Environmental Product Declaration of Processed Glass

In accordance with EN 15804 and ISO 14025

ASAHI INDIA GLASS LTD.(AIS)

April 2019

EPD registration number:	S-P-01411
Publication date:	2019-04-19
Validity date:	2024-04-18
Geographical scope:	India

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 Processed Glass (Heat Tempered, Laminated, IGU and Printed) of thickness 6 mm 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 four variants of Processed Glass i.e., Heat Tempered, Laminated, IGU and Printed glass manufactured at Taloja unit 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	Processed 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	2019-04-19
Period of Validity	2024-04-18

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 Processed 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 Processed Glass of varying thicknesses at their Taloja plant. The EPD is declared for four variants of Processed Glass for 6 mm thickness since 85% of processed glass production at AIS falls in this range and hence can be considered as a representative fraction for the entire production unit. The upstream glass for manufacturing Processed glass has been considered as an average soft coated float glass comprising of weighted average production volume of clear and tinted float glass at AIS 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
- Coating of the float glass
- Pre-processing of the coated glass
- Processing operations such as tempering, lamination, glazing and printing
- Packing and Storage of the processed glass.

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

The glass is 100% glass made up of silica sand, soda ash, lime, feldspar and so on. 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). The average float glass model (to be used as upstream database for processed glass) has been considered by taking the weighted average production volume of clear and tinted float glass for FY 16-17 as shown in table 5. Almost all the processed glass goes through a preliminary coating process and hence the impacts of soft coating has also been considered in calculation of results.

Table 5 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.

The product system consists of 4 variants of processed glass:

1. Tempered Glass

This type of glass is heated to more than 600 °C and then quickly cooled. If broken, it shatters into many small blunt pieces. Tempered glass retains the light transmission and energy properties of the base product. Once toughened, they can no longer be cut or shaped. AIS manufactures this glass under the name of AIS Stronglas.

AIS Stronglas is a very high grade tempered glass that is several orders of magnitude stronger than ordinary glass. It makes glass safer and durable by lowering the risk of impact related breakage.

2. Laminated Glass

Laminated glass is a type of safety glass that holds together when shattered. In the event of breaking, it is held in place by an interlayer, typically of polyvinyl butyral (PVB) or ethylene-vinyl acetate (EVA), between its two or more layers of glass. The interlayer keeps the layers of glass bonded even when broken, and its high strength prevents the glass from breaking up into large sharp pieces. Laminated glass is normally used when there is a possibility of human impact or where the glass could fall if shattered and also for architectural applications. AIS manufactures this glass under the name of AIS Acousticglas.

AIS Acousticglas is a range of laminated glass with a specialized PVB interlayer that dampens external sounds and provides 90% sound reduction. When compared to normal 5mm ordinary glass, AIS Acousticglas provides an extra 50-60% sound reduction. AIS Acousticglas is ideal for homes, offices and shops in high traffic zones or near railway-lines and airports.

3. IGU Glass or Insulating Glass

Insulating glass (IG), more commonly known as double glazing (or double-pane, and increasingly triple glazing/pane), consists of two or three glass window panes separated by a vacuum or gas filled space to reduce heat transfer across a part of the building envelope.

AIS Renew is the appropriate retrofitting solution which facilitates energy efficiency in a building. The glass solution’s Low-E addition conserves energy by allowing adequate light inside and filtering out the harmful radiation. It also enables insulation of the building, drastically reducing the cost of heating and cooling of the building’s interiors.

4. Printed Glass or Ceramic Frit Glass

Printed Glass is an enamel painted tempered glass suitable for decorative purposes. By using specifically formulated ceramic inks, extreme durability is achieved through the toughening process where the ink is infused with the glass. This type of glass is suitable for most glass applications, including curtain walls, glazing systems, shower cubicles, glass doors, and partitions in architectural interiors and exteriors.

Hard coating can be applied on both clear and tinted float glass. The product studied in the EPD is a representative of all hard coated glass, i.e., “Hard coating on 1m^2 of average float glass”.

Table 6 shows the performance data for variants of processed glass for a combination of thicknesses. It is in accordance to EN 410 – 2011 standard.

