ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

Owner of the Declaration	Trakya Cam Sanayii A.Ş. (Şişecam Flat Glass)
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-TCS-20170106-CAD1-EN
Issue date	05.10.2017
Valid to	04.10.2022

Clear Laminated Glass

Trakya Cam Sanayii A.Ş. (Şişecam Flat Glass)

Institut Bauen und Umwelt e.V.

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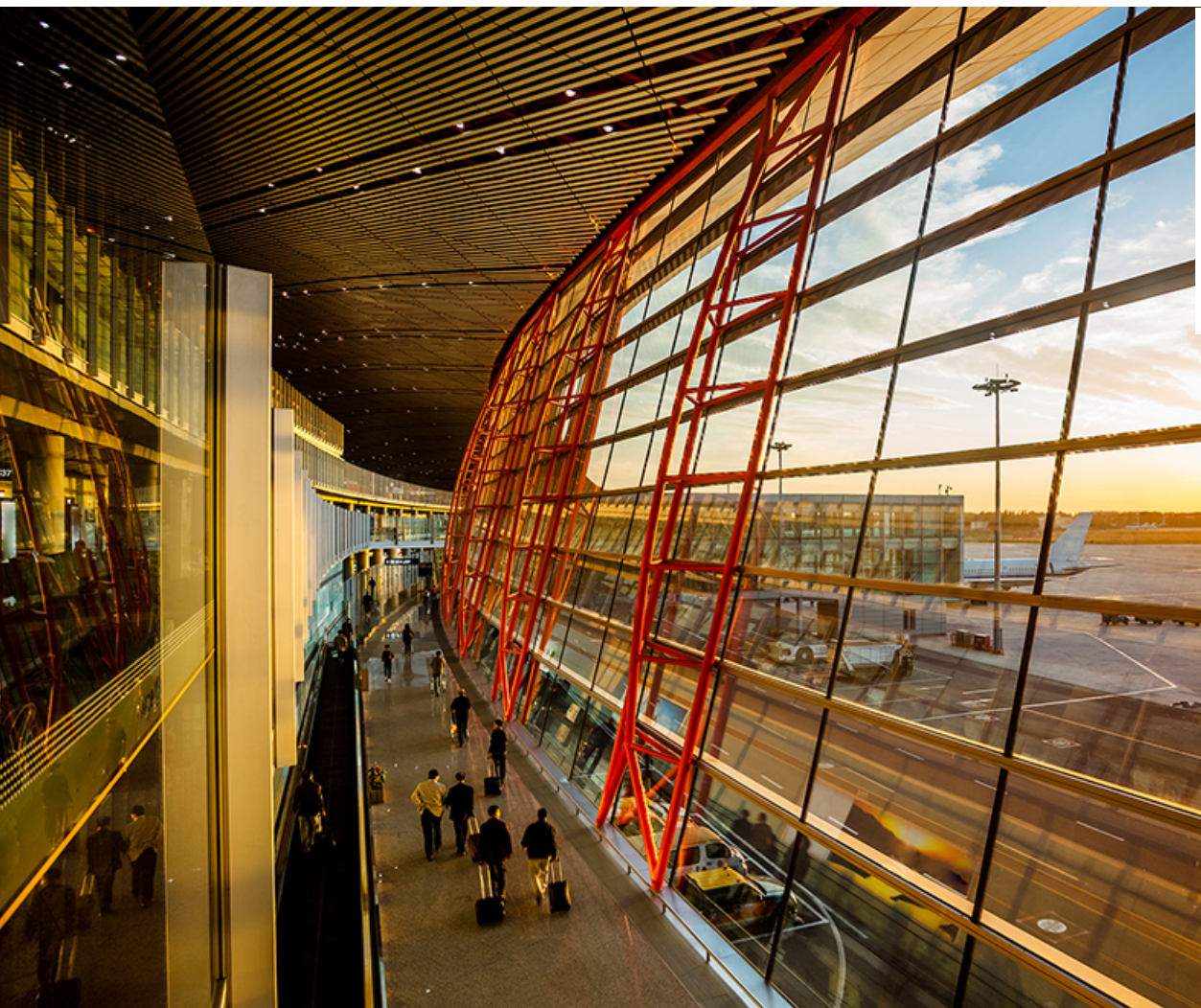

