Environmental Product Declaration (EPD)

Declaration code: EPD-APG-GB-21.1

AGC Glass Europe

Fire resistant glass

PYROBEL und PYROBELite

Basis:

DIN EN ISO 14025
EN15804

Company-EPD
Environmental
Product **D**eclaration

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Programme operator	ift Rosenheim GmbH Theodor-Gietl-Straße 7-9 83026 Rosenheim
Practitioner of the LCA	ift Rosenheim GmbH Theodor-Gietl-Straße 7-9 83026 Rosenheim
Declaration holder	AGC Glass Europe Avenue Jean Monnet 4 BE-1348 Louvain-la-Neuve
Declaration code	EPD-APG-GB-21.1
Designation of the declared product	PYROBEL und PYROBELite
Scope	Fire resistant glass can be used either as component of an external glazing or as internal partition.
Basis	This EPD was prepared on the basis of EN ISO 14025:2011 and DIN EN 15804:2012+A1:2013. In addition, the “Allgemeiner Leitfaden zur Erstellung von Typ III Umweltproduktdeklarationen” (General guideline for elaboration of Type III Environmental Product Declarations) applies. The Declaration is based on the PCR Documents DIN EN 17074 “PCR for Flat glass products”, “PCR Teil A” (Part A) PCR-A-0.2:2018 and “Flachglas im Bauwesen” (Flat Glass in Building) PCR-FG-1.4:2016.
Validity	Publication date: 17.03.2021 — Last revision: 28.05.2021 — Next revision: 17.03.2026 This verified company Environmental Product Declaration applies solely to the specified products and is valid for a period of five years from the date of publication in accordance with DIN EN 15804.
LCA basis	The LCA was prepared in accordance with EN ISO 14040 and DIN EN ISO 14044. The base data include both data collected from the production site of AGC Glass Europe and the generic data derived from the "GaBi 10" database. LCA calculations were based on the "cradle to gate – with options" life cycle including all upstream processes (e.g. raw materials extraction, etc.).
Notes on publication	The "Conditions and Guidance on the Use of ift Test Documents" apply. The declaration holder assumes full liability for the underlying data, certificates and verifications.

Christian Kehrer	Dr. Torsten Mielecke	Patrick Wortner
Director of ift Certification and Surveillance Body	Chairman of commitee of experts ift EPD and PCR	External Verifier

1 General product information

product definition

This EPD relates to the product group Fire resistant glass and applies to:

Fehler! Verweisquelle konnte nicht gefunden werden. **PYROBEL und PYROBELite fire restitant glass of the company AGC Glass Europe**

The functional unit is declared as follows:

Considered product	Declared unit	Grammage
Pyrobelite 7	1 m²	18,9 kg/m²
Pyrobel 16	1 m²	41,6 kg/m²
Pyrobel 25	1 m²	63,2 kg/m²
Pyrobel 54 EG	1 m²	138,3 kg/m²

Table 1: Product groups

Considered product	Reference product	Weight	Thickness	Density
Pyrobelite 7	1 m²	18,9 kg	7,9 mm	2,4 g/cm³
Pyrobel 16	1 m²	41,6 kg	17,3 mm	2,4 g/cm³
Pyrobel 25	1 m²	26,6 kg	26,6 mm	2,4 g/cm³
Pyrobel 54 EG	1 m²	138,3 kg	57,8 mm	2,4 g/cm³

Table 2: Functional unit

The average unit is declared as follows:
Directly used material flows are determined using produced area (m²) and assigned to the declared unit. All other inputs and outputs in the manufacture were scaled to the declared unit as a whole, since there is no typical functional unit due to the high number of variations. The reference period is 2018.

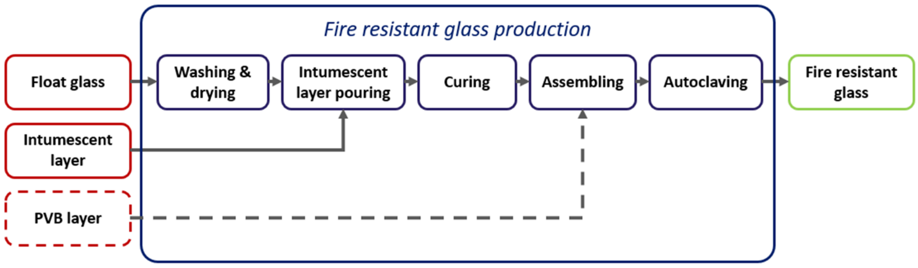
Product description

PYROBEL and PYROBELite are fire resistant glass products made of glass sheets and intumescent interlayers.