Table 6 Performance Data of Processed Glass

Thickness (mm)	6 + 12 + 6 mm				
Type of Processed Glass	Blue Vision (6 + 12 + 6)	Clear Vision (6 + 12 + 6)	Clear Lite plus (6 + 12 + 6)	Clear Radiance (6 + 12 + 6)	Clear Essence plus (6 + 12 + 6)
Visible parameters					
Light transmittance (LT) %	24	39	54	49	72
External light reflection (RLE) (%)	13	23	15	20	15
Internal light reflection (RLI) %	10	10	11	14	14
Energetic parameters					
U value	1.7	1.7	1.7	1.7	1.8
Solar factor g	22	31	37	32	53

Type of Processed Glass	Heat Tempered (Clear Radiance Plus + 12mm Air + 6 MM Clear)	Laminated (Clear Vision +1.52 mm PVB + 6mm Clear	Laminated (Clear Excel Pear + 1.52 PVB + 6 mm Clear)
Visible parameters			
Light transmittance (LT) %	45.73	45.55	41.50
External light reflection (RLE) (%)	14.37	21.33	17.90
UV transmittance (ET) %	8.66	0.01	-
Solar Direct Transmittance %	21.64	23.96	18.40
Solar factor g	0.32	0.32	0.23

AIS manufactures a wide variety of other processed glass, the performance data of which can be found on: https://www.aisglass.com/ais-glass-performance-parameters.

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 ^{0}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.

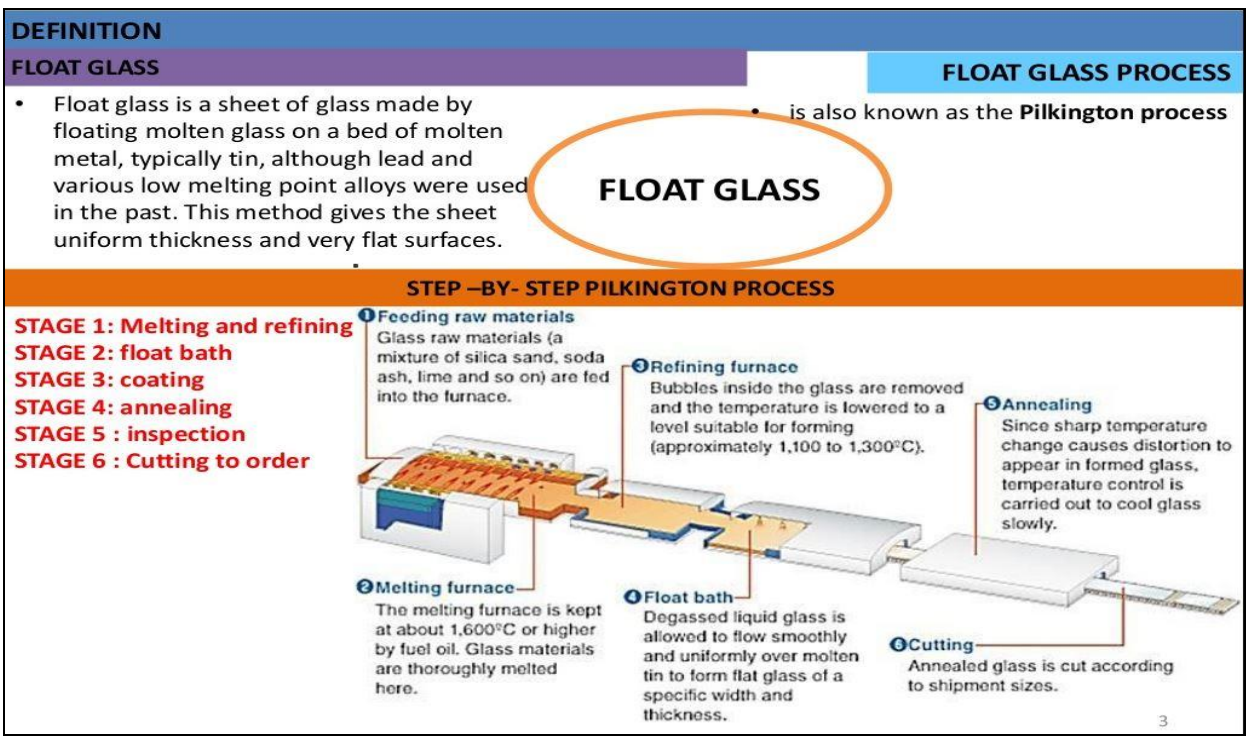

Figure 1: Manufacturing Process Flow Diagram of Float Glass

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 Coating

Coatings can be applied either on-line (with the float glass manufacturing process) or off-line (independently of the float glass manufacturing process).

