE)
- Exported thermal energy (EET)



Additional environmental impact indicators

The models for impact assessment were applied as described in DIN EN 15804-A2.
The additional impact categories presented in the EPD are as follows:

- Particulate matter emissions (PM)
- Ionizing radiation, human health (IRP)
- Ecotoxicity – freshwater (ETP-fw)
- Human toxicity, carcinogenic effects (HTP-c)
- Human toxicity, non-carcinogenic effects (HTP-nc)
- Impacts associated with land use/soil quality (SQP)

Product Manager 
IRP 
ETP-fw 
HTP-c 
HTP-nc 
SQP 

Results per 1 m² Laminated safety glass double (LSG 10-10)																
	Unit	**A1-A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Core indicators																
GWP-t	kg CO_2 equivalent	139.59	1.47	8.17E-02	0.00	7.70E-04	0.00	0.00	0.00	0.00	0.00	0.00	0.13	1.61	0.53	-7.92
GWP-f	kg CO_2 equivalent	135.58	1.47	7.54E-02	0.00	7.63E-04	0.00	0.00	0.00	0.00	0.00	0.00	0.13	1.60	0.54	-7.90
GWP-b	kg CO_2 equivalent	3.97	-5.38E-03	6.24E-03	0.00	6.37E-06	0.00	0.00	0.00	0.00	0.00	0.00	-4.78E-04	1.65E-02	-1.80E-02	-2.22E-02
GWP-l	kg CO_2 equivalent	6.77E-02	8.74E-03	1.65E-06	0.00	6.47E-08	0.00	0.00	0.00	0.00	0.00	0.00	7.76E-04	1.52E-04	1.68E-03	-1.13E-03
ODP	kg CFC-11-eq.	4.41E-09	2.56E-13	2.69E-14	0.00	1.18E-15	0.00	0.00	0.00	0.00	0.00	0.00	2.27E-14	2.57E-11	1.38E-12	-2.09E-11
AP	mol H^+-eq.	1.12	1.48E-03	1.47E-05	0.00	8.17E-07	0.00	0.00	0.00	0.00	0.00	0.00	1.31E-04	1.62E-03	3.84E-03	-4.89E-02
EP-fw	kg P-eq.	5.75E-04	3.41E-06	6.85E-09	0.00	3.47E-09	0.00	0.00	0.00	0.00	0.00	0.00	3.02E-07	5.63E-06	1.09E-06	-5.85E-06
EP-m	kg N-eq.	0.21	5.18E-04	3.52E-06	0.00	2.80E-07	0.00	0.00	0.00	0.00	0.00	0.00	4.59E-05	5.28E-04	9.92E-04	-1.42E-02
EP-t	mol N-eq.	2.51	6.10E-03	6.85E-05	0.00	2.86E-06	0.00	0.00	0.00	0.00	0.00	0.00	5.42E-04	5.76E-03	1.09E-02	-0.16
POCP	kg NMVOC-eq.	0.61	1.29E-03	9.61E-06	0.00	1.30E-06	0.00	0.00	0.00	0.00	0.00	0.00	1.15E-04	1.28E-03	2.99E-03	-2.87E-02
ADPF*²	MJ	2330.70	19.80	4.03E-02	0.00	2.30E-02	0.00	0.00	0.00	0.00	0.00	0.00	1.76	13.40	7.21	-124.00
ADPE*²	kg Sb equivalent	1.90E-05	1.04E-07	2.10E-10	0.00	2.29E-11	0.00	0.00	0.00	0.00	0.00	0.00	9.19E-09	1.71E-07	2.50E-08	-2.34E-07
WDP*²	m^3 world-eq. deprived	10.99	7.61E-03	7.81E-03	0.00	2.77E-04	0.00	0.00	0.00	0.00	0.00	0.00	6.75E-04	9.39E-02	5.95E-02	-0.44
Resource management																
PERE	MJ	1176.69	1.28	0.73	0.00	6.07E-04	0.00	0.00	0.00	0.00	0.00	0.00	0.11	12.50	1.18	-13.20
PERM	MJ	0.72	0.00	-0.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PERT	MJ	1177.41	1.28	1.33E-02	0.00	6.07E-04	0.00	0.00	0.00	0.00	0.00	0.00	0.11	12.50	1.18	-13.20
PENRE	MJ	2310.49	19.80	0.65	0.00	2.30E-02	0.00	0.00	0.00	0.00	0.00	0.00	1.76	22.28	27.94	-124.00
PENRM	MJ	30.21	0.00	-0.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-8.88	-20.72	0.00
PENRT	MJ	2340.70	19.80	4.03E-02	0.00	2.30E-02	0.00	0.00	0.00	0.00	0.00	0.00	1.76	13.40	7.22	-124.00
SM	kg	3.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RSF	MJ	7.35E-20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NRSF	MJ	8.63E-19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FW	m^3	0.53	1.17E-03	1.87E-04	0.00	2.04E-04	0.00	0.00	0.00	0.00	0.00	0.00	1.04E-04	5.93E-03	1.82E-03	-1.67E-02
Categories of waste																
HWD	kg	2.50E-06	5.31E-11	-7.07E-13	0.00	2.75E-12	0.00	0.00	0.00	0.00	0.00	0.00	4.71E-12	-2.58E-09	1.57E-10	-1.43E-08
NHWD	kg	81.07	2.89E-03	7.63E-03	0.00	6.77E-05	0.00	0.00	0.00	0.00	0.00	0.00	2.57E-04	2.61E-02	36.10	-0.98
RWD	kg	8.12E-02	2.07E-05	1.36E-06	0.00	6.37E-08	0.00	0.00	0.00	0.00	0.00	0.00	1.84E-06	1.29E-03	8.23E-05	-2.96E-03
Output material flows																
CRU	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MFR	kg	27.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.20	0.00	0.00
MER	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EEE	MJ	3.71	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.10	0.00	0.00
EET	MJ	8.65	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.53	0.00	0.00