The products are composed of several layers of glass and intumescent interlayers as well as possible PVB interlayer for external applications to provide additional safety against falls.
In case of fire, the intumescent interlayers are activated and form highly effective insulation layers. The products ensure integrity, maintaining room closure, and also prevent thermal radiation transfer and thus the heating or ignition of flammable substances on the other side of the fire resistant glass.

For a detailed product description refer to the manufacturer specifications or the product specifications of the respective offer/quotation.

Product manufacture



Application

Fire resistant glass can be used either as component of an external glazing or as internal partition.

Verifications

The following verifications are held:

- Product quality according to DIN EN 13501-2
- Product quality according to DIN EN 410

Further and each current documentation (including other national permits) is available at www.yourglass.com.

Management systems

The following management systems are held:

- Quality management system according to DIN EN ISO 9001:2015 (Seneffe, Belgium and Oloví, Czech Republic)
- Environmental management system according to DIN EN ISO 4001:2015 (Seneffe, Belgium and Oloví, Czech Republic)

Additional information

For additional proof of usability or conformity, refer to the CE marking and the documents accompanying the product.

PYROBEL und PYROBELite fulfill the following physical building performance criteria:

- Fire resistance (Radiation) according to EN 13501-2 (EW 30, EW60, EW90, EW120)
- Fire resistance (Insulation) according to EN 13501-2 (EI15, EI30, EI60, EI90, EI120)
- Pendulum impact resistance according to EN 12600 (3B3, 1B1, 2B2)
- Light transmission according to EN 410 (77 - 88 %)
- Light reflection according to EN 410 (7 - 8 %)
- Direct airborne sound insulation according to EN 12758 (34 - 42 dB

2 Materials used

Primary materials

The primary materials used can be found in the Life Cycle Assessment (LCA) (see chapter 6).

Declarable substances

The product contains no substances from the REACH candidate list (declaration dated 20. October 2020).

All relevant safety data sheets are available from AGC Glass Europe.

3 Construction process stage

Processing recommendations, installation

The instructions for installation, operation, maintenance and disassembly must be noted. See www.yourglass.com for more information.

4 Use stage

Emissions to the environment

There are no known emissions to indoor air and soil. There may be VOC emissions. According to the manufacturer´s declaration the PYROBEL und PYROBELite are in category A+ according to French scheme „*Emissions dans l'air interieur*". For further information, please visit www.your-glass.com.
The washing process produces emissions in water.

Reference service life (RSL)

RSL information to be declared in an EPD covering the use stage shall be provided by the manufacturer. The RSL shall refer to the declared technical and functional performance of the product within a building. It shall be established in accordance with any specific rules given in European product standards and shall take into account ISO 15686-1, -2, -7 and -8. Where European product standards provide guidance on deriving the RSL, such guidance shall have priority. If the reference service life can´t be determined according to ISO 15686, the BBSR table „Nutzungsdauern von Bauteilen zur Lebenszyklusanalyse nach BNB" can be used. For further information visit www.nachhaltigesbauen.de

Relevant for this EPD is:
The reference service life (RSL) can be determined for a "cradle to gate – with options" EPD only if alle the modules A1-A3 and B1-B5 are specified; The reference service life of the PYROBEL und PYROBELite from AGC Glass Europe is not specified.

The service life is for the features, which are reported in this EPD or the relevant references for this purpose.
The RSL does not reflect the actual life time, which is usually determined by the service life and the redevolpement of a building. It represents no statement about service life, guarantee of performance or promise of guarantee.

5 End of life stage

Possible end-of-life stages

Although glass is recyclable, only a limited share is effectively recycled so far. EN 17074 proposes a European default scenario, 75 % goes to landfill and 25 % is recycled, of which 5 % in closed loop. However, a conservative assumption of 100 % landfilling is considered as baseline scenario, reflecting the facts that fire resistant glass is more difficult to recycle than usual insulting glazing units, since the intumescent layer is sticking to the glass product and that the manufacturer does not use post-consumer external cullet in its floats

The end-of-life stage depends on the site where the products are used and is therefore subject to local regulations. Observe the locally applicable regulatory requirements.

