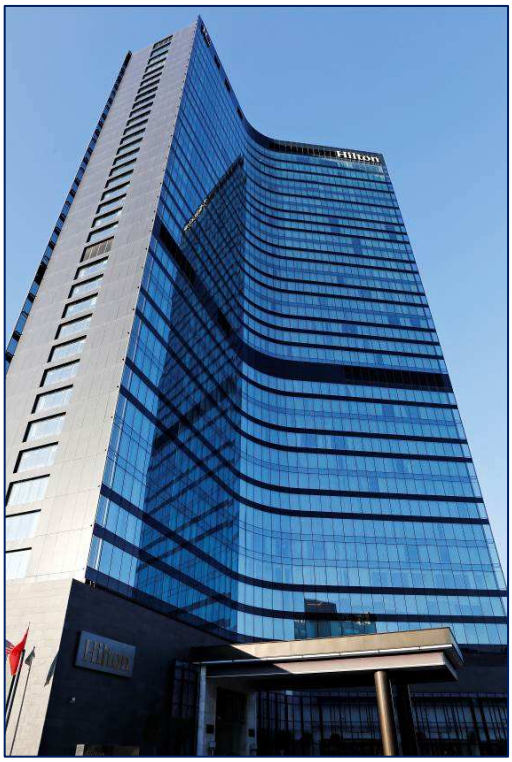
Environmental Product Declaration (EPD)

Declaration code: EPD-GFEV-GB-19.0

Guardian Europe S.à.r.l.

Uncoated flat glass, laminated safety glass and coated flat glass



Basis:

DIN EN ISO 14025
EN 15804

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

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Prüfung und Kalibrierung – EN ISO/IEC 17025
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PÜZ-Stelle: **BAY 18**

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

Environmental Product Declaration (EPD)

Declaration code: EPD-GFEV-GB-19.0

Programme operator	ift Rosenheim GmbH Theodor-Gietl-Straße 7-9 D-83026 Rosenheim
Practitioner of the LCA	ift Rosenheim GmbH Theodor-Gietl-Straße 7-9 D-83026 Rosenheim
Declaration holder	Guardian Europe S.à.r.l. 19, rue du Puits Romain L-8070 Bertrange Luxembourg
Declaration code	EPD-GFEV-GB-19.0
Designation of declared product	Uncoated flat glass, laminated safety glass and coated flat glass – hereinafter “FG and LSG”
Scope	Uncoated flat glass, laminated safety glass and coated flat glass for processing into insulating glass units and for use as glass for building and other works (e.g. bus passenger compartments, sound insulation panels, etc.)
Basis	This EPD was prepared on the basis of EN ISO 14025:2011 and EN 15804:2012+A1:2013. In addition, the “Allgemeiner Leitfaden zur Erstellung von Typ III Umweltproduktdeklarationen” (Guidance on preparing Type III Environmental Product Declarations) applies. This Declaration is based on the PCR Document “Glass in Building” (PCR-FG-1.1: 2013).
Validity	Publication date: 01.07.2016 / Last revision: 01.07.2016 / Next revision: 01.07.2021 This verified Company Environmental Product Declaration applies solely to the specified products and is valid for a period of 5 years from the publication date 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 base data include both the data collected at the Guardian Europe S.à.r.l. production site and the generic data derived from the GaBi ts database. LCA calculations were carried out for the product stage “from cradle to gate” including all upstream processes (e.g. raw material extraction, etc.).
Notes	The “Conditions and Guidance on the Use of ift Test Documents” apply. The declaration holder assumes full liability for the underlying data, certificates and verifications.