Key:
GWP-t – Global warming potential – total **GWP-f** – global warming potential fossil fuels **GWP-b** – global warming potential - biogenic **GWP-l** – global warming potential - land use and land use change **ODP** – ozone depletion potential **AP** - acidification potential **EP-fw** - eutrophication potential - aquatic freshwater **EP-m** - eutrophication potential - aquatic marine **EP-t** - feutrophication potential - terrestrial **POCP** - photochemical ozone formation potential **ADPF*²** - abiotic depletion potential – fossil resources **ADPE*²** - abiotic depletion potential –minerals&metals **WDP*²** – Water (user) deprivation potential **PERE** - Use of renewable primary energy **PERM** - use of renewable primary energy resources **PERT** - total use of renewable primary energy resources **PENRE** - use of non-renewable primary energy **PENRM** - use of non-renewable primary energy resources **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 **HWD** - hazardous waste disposed **NHWD** - non-hazardous waste disposed **RWD** - radioactive waste disposed **CRU** - components for re-use **MFR** - materials for recycling **MER** - materials for energy recovery **EEE** - exported electrical energy **EET** - exported thermal energy

Results per 1 m² Laminated safety glass double (LSG 10-10)															
	Unit	**A1-A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Additional environmental impact indicators																
PM	Disease incidence	1.02E-05	9.67E-09	1.56E-10	0.00	6.17E-12	0.00	0.00	0.00	0.00	0.00	0.00	8.58E-10	1.23E-08	4.72E-08	-2.84E-07
IRP*[1]	kBq U235-eq.	8.52	2.14E-03	1.43E-04	0.00	6.73E-06	0.00	0.00	0.00	0.00	0.00	0.00	1.90E-04	0.14	9.51E-03	-0.47
ETP-fw*[2]	CTUe	3979.90	14.70	1.31E-02	0.00	9.00E-03	0.00	0.00	0.00	0.00	0.00	0.00	1.31	5.50	3.93	-136.00
HTP-c*[2]	CTUh	8.66E-08	2.94E-10	1.22E-12	0.00	2.54E-13	0.00	0.00	0.00	0.00	0.00	0.00	2.61E-11	2.64E-10	6.06E-10	-9.20E-10
HTP-nc*[2]	CTUh	1.27E-06	1.48E-08	1.05E-10	0.00	1.30E-11	0.00	0.00	0.00	0.00	0.00	0.00	1.31E-09	5.43E-09	6.66E-08	-7.72E-08
SQP*[2]	dimensionless	581.95	7.04	1.21E-02	0.00	4.37E-04	0.00	0.00	0.00	0.00	0.00	0.00	0.63	8.67	1.75	-9.41

Key:
PM – particulate matter emissions potential **IRP*[1]** – ionizing radiation potential – human health **ETP-fw*[2]** - Ecotoxicity potential – freshwater **HTP-c*[2]** - Human toxicity potential – cancer effects **HTP-nc*[2]** - Human toxicity potential – non-cancer effects **SQP*[2]** – soil quality potential

Disclaimers:

*1 This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

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

Results per 1 m² Laminated safety glass triple (LSG 6-10-6)																
	Unit	**A1-A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Core indicators																
GWP-t	kg CO_2 equivalent	176.89	1.74	8.17E-02	0.00	7.70E-04	0.00	0.00	0.00	0.00	0.00	0.00	0.15	3.76	0.62	-10.30
GWP-f	kg CO_2 equivalent	172.78	1.73	7.55E-02	0.00	7.63E-04	0.00	0.00	0.00	0.00	0.00	0.00	0.15	3.74	0.64	-10.30
GWP-b	kg CO_2 equivalent	4.38	-6.36E-03	6.24E-03	0.00	6.37E-06	0.00	0.00	0.00	0.00	0.00	0.00	-5.64E-04	1.97E-02	-2.13E-02	-3.66E-02
GWP-l	kg CO_2 equivalent	7.96E-02	1.03E-02	1.65E-06	0.00	6.47E-08	0.00	0.00	0.00	0.00	0.00	0.00	9.17E-04	1.91E-04	1.99E-03	-1.39E-03
ODP	kg CFC-11-eq.	5.59E-09	3.02E-13	2.69E-14	0.00	1.18E-15	0.00	0.00	0.00	0.00	0.00	0.00	2.68E-14	3.07E-11	1.63E-12	-3.60E-11
AP	mol H^+-eq.	1.27	1.75E-03	1.47E-05	0.00	8.17E-07	0.00	0.00	0.00	0.00	0.00	0.00	1.55E-04	2.46E-03	4.54E-03	-5.59E-02
EP-fw	kg P-eq.	7.64E-04	4.03E-06	6.85E-09	0.00	3.47E-09	0.00	0.00	0.00	0.00	0.00	0.00	3.57E-07	6.73E-06	1.29E-06	-9.94E-06
EP-m	kg N-eq.	0.25	6.12E-04	3.52E-06	0.00	2.80E-07	0.00	0.00	0.00	0.00	0.00	0.00	5.43E-05	7.93E-04	1.17E-03	-1.63E-02
EP-t	mol N-eq.	2.89	7.21E-03	6.86E-05	0.00	2.86E-06	0.00	0.00	0.00	0.00	0.00	0.00	6.40E-04	9.41E-03	1.29E-02	-0.19
POCP	kg NMVOC-eq.	0.71	1.53E-03	9.62E-06	0.00	1.30E-06	0.00	0.00	0.00	0.00	0.00	0.00	1.35E-04	1.95E-03	3.54E-03	-3.41E-02
ADPF*²	MJ	3093.10	23.40	4.03E-02	0.00	2.30E-02	0.00	0.00	0.00	0.00	0.00	0.00	2.08	16.30	8.52	-170.00
ADPE*²	kg Sb equivalent	2.36E-05	1.22E-07	2.10E-10	0.00	2.29E-11	0.00	0.00	0.00	0.00	0.00	0.00	1.09E-08	2.05E-07	2.95E-08	-3.61E-07
WDP*²	m^3 world-eq. deprived	13.16	8.99E-03	7.81E-03	0.00	2.77E-04	0.00	0.00	0.00	0.00	0.00	0.00	7.97E-04	0.30	7.03E-02	-0.54
Resource management																
PERE	MJ	1494.44	1.52	0.73	0.00	6.07E-04	0.00	0.00	0.00	0.00	0.00	0.00	0.13	14.90	1.39	-20.90
PERM	MJ	0.72	0.00	-0.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PERT	MJ	1495.16	1.52	1.33E-02	0.00	6.07E-04	0.00	0.00	0.00	0.00	0.00	0.00	0.13	14.90	1.39	-20.90
PENRE	MJ	2974.08	23.40	0.65	0.00	2.30E-02	0.00	0.00	0.00	0.00	0.00	0.00	2.08	51.82	91.42	-170.00
PENRM	MJ	119.02	0.00	-0.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-35.52	-82.89	0.00
PENRT	MJ	3093.10	23.40	4.03E-02	0.00	2.30E-02	0.00	0.00	0.00	0.00	0.00	0.00	2.08	16.30	8.53	-170.00
SM	kg	3.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RSF	MJ	8.08E-20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NRSF	MJ	9.49E-19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FW	m^3	0.71	1.38E-03	1.87E-04	0.00	2.04E-04	0.00	0.00	0.00	0.00	0.00	0.00	1.22E-04	1.15E-02	2.15E-03	-2.51E-02
Categories of waste																
HWD	kg	2.79E-06	6.28E-11	-7.07E-13	0.00	2.75E-12	0.00	0.00	0.00	0.00	0.00	0.00	5.57E-12	-3.04E-09	1.86E-10	-1.93E-08
NHWD	kg	90.46	3.42E-03	7.64E-03	0.00	6.77E-05	0.00	0.00	0.00	0.00	0.00	0.00	3.03E-04	7.05E-02	42.60	-1.10
RWD	kg	0.10	2.45E-05	1.36E-06	0.00	6.37E-08	0.00	0.00	0.00	0.00	0.00	0.00	2.17E-06	1.54E-03	9.72E-05	-3.92E-03
Output material flows																
CRU	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MFR	kg	31.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.10	0.00	0.00
MER	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EEE	MJ	3.71	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.41	0.00	0.00
EET	MJ	8.65	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.10	0.00	0.00

