Environmental Product Declaration of Float Glass

In accordance with EN 15804 and ISO 14025

ASAHI INDIA GLASS LTD.(AIS)

October 2018

EPD registration number:	S-P-01114
Publication date:	2018-11-01
Validity date:	2023-10-31
Geographical scope:	India

EPD®

THE INTERNATIONAL EPD® SYSTEM

1. Introduction

This current declaration aims to provide the effects measurable and verifiable for the environmental assessment of 1 m^2 of average float glass (Clear and Tinted) manufactured at Asahi India Glass Ltd. (AIS)

Asahi India Glass Ltd. (AIS) is India's leading integrated glass solutions company and a dominant player both in the automotive glass and architectural glass segments. It commands over 70% share in the Indian automotive glass market. Established in 1984, AIS is an outcome of a Joint Venture between the Labroo family, Asahi Glass Co. Limited Japan, and Maruti Suzuki India Limited. AIS is an ISO 9001, OHSAS 14001, EnMS 50001 and ISO 14001 company listed on the National Stock Exchange Limited and Bombay Stock Exchange Limited.

Today, more than ever, AIS - India’s leading glass manufacturer, is driven to market-leading innovations providing the right blend between daylight and energy saving, visual and thermal comfort, technology and sensitivity, along with state-of-the-art glass manufacturing plants. AIS enables an age of Green Buildings and supporting a truly sustainable future resources and offers effective solutions for waste management including testing and co-processing.

Life Cycle Assessment approach is one of the key tool for evaluating and assessing the environmental burdens associated with resource consumption, energy consumption, emissions, effluent and solid waste generation during the life span of the product. It means the study helps in identifying the “hot-spots” with respect to various environment parameters at various stages of production process value chain.

The EPD is declared for an average float glass comprising of 60% clear and 40% tinted float glass manufactured at 2 locations of AIS.

The LCA conducted is in accordance with PCR 2012:01 Construction products and construction services (EN 15804) for preparation of Environmental Product Declaration (EPD).

2. General Information

2.1 EPD, PCR, LCA Information

Table 1 EPD Information

Programme	**The International EPD® System,** www.environdec.com
Program operator	EPD International AB Box 210 60, SE- 100 31 Stockholm, Sweden.
Declaration holder	Mr. Praveen Saini Asahi India Glass Ltd Unit Head – Quality Assurance_ Platinum Techno Park, Sector 30, Vashi Navi Mumbai, Maharashtra 400703, India Email: praveen.saini@aisglass.com
Product	Float Glass, CPC Code: 37113
Reference standards	IS0 14025:2010; 1SO 14001; 1SO 14040/44 EN 15804:2012

Table 2 PCR Information

Reference PCR	PCR 2012:01 Construction products and construction services, version 2.2 in compliant with EN 15804
Date of Issue	2018-11-01
Period of Validity	2023-10-31

Table 3 Verification Information

Demonstration of verification	External, independent verification
Third party verifier	Dr Hudai Kara, Metsims Sustainability Consulting, 4 Clear Water Place, Oxford OX2 7NL, UK Email: hudai.kara@metsims.com

Table 4 LCA Information

Title	Environmental Product Declaration of Float Glass
Preparer	Dr. Rajesh Kumar Singh Thinkstep Sustainability Solutions Pvt. Ltd. 421, MIDAS, Sahar Plaza, Andheri Kurla Road, Andheri East, Mumbai, India - 400059 Email: rajesh.singh@thinkstep.com
Reference standards	ISO 14040/44 standard

2.2 Reference Period of EPD Data

The reference period for the data used within this EPD is the year April’ 2016 – March’ 2017

2.3 Geographical Scope of EPD Application

The geographical scope of this EPD is India.

2.4 Additional Information about EPD

AIS manufactures Clear Float Glass and Tinted Float Glass of varying thicknesses at their Taloja and Roorkee plants respectively. The EPD is declared for an average float glass comprising of weighted average production volume of clear and tinted float glass for the year April 2016 – March 2017. The target group of EPD are Green Building Certification Program holders and consultants, customers, project developers, statutory agencies and government.

This EPD is in accordance with ISO 14025 and EN 15804. EPD of construction products may not be comparable if they do not comply with EN 15804. Product Category Rules (PCR) used for the assessment of the environmental performance of glass is PCR 2012:01 Construction products and construction services, version 2.2, in compliant with EN 15804.

The environmental impacts are calculated on the basis of the functional unit wherein each flow related to material consumption, energy consumption, emissions, effluent and waste is scaled to the reference flow.

The processes listed below for the production of the final product including primary packaging is included. The processes which are mandatory to be included in plant operation, in particular are:

- Raw material production (mining and crushing)
- Batch mixing
- Float Glass production
- Cutting and Packaging
- Storage and Dispatch of the float glass manufactured.