Disposal methods

The average disposal routes were taken into account in the LCA.

All life cycle scenarios are detailed in the Annex.

6 Life Cycle Assessment (LCA)

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

As the basis for this, LCAs were prepared for PYROBEL und PYROBELite fire resistant glass. The LCAs were developed in accordance with DIN EN 15804 and the requirements set out by the international standards DIN EN ISO 14040, DIN EN ISO 14044, ISO 21930 and EN ISO 14025.

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

6.1 Definition of goal and scope

Goal

The goal of the LCA is to demonstrate the environmental impacts of PYROBEL und PYROBELite. In accordance with DIN EN 15804, the environmental impacts covered by this Environmental Product Declaration are presented for the entire product life cycle in the form of basic information. Apart from these, no other environmental impacts have been specified.

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

The specific data originate exclusively from the fiscal year 2018. These were recorded at the plants in BE-7180 Seneffe und CZ-357 07 Oloví by on-site collection through the manufacturer and originate partly from company records and partly from values directly obtained by measurement. The data were verified for validity by the ift Rosenheim.

The generic data originates from the "Professional Datenbank" and "Baustoff Datenbank" (professional database and building materials database) from the software "GaBi ts" and from the database “EcoInvent 2.2”. The last update of both databases was in 2020. Data from before this date originate also from this databases and are not more than ten years old. No other generic data were used for the calculation.

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

The life cycle was modelled using the sustainability software tool “GaBi 10” for the development of Life Cycle Assessments.

Scope / System boundaries	The system boundaries refer to the supply of raw materials and purchased parts, the manufacture and the end-of-life stage of PYROBEL und PYROBELite fire resistant glass. No additional data from pre-suppliers / subcontractors or other sites were taken into consideration.
Cut-off criteria	All company data collected, i.e. all input and output materials used, the thermal energy, the electricity consumption were taken into consideration. The boundaries cover only the production-relevant data. Building sections / parts of facilities that are not relevant to the manufacture of the products were excluded. The transport distances of the pre-products were taken into consideration as a function of 100 % of the mass of the products. The criteria for the exclusion of inputs and outputs as set out in DIN EN 15804 are fulfilled. Bases on the data analysis, it can be assumed that the total negligible processes per life cycle stage doesn´t exceed 1 %of the mass or the primary energy. This way the total of negligible processes does not exceed 5 % of the energy and mass input. The life cycle calculation also includes material and energy flows that account for less than 1 %.

6.2 Inventory analysis

Goal	All material and energy flows are described below. The processes covered are presented as input and output parameters and refer to the declared / functional units.
Life cycle stages	The Annex shows the entire life cycle of PYROBEL und PYROBELite. Product stage “A1 – A3”, construction stage “A4 – A5”, end-of-life stage “C2 – C4” and benefits and loads beyond the system boundaries “D” are considered.
Benefits	The below benefits have been defined as per DIN EN 15804: • Benefits from recycling • Benefits from (thermal and electric) incineration
Allocation of co-products	During the manufacture no allocations occur.
Allocations for reuse, recycling and recovery	If products are reused / recycled during product stage (rejects), the elements are shredded, as necessary, and then sorted into original pure components. This is done by various process plants such as magnetic separators. The system boundaries were set following their disposal, with termination of their waste characteristics.
Allocations beyond life cycle boundaries	The use of recycled materials in the product stage is based on the current market-specific situation. In parallel to this, a recycling potential was taken into consideration that reflects the economic value of the product after processing (recyclate).

The system boundary of the recycled material was set during collection.

Secondary material

The use of secondary materials in the module A3 was considered. Secondary material is used.

Inputs

The LCA includes the following production-relevant inputs per 1 m² PYROBEL und PYROBELite:

Energy

The electricity mix is based on the following electricity mix (see Table 3):

Electricity mix	Share in %
Belgium - grid	37.6
Czech Republic - grid	53.8
PV panels	8.6

Table 3: Electricity mix

The input material natural gas is based on the following natural gas mix (see Table 4):

Natural gas mix	Share in %
Belgium mix	46.8
Slovakia mix	53.2

Table 4: Natural gas mix

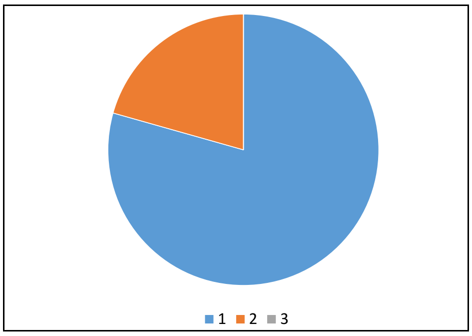
Water

The water consumed by the individual process steps for the manufacture is 54.4 l per m² element.