Prof. Ulrich Sieberath Director of the Institute	Patrick Wortner, MBA and Eng., Dipl.-Ing. (FH) Independent external verifier

Production sites of Guardian Europe S.à.r.l.			
Site	**Uncoated flat glass**	**Laminated safety glass**	**Coated flat glass**
Guardian Flachglas – *Germany*	x	x	x
Guardian Oroshaza – *Hungary*	x		x
Guardian Bascharage – *Luxembourg*	x		x
Guardian Dudelange – *Luxembourg*	x	x	
Guardian Industries Poland – *Poland*	x	x	x
Guardian Llodio Uno – *Spain*	x		
Guardian Navarra S.L – *Spain*	x	x	x
Guardian Industries UK – *UK*	x	x	x

1 General product information

Product definition

The EPD relates to the product group "flat glass" and applies to the product:

FG and LSG from the company Guardian Europe S.à.r.l.

The LCA was prepared using the declared unit:

1 m^2 area and 1 mm thickness

Directly used material flows are assigned to the functional unit.
All other inputs and outputs of the FG and LSG were scaled to the declared unit since no typical functional unit was available due to the great diversity of variants. The reference period is the year 2014.

Product description

Uncoated flat glass is a clear, flat soda lime silicate glass with parallel surfaces. It is manufactured using the float-glass method.

Laminated safety glass (LSG) consists of at least two sheets of flat glass (coated and/or uncoated) lying one on top of the other, with one or several layers of a tear-resistant, toughened film, usually polyvinyl butyral (PVB), positioned between the panes.

Coated flat glass can be colourless or coloured, depending on the coating used. The coating can also modify the radiation (thermal insulation and/or solar control) properties of the flat glass. This multi-layer system is produced in a vacuum using magnetron sputtering.

For a detailed product description refer to the manufacturer specifications at www.guardian.com or the product descriptions for the desired product.

Product manufacture

Float glass process:	Laminating process:	Coating process:
Raw material - Storage	Loading	Loading
Raw material - Batch mixing	Washing Drying	Washing
Raw material - Charging	Lay-up	Buffer Chamber
Melting furnace - Refining zone	Nip Roll De-airing	Sputtering Chamber
Melting furnace - Cooling zone	Autoclaving	Buffer Chamber
Tin bath - Floating	Quality Control	Quality Control
Annealing Lehr - Cooling	Unloading	Unloading
Cold End Operations - Inspection	Packing	Packing
Cold End Operations - Cutting		
Cold End Operations - Unloading		
Cold End Operations - Packing		

Application

Uncoated flat glass, laminated safety glass and coated flat glass for processing into insulating glass units and for use as glass for building and other works (e.g. bus passenger compartments, sound insulation panels, etc.)

Verifications

The following verifications are held:

- Uncoated flat glass: EN 572
- Laminated safety glass: ISO 12543 and EN 14449
- Coated flat glass: EN 1096

Management systems

The following management systems are in place:

- Quality management system as per DIN EN ISO 9001:2008
- Environmental management system as per DIN EN ISO 14001:2009

Additional information

For detailed building physics characteristics please refer to the CE marking and to the accompanying documents.

The FG and LSG display the required performance characteristics relating to building physics; see:
http://cemarking.eu.guardian.com/CeMarking/Default.aspx

2 Materials used

Primary materials

The primary materials used are listed in the LCA (see Section 7).

Declarable substances

The product contains no substances from the REACH candidate list (flat glass: declaration dated 26 November 2009; coated flat glass: declaration dated 03 May 2012; LSG: declaration dated 26 November 2009).

All relevant safety data sheets are available from Guardian Europe S.à.r.l.

3 Construction process stage

Processing recommendations – installation

Observe the manufacturer's instructions for interim storage, processing, assembly/installation and information on compatibility.

4 Use stage

Emissions to the environment

Uncoated and coated flat glass produce no VOC emissions.
Standard and sound-insulating PVB as used in laminated safety glass produce minimal VOC emissions. Certificates are available from the manufacturer on request.