The installation of glass in buildings, end of life and reuse is not included. Inbound transportation of raw materials and fuel are included and outbound transportation of glass product is not included

3. Product Description and System Boundaries

3.1 Product Identification and Usage

Float glass is a sheet of glass made by floating molten glass on a bed of molten metal, typically tin, although lead and various low melting point alloys were used in the past. This method gives the sheet uniform thickness and very flat surfaces. The present declaration is conducted for 1 m^2 of average float glass manufactured at Taloja and Roorkee locations of AIS.

Clear float glass is a basic soda-lime-silicate glass produced using the float procedure to be used in building, furniture and industrial applications. The low iron content of clear float glass reduces the level of green coloring so that the appearance is clearer and more neutral. This helps to increase the level of natural daylight and reduces the need for artificial lighting. It is available in a range of thicknesses, from 3 mm to 12 mm

Tinted float glass is a body tinted soda-lime-silicate glass produced using the float procedure. It is meant to be used in building & industrial applications. Tinted glass has a colored appearance, as well as basic solar control properties. There are 5 colors in the tinted float glass range: Dark grey, Aqua blue, Bronze, Dark Green (Cool Green) and Dark blue (Royal Blue). It is available in a range of thicknesses, from 3 mm to 12 mm.

Table 4 – 9 shows the performance data for clear and tinted float glass. It is in accordance to EN 410 – 2011 standard.

Clear Float Glass

Table 4 Performance Data of Clear Float Glass

Thickness (mm)	3	3.5	4	5	6	8	10	12
Visible parameters								
Light transmittance (LT) %	90	90	89	89	88	87	86	85
External light reflection (RLE) (%)	9	9	9	9	9	8	8	8
Energetic parameters								
Solar Energy transmittance (ET) %	8	8	8	8	7	7	7	7
Solar Energy absorbance (EA) %	0	0	0	0	0	0	0	0
Solar factor g	85	83	85	84	80	80	78	76

Tinted Float Glass (Dark Grey)

Table 5 Performance Data of Dark Grey Tinted Float Glass

Thickness (mm)	3	3.5	4	5	6	8	10	12
Visible parameters								
Light transmittance (LT) %	36	30	28	20	14	12	10	9
External light reflection (RLE) (%)	5	5	5	5	4	4	4	3
Energetic parameters								
Solar Energy transmittance (ET) %	6	6	6	5	5	5	5	5
Solar Energy absorbance (EA) %	0	1	1	1	1	1	1	2
Solar factor g	60	56	57	52	52	47	43	39

Tinted Float Glass Dark Blue- (Royal Blue)

Table 6 Performance Data of Royal Blue Tinted Float Glass

Thickness (mm)	3	3.5	4	5	6	8	10	12
Visible parameters								
Light transmittance (LT) %	43	40	37	33	29	26	22	19
External light reflection (RLE) (%)	12	13	14	11	9	9	9	8
Energetic parameters								
Solar Energy transmittance (ET) %	16	15	15	13	11	10	9	8
Solar Energy absorbance (EA) %	0	0	0	1	1	1	2	2
Solar factor g	57	54	53	49	47	45	42	40

Tinted Float Glass (Bronze)

Table 7 Performance Data of Bronze Tinted Float Glass

Thickness (mm)	3	3.5	4	5	6	8	10	12
Visible parameters								
Light transmittance (LT) %	62	61	57	53	45	35	29	23
External light reflection (RLE) (%)	7	6	6	6	6	5	5	5
Energetic parameters								
Solar Energy transmittance (ET) %	64	63	59	55	48	38	31	25
Solar Energy absorbance (EA) %	7	6	6	6	6	5	5	5
Solar factor g	72	70	68	65	60	52	47	43

Tinted Float Glass Dark Green (Cool Green)

Table 8 Performance Data of Dark Green (Cool Green) Tinted Float Glass

Thickness (mm)	3	3.5	4	5	6	8	10	12
Visible parameters								
Light transmittance (LT) %	74	70	76	62	63	60	57	54
External light reflection (RLE) (%)	9	9	8	8	8	7	7	6
Energetic parameters								
Solar Energy transmittance (ET) %	16	16	16	13	13	12	11	10
Solar Energy absorbance (EA) %	0	0	0	1	1	1	1	2
Solar factor g	55	53	52	49	48	46	44	42

Tinted Float Glass Aqua Blue

Table 9 Performance Data of Aqua Blue Tinted Float Glass

Thickness (mm)	3	3.5	4	5	6	8	10	12
Visible parameters								
Light transmittance (LT) %	53	47	41	36	31	28	25	20
External light reflection (RLE) (%)	8	7	7	6	6	6	5	5
Energetic parameters								
Solar Energy transmittance (ET) %	17	16	13	11	9	7	5	3
Solar Energy absorbance (EA) %	0	0	0	1	1	1	1	2
Solar factor g	65	61	57	55	51	48	44	41

The average float glass model has been considered by taking the weighted average production volume of clear and tinted float glass for FY 16-17 as shown in table 10.

Table 10 Production Volume Ratio of Clear and Tinted Float Glass

	Average Float Glass	Clear Float Glass	Tinted Float Glass
Quantity (in %)	100	60	40

100% of clear float glass is manufactured at Taloja plant and 100% tinted float glass is manufactured at Roorkee plant.