- On-Line Coating is a silicon based coating and is deposited onto the surface of the glass during glass production and while the glass is still in semi molten state, typically at 600-700 ^{0}C. A chemical reaction occurs between the silicon vapour and the glass surface, changing the chemical composition of the glass surface, resulting in a hard coating that strongly adheres to the glass.
- Off-Line Coating the glass passes through a tightly sealed pumping chamber in which the vacuum is formed. Multiple layers of metals, metal and non-metal oxides and nitrides are then applied to the glass using a magnetically enhanced cathodic sputtering method. The resultant thin and transparent coating offers thermal insulation and solar control properties.

3.2.6 Processing

The coated float glass can further undergo a variety of processing operations to improve the performance and characteristics of the glass. The resultant glass are Heat Tempered Glass, Laminated glass, IGU or Glazed Glass and Printed Glass.

3.3 System Boundaries

The LCA model of processed 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 7 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 18 summarizes those processes that are included within the system boundaries of the study.

Table 8 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	Processed Glass Production by mixing of raw materials and disposal of waste generated followed by coating and processing	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 processed glass for thickness 6 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 and processing 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 processed 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) EN 15804 for construction products and services. 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

4.6.1 Heat Tempered Glass

Table 9 (a-c) shows the life cycle environmental impacts for 1 m^2 of soft coated tempered glass product for 6 mm thickness.

Table 9 (a) LCIA for 1 m^2 of soft coated tempered glass of thickness 6 mm

Parameter	Unit	Module A1-A3
Global warming potential (GWP fossil)	kg CO_2-eq	44.7
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC 11-eq	6.40E-10
Acidification potential of land and water (AP)	kg SO_2-eq	0.410
Eutrophication potential (EP)	kg PO_4^{3-}-eq	0.025
Formation potential of tropospheric ozone photochemical oxidants (POCP)	kg ethene-eq	0.020
Abiotic depletion potential for non-fossil resources (ADP elements)	kg Sb-eq	1.70E-04
Abiotic depletion potential for fossil resources (ADP fossil fuels)	MJ	500.0

(b) Use of Natural Resources analysis for 1 m^2 of soft coated tempered glass of thickness 6 mm

Parameter	Unit	Module A1-A3
Renewable primary energy as energy carrier	MJ	35.1
Renewable primary energy resources as material utilization	MJ	0
Total use of renewable primary energy resources	MJ	35.1
Non-renewable primary energy as energy carrier	MJ	508.8
Non-renewable primary energy as material utilization	MJ	0
Total use of non-renewable primary energy resources	MJ	508.8
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	0.29

(c) Waste Category for 1 m^2 of soft coated tempered glass of thickness 6 mm

Parameter	Unit	Module A1-A3
Non-hazardous waste	kg	0.560
Hazardous waste	kg	8.08E-07
Radioactive waste	kg	0.003

4.6.2 Laminated Glass

Table 10 (a-c) show the life cycle environmental impacts for 1 m^2 of soft coated laminated glass product for 6 mm thickness.

Table 10 (a) LCIA for 1 m^2 of soft coated laminated glass of thickness 6 mm

Parameter	Unit	Module A1-A3
Global warming potential (GWP)	kg CO_2-eq	93.6
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC 11-eq	1.49E-19
Acidification potential of land and water (AP)	kg SO_2-eq	0.858
Eutrophication potential (EP)	kg PO_4 $^{3-}$-eq	0.046
Formation potential of tropospheric ozone photochemical oxidants (POCP)	kg ethene-eq	0.043
Abiotic depletion potential for non-fossil resources (ADP elements)	kg Sb-eq	1.89E-04
Abiotic depletion potential for fossil resources (ADP fossil fuels)	MJ	1124.5