General Information

Trakya Cam Sanayii A.Ş. (Şişecam Flat Glass)

Programme holder
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10178 Berlin
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Declaration number
EPD-TCS-20170106-CAD1-EN

This Declaration is based on the Product Category Rules:
Plate glass for construction, 07.2014
(PCR tested and approved by the SVR)

Issue date
05.10.2017

Valid to
04.10.2022

Prof. Dr.-Ing. Horst J. Bossenmayer
(President of Institut Bauen und Umwelt e.V.)

Dr. Burkhart Lehmann
(Managing Director IBU)

Clear Laminated Glass

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Trakya Cam Sanayii A.Ş. (Şişecam Flat Glass)

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Declared product / Declared unit
Clear Laminated Glass / 1m^2

Scope:
This Life Cycle Assessment study is carried out for clear laminated glass produced in the manufacturing plants of Trakya Cam Sanayii A.Ş. located in Bulgaria (Targovishte) and Yenişehir (Bursa)/Turkey.
This EPD is prepared as a weighted average for a clear laminated glass product group manufactured in these plants. The data collected refers to the year 2014. Life Cycle Assessment (LCA) was conducted based on the modules A1-A3 (cradle-to-gate).

The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.

Verification

The CEN Norm /EN 15804/ serves as the core PCR
Independent verification of the declaration according to /ISO 14025/
☐ internally ☒ externally

Matthias Klingler
(Independent verifier appointed by SVR)

Product

Product description / Product definition
Şişecam Laminated Glass is laminated safety and security glass of Şişecam Flat Glass. It is produced by combining two or more panes of float glass with the special binding agency Polyvinyl Butyral (PVB) interlayer under heat and pressure.

The table below shows laminated glasses manufactured by Trakya Cam Sanayii A.Ş in 2014.

Product	PVB Thickness (mm)	Glass Thickness (mm)	Tolerance on Thickness (mm)
Şişecam Clear Laminated Glass	0.38	3+3	± 0.4
	0.76		± 0.4
	0.38	4+4	± 0.4
	0.76		± 0.4
	0.38	5+5	± 0.4
	0.76		± 0.4
	0.38	6+6	± 0.4
	0.76		± 0.4

For the placing on the market of the product in the EU/EFTA (with the exception of Switzerland) Regulation (EU) No. 305/2011 /CPR/ dated 9 March 2011 applies. The product needs a Declaration of Performance taking into consideration /EN 14449: 2005 - Glass in building –and the /CE-marking/. Şişecam Laminated Glass products are certified according to these standards.

Application
For the application and use, the respective national previsions apply.

Laminated glass can be incorporated into insulating glass units. Laminated Glass is used in various window types such as curtain walls, ribbon windows, store fronts, punched or architectural windows, overhead glazing, handrails & floors.
Laminated glass is used extensively in building and housing products and in the automotive and transport

industries. Most building facades and most car windscreens, are made of laminated glass, usually with other technologies also incorporated.
Laminated Glass is suitable for applications where the protection of people and goods is required.
Regulations for safety glass applications; can be found at /TS 13433/ - Glazing in buildings – Code of practice for safety related to human impact. Laminated glass is used in many applications such as:

- Curtain walling
- Windows
- Overhead glazing
- Internal partitions
- Balustrades
- Doors
- Interior fittings
- Shower and bath enclosures
- Areas of high pedestrian traffic, museums & art galleries where UV protection is necessary
- Areas where improved acoustic performance is a requirement
- Passageways with busy pedestrian traffic
- Store fronts
- Canopies
- Banks
- Hospitals
- Schools and kindergartens
- Facilities and sport centers

Technical Data

Constructional data

Name	Value	Unit
Heat transfer coefficient acc. to /EN 673/	5.4 - 5.7	W/(m²K)
Total energy transmittance acc. to /DIN EN 410/	71 - 77	%
Light transmission level acc. to /EN 410/	85 - 87	%
Airborne sound reduction acc. to /EN 12758/	32 (-1; -3)-34 (-1;-3)	dB

Product according to the /CPR/, based on a hEN:
Performance data of the product in accordance with the Declaration of Performance with respect to its Essential Characteristics according to /EN 14449:2005/ Glass in building/ and /CE-marking/.