Declaration of the main products components and/or materials

The product is 100% glass CAS number 65997-17-3, EINECS number 266-046-0.

At the date of issue of this declaration, there is no "Substance of Very High Concern" (SVHC) in concentration above 0.1% by weight, and neither do their packaging, following the European REACH regulation (Registration, Evaluation, Authorization and Restriction of Chemicals).

3.2 Product Manufacturing

The main steps in float glass manufacturing process are:

3.2.1 Batch Mixer

Mix of raw materials (silica, soda ash, lime, feldspar and dolomite) to which is added recycled glass (cullet) and other compounds depending on the desired color and properties.

3.2.2 Float Glass Production

Raw materials are melted at 1550 °C in a furnace by fuel oil. Bubbles inside the glass are removed and the temperature is lowered to a level suitable for forming (1100 to 1300 ^{0}C). The molten glass is fed into a bath of molten tin. The glass floats on this flat surface and is drawn off in a ribbon. Serrated wheels, or top rolls, pull and push the glass sideways depending on the desired thickness (from 3 to 12 millimeters).

3.2.3 Annealing

Since the sharp temperature change causes distortion to appear in formed glass, temperature control is carried out to cool glass slowly. The glass is lifted onto conveyor rollers and passes through a controlled cooling tunnel measuring more than 150 meters in length. Approximately 680 °C at the start of this step, the glass exits the lehr at room temperature.

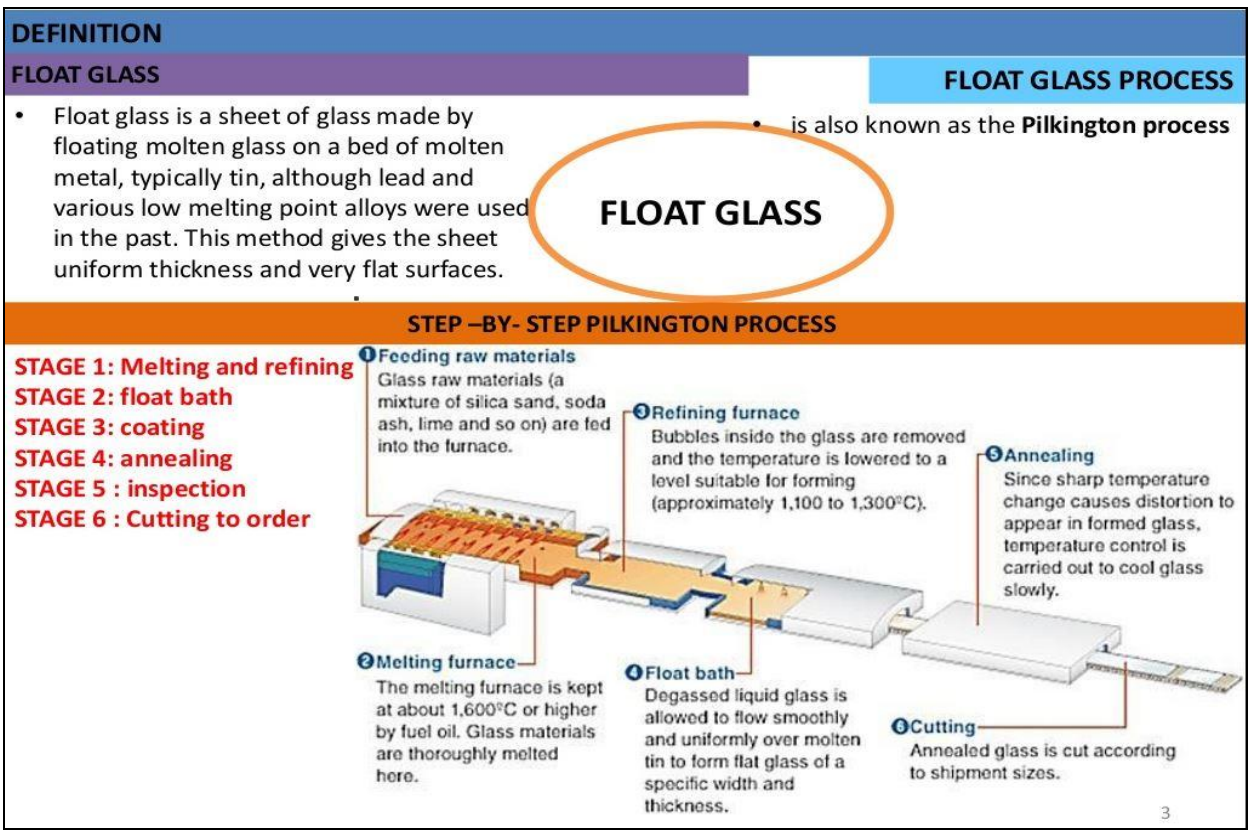

Figure 1 Manufacturing Process Flow Diagram of Float Glass

3.2.4 Cutting and Packing

The glass is automatically cut lengthwise and crosswise. The sheets of glass are raised by vacuum cups that then place them for packing.