(b) Use of Natural Resources analysis for 1 m^2 of soft coated laminated glass of thickness 6 mm

Parameter	Unit	Module A1-A3
Renewable primary energy as energy carrier	MJ	87.5
Renewable primary energy resources as material utilization	MJ	0
Total use of renewable primary energy resources	MJ	87.5
Non-renewable primary energy as energy carrier	MJ	1149
Non-renewable primary energy as material utilization	MJ	0
Total use of non-renewable primary energy resources	MJ	1149
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	0.607

(c) Waste Category for 1 m^2 of soft coated laminated glass of thickness 6 mm

Parameter	Unit	Module A1-A3
Non-hazardous waste	kg	0.75
Hazardous waste	kg	1.16E-06
Radioactive waste	kg	0.009

4.6.3 IGU (Glazed) Glass

Table 11 (a-c) show the life cycle environmental impacts for 1 m^2 of soft coated glazed glass product for 6 mm thickness.

Table 11 (a) LCIA for 1 m^2 of soft coated glazed glass of thickness 6 mm

Parameter	Unit	Module A1-A3
Global warming potential (GWP)	kg CO_2-eq	52.7
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC 11-eq	7.97E-10
Acidification potential of land and water (AP)	kg SO_2-eq	0.463
Eutrophication potential (EP)	kg $PO_4{}^{3-}$-eq	0.029
Formation potential of tropospheric ozone photochemical oxidants (POCP)	kg ethene-eq	0.022
Abiotic depletion potential for non-fossil resources (ADP elements)	kg Sb-eq	4.0E-04
Abiotic depletion potential for fossil resources (ADP fossil fuels)	MJ	603.6

(b) Use of Natural Resources analysis for 1 m^2 of soft coated glazed glass of thickness 6 mm

Parameter	Unit	Module A1-A3
Renewable primary energy as energy carrier	MJ	64.8
Renewable primary energy resources as material utilization	MJ	0
Total use of renewable primary energy resources	MJ	64.8
Non-renewable primary energy as energy carrier	MJ	621.7
Non-renewable primary energy as material utilization	MJ	0
Total use of non-renewable primary energy resources	MJ	621.7
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	0.055

(c) Waste Category for 1 m^2 of soft coated glazed glass of thickness 6 mm

Parameter	Unit	Module A1-A3
Non-hazardous waste	kg	1.83
Hazardous waste	kg	1.22E-06
Radioactive waste	kg	0.007

4.6.4 Printed Glass

Table 12 (a-c) show the life cycle environmental impacts for 1 m^2 of soft coated printed glass product for 6 mm thickness.

Table 12 (a) LCIA for 1 m^2 of soft coated printed glass of thickness 6 mm

Parameter	Unit	Module A1-A3
Global warming potential (GWP)	kg CO_2-eq	47.2
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC 11-eq	6.92E-10
Acidification potential of land and water (AP)	kg SO_2-eq	0.43
Eutrophication potential (EP)	kg $PO_4{}^{3-}$-eq	0.026
Formation potential of tropospheric ozone photochemical oxidants (POCP)	kg ethene-eq	0.021
Abiotic depletion potential for non-fossil resources (ADP elements)	kg Sb-eq	1.7E-04
Abiotic depletion potential for fossil resources (ADP fossil fuels)	MJ	526.6

(b) Use of Natural Resources analysis for 1 m^2 of soft coated printed glass of thickness 6 mm

Parameter	Unit	Module A1-A3
Renewable primary energy as energy carrier	MJ	38.1
Renewable primary energy resources as material utilization	MJ	0
Total use of renewable primary energy resources	MJ	38.1
Non-renewable primary energy as energy carrier	MJ	536.6
Non-renewable primary energy as material utilization	MJ	0
Total use of non-renewable primary energy resources	MJ	536.6
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	0.31

(c) Waste Category for 1 m^2 of soft coated printed glass of thickness 6 mm

Parameter	Unit	Module A1-A3
Non-hazardous waste	kg	0.57
Hazardous waste	kg	8.32E-07
Radioactive waste	kg	0.004