Key:
GWP-t – Global warming potential – total **GWP-f** – global warming potential fossil fuels **GWP-b** – global warming potential - biogenic **GWP-l** – global warming potential - land use and land use change **ODP** – ozone depletion potential **AP** - acidification potential **EP-fw** - eutrophication potential - aquatic freshwater **EP-m** - eutrophication potential - aquatic marine **EP-t** - feutrophication potential - terrestrial **POCP** - photochemical ozone formation potential **ADPF*²** - abiotic depletion potential – fossil resources **ADPE*²** - abiotic depletion potential –minerals&metals **WDP*²** – Water (user) deprivation potential **PERE** - Use of renewable primary energy **PERM** - use of renewable primary energy resources **PERT** - total use of renewable primary energy resources **PENRE** - use of non-renewable primary energy **PENRM** - use of non-renewable primary energy resources **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 **HWD** - hazardous waste disposed **NHWD** - non-hazardous waste disposed **RWD** - radioactive waste disposed **CRU** - components for re-use **MFR** - materials for recycling **MER** - materials for energy recovery **EEE** - exported electrical energy **EET** - exported thermal energy

Results per 1 m² Laminated safety glass triple (LSG 6-10-6)																
	Unit	**A1-A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Additional environmental impact indicators																
PM	Disease incidence	1.16E-05	1.14E-08	1.56E-10	0.00	6.17E-12	0.00	0.00	0.00	0.00	0.00	0.00	1.01E-09	1.75E-08	5.58E-08	-3.27E-07
IRP*[1]	kBq U235-eq.	10.95	2.53E-03	1.43E-04	0.00	6.73E-06	0.00	0.00	0.00	0.00	0.00	0.00	2.24E-04	0.16	1.12E-02	-0.59
ETP-fw*[2]	CTUe	4546.90	17.40	1.31E-02	0.00	9.00E-03	0.00	0.00	0.00	0.00	0.00	0.00	1.55	6.68	4.65	-157.00
HTP-c*[2]	CTUh	1.02E-07	3.48E-10	1.22E-12	0.00	2.54E-13	0.00	0.00	0.00	0.00	0.00	0.00	3.09E-11	3.31E-10	7.16E-10	-1.36E-09
HTP-nc*[2]	CTUh	1.65E-06	1.75E-08	1.05E-10	0.00	1.30E-11	0.00	0.00	0.00	0.00	0.00	0.00	1.55E-09	7.59E-09	7.87E-08	-9.90E-08
SQP*[2]	dimensionless	740.26	8.32	1.21E-02	0.00	4.37E-04	0.00	0.00	0.00	0.00	0.00	0.00	0.74	10.40	2.07	-14.80

Key:
PM – particulate matter emissions potential **IRP*[1]** – ionizing radiation potential – human health **ETP-fw*[2]** - Ecotoxicity potential – freshwater **HTP-c*[2]** - Human toxicity potential – cancer effects **HTP-nc*[2]** - Human toxicity potential – non-cancer effects **SQP*[2]** – soil quality potential

Disclaimers:

*1 This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

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

Results per 1 m² Laminated safety glass triple (LSG 6-6-6) printed																
	Unit	**A1-A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Core indicators																
GWP-t	kg CO_2 equivalent	186.02	1.46	0.13	0.00	7.70E-04	0.00	0.00	0.00	0.00	0.00	0.00	0.13	3.74	0.52	-9.73
GWP-f	kg CO_2 equivalent	181.62	1.46	0.13	0.00	7.63E-04	0.00	0.00	0.00	0.00	0.00	0.00	0.13	3.73	0.54	-9.70
GWP-b	kg CO_2 equivalent	4.56	-5.36E-03	6.24E-03	0.00	6.37E-06	0.00	0.00	0.00	0.00	0.00	0.00	-4.76E-04	1.66E-02	-1.79E-02	-3.09E-02
GWP-l	kg CO_2 equivalent	6.92E-02	8.71E-03	2.75E-06	0.00	6.47E-08	0.00	0.00	0.00	0.00	0.00	0.00	7.72E-04	1.64E-04	1.68E-03	-1.13E-03
ODP	kg CFC-11-eq.	2.93E-07	2.55E-13	4.42E-14	0.00	1.18E-15	0.00	0.00	0.00	0.00	0.00	0.00	2.26E-14	2.59E-11	1.37E-12	-1.52E-08
AP	mol H^+-eq.	1.11	1.47E-03	2.34E-05	0.00	8.17E-07	0.00	0.00	0.00	0.00	0.00	0.00	1.31E-04	2.24E-03	3.82E-03	-4.80E-02
EP-fw	kg P-eq.	8.91E-04	3.39E-06	1.13E-08	0.00	3.47E-09	0.00	0.00	0.00	0.00	0.00	0.00	3.01E-07	5.70E-06	1.09E-06	-8.98E-06
EP-m	kg N-eq.	0.22	5.16E-04	5.46E-06	0.00	2.80E-07	0.00	0.00	0.00	0.00	0.00	0.00	4.57E-05	7.20E-04	9.88E-04	-1.38E-02
EP-t	mol N-eq.	2.54	6.08E-03	1.09E-04	0.00	2.86E-06	0.00	0.00	0.00	0.00	0.00	0.00	5.39E-04	8.73E-03	1.09E-02	-0.16
POCP	kg NMVOC-eq.	0.65	1.29E-03	1.49E-05	0.00	1.30E-06	0.00	0.00	0.00	0.00	0.00	0.00	1.14E-04	1.78E-03	2.98E-03	-3.03E-02
ADPF*²	MJ	3162.50	19.80	6.63E-02	0.00	2.30E-02	0.00	0.00	0.00	0.00	0.00	0.00	1.75	13.90	7.18	-160.00
ADPE*²	kg Sb equivalent	2.39E-05	1.03E-07	3.46E-10	0.00	2.29E-11	0.00	0.00	0.00	0.00	0.00	0.00	9.15E-09	1.73E-07	2.49E-08	-3.11E-07
WDP*²	m^3 world-eq. deprived	11.79	7.58E-03	1.26E-02	0.00	2.77E-04	0.00	0.00	0.00	0.00	0.00	0.00	6.72E-04	0.31	5.92E-02	-0.46
Resource management																
PERE	MJ	1606.31	1.28	0.74	0.00	6.07E-04	0.00	0.00	0.00	0.00	0.00	0.00	0.11	12.60	1.17	-18.60
PERM	MJ	0.72	0.00	-0.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PERT	MJ	1607.03	1.28	2.18E-02	0.00	6.07E-04	0.00	0.00	0.00	0.00	0.00	0.00	0.11	12.60	1.17	-18.60
PENRE	MJ	3036.32	19.80	0.68	0.00	2.30E-02	0.00	0.00	0.00	0.00	0.00	0.00	1.75	51.57	95.09	-160.00
PENRM	MJ	126.18	0.00	-0.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-37.67	-87.90	0.00
PENRT	MJ	3162.50	19.80	6.64E-02	0.00	2.30E-02	0.00	0.00	0.00	0.00	0.00	0.00	1.75	13.90	7.19	-160.00
SM	kg	2.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RSF	MJ	6.61E-20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NRSF	MJ	7.77E-19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FW	m^3	0.66	1.16E-03	3.02E-04	0.00	2.04E-04	0.00	0.00	0.00	0.00	0.00	0.00	1.03E-04	1.10E-02	1.81E-03	-1.97E-02
Categories of waste																
HWD	kg	2.25E-06	5.29E-11	-1.21E-12	0.00	2.75E-12	0.00	0.00	0.00	0.00	0.00	0.00	4.69E-12	-2.56E-09	1.56E-10	-1.49E-08
NHWD	kg	75.22	2.88E-03	1.28E-02	0.00	6.77E-05	0.00	0.00	0.00	0.00	0.00	0.00	2.56E-04	7.15E-02	35.90	-0.90
RWD	kg	0.12	2.07E-05	2.23E-06	0.00	6.37E-08	0.00	0.00	0.00	0.00	0.00	0.00	1.83E-06	1.30E-03	8.19E-05	-3.58E-03
Output material flows																
CRU	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MFR	kg	26.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.20	0.00	0.00
MER	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EEE	MJ	3.83	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.68	0.00	0.00
EET	MJ	8.90	0.00	0.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.70	0.00	0.00

Key:
GWP-t – Global warming potential – total **GWP-f** – global warming potential fossil fuels **GWP-b** – global warming potential - biogenic **GWP-l** – global warming potential - land use and land use change **ODP** – ozone depletion potential **AP** - acidification potential **EP-fw** - eutrophication potential - aquatic freshwater **EP-m** - eutrophication potential - aquatic marine **EP-t** - feutrophication potential - terrestrial **POCP** - photochemical ozone formation potential **ADPF*²** - abiotic depletion potential – fossil resources **ADPE*²** - abiotic depletion potential –minerals&metals **WDP*²** – Water (user) deprivation potential **PERE** - Use of renewable primary energy **PERM** - use of renewable primary energy resources **PERT** - total use of renewable primary energy resources **PENRE** - use of non-renewable primary energy **PENRM** - use of non-renewable primary energy resources **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 **HWD** - hazardous waste disposed **NHWD** - non-hazardous waste disposed **RWD** - radioactive waste disposed **CRU** - components for re-use **MFR** - materials for recycling **MER** - materials for energy recovery **EEE** - exported electrical energy **EET** - exported thermal energy

Results per 1 m² Laminated safety glass triple (LSG 6-6-6) printed

	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Additional environmental impact indicators																
PM	Disease incidence	9.97E-06	9.63E-09	2.55E-10	0.00	6.17E-12	0.00	0.00	0.00	0.00	0.00	0.00	8.55E-10	1.57E-08	4.70E-08	-2.83E-07
IRP*[1]	kBq U235-eq.	12.16	2.13E-03	2.36E-04	0.00	6.73E-06	0.00	0.00	0.00	0.00	0.00	0.00	1.89E-04	0.14	9.47E-03	-0.52
ETP-fw*[2]	CTUe	3883.30	14.70	2.15E-02	0.00	9.00E-03	0.00	0.00	0.00	0.00	0.00	0.00	1.30	5.68	3.92	-130.00
HTP-c*[2]	CTUh	9.17E-08	2.93E-10	2.02E-12	0.00	2.54E-13	0.00	0.00	0.00	0.00	0.00	0.00	2.60E-11	2.85E-10	6.03E-10	-1.20E-09
HTP-nc*[2]	CTUh	1.61E-06	1.47E-08	1.75E-10	0.00	1.30E-11	0.00	0.00	0.00	0.00	0.00	0.00	1.31E-09	6.76E-09	6.63E-08	-8.06E-08
SQP*[2]	dimensionless	781.69	7.02	1.98E-02	0.00	4.37E-04	0.00	0.00	0.00	0.00	0.00	0.00	0.62	8.80	1.74	-13.10