3.2.5 Storage and Dispatch

The glass is then stored in warehouses and which are then dispatched to the corresponding locations.

3.3 System Boundaries

The LCA model of float glass represents a cradle-to-gate system starting from raw materials extraction and ending with the processing of flat glass (A1 to A3). The table below shows the description of the system boundary considered for conducting the LCA of float glass. The environmental impacts of all the other stages in the life cycle of average float glass are not assessed (MNA).

Table 11 Description of the system boundary (X = Included in LCA, MNA = Module Not Assessed)

Product Stage			Installation Stage		Use stage							End-of-Life Stage				Benefits beyond system boundary
Raw material supply	Transport	Manufacturing	Transport to building site	Installation into building	Use / application	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction / demolition	Transport to EoL	Waste processing for reuse, recovery or recycling	Disposal	Reuse, recovery or recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA

Table 12 summarizes those processes that are included within the system boundaries of the study.

Table 12 Details of System Boundary Included in the Study

Life Cycle stages	Life Cycle sub-stages	Definitions	Module
Materials	Primary raw materials production	Extraction, production of the raw materials such as silica, soda ash, lime, dolomite, etc.)	A1
Upstream Transport	Ocean Rail and Road Transport	Transport of the raw materials	A2
Manufacturing	Float Glass Production by mixing of raw materials and disposal of waste generated.	Manufacturing and processing of float glass, Disposal of waste generated	A3

The system boundary does not include:

- Capital equipment and maintenance of production facility
- Maintenance and operation of equipment
- Human labor
- Distribution of the product

- Use phase of the product
- Disposal phase of the product

4. LCA

4.1 Information Sources and Data Quality

It is important that data quality is in accordance with the requirements of the LCA's goal and scope. This is essential to the reliability of LCA and achievement of the intended application. The quality of the LCI data for modelling the life cycle stages have been assessed according to ISO 14044 (ISO, 2006b). Data quality is judged by its precision (measured, calculated or estimated), completeness (e.g. are there unreported emissions?), consistency (degree of uniformity of the methodology applied on a LCA serving as a data source) and representativeness (geographical, time period, technology). To cover these requirements and to ensure reliable results, first-hand industry data in combination with consistent, upstream LCA information is used. The datasets have been used in LCA-models worldwide for several years in industrial and scientific applications for internal as well as critically reviewed studies. In the process of providing these datasets, they have been cross-checked with other databases and values from industry and science. AIS provided the most accurate and representative data for cement production. For all data requirements, primary data were used where possible.

4.2 Estimations and Methodology

4.2.1 Allocation procedures

As much as possible, allocation has been avoided by expanding the system boundaries.

4.2.2 Average float glass

The average is determined based on the produced amounts of clear and tinted float glass by weight for the year April 2016 – March 2017.

4.2.3 Declared unit

The declared unit for the EPD is 1 m^2 of average float glass for a range of thicknesses: 3 mm, 3.5 mm, 4 mm, 5 mm, 6 mm, 8 mm, 10 mm and 12 mm

4.2.4 Impact assessment

A list of relevant impact categories and category indicators is defined and associated with the inventory data. Various environmental impacts and emissions are associated with production of float glass, from raw material production, transport of materials to manufacturing site to final glass production.

CML 2001 (April 2013) method developed by Institute of Environmental Sciences, Leiden University, Netherlands have been selected for evaluation of environmental impacts. These indicators are scientifically and technically valid.

A list of relevant impact categories and category indicators is defined and associated with the inventory data. PCR EN 15804 has been used to conduct the LCA. The PCR identifies the following LCI and LCIA.

1. Potential Environmental Impact (according with EN15804)
   - Global warming potential, GWP (100 years) (kg CO_2 equivalent)
   - Depletion potential of the stratospheric ozone layer, ODP (20 years) (kg CFC-11 equivalent)
   - Acidification potential of soil and water, AP (kg SO_2 equivalent)
   - Eutrophication potential, EP (kg PO_4^{3-} equivalent)
   - Formation potential of tropospheric ozone, POCP (kg Ethene (C_2H_2) equivalent)
   - Abiotic depletion potential (ADP-elements) for non-fossil resources (kg Sb equivalent)

- Abiotic depletion potential (ADP-fossil fuels) for fossil resources (MJ, net calorific value)

2. Use of Natural Resources (according with EN15804)
    - Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials) (MJ, net calorific value)
    - Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials) (MJ, net calorific value)
    - Use of secondary material (kg)
    - Use of renewable secondary fuels (MJ, net calorific value)
    - Use of non- renewable secondary fuels (MJ, net calorific value)
    - Use of net fresh water (m^3)

3. Other Environmental Indicators
    - Components for re-use (kg)
    - Materials for recycling (kg)
    - Materials for energy recovery (kg)
    - Exported energy (MJ)
    - Dust (total dust and PM_{10}) (kg)
    - Hazardous waste (as defined by regional directives) disposed (kg)
    - Non-hazardous waste disposed (kg)
    - Radioactive waste disposed/stored (kg)

4.3 Cut Off Rules

Input and output data have been collected through detailed questionnaires which have been developed and refined. In practice, this means that, at least, all material flows going into the float glass production processes (inputs) higher than 1% of the total mass flow (t) or higher than 1% of the total primary energy input (MJ) are part of the system and modelled in order to calculate elementary flows. All material flows leaving the product system (outputs) accounting for more than 1% of the total mass flow is part of the system. All available inputs and outputs, even below the 1% threshold, have been considered for the LCI calculation. For hazardous and toxic materials and substances the cut-off rules do not apply.