Base materials / Ancillary materials
Şişecam Laminated Glass is produced by combining two or more panes of float glass with special binding agency Polyvinyl Butyral (PVB) interlayers.
Float glass is primarily made of raw materials like silica sand, soda ash, dolomite, limestone. In addition, recycled glasses (internal cullet and cullet coming from other operations) are also used to produce float glass. Water is added to the glass composition to prevent segregation of the mixture. Silica sand is the main ingredient of the glass composition.

- Float glass approx. >98%
- PVB approx. <2%

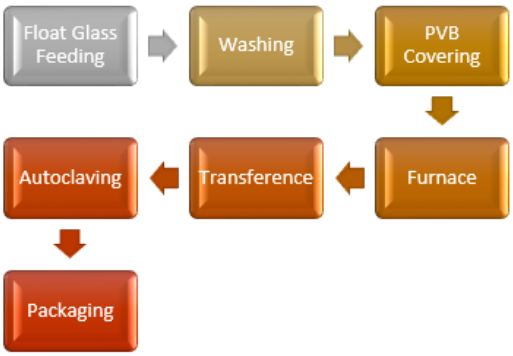
There are no raw materials used in the formulation that are included in “Candidate List of Substances of Very High Concern for Authorisation”.

Manufacture
Float Glass Production
Glass batch, which is a mixture of sand, soda ash, dolomite, feldspar, limestone and some additional raw materials (cullet) of specific specialties and quantities, is melted at approximately 1600°C in the furnace. Molten glass is poured from the furnace on to the surface of a bath of molten tin at 1100°C. The inside of the tin bath is full of nitrogen and hydrogen protective atmosphere for avoiding oxidation. As glass spreads and floats on the tin, the two surfaces of glass become flat and parallel, and the thickness and width of the glass ribbon is formed. As the glass ribbon moves further along the bath, it is progressively cooled and internal stress of the glass is eliminated at the annealing lehr. Consequently, glass is cut into required sizes.

Laminated Glass Production
The float glasses manufactured by Şişecam Flat Glass are used as raw material for the production of laminated glass. The glasses are scrubbed clean to remove any impurities, after which the first sheet of quality float glass is fed along the laminating line. A PVB (Polyvinyl Butyral) interlayer is drawn over the first sheet of glass and a second sheet of glass is then placed on top of the PVB to create a 'sandwich'. This 'sandwich' passes through a specialized press and heating process. Air between PVB and glasses is removed. The laminated sheets are then stacked in a specific configuration for loading into an autoclave at high temperature and pressure.

Strick stock control, with barcode system, finished laminated safety glass sheets are stacked in a dedicated laminates warehouse.

Manufacturing process of laminated glass is shown as below:



Packaging
Strick stock control, with barcode system, finished laminated safety glass sheets are stacked in a dedicated laminates warehouse.

Wood frames and metal band are used for fixation; plastic material (LDPE) is used for protection. Lucid powder is used as spacer.

Reference service life
In this study, Reference Service Life (RSL) is not taken into consideration during the calculations, since the system boundary of this EPD is cradle-to-gate.

Further Information
For further information, please contact Trakya Cam Sanayii A.Ş (Şişecam Flat Glass) through its website at www.sisecamduzcam.com

LCA: Calculation rules

Declared Unit
In this study, the functional unit for this product category is defined as 1m^2 of clear laminated glass. The final average weight (weighted average value) of laminated glass in 2014 is 23.1kg per 1m^2 .

Declared unit

Name	Value	Unit
Declared unit	1	m^2
Conversion factor to 1 kg	0.04329	-

System boundary
Type of the EPD: cradle-to-gate

The life cycle analysis for laminated glass comprises the boundary stages A1 (extraction, processing, production of raw materials), A2 (Transport to the manufacturer and internal transport) and A3 (Manufacturing operations) modules. These are declared separately.