Key:
PM – particulate matter emissions potential **IRP*[1]** – ionizing radiation potential – human health **ETP-fw*[2]** - Ecotoxicity potential – freshwater **HTP-c*[2]** - Human toxicity potential – cancer effects **HTP-nc*[2]** - Human toxicity potential – non-cancer effects **SQP*[2]** – soil quality potential

Disclaimers:

*1 This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

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

6.4 Interpretation, LCA presentation and critical review

Evaluation

The environmental impacts of

- Laminated safety glass double (LSG 10-10)
- Laminated safety glass triple (LSG 6-10-6)
- Laminated safety glass triple (LSG 6-6-6)

differ noticeably from each other. The differences lie primarily in the varying use of the amount of float glass and the varying use of lamination film in terms of plastic and material thickness. This results in significantly different product weights. This was to be expected in particular due to the different glass thicknesses and different numbers of panes per product group.

In the area of production, the environmental impacts for all the laminated safety glass analysed are essentially caused by the use of float glass and its upstream chains. Due to internal further processing into thermally toughened safety glass by means of thermal treatment, a relevant proportion of the environmental impact is still attributable to electricity requirements. As additional energy is used for the printing process for LSG 6-6-6, the energy consumption is highest here. The use of Sentryglass film and/or PVB foil accounts for a marginal proportion of the environmental impact.
For the utilisation phase, an identical amount of environmental impact is attributable exclusively to cleaning during the 30-year service life and does not represent a significant proportion of the total environmental impact.

In scenario C4, only marginal expenditures for the physical pretreatment and the landfill operation are to be expected, as all product groups are predominantly inert substances for disposal.
For glass recycling (downcycling to container glass), 3.4 % for LSG 10-10, 3.0 % for LSG 6-10-6 and 2.6 % for LSG 6-6-6 of the life cycle environmental impacts of the core indicators without WDP in scenario D can be credited. Sentryglass film and PVB foil each account for less than 1%.

The charts below show the allocation of the main environmental impacts.

The values obtained from the LCA calculation are suitable for the certification of buildings.

Diagrams

These diagrams below show the B modules with reference to the specified RSL.

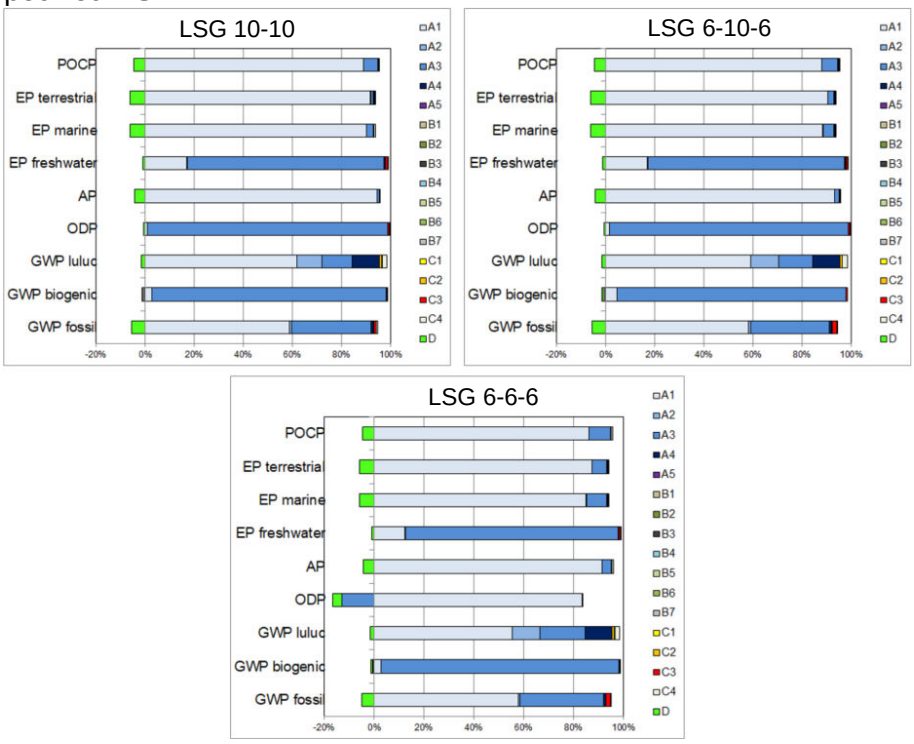


Illustration 2 Percentage of the modules in selected environmental impact indicators

Report

The LCA report underlying this EPD was developed according to the requirements of DIN EN ISO 14040 and DIN EN ISO 14044 as well as DIN EN 15804 and DIN EN ISO 14025. It is deposited with ift Rosenheim. The results and conclusions reported to the target group are complete, correct, without bias and transparent. The results of the study are not designed to be used for comparative statements intended for publication.

Critical review

The critical review of the LCA and of the report took place in the course of verification of the EPD and was carried out by the internal auditor Benedikt Dellawalle, M.Sc.

7 General information regarding the EPD

Comparability

This EPD was prepared in accordance with DIN EN 15804 and is therefore only comparable to those EPDs that also comply with the requirements set out in DIN EN 15804.
Any comparison must refer to the building context and the same boundary conditions of the various life cycle stages.
For comparing EPDs of construction products, the rules set out in DIN EN 15804, Clause 5.3, apply.

Communication

The communications format of this EPD meets the requirements of EN 15942:2012 and is therefore the basis for B2B communication. Only the nomenclature has been changed according to DIN EN 15804.

Verification

Verification of the Environmental Product Declaration is documented in accordance with the ift "Richtlinie zur Erstellung von Typ III Umweltproduktdeklarationen" (Guidance on preparing Type III Environmental Product Declarations) in accordance with the requirements set out in DIN EN ISO 14025.

This declaration is based on PCR documents "PCR Part A" PCR-A-0.3-2018, "Flat glass in building industry" PCR-FG-2.0:2021 as well as EN 17074 "PCR for flat glass products".