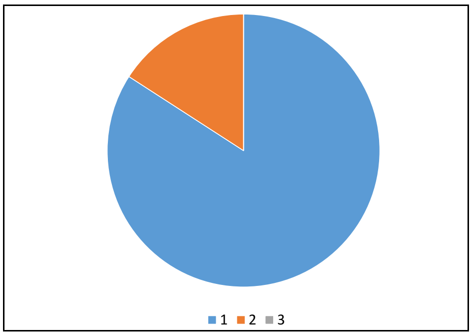
The consumption of fresh water specified in Section 6.3 originates (among others) from the upstream processes of the pre-products and by process water for cooling.

Raw material / Pre-products:

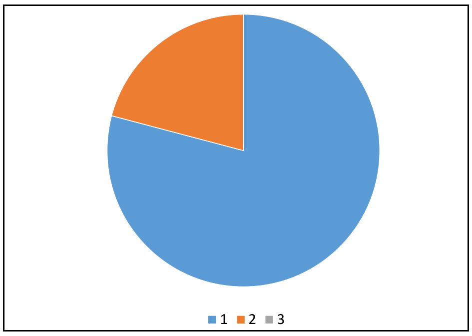
The chart below shows the use of raw materials / pre-products per cent.



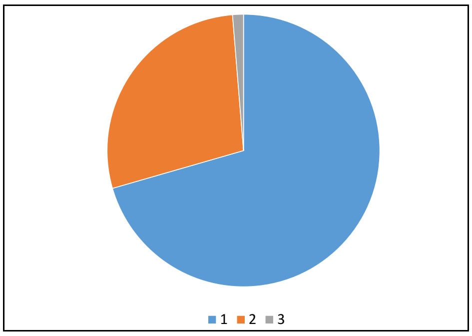
Pyrobelite 7



Pyrobel 16



Pyrobel 25



Pyorbel 54 EG

Figure 1: Percentage representation of individual materials per declared unit

Nr.	Material	Mass in %			
		Pyrobelite 7	Pyrobel 16	Pyrobel 25	Pyrobel 54 EG
1	Float glass	79.37	84.13	79.11	70.50
2	Intumescent layer	20.63	15.87	20.89	28.20
3	Lamination	0.00	0.00	0.00	1.28

Table 5: Representation of individual materials in % per declared unit

Operating supplies
Per m² PYROBEL und PYROBELite accumulate 33 g operating supplies.

Product package
The following quantities of product package accumulate:

Nr.	Material	Mass in g			
		Pyrobelite 7	Pyrobel 16	Pyrobel 25	Pyrobel 54 EG
1	Wood	248.0	545.0	828.0	1812.0
2	Steel	5.0	11.1	16.9	36.9
3	Paper, carton	38.3	38.3	38.3	38.3
4	Plastic	0.5	0.5	0.5	0.5

Table 6: Representation of packaging in kg per declared unit

Outputs

The LCA includes the following production-relevant outputs per 1 m² PYROBEL und PYROBELite:

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

Waste water
The manufacture produces 40.3 l waste water.

6.3 Impact assessment

Goal

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

Waste

The waste generated during the production of 1 m² PYROBEL und PYROBELite is evaluated and shown separately for each of the three main fractions, namely trade wastes, special wastes and radioactive wastes. Since waste handling is modelled within the system boundaries, the amounts shown refer to the deposited wastes. A portion of the waste indicated is generated during the manufacture of the pre-products.