4.7 Interpretation

4.7.1 Heat Tempered Glass

Table 13 Interpretation of most significant contributors to life cycle parameters for 1 m^2 of soft coated tempered glass of thickness 6 mm

Parameter	Most significant contributor
ADP elements	Abiotic depletion potential (ADP element) is 1.7E-04 Kg Sb-Equiv. of which 68% contribution is from the production of float glass and 29% from the silver used in coating process.
ADP Fossil	Abiotic depletion potential for fossil resources (ADP fossil) is 500 MJ of which 50% contribution is from the production of float glass, and 45% from electricity consumption in coating and tempering process.
Acidification Potential	Acidification Potential is 0.41 Kg SO_2-Equiv. of which 21% contribution is from the production of float glass, 12% from the transport of raw materials and 66% from the electricity consumption in coating and tempering process.
Eutrophication Potential	Eutrophication Potential is 0.025 kg Phosphate-Equiv. of which 33% contribution is from the production of float glass, 20% from the transport of raw materials and 46% from the electricity consumption in coating and tempering process
Global Warming Potential	Global Warming Potential is 44.7 kg CO_2-Equiv., of which 46% contribution is from the production of float glass and 49% from the electricity consumption in coating and tempering process
Ozone Layer Depletion Potential	Ozone Layer Depletion Potential is 6.4E-11 kg CFC 11-Equiv. of which 15.5% contribution is from the production of float glass and 83% from the electricity consumption in coating and tempering process.
Photochemical Ozone Creation Potential	Photochemical Ozone Creation Potential is 0.019 kg Ethene-Equiv. of which 21% contribution is from the production of float glass, 13% from the transport of raw materials and 65% from the electricity consumption in coating and tempering process.
Water Demand	The net fresh water used is 0.29 m^3
Waste Generation	The total amount of hazardous waste generated is 8.07E-07 kg and the non-hazardous waste is 0.56 kg. The amount of radioactive waste disposed is 3.5E-03 kg. Most of the hazardous and non-hazardous waste is contributed by the production of float glass (78% and 82% respectively). A small amount is contributed by the electricity consumption in coating and tempering process.

4.7.2 Laminated Glass

Table 14 Interpretation of most significant contributors to life cycle parameters for 1 m^2 of soft coated laminated glass of thickness 6 mm

Parameter	Most significant contributor
ADP elements	Abiotic depletion potential (ADP element) is 1.9E-04 Kg Sb-Equiv. of which 66% contribution is from the production of float glass, 28% from the production of silver cathode and 2% from PVB.
ADP Fossil	Abiotic depletion potential for fossil resources (ADP fossil) is 1124.5 MJ of which 24% contribution is from the production of float glass, 50% from electricity consumption and 23% from PVB
Acidification Potential	Acidification Potential is 0.86 Kg SO2-Equiv. of which 10% contribution is from the production of float glass, 76% from electricity consumption and 7% from transport of raw materials.
Eutrophication Potential	Eutrophication Potential is 0.046 kg Phosphate-Equiv. of which 19% contribution is from the production of float glass, 64% from electricity consumption and 12% from transport of raw materials.
Global Warming Potential	Global Warming Potential is 93.6 kg CO2-Equiv., of which 24% contribution is from the production of float glass, 61% from the electricity consumption and 13.6% from PVB
Ozone Layer Depletion Potential	Ozone Layer Depletion Potential is 1.5E-09 kg CFC 11-Equiv. of which 7% contribution is from the production of float glass and 91% from electricity consumption.
Photochemical Ozone Creation Potential	Photochemical Ozone Creation Potential is 0.042 kg Ethene-Equiv. of which 9% contribution is from the production of float glass, 6.5% from the transport of raw materials, 75% from the electricity consumption and 8% from PVB
Water Demand	The net fresh water used is 0.61 m^3
Waste Generation	The total amount of hazardous waste generated is 1.16E-06 kg and the non-hazardous waste is 0.75 kg. The amount of radioactive waste disposed is 9.4E-03 kg. Most of the hazardous and non-hazardous waste is contributed by the production of float glass (66% and 75% respectively). Around 28% of the hazardous waste and 18% of non-hazardous waste is contributed by electricity consumption.