The European standard EN 15804 serves as the core PCR [a)]
Independent verification of the Declaration and statement according to EN ISO 14025:2010 ☒ internal ☐ external
Independent third party verifier: [b)] Benedikt Dellawalle
[a)] Product category rules [b)] Optional for business-to-business communication Mandatory for business-to-consumer communication (see EN ISO 14025:2010, 9.4).

Revisions of this document

No.	Date	Note	Person in charge	Testing personnel
1	24.10.2023	Internal test	Pscherer	Dellawalle

8 Bibliography

1. **PCR Part A.** *Product category rules for environmental product declarations as per EN ISO 14025 and EN 15804.* Rosenheim: ift Rosenheim, 2018.
2. **ift-Guideline NA-01/3.** *General guideline for preparation of Type III Environmental Product Declarations* Rosenheim: ift Rosenheim GmbH, 2015.
3. **Klöpffer, W und Grahl, B.** *Ökobilanzen (LCA).* Weinheim: Wiley-VCH-Verlag, 2009.
4. **Eyerer, P. und Reinhardt, H.-W.** *Ökologische Bilanzierung von Baustoffen und Gebäuden - Wege zu einer ganzheitlichen Bilanzierung. (LCA of building materials and buildings - Routes to integrated LCA).* Basel: Birkhäuser Verlag, 2000.
5. **Gefahrstoffverordnung - GefStoffV. (Hazardous substances regulation).** *Verordnung zum Schutz vor Gefahrstoffen (Regulation on protection against hazardous substances).* Berlin: BGBI. (Federal Gazette) I S. 3758, 2017.
6. **Chemikalien-Verbotsverordnung - ChemVerbotsV. (Chemicals Prohibition Regulation).** *Verordnung über Verbote und Beschränkungen des Inverkehrbringens gefährlicher Stoffe, Zubereitungen und Erzeugnisse Chemikaliengesetz (Regulation on bans and restrictions of the placing on the market of hazardous substances, formulations and products covered by the Chemicals Law).* Berlin: BGBI. (Federal Gazette) I S. 1328, 2017.
7. **DIN EN ISO 14040:2018-05.** *Environmental management - Life cycle assessment - Principles and framework.* Berlin: Beuth Verlag GmbH, 2018.
8. **DIN EN ISO 14044:2006-10.** *Environmental management - Life cycle assessment - Requirements and guidelines.* Berlin: Beuth Verlag GmbH, 2006.
9. **EN ISO 14025:2011-10.** *Environmental labels and declarations - Type III environmental declarations - Principles and procedures.* Berlin: Beuth Verlag GmbH, 2011.
10. **OENORM S 5200:2009-04-01.** *Radioactivity in construction materials.* Berlin: Beuth Verlag GmbH, 2009.
11. **PCR Part B - Flat glass in building.** *Product category rules for environmental product declarations as per EN ISO 14025 and EN 15804.* Rosenheim: ift Rosenheim, 2016.
12. **EN 15942:2012-01.** *Sustainability of construction works - Environmental product declarations - Communication format business-to-business.* Berlin: Beuth Verlag GmbH, 2012.
13. **Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety).** *Leitfaden Nachhaltiges Bauen (Guidance on Sustainable Building).* Berlin: s.n., 2016.
14. **DIN EN 13501-1:2010-01.** *Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests.* Berlin: Beuth Verlag GmbH, 2010.
15. **ISO 21930:2017-07.** *Sustainability in building construction - Environmental declaration of building products.* Berlin: Beuth Verlag, 2017.
16. **Bundesimmissionsschutzgesetz - BImSchG. (Federal Immission Law).** *Gesetz zum Schutz vor schädlichen Umwelteinwirkungen durch Luftverunreinigungen, Geräusche, Erschütterungen und ähnlichen Vorgängen (Law on harmful environmental impacts by air contamination, noise, vibrations and similar processes).* Berlin: BGBI. (Federal Gazette) I S. 3830, 2017.
17. **Chemikaliengesetz – ChemG (Chemicals Act).** *Law on protection against hazardous substances - Subdivided into Chemicals Law and a series of regulations; of relevance here: Law on protection against hazardous substances.* Berlin: BGBI. (Federal Gazette) I S. 1146, 2017.
18. **IKP Universität Stuttgart and PE Europe GmbH.** *GaBi 8: Software and database for LCA.* Leinfelden-Echterdingen: s.n., 2017.
19. **Research project.** *"EPDs für transparente Bauelemente" (EPDs for transparent building components) - Final report.* Rosenheim: ift Rosenheim GmbH, 2011. SF-10.08.18.7-09.21/II 3-F20-09-1-067.
20. **DIN EN ISO 12457- Parts 1-4 :2003-01.** *Characterization of waste - Leaching; Compliance test for leaching of granular waste materials and sludges - Part 1-4:* Berlin: Beuth Verlag GmbH, 2003.
21. **DIN EN 12457 - Parts 1-4:2003-01.** *Characterization of waste - Leaching; Compliance test for leaching of granular waste materials and sludges - Part 1-4:* Berlin: Beuth Verlag GmbH, 2003.
22. **Federal Environmental Agency.** *TEXTS 151/2021 - Promoting high-quality recycling of plastic waste from demolition waste and strengthening the use of recycled materials in construction products in line with the European Plastics Strategy.* Dessau-Roßlau: Federal Environmental Agency, 2021. Vol. ISSN 1862-4804.
23. **ift Rosenheim GmbH.** *Conditions and Guidance for the Use of ift Test Documents.* Rosenheim: s.n., 2016.
24. **DIN EN 17074.** *Glass in building - Environmental product declaration - Product category rules for flat glass products.* Berlin: Beuth Verlag GmbH, 2020.
25. **DIN EN ISO 16000 Parts 6, 9 11.** *Indoor air: Determination of the emission of volatile organic compounds from building products and furnishing.* Berlin: Beuth Verlag GmbH, 2012, 2008, 2006.
26. **DIN EN 15804:2012+A2:2019+AC:2021.** *Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products:* Berlin: Beuth Verlag GmbH, 2022.