Secondary raw materials used in the production system is accounted adopting the following approach:

- The environmental impacts related to the ‘previous life’ is not considered.
- The processes needed to prepare the secondary raw material to the new use is considered.
- If the secondary raw material contains energy, the amount is estimated considering the gross calorific value and presented as secondary energy resource.
- If the secondary raw material does not contain energy, the quantity that enter the system is considered as secondary raw material.

4.4 Background Data

All relevant background datasets were taken from the GaBi-8 software database (2018) developed by thinkstep AG. To ensure comparability of results in the LCA, the basic data from the GaBi-8 database were used for fuel, energy, transportation and auxiliary materials.

4.5 Comparability

The EPD is established on the basis of the Product Category Rules (PCR 2012:01 Construction products and construction services, version 2.2, compliant with EN 158040

According to these standards, EPDs do not compare the environmental performance of products in the construction sector. Any comparison of the declared environmental performance of products lies outside the scope of these standards and is suggested to be feasible only if all compared declarations follow equal standard provisions.

4.6 Results

This section covers the environmental impacts of 1 m^2 of average float glass of thicknesses: 3 mm, 3.5 mm, 4 mm, 5 mm, 6 mm, 8 mm, 10 mm and 12 mm respectively in the sub sections.

4.6.1 Float Glass: 3 mm

Table 13 (a-c) show the life cycle environmental impacts for 1 m2 of average Float Glass product for 3 mm thickness.

Table 13 (a) LCIA for 1 m^2 of average Float Glass of thickness 3 mm

Parameter	Unit	Module A1-A3
Global warming potential (GWP)	kg CO_2-eq	9.67
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC 11-eq	4.66E-11
Acidification potential of land and water (AP)	kg SO_2-eq	0.039
Eutrophication potential (EP)	kg $PO_4{}^{3-}$-eq	0.0039
Formation potential of tropospheric ozone photochemical oxidants (POCP)	kg ethene-eq	0.0018
Abiotic depletion potential for non-fossil resources (ADP elements)	kg Sb-eq	5.50E-05
Abiotic depletion potential for fossil resources (ADP fossil fuels)	MJ	117

(b) Use of Natural Resources analysis for 1 m^2 of average Float Glass of thickness 3 mm

Parameter	Unit	Module A1-A3
Renewable primary energy as energy carrier	MJ	3.6
Renewable primary energy resources as material utilization	MJ	0
Total use of renewable primary energy resources	MJ	3.6
Non-renewable primary energy as energy carrier	MJ	118
Non-renewable primary energy as material utilization	MJ	0
Total use of non-renewable primary energy resources	MJ	118
Use of secondary material	kg	3.15
Use of renewable secondary fuels	MJ	0
Use of non-renewable secondary fuels	MJ	0
Use of net fresh water	m^3	0.02

(c) Waste Category for 1 m^2 of average Float Glass of thickness 3 mm

Parameter	Unit	Module A1-A3
Non-hazardous waste	Kg	0.22
Hazardous waste	Kg	3.00E-07
Radioactive waste	Kg	2.60E-04

4.6.2 Float Glass: 3.5 mm

Table 14 (a-c) show the life cycle environmental impacts for 1 m^2 of average Float Glass product for 3.5 mm thickness.

Table 14 (a) LCIA for 1 m^2 of average Float Glass of thickness 3.5 mm

Parameter	Unit	Module A1-A3
Global warming potential (GWP)	kg CO_2-eq	11.3
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC 11-eq	5.43E-11
Acidification potential of land and water (AP)	kg SO_2-eq	0.046
Eutrophication potential (EP)	kg $PO_4{}^{3-}$-eq	0.0046
Formation potential of tropospheric ozone photochemical oxidants (POCP)	kg ethene-eq	0.0021
Abiotic depletion potential for non-fossil resources (ADP elements)	kg Sb-eq	6.41E-05
Abiotic depletion potential for fossil resources (ADP fossil fuels)	MJ	137

(b) Use of Natural Resources analysis for 1 m^2 of average Float Glass of thickness 3.5 mm

Parameter	Unit	Module A1-A3
Renewable primary energy as energy carrier	MJ	4.20
Renewable primary energy resources as material utilization	MJ	0
Total use of renewable primary energy resources	MJ	4.20
Non-renewable primary energy as energy carrier	MJ	138
Non-renewable primary energy as material utilization	MJ	0
Total use of non-renewable primary energy resources	MJ	138
Use of secondary material	kg	3.70
Use of renewable secondary fuels	MJ	0
Use of non-renewable secondary fuels	MJ	0
Use of net fresh water	m^3	0.024

(c) Waste Category for 1 m^2 of average Float Glass of thickness 3.5 mm

Parameter	Unit	Module A1-A3
Non-hazardous waste	Kg	0.25
Hazardous waste	Kg	3.50E-07
Radioactive waste	Kg	3.10E-04

4.6.3 Float Glass: 4 mm

Table 15 (a-c) show the life cycle environmental impacts for 1 m^2 of average Float Glass product for 4 mm thickness.