4.7.3 IGU (Glazed) Glass

Table 15 Interpretation of most significant contributors to life cycle parameters for 1 m^2 of soft coated IGU glass of thickness 6 mm

Parameter	Most significant contributor
ADP elements	Abiotic depletion potential (ADP element) is 4.0E-04 Kg Sb-Equiv. of which 31% contribution is from the production of float glass, 13% from the production of silver cathode and 55% from silicon sealing compound.
ADP Fossil	Abiotic depletion potential for fossil resources (ADP fossil) is 603.6 MJ of which 43% contribution is from the production of float glass, 4% from transport of raw materials, 42% from the electricity consumption and 9% from silicon sealing compound.
Acidification Potential	Acidification Potential is 0.46 Kg SO2-Equiv. of which 19% contribution is from the production of float glass, 65% from electricity consumption and 11% from transport of raw materials.
Eutrophication Potential	Eutrophication Potential is 0.028 kg Phosphate-Equiv. of which 30% contribution is from the production of float glass, 45% from electricity consumption and 18% from transport of raw materials.
Global Warming Potential	Global Warming Potential is 52.7 kg CO2-Equiv., of which 41% contribution is from the production of float glass, 45% from the electricity consumption and 7% from silicon sealing compound.
Ozone Layer Depletion Potential	Ozone Layer Depletion Potential is 7.8E-10 kg CFC 11-Equiv. of which 13% contribution is from the production of float glass, 75% from electricity consumption and 8% from silicon sealing compound.
Photochemical Ozone Creation Potential	Photochemical Ozone Creation Potential is 0.022 kg Ethene-Equiv. of which 19% contribution is from the production of float glass, 11% from the transport of raw materials, 63% from the electricity consumption and 5% from silicon sealing compound.
Water Demand	The net fresh water used is 0.36 m^3
Waste Generation	The total amount of hazardous waste generated is 1.23E-06 kg and the non-hazardous waste is 1.83 kg. The amount of radioactive waste disposed is 7.04E-03 kg. Most of the hazardous and non-hazardous waste is contributed by the production of float glass (62% and 30% respectively). Around 29% of the hazardous waste and 51% of non-hazardous waste is contributed by the silicon sealing compound.

4.7.4 IGU (Glazed) Glass

Table 16 Interpretation of most significant contributors to life cycle parameters for 1 m^2 of soft coated printed glass of thickness 6 mm

Parameter	Most significant contributor
ADP elements	Abiotic depletion potential (ADP element) is 1.7E-04 Kg Sb-Equiv. of which 68% contribution is from the production of float glass and 29% from the production of silver cathode.
ADP Fossil	Abiotic depletion potential for fossil resources (ADP fossil) is 526.6 MJ of which 48% contribution is from the production of float glass, 4% from transport of raw materials and 47% from the electricity consumption.
Acidification Potential	Acidification Potential is 0.44 Kg SO2-Equiv. of which 19.5% contribution is from the production of float glass, 68% from electricity consumption and 11% from transport of raw materials.
Eutrophication Potential	Eutrophication Potential is 0.026 kg Phosphate-Equiv. of which 32% contribution is from the production of float glass, 48% from electricity consumption and 19% from transport of raw materials.
Global Warming Potential	Global Warming Potential is 47.2 kg CO2-Equiv., of which 44% contribution is from the production of float glass and 52% from the electricity consumption.
Ozone Layer Depletion Potential	Ozone Layer Depletion Potential is 6.9E-10 kg CFC 11-Equiv. of which 14.5% contribution is from the production of float glass and 85% from electricity consumption.
Photochemical Ozone Creation Potential	Photochemical Ozone Creation Potential is 0.029 kg Ethene-Equiv. of which 19.5% contribution is from the production of float glass, 12% from the transport of raw materials and 67% from the electricity consumption.
Water Demand	The net fresh water used is 0.31 m^3
Waste Generation	The total amount of hazardous waste generated is 8.3E-07 kg and the non-hazardous waste is 0.57 kg. The amount of radioactive waste disposed is 3.8E-03 kg. Most of the hazardous and non-hazardous waste is contributed by the production of float glass (88% and 92% respectively). Around 11% of the hazardous waste and 7% of non-hazardous waste is contributed by electricity consumption.

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