9 Annex

Description of life cycle scenarios for GlasCobond® (with SG Interlayer) as well as sedak safety glass (with PVB or mixed interlayer)

Product stage			Cons-truction process stage		Use stage*							End-of-life stage				Benefits and loads beyond system boundaries
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw material supply	Transport	production	Transport	Construction/installation process	Use	maintenance	Repair	replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction/demolition	Transport	Waste processing	Disposal	Reuse Recovery Recycling potential
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

* For declared B-modules, the calculation of the results is performed taking into account the specified RSL related to one year

Table 5 Overview of applied life cycle stages

The scenarios were calculated taking into account the defined RSL (see 4 Use stage).

The scenarios were furthermore based on the research project “EPDs for transparent building components” (1) and on standard EN 17074 (2).

Note: The standard scenarios selected are presented in bold type. They were also used for calculating the indicators in the summary table.

✓ Included in the LCA
— Not included in the LCA

A4 Transport to construction site

No.	Scenario	Description
A4	Large-scale project	40 t truck, 150 km fully loaded there and 150 km empty back, total 300 km.

[1] Capacity used: utilized loading capacity of the truck

A4 Transport to construction site	Transport weight [kg/m²]	Density [kg/m³]	Capacity load factor[2]
LSG 10-10	258.04	2390.5	< 1
LSG 6-10-6	68.55	2164.4	< 1
LSG 6-6-6	57.82	2128.3	< 1

[2] Capacity load factor:
= 1 Product completely fills the packaging (without air inclusion)
< 1 Packaging contains unused volume (e.g.: air, filling material)
> 1 Product is packed in compressed form

Since this is a single scenario, the results are shown in the relevant summary table.

A5 Construction/Installation

No.	Scenario	Description
A5	Manual	The products are installed without additional lifting and auxiliary equipment. According to EN 17074, the glass products are delivered in the final configuration and ready for installation.

In case of deviating consumption the installation of the products forms part of site management and is covered at the building level.

Ancillary materials, consumables, use of energy and water, other resource use, material losses, direct emissions as well as waste during construction / installation are negligible.

It is assumed that the packaging material in the Module construction / installation is sent to waste handling. Waste is only thermally recycled in line with the conservative approach: Films/casings and carton in incineration plants. Benefits from A5 are specified in module D. Benefits from waste incineration: Electricity replaces electricity mix (DE); thermal energy replaces thermal energy from natural gas (DE).
Transport to the recycling plants is not taken into account.

Since this is a single scenario, the results are shown in the summary table.

B1 Use (not relevant)
According to EN 17074, the use of glass products in buildings does not generate any environmental impact.

B2 Cleaning, maintenance and repair

B2.1 Cleaning

No.	Scenario	Description
B2.1	**Rarely, manual**	**According to EN 17074: Manually with 0.2 l cleaning solution (0.2 l water with 0.01 l cleaner) per m², annually.**

Ancillary materials, consumables, use of energy, material losses and waste as well as transport distances during cleaning are negligible.

Since this is a single scenario, the results are shown in the summary table.

B2.2 Maintenance and repair (not relevant)
According to EN 17074, glass products do not require maintenance activities during their service life.

For updated information refer to the relevant manufacturer "*instructions for assembly/installation, operation and maintenance".*

Ancillary materials, consumables, use of energy and water, material losses and waste as well as transport distances during maintenance are negligible.

Since this is a single scenario, the results are shown in the summary table.

B3 Repair (not relevant)
According to EN 17074, glass products do not require repair activities during their service life.

Ancillary materials, consumables, use of energy and water, waste, material losses and transport distances during repair are negligible.

Since this is a single scenario, the results are shown in the summary table.

B4 Exchange / Replacement

No.	Scenario	Description
B4.1	**No replacement**	**According to EN 17074, a replacement is not planned.**
B4.2	Normal and high load and exceptional load	One-time replacement after 30 years (RSL)*.

* Assumptions for evaluation of possible environmental impacts; statements made do not constitute any guaranty or warranty of performance.

According to EN 17074, glass products do not require exchange activities during their service life (30 years). Regarding the assumed 50-year building service life, the one-off replacement is considered in a second scenario.

For updated information refer to the relevant manufacturer "*instructions for assembly/installation, operation and maintenance".*

The environmental impacts of the scenario B4.2 originate from the product, construction and disposal phases.
Ancillary materials, consumables, use of energy and water, material losses, waste as well as transport distances during replacement are taken into account.

In the following table, the results were based on one year, taking into account the RSL.

B4 Exchange / Replacement	Unit	for all LSG	LSG 10-10	LSG 6-10-6	LSG 6-6-6
		B4.1	B4.2	B4.2	B4.2
Core indicators					
GWP-t	kg CO_2 equivalent	**0.00**	4.52	5.76	6.08
GWP-f	kg CO_2 equivalent	**0.00**	4.38	5.63	5.93
GWP-b	kg CO_2 equivalent	**0.00**	0.13	0.14	0.15
GWP-l	kg CO_2 equivalent	**0.00**	2.60E-03	3.05E-03	2.64E-03
ODP	kg CFC-11-eq.	**0.00**	1.47E-10	1.86E-10	9.27E-09
AP	mol H^+-eq.	**0.00**	3.60E-02	4.06E-02	3.55E-02
EP-fw	kg P-eq.	**0.00**	1.93E-05	2.56E-05	2.97E-05
EP-m	kg N-eq.	**0.00**	6.71E-03	7.74E-03	6.92E-03
EP-t	mol N-eq.	**0.00**	7.89E-02	9.12E-02	8.04E-02
POCP	kg NMVOC-eq.	**0.00**	1.95E-02	2.28E-02	2.09E-02
ADPF	MJ	**0.00**	74.96	99.11	101.51
ADPE	kg Sb equivalent	**0.00**	6.37E-07	7.87E-07	7.98E-07
WDP	m^3 world-eq. deprived	**0.00**	0.36	0.43	0.39
Resource management					
PERE	MJ	**0.00**	39.31	49.74	53.45
PERM	MJ	**0.00**	0.00	0.00	0.00
PERT	MJ	**0.00**	39.31	49.74	53.45
PENRE	MJ	**0.00**	75.30	99.12	101.51
PENRM	MJ	**0.00**	0.00	-4.74E-16	0.00
PENRT	MJ	**0.00**	75.30	99.12	101.51
SM	kg	**0.00**	0.10	0.11	9.23E-02
RSF	MJ	**0.00**	2.45E-21	2.69E-21	2.20E-21
NRSF	MJ	**0.00**	2.88E-20	3.16E-20	2.59E-20
FW	m^3	**0.00**	1.74E-02	2.34E-02	2.17E-02
Categories of waste					
HWD	kg	**0.00**	8.28E-08	9.23E-08	7.46E-08
NHWD	kg	**0.00**	3.87	4.40	3.68
RWD	kg	**0.00**	2.66E-03	3.40E-03	3.79E-03
Output material flows					
CRU	kg	**0.00**	0.00	0.00	0.00
MFR	kg	**0.00**	1.42	1.61	1.35
MER	kg	**0.00**	0.00	0.00	0.00
EEE	MJ	**0.00**	0.16	0.27	0.29
EET	MJ	**0.00**	0.38	0.63	0.67
Additional environmental impact indicators					
PM	Disease incidence	**0.00**	3.34E-07	3.78E-07	3.25E-07
IRP	kBq U235-eq.	**0.00**	0.27	0.35	0.39
ETPfw	CTUe	**0.00**	128.98	147.34	125.96
HTPc	CTUh	**0.00**	2.89E-09	3.40E-09	3.06E-09
HTPnc	CTUh	**0.00**	4.26E-08	5.51E-08	5.39E-08
SQP	dimensionless	**0.00**	19.69	24.90	26.23