Table 15 (a) LCIA for 1 m^2 of average Float Glass of thickness 4 mm

Parameter	Unit	Module A1-A3
Global warming potential (GWP)	kg CO_2-eq	12.9
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC 11-eq	6.20E-11
Acidification potential of land and water (AP)	kg SO_2-eq	0.053
Eutrophication potential (EP)	kg $PO_4{}^{3-}$-eq	0.005
Formation potential of tropospheric ozone photochemical oxidants (POCP)	kg ethene-eq	0.0025
Abiotic depletion potential for non-fossil resources (ADP elements)	kg Sb-eq	7.30E-05
Abiotic depletion potential for fossil resources (ADP fossil fuels)	MJ	157

(b) Use of Natural Resources analysis for 1 m^2 of average Float Glass of thickness 4 mm

Parameter	Unit	Module A1-A3
Renewable primary energy as energy carrier	MJ	4.80
Renewable primary energy resources as material utilization	MJ	0
Total use of renewable primary energy resources	MJ	4.80
Non-renewable primary energy as energy carrier	MJ	157
Non-renewable primary energy as material utilization	MJ	0
Total use of non-renewable primary energy resources	MJ	157
Use of secondary material	kg	4.20
Use of renewable secondary fuels	MJ	0
Use of non-renewable secondary fuels	MJ	0
Use of net fresh water	m^3	0.027

(c) Waste Category for 1 m^2 of average Float Glass of thickness 4 mm

Parameter	Unit	Module A1-A3
Non-hazardous waste	Kg	0.29
Hazardous waste	Kg	4.00E-07
Radioactive waste	Kg	3.50E-04

4.6.4 Float Glass: 5 mm

Table 16 (a-c) show the life cycle environmental impacts for 1 m^2 of average Float Glass product for 5 mm thickness.

Table 16 (a) LCIA for 1 m^2 of average Float Glass of thickness 5 mm

Parameter	Unit	Module A1-A3
Global warming potential (GWP)	kg CO_2-eq	16.1
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC 11-eq	7.7E-11
Acidification potential of land and water (AP)	kg SO_2-eq	0.066
Eutrophication potential (EP)	kg $PO_4{}^{3-}$-eq	0.006
Formation potential of tropospheric ozone photochemical oxidants (POCP)	kg ethene-eq	0.003
Abiotic depletion potential for non-fossil resources (ADP elements)	kg Sb-eq	9.16E-05
Abiotic depletion potential for fossil resources (ADP fossil fuels)	MJ	196

(b) Use of Natural Resources analysis for 1 m^2 of average Float Glass of thickness 5 mm

Parameter	Unit	Module A1-A3
Renewable primary energy as energy carrier	MJ	6.0
Renewable primary energy resources as material utilization	MJ	0
Total use of renewable primary energy resources	MJ	6.0
Non-renewable primary energy as energy carrier	MJ	197
Non-renewable primary energy as material utilization	MJ	0
Total use of non-renewable primary energy resources	MJ	197
Use of secondary material	kg	5.25
Use of renewable secondary fuels	MJ	0
Use of non-renewable secondary fuels	MJ	0
Use of net fresh water	m^3	0.034

(c) Waste Category for 1 m^2 of average Float Glass of thickness 5 mm

Parameter	Unit	Module A1-A3
Non-hazardous waste	Kg	0.37
Hazardous waste	Kg	5.00E-07
Radioactive waste	Kg	4.40E-04

4.6.5 Float Glass: 6 mm

Table 17 (a-c) show the life cycle environmental impacts for 1 m^2 of average Float Glass product for 6 mm thickness.

Table 17 (a) LCIA for 1 m^2 of average Float Glass of thickness 6 mm

Parameter	Unit	Module A1-A3
Global warming potential (GWP)	kg CO_2-eq	19.3
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC 11-eq	9.3E-11
Acidification potential of land and water (AP)	kg SO_2-eq	0.08
Eutrophication potential (EP)	kg $PO_4{}^{3-}$-eq	0.0078
Formation potential of tropospheric ozone photochemical oxidants (POCP)	kg ethene-eq	0.0037
Abiotic depletion potential for non-fossil resources (ADP elements)	kg Sb-eq	1.10E-04
Abiotic depletion potential for fossil resources (ADP fossil fuels)	MJ	235

(b) Use of Natural Resources analysis for 1 m^2 of average Float Glass of thickness 6 mm