Background data:
All relevant background datasets were taken from the /Ecoinvent/ database (version3.3) within /SimaPro/ software.

Comparability
Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to /EN 15804/ and the building context, respectively the product-specific characteristics of performance, are taken into account. The used background database has to be mentioned.

LCA: Scenarios and additional technical information

As stated in the system boundary chapter above, only A1, A2 and A3 modules are declared within the scope of this study. Therefore, there are no scenarios provided below regarding the other modules A4, A5, B1-B7, C1-C4 and D.

Şişecam Flat Glass plants utilize broken glass (cullet) that comes from internally recycled (closed-loop) and also from other operations of Trakya Cam Sanayii A.Ş (at the same site).

Bursa plant reduces energy consumption in the production by reusing waste heat. Recovery of waste heat has an effect on the efficiency of the process. This is reflected by the reduction in the energy consumption.

LCA: Results

The impact estimate results are relative expressions and do not predict impacts on category endpoints or the transgression of thresholds, safety margins or risks.

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	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	MND	MND	MND	MND	MNR	MNR	MNR	MND	MND	MND	MND	MND	MND	MND

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: Clear Laminated Glass/1m2

Parameter	Unit	A1	A2	A3
Global warming potential	[kg CO_2-Eq.]	7.94E+0	1.09E+0	1.74E+1
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	6.26E-7	2.01E-7	1.04E-6
Acidification potential of land and water	[kg SO_2-Eq.]	4.18E-2	5.89E-3	4.17E-2
Eutrophication potential	[kg $(PO_4)^{3-}$-Eq.]	1.11E-2	8.65E-4	2.31E-3
Formation potential of tropospheric ozone photochemical oxidants	[kg ethene-Eq.]	1.96E-3	2.28E-4	2.08E-3
Abiotic depletion potential for non-fossil resources	[kg Sb-Eq.]	4.73E-5	2.59E-6	1.26E-6
Abiotic depletion potential for fossil resources	[MJ]	1.05E+2	1.63E+1	1.72E+2

RESULTS OF THE LCA - RESOURCE USE: Clear Laminated Glass/1m2

Parameter	Unit	A1	A2	A3
Renewable primary energy as energy carrier	[MJ]	2.93E+0	2.85E-1	4.21E+0
Renewable primary energy resources as material utilization	[MJ]	8.89E+0	0.00E+0	0.00E+0
Total use of renewable primary energy resources	[MJ]	1.18E+1	2.85E-1	4.21E+0
Non-renewable primary energy as energy carrier	[MJ]	1.11E+2	1.70E+1	1.72E+2
Non-renewable primary energy as material utilization	[MJ]	8.95E+0	0.00E+0	0.00E+0
Total use of non-renewable primary energy resources	[MJ]	1.20E+2	1.70E+1	1.72E+2
Use of secondary material	[kg]	2.71E-1	0.00E+0	0.00E+0
Use of renewable secondary fuels	[MJ]	0.00E+0	0.00E+0	0.00E+0
Use of non-renewable secondary fuels	[MJ]	0.00E+0	0.00E+0	0.00E+0
Use of net fresh water	[m^3]	8.86E-4	2.83E-4	3.19E-2

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: Clear Laminated Glass/1m2

Parameter	Unit	A1	A2	A3
Hazardous waste disposed	[kg]	1.18E-4	8.87E-6	1.22E-4
Non-hazardous waste disposed	[kg]	7.75E-1	7.82E-1	1.08E-1
Radioactive waste disposed	[kg]	3.16E-4	1.17E-4	1.46E-4
Components for re-use	[kg]	0.00E+0	0.00E+0	0.00E+0
Materials for recycling	[kg]	0.00E+0	0.00E+0	0.00E+0
Materials for energy recovery	[kg]	0.00E+0	0.00E+0	0.00E+0
Exported electrical energy	[MJ]	0.00E+0	0.00E+0	0.00E+0
Exported thermal energy	[MJ]	0.00E+0	0.00E+0	0.00E+0

MND: Module Not Declared

Life Cycle Interpretation

The declared average product has an average thickness of around 9.24mm. Since the thicknesses of specific products is in a range between 6mm to 12mm the environmental impacts of those specific products can be significantly different than the ones of the average product. It is assumed that the environmental impacts per m2 of product correlate approximately with the thickness of the product.