Reference service life (RSL)

The RSL information was provided by the manufacturer. The RSL shall refer to the declared technical and functional performance of the product within the building. It shall be established in accordance with specific rules set out in the European product standards and shall also take into account ISO 15686-1, -2, -7 and -8. Where European product standards provide guidance on determining RSL, such guidance shall have priority. If it is not possible to determine the service life as the RSL in accordance with ISO 15686, the table "Nutzungsdauern von Bauteilen zur Lebenszyklusanalyse nach BNB" ("Service life of building components for life cycle analysis in accordance with the Sustainable Construction evaluation system" of the German Federal Institute for Research on Building, Urban Affairs and Spatial Development) can be used. For further information and explanations refer to www.nachhaltigesbauen.de.

For this EPD the following applies:

The reference service life (RSL) can be determined for a "cradle to gate – with options" EPD only if all of the modules A1-A3 and B1-B5 are specified;
The reference service life (RSL) of the "FG and LSG" from Guardian Europe S.à.r.l. is not specified.

According to information provided by the manufacturer, the manufacturer's warranty is valid for a period of 10 years.

5 End-of-life stage

Possible end-of-life stages

The "FG and LSG"can be shipped to central collecting points. There they are generally shredded and sorted into their original pure components. The glass can be recycled. Residual fractions are thermally recycled or disposed of in landfill.

6 Life Cycle Assessment (LCA)

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

As the basis for this, a Life Cycle Analysis (LCA) was prepared for the "FG and LSG". The LCA is in conformity with EN 15804 and the requirements set out in 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

Goal

The goal of the LCA is to demonstrate the environmental impacts of the "FG and LSG". In accordance with EN 15804, the environmental impacts covered by this Environmental Product Declaration are presented for the product stage in the form of basic information. Apart from these, no other environmental impacts have been specified.

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

The specific data originate exclusively from the fiscal year 2014. They were collected at several sites of Guardian Europe S.à.r.l. and originate partly from company records and partly from values directly obtained by measurement. Validity of the data was checked by the ift Rosenheim.

The generic data originate from the GaBi ts professional and construction materials databases. The last update of both databases was in 2016. Data from before this date originate also from these databases and are not more than 4 years old. No other generic data were used for the calculation.

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 "GaBi ts" for the development of Life Cycle Assessments.

Scope/system boundaries

The system boundaries refer to the supply of raw materials and purchased parts, and to the manufacture of the "FG and LSG" (cradle to gate).
No additional data from pre-suppliers/subcontractors were taken into consideration.

Cut-off criteria

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

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

Where available, the precise transport distances of the pre-products for the manufacture of "FG and LSG"were taken into consideration. Mean values were used for the remaining transport distances of the pre-products for the sites under consideration.

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

6.2 Inventory analysis

Goal

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

Life cycle stages

The LCA calculations were carried out for the stage "cradle to gate" (i.e. the product stage). The modules considered were those corresponding to the manufacturing process, i.e. A1-A3.

Benefits

Benefits from end-of-life processes were not taken into consideration. Benefits during manufacture were allocated to the product stage.

Allocation procedures
Allocation of co-products
Allocations for re-use, recycling and recovery

The manufacture of "FG and LSG"does not produce any allocations.

If the "FG and LSG" are re-used/recycled and recovered during the product stage (rejects), the resulting material is reintroduced into the production process. The system boundaries of the "FG and LSG"were set following their disposal, with termination of their waste characteristics.

Secondary material

The use of secondary material in Module A3 by the company Guardian Europe S.à.r.l. was considered. Secondary material is used as follows:

- PVB for laminated safety glass; various coating materials

Inputs

The LCA includes the following production-relevant inputs:

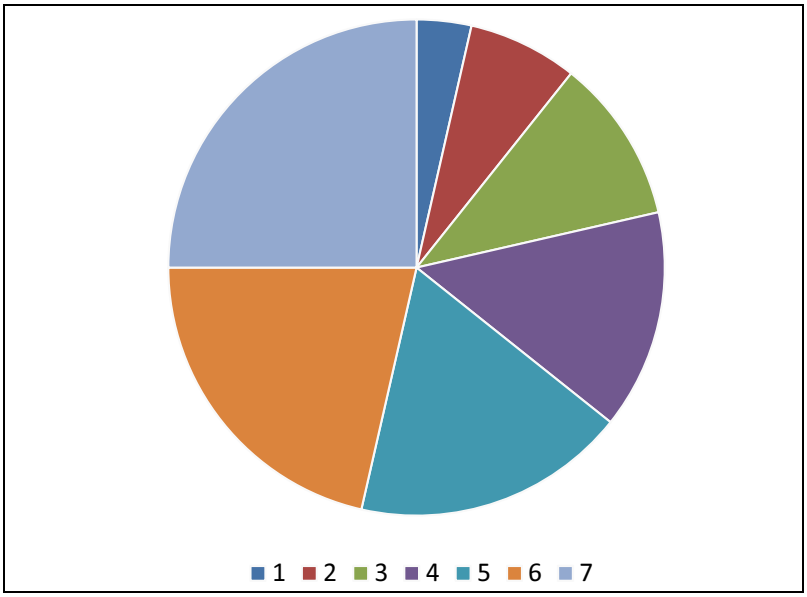
Energy
The electricity mix is based on "Strommix Europa" (European electricity mix).
Gas is based on "Erdgas Europa" (European natural gas).

A portion of the process heat is used for space heating at the production sites. 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 of the "FG and LSG"was approx. 9.5 l per m² unit for flat glass, approx. 11.5 l per m² unit for coated flat glass, and approx. 19.3 l per m² unit for LSG.

The consumption of fresh water specified in Section 6.3 originates from (among other sources) the upstream processes of the pre-products.

Raw materials/pre-products:
The chart below shows the share of raw materials/pre-products in %.



No.	Material	Mass in %
1	Siliceous sand	45.8
2	Recycled flat glass	18.5
3	Sodium	13.8
4	Dolomite	12.0
5	Other	4.0
6	Limestone	3.7
7	Feldspar	2.0

Ancillary materials and consumables
Around 1.3 kg of ancillary materials and consumables are used per m² of "FG and LSG".

Outputs

The LCA includes the following production-relevant outputs per m² of "FG and LSG":

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

Waste water
The manufacture of the "FG and LSG"produces 14.9 l of waste water per m².

6.3 Impact assessment

Goal

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

Impact categories

The models for impact assessment were applied as described in EN 15804-A1.
The impact categories presented in the EPD are as follows:

- Depletion of abiotic resources (fossil fuels);
- Depletion of abiotic resources (elements);
- Acidification of soil and water;
- Ozone depletion;
- Global warming;
- Eutrophication;
- Photochemical ozone creation.

Waste

The waste generated during the production of 1 m² of "FG and LSG"is evaluated and shown separately for each of the three main fractions, namely 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.

Results per m^2 and mm of flat glass (Part 1)		Flat glass	Coated flat glass	LSG
Environmental impacts	**Unit**	**A1-A3**	**A1-A3**	**A1-A3**
Global warming potential (GWP)	kg CO_2 equiv	2.30	2.46	2.78
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC 11 equiv	2.75E-10	3.85E-10	3.65E-10
Acidification potential of soil and water (AP)	kg SO_2 equiv	5.65E-03	6.09E-03	0.01
Eutrophication potential (EP)	kg PO_4^3 equiv	9.76E-04	1.02E-03	1.04E-03
Formation potential of tropospheric ozone (POCP)	kg C_2H_4 equiv	5.06E-04	5.36E-04	5.83E-04
Abiotic depletion potential – non-fossil resources (ADP – elements)	kg Sb equiv	2.25E-05	2.26E-05	2.27E-05
Abiotic depletion potential – fossil resources (ADP – fossil fuels)	MJ	33.15	34.87	40.20
Use of resources	**Unit**	**A1-A3**	**A1-A3**	**A1-A3**
Use of renewable primary energy – excluding renewable primary energy resources used as raw materials	MJ	1.75	2.51	2.39
Use of renewable primary energy resources used as raw materials (material use)	MJ	0	0	0
Total use of renewable primary energy resources (primary energy and renewable primary energy resources used as raw materials) (energy + material use)	MJ	1.75	2.51	2.39
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ	34.93	37.66	38.01
Use of non-renewable primary energy resources used as raw materials (material use)	MJ	0	0	4.81
Total use of non-renewable primary energy resources (primary energy and non-renewable primary energy resources used as raw materials) (energy + material use)	MJ	34.93	37.66	42.82
Use of secondary material	kg	0	0	0
Use of renewable secondary fuels	MJ	3.34E-04	3.71E-04	3.92E-04
Use of non-renewable secondary fuels	MJ	4.35E-03	4.91E-03	5.22E-03
Use of net fresh water	m^3	6.74E-03	0.01	0.01
Waste categories	**Unit**	**A1-A3**	**A1-A3**	**A1-A3**
Hazardous waste disposed	kg	1.20E-07	1.22E-07	1.23E-07
Non-hazardous waste disposed (municipal waste)	kg	0.14	0.14	0.14
Radioactive waste	kg	7.08E-04	1.11E-03	1.04E-03
Output material flows	**Unit**	**A1-A3**	**A1-A3**	**A1-A3**
Components for re-use	kg	0	0	0
Materials for recycling	kg	2.84E-04	2.84E-04	2.84E-04
Materials for energy recovery	kg	0	0	0
Exported energy (electricity)	MJ	0	0	0
Exported energy (thermal energy)	MJ	0	0	0