Parameter	Unit	Module A1-A3
Renewable primary energy as energy carrier	MJ	7.19
Renewable primary energy resources as material utilization	MJ	0
Total use of renewable primary energy resources	MJ	7.19
Non-renewable primary energy as energy carrier	MJ	236
Non-renewable primary energy as material utilization	MJ	0
Total use of non-renewable primary energy resources	MJ	236
Use of secondary material	kg	6.30
Use of renewable secondary fuels	MJ	0
Use of non-renewable secondary fuels	MJ	0
Use of net fresh water	m^3	0.041

(c) Waste Category for 1 m^2 of average Float Glass of thickness 6 mm

Parameter	Unit	Module A1-A3
Non-hazardous waste	Kg	0.44
Hazardous waste	Kg	6.00E-07
Radioactive waste	Kg	5.30E-04

4.6.6 Float Glass: 8 mm

Table 18 (a-c) show the life cycle environmental impacts for 1 m^2 of average Float Glass product for 8 mm thickness.

Table 18 (a) LCIA for 1 m^2 of average Float Glass of thickness 8 mm

Parameter	Unit	Module A1-A3
Global warming potential (GWP)	kg CO_2-eq	25.8
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC 11-eq	1.24E-10
Acidification potential of land and water (AP)	kg SO_2-eq	0.106
Eutrophication potential (EP)	kg $PO_4{}^{3-}$-eq	0.01
Formation potential of tropospheric ozone photochemical oxidants (POCP)	kg ethene-eq	0.005
Abiotic depletion potential for non-fossil resources (ADP elements)	kg Sb-eq	1.46E-04
Abiotic depletion potential for fossil resources (ADP fossil fuels)	MJ	313

(b) Use of Natural Resources analysis for 1 m^2 of average Float Glass of thickness 8 mm

Parameter	Unit	Module A1-A3
Renewable primary energy as energy carrier	MJ	9.60
Renewable primary energy resources as material utilization	MJ	0
Total use of renewable primary energy resources	MJ	9.60
Non-renewable primary energy as energy carrier	MJ	315
Non-renewable primary energy as material utilization	MJ	0
Total use of non-renewable primary energy resources	MJ	315
Use of secondary material	kg	8.40
Use of renewable secondary fuels	MJ	0
Use of non-renewable secondary fuels	MJ	0
Use of net fresh water	m^3	0.055

(c) Waste Category for 1 m^2 of average Float Glass of thickness 8 mm

Parameter	Unit	Module A1-A3
Non-hazardous waste	Kg	0.59
Hazardous waste	Kg	8.00E-07
Radioactive waste	Kg	7.05E-04

4.6.7 Float Glass: 10 mm

Table 19 (a-c) show the life cycle environmental impacts for 1 m^2 of average Float Glass product for 10 mm thickness.

Table 19 (a) LCIA for 1 m^2 of average Float Glass of thickness 10 mm

Parameter	Unit	Module A1-A3
Global warming potential (GWP)	kg CO_2-eq	32.2
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC 11-eq	1.55E-10
Acidification potential of land and water (AP)	kg SO_2-eq	0.13
Eutrophication potential (EP)	kg $PO_4{}^{3-}$-eq	0.013
Formation potential of tropospheric ozone photochemical oxidants (POCP)	kg ethene-eq	0.006
Abiotic depletion potential for non-fossil resources (ADP elements)	kg Sb-eq	1.80E-04
Abiotic depletion potential for fossil resources (ADP fossil fuels)	MJ	391

(b) Use of Natural Resources analysis for 1 m^2 of average Float Glass of thickness 10 mm

Parameter	Unit	Module A1-A3
Renewable primary energy as energy carrier	MJ	12.00
Renewable primary energy resources as material utilization	MJ	0
Total use of renewable primary energy resources	MJ	12.00
Non-renewable primary energy as energy carrier	MJ	394
Non-renewable primary energy as material utilization	MJ	0
Total use of non-renewable primary energy resources	MJ	394
Use of secondary material	kg	10.5
Use of renewable secondary fuels	MJ	0
Use of non-renewable secondary fuels	MJ	0
Use of net fresh water	m^3	0.068

(c) Waste Category for 1 m^2 of average Float Glass of thickness 10 mm

Parameter	Unit	Module A1-A3
Non-hazardous waste	Kg	0.74
Hazardous waste	Kg	1.00E-06
Radioactive waste	Kg	8.80E-04

4.6.8 Float Glass: 12 mm

Table 20 (a-c) show the life cycle environmental impacts for 1 m^2 of average Float Glass product for 12 mm thickness.