B5 Improvement/modernisation (not relevant)
According to EN 17074, glass products do not require renewal activities during their service life.

For updated information refer to the relevant manufacturer “instructions for assembly/installation, operation and maintenance”.

Ancillary materials, consumables, use of energy and water, material losses, waste as well as transport distances during replacement are negligible.

Since this is a single scenario, the results are shown in the summary table.

B6 Operational energy use (not relevant)
According to EN 17074, there is no energy consumption during normal use.

There is no transport consumption for energy use in buildings. Ancillary materials, consumables and water, waste materials and other scenarios are negligible.

Since this is a single scenario, the results are shown in the summary table.

B7 Operational water use (not relevant)
According to EN 17074, no water consumption occurs during intended operation. Water consumption for cleaning is specified in Module B2.1.

There is no transport consumption for water use in buildings. Ancillary materials, consumables, waste materials and other scenarios are negligible.

Since this is a single scenario, the results are shown in the summary table.

C1 Deconstruction

No.	Scenario	Description
C1	**Deconstruction**	**According to EN 17074 (9.8.4 Disposal phase (C1 to C4)):** • **Glass 30 % deconstruction, 70 % residues (landfill)** **Further deconstruction rates are possible, give adequate reasons.**

No relevant inputs or outputs apply to the scenario selected. The energy consumed for deconstruction is negligible. Any arising consumption is marginal.

In case of deviating consumption the removal of the products forms part of site management and is covered at the building level.

Since this is a single scenario, the results are shown in the summary table.

C2 Transport

No.	Scenario	Description
C2	Transport	**Transport to collection point with 40 t truck (Euro 0-6 Mix), diesel, 27 t payload, 50 % capacity used, 100 km**. (1)

Since this is a single scenario, the results are shown in the relevant summary table.

C3 Waste management

No.	Scenario	Description
C3	Current market situation	**Share for recirculation of materials:** • **100% glass in melt** (EN 17074) • **Plastics 66 % thermal recycling in incineration plants** (Zukunft Bauen, 2017) • **Plastics 34 % recycled** (Zukunft Bauen, 2017)

Electricity consumption of recycling plant: 0.5 MJ/kg.

As the products are mainly sold within Germany, the disposal scenario was based on average data rates for Germany.

The below table presents the disposal processes and their percentage by mass/weight. The calculation is based on the above mentioned shares in percent related to the declared unit of the product system.

C3 Disposal	Unit	LSG 10-10	LSG 6-10-6	LSG 6-6-6
Collection process, collected separately	kg	15.43	18.23	15.38
Collection process, collected as mixed construction waste	kg	36.01	42.54	35.88
Recovery system, for re-use	kg	0.00	0.00	0.00
Recovery system, for recycling	kg	15.15	17.09	14.13
Recovery system, for energy recovery	kg	0.29	1.14	1.21
Disposal	kg	36.01	42.54	35.88

The 100% scenarios differ from the current average recovery shown here (in background report C3.1). The evaluation of each scenario is described in the background report.

Since this is a single scenario, the results are shown in the summary table.

C4 Disposal		
No.	**Scenario**	**Description**
C4	**Disposal**	**The non-recordable amounts and losses within the re-use/recycling chain (C1 and C3) are modelled as "disposed" (DE).**

The 100% scenarios differ from the current average recovery shown here (in background report C4.1). The evaluation of each scenario is described in the background report.

The consumption in scenario C4 results from physical pre-treatment, waste recycling and management of the disposal site. The benefits obtained here from the substitution of primary material production are allocated to Module D, e.g. electricity and heat from waste incineration.

Since this is a single scenario, the results are shown in the summary table.

D Benefits and loads from beyond the system boundaries		
No.	**Scenario**	**Description**
D	**Recycling potential**	**Glass shards from C3 excluding the glass shards used in A3 replace 60% of container glass; Sentryglass recyclate from C3 excluding the Sentryglass recyclate used in A3 replaces 60% of Sentryglass; PVB recyclate from C3 excluding the PVB recyclate used in A3 replaces 60% of PVB;** **Benefits from incineration plant: Electricity replaces electricity mix (DE); thermal energy replaces thermal energy from natural gas (DE).**

The values in Module D result from recycling of the packaging material in Module A5 and from deconstruction at the end of service life.

The 100% scenarios differ from the current average recovery shown here (in background report D1). The evaluation of each scenario is described in the background report.

Since this is a single scenario, the results are shown in the summary table.

Imprint

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Notes
This EPD is mainly based on the work and findings of Institut für Fenstertechnik e.V., Rosenheim (ift Rosenheim) and specifically on ift-Guideline NA-01/3 “Allgemeiner Leitfaden zur Erstellung von Typ III Umweltproduktdeklarationen” (Guidance on preparing Type III Environmental Product Declarations).

Layout
ift Rosenheim GmbH – 2021

Photographs (front page)
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