6.4 Interpretation, LCA presentation and critical review

Evaluation

Flat glass, coated flat glass and laminated safety glass differ considerably from one another in their environmental impacts. This is due to substantial differences in the amount of energy used for the production processes of the various pre-products. For this reason three separate tables are used to show the environmental impacts of the different products.

Because the products are used in a very wide range of applications, only the product stage is taken into account in this EPD. The end-of-life processes and benefits were not taken into consideration as the base data are not adequate, especially given the very wide range of possible applications.

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

Report

The LCA underlying this EPD was developed according to the requirements set out in DIN EN ISO 14040 and DIN EN ISO 14044 as well as EN 15804 and EN ISO 14025. For reasons of confidentiality, it is not addressed to third parties. It is deposited with the 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 took place in the course of verification of the EPD and was carried out by Patrick Wortner, MBA and Eng., Dipl.-Ing. (FH).

7 General information regarding the EPD

Comparability

This EPD was prepared in accordance with EN 15804 and is therefore only comparable with those EPDs that also comply with the requirements set out in 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 EN 15804 (Clause 5.3) apply.

Communication

The communications format of this EPD meets the requirements of EN 15942:2011 and is therefore the basis for B2B communication. Only the nomenclature has been changed according to 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 EN ISO 14025.

This Declaration is based on the ift PCR Document "Glass in Building" (PCR-FG-1.1: 2013).

The European standard EN 15804 serves as the core PCR [a)]
Independent verification of the declaration and statements according to EN ISO 14025:2010 ☐ Internal ☒ External
Independent third-party verifier: [b)] Patrick Wortner
[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	Practitioner of the LCA	Verifier
1	01.07.2016	External verification and approval	Stich	Wortner

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8 Annex

Description of life cycle scenarios for "FG and LSG"

Product stage			Con-struction stage		Use stage							End-of-life stage				Benefits and loads be-yond the system boundaries
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw material supply	Transport	Manufacture	Transport	Construction/installation	Use	Inspection, maintenance, clean-ing	Repair	Exchange/replacement	Improvement/modernisation	Operational energy use	Operational water use	Deconstruction	Transport	Waste management	Disposal	Re-use Recovery Recycling potential
✓	✓	✓	—	—	—	—	—	—	—	—	—	—	—	—	—	—

The manufacturer was unable to supply information to enable calculation of the scenarios for the additional modules B1-B7, C1-C4 and D, thus these were not included in the LCA.
It is possible to simulate the scenarios for the end-of-life stage according to the research project "EPDs for transparent building components" [31].

- ✓ Included in the LCA
- — Not included in the LCA

Imprint

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Notes
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