Table 20 (a) LCIA for 1 m^2 of average Float Glass of thickness 12 mm

Parameter	Unit	Module A1-A3
Global warming potential (GWP)	kg CO_2-eq	38.7
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC 11-eq	1.86E-10
Acidification potential of land and water (AP)	kg SO_2-eq	0.16
Eutrophication potential (EP)	kg $PO_4{}^{3-}$-eq	0.0157
Formation potential of tropospheric ozone photochemical oxidants (POCP)	kg ethene-eq	0.0075
Abiotic depletion potential for non-fossil resources (ADP elements)	kg Sb-eq	2.20E-04
Abiotic depletion potential for fossil resources (ADP fossil fuels)	MJ	470

(b) Use of Natural Resources analysis for 1 m^2 of average Float Glass of thickness 12 mm

Parameter	Unit	Module A1-A3
Renewable primary energy as energy carrier	MJ	14.4
Renewable primary energy resources as material utilization	MJ	0
Total use of renewable primary energy resources	MJ	14.4
Non-renewable primary energy as energy carrier	MJ	472
Non-renewable primary energy as material utilization	MJ	0
Total use of non-renewable primary energy resources	MJ	472
Use of secondary material	kg	12.6
Use of renewable secondary fuels	MJ	0
Use of non-renewable secondary fuels	MJ	0
Use of net fresh water	m^3	0.082

(c) Waste Category for 1 m^2 of average Float Glass of thickness 12 mm

Parameter	Unit	Module A1-A3
Non-hazardous waste	Kg	0.89
Hazardous waste	Kg	1.20E-06
Radioactive waste	Kg	0.001

4.7 Interpretation

1 m^2 of float glass with 10 mm thickness is used for interpreting the LCIA results in this section. Other thicknesses are on the basis of relative mass of the float glass for the respective thickness and the same interpretation will apply. The LCIA interpretations of 10 mm thickness float glass are as given below:-

Table 21 Interpretation of most significant contributors to life cycle parameters for 1 m^2 of float glass of thickness 10 mm

Parameter	Most significant contributor
ADP elements	Abiotic depletion potential (ADP element) is 1.80E-04 Kg Sb-Equiv. of which 99.7% contribution is from raw material production. In raw materials, soda ash and sodium sulphate accounts for 55% and 33% of the impacts respectively.
ADP Fossil	Abiotic depletion potential for fossil resources (ADP fossil) is 391 MJ of which 64.3% contribution is from energy production (electricity, HFO, NG and diesel); 31.4% is from raw material production and 4.3% from transport. In energy production, natural gas and HFO production accounts for 55% and 33.5% of the impacts respectively.
Acidification Potential	Acidification Potential is 0.13 Kg SO_2-Equiv. with major contribution from raw material production (53%) and energy production (36%). Transport accounts to only 4.5% of the acidification potential. In raw materials, the major impact comes from soda ash (57%)
Eutrophication Potential	Eutrophication Potential is 0.013 kg Phosphate-Equiv. with major contribution from raw material production (60%) and energy production (22%). Transport accounts to only 9% of the total eutrophication potential. In raw materials, the major impact comes from soda ash (72%)
Global Warming Potential	Global Warming Potential is 32.2 kg CO_2-Equiv., with major contribution from fuel combustion in melting furnace (47%), raw material production (31%) and energy production (HFO, NG, diesel and electricity) (17%). In raw materials, the major impact comes from soda ash (62%)
Ozone Layer Depletion Potential	Ozone Layer Depletion Potential is 1.55E-10 kg CFC 11-Equiv. with major contribution from raw material production (55%) and energy production (43%). In raw materials, the major impact comes from external cullets production (33%) and soda ash (31%).
Photochemical Ozone Creation Potential	Photochemical Ozone Creation Potential is 0.006 kg Ethene-Equiv. with major contribution from raw material production (50%) and energy production (37%). Process emissions accounts for only 10% of the total POCP. In raw materials, the major impact comes from soda ash (60%)

Water Demand	The net fresh water used is 6.86E-02 m^3
Waste Generation	The total amount of hazardous waste generated is 1.0E-06 kg and the non-hazardous waste is 0.74 kg. The amount of radioactive waste disposed is 8.8E-04 kg. Most of the hazardous and non-hazardous waste is contributed by raw material production (92% and 98% respectively). In raw material production, the major hazardous waste comes from sodium nitrate (90%), whereas the major non-hazardous waste comes from soda ash production (56%)

5. Other Environmental Information

The constituent materials used within our products are responsibly sourced and we apply the principles of Sustainable Development and of Environmental Stewardship as a standard business practice in our operations. Protecting the environment by preserving non-renewable natural resources, increasing energy efficiency, reducing the environmental emissions, limiting the impact of materials transportation to and from our operations is part of our way in doing business.

6. References

- EN 15804:2012, Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products
- GABI 8: 2017. thinkstep AG; GaBi 8: Software-System and Database for Life Cycle Engineering. Copyright. Leinfelden, Echterdingen, 1992-2017.
- ISO 14020:2001 Environmental labels and declarations - General principles
- ISO 14025:2006 Environmental labels and declarations - Type III environmental declarations - Principles and procedures
- ISO 14040:2006 Environmental management - Life cycle assessment - Principles and framework
- ISO 14044:2006 Environmental management - Life cycle assessment - Requirements and guidelines
- Product Category Rules PCR 2012:01 Construction products and construction services, version 2.2 in compliance with EN 15804