When considering LCA results, manufacturing stage (A3) has the highest impact for global warming potential (**GWP**), depletion potential of the stratospheric ozone layer (**ODP**), formation potential of tropospheric ozone photochemical oxidants (**POCP**), abiotic depletion potential for fossil resources (**ADPF**).
The raw materials supply stage (A1) has the highest effect for eutrophication potential (**EP**), acidification potential of land and water (**AP**) and abiotic depletion potential for non-fossil resources (**ADPE**). Considering contribution of all these impacts within raw materials in the composition, the most important contributor is soda ash.
Concerning the lowest environmental impact, transport stage (A2) has the lowest values in all environmental impacts (except ADPE).
Regarding total energy requirement, manufacturing stage has the highest energy demand followed by raw materials supply stage. In manufacturing stage, it is mainly caused by natural gas.

Related total water consumption, manufacturing and raw material supply stages have the biggest impact. Within the manufacturing stage, the water consumption is mostly linked to processes during production (such as bath humidification, cutting line, cooling, washing and autoclaving, etc.). In the raw materials supply phase, the water use is mainly caused by upstream processes of soda ash.

The analysis of the waste generation is shown separately for the three fractions as hazardous waste, non-hazardous waste and radioactive waste.

The hazardous waste is mainly generated by manufacturing (due to mostly upstream processes of natural gas), followed by raw materials supply stage (mostly caused by soda ash).
The non-hazardous waste is mainly linked to transport and raw materials supply, respectively. Within the raw materials supply stage, it is due to upstream processes of soda ash.
The radioactive waste is mainly linked to upstream processes of the raw materials supply stage followed by manufacturing. Within the raw materials supply stage, the radioactive waste is caused mainly by upstream processes of soda ash. There are no direct radioactive wastes during the manufacturing processes of laminated glass. In the manufacturing stage, it is due to energy consumption (mostly upstream processes of electricity and natural gas, respectively).

References

Institut Bauen und Umwelt
Institut Bauen und Umwelt e.V., Berlin(pub.): Generation of Environmental Product Declarations (EPDs);
www.ibu-epd.de

ISO 14025
DIN EN ISO 14025:2011-10: Environmental labels and declarations — Type III environmental declarations — Principles and procedures

EN 15804
EN 15804:2012-04+A1 2013: Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products

PCR Part A
Institut Bauen und Umwelt e.V., Berlin (pub.): Product Category Rules for Construction Products from the range of Environmental Product Declarations of Institut Bauen und Umwelt (IBU). Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report (version 1.4); 18.03.2016
www.bau-umwelt.de

PCR Part B
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www.bau-umwelt.de

ISO 14040-44
DIN EN ISO 14040:2006: Environmental management - Life cycle assessment - Principles and framework (ISO 14040:2006) and Requirements and guidelines (ISO 14044:2006)

EN 14449:2005
Glass in building. Laminated glass and laminated safety glass. Evaluation of conformity/product standard (Foreign Standard)

EN 673:2011
Glass in building - Determination of thermal transmittance (U value) - Calculation method

EN 410:2011
Glass in building - Determination of luminous and solar characteristics of glazing

EN 12758: 2011
Glass in building. Glazing and airborne sound insulation. Product descriptions and determination of properties

TS 13433: 2010
Glazing for buildings - Code of practice for safety related to human impact

CE marking
Construction Products Regulation (CPR) Regulation (Eu) No 305/2011 of The European Parliament and of The Council

Construction Products Regulation (CPR)
Construction Products Regulation (CPR) Regulation (EU) No 305/2011 of the European Parliament and of the Council

SimaPro
SimaPro LCA Package, Pré Consultants, the Netherlands
www.pre-sustainability.com

Ecoinvent
Ecoinvent Centre, www.ecoinvent.org

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