Results per 1 m² Pyrobelite 7																
	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Core environmental impacts																
GWP	kg CO_2-equiv.	2.73E+01	1.23E+00	2.75E-01	-	-	-	-	-	-	-	-	7.16E-02	0,00	2.58E-01	9.70E-01
ODP	kg CFC-11-equiv.	1.86E-08	2.00E-16	4.93E-16	-	-	-	-	-	-	-	-	1.19E-17	0,00	1.42E-15	1.15E-09
AP	kg SO_2-equiv.	9.26E-02	2.79E-03	7.20E-05	-	-	-	-	-	-	-	-	4.16E-04	0,00	1.64E-03	1.57E-03
EP	kg PO_4^{3-}-equiv.	1.43E-02	6.57E-04	1.59E-05	-	-	-	-	-	-	-	-	1.05E-04	0,00	1.84E-04	3.04E-04
POCP	kg Ethen-equiv.	5.82E-03	-9.62E-04	3.40E-06	-	-	-	-	-	-	-	-	-1.88E-04	0,00	1.24E-04	1.22E-04
ADPE	kg Sb-equiv.	2.13E-05	8.97E-08	5.47E-09	-	-	-	-	-	-	-	-	5.32E-09	0,00	2.60E-08	6.70E-08
ADPF	MJ	3.51E+02	1.66E+01	2.65E-01	-	-	-	-	-	-	-	-	9.82E-01	0,00	3.65E+00	6.94E+00
Use of ressources																
PERE	MJ	5.91E+01	9.35E-01	1.32E-01	-	-	-	-	-	-	-	-	5.54E-02	0,00	4.92E-01	-1.99E+00
PERM	MJ	4.76E+00	0,00	-4.76E+00	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0,00
PERT	MJ	6.39E+01	9.35E-01	-4.63E+00	-	-	-	-	-	-	-	-	5.54E-02	0,00	4.92E-01	-1.99E+00
PENRE	MJ	4.14E+02	1.66E+01	3.77E-01	-	-	-	-	-	-	-	-	9.87E-01	0,00	3.76E+00	8.00E+00
PENRM	MJ	2.21E-02	0,00	-2.21E-02	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0,00
PENRT	MJ	4.14E+02	1.66E+01	3.55E-01	-	-	-	-	-	-	-	-	9.87E-01	0,00	3.76E+00	8.00E+00
SM	kg	1.41E+00	0,00	0,00	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0,00
RSF	MJ	0,00	0,00	0,00	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0,00
NRSF	MJ	0,00	0,00	0,00	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0,00
FW	m³	7.97E-02	1.08E-03	7.03E-04	-	-	-	-	-	-	-	-	6.42E-05	0,00	9.48E-04	1.56E-03
Waste categories																
HWD	kg	9.87E-07	7.75E-07	2.06E-09	-	-	-	-	-	-	-	-	4.59E-08	0,00	5.74E-08	1.52E-08
NHWD	kg	5.72E-01	2.55E-03	1.31E-02	-	-	-	-	-	-	-	-	1.51E-04	0,00	1.89E+01	3.00E-02
RWD	kg	1.95E-02	2.06E-05	4.40E-05	-	-	-	-	-	-	-	-	1.22E-06	0,00	4.27E-05	-7.22E-05
Output material flows																
CRU	kg	0,00	0,00	0,00	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0,00
MFR	kg	1.18E+00	0,00	1.79E-01	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0,00
MER	kg	0,00	0,00	0,00	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0,00
EEE	MJ	8.78E-02	0,00	3.42E-01	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0,00
EET	MJ	1.98E-01	0,00	5.97E-01	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0,00

Legend:
GWP – global warming potential **ODP** – ozone depletion potential **AP** - acidification potential **EP** - eutrophication potential **POCP** - photochemical ozone formation potential **ADPE** - abiotic depletion potential – non fossil resources **ADPF** - abiotic depletion potential – fossil resources **PERE** - Use of renewable primary energy **PERM** - use of renewable primary energy resources **PERT** - total use of renewable primary energy resources **PENRE** - use of non-renewable primary energy **PENRM** - use of non-renewable primary energy resources **PENRT** - total use of non-renewable primary energy resources **SM** - use of secondary material **RSF** - use of renewable secondary fuels **NRSF** - use of non-renewable secondary fuels **FW** - net use of fresh water **HWD** - hazardous waste disposed **NHWD** - non-hazardous waste disposed **RWD** - radioactive waste disposed **CRU** - components for re-use **MFR** - materials for recycling **MER** - materials for energy recovery **EEE** - exported electrical energy **EET** - exported thermal energy

Results per 1 m² Pyrobel 16																
	Unit	**A1-A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Core environmental impacts																
GWP	kg CO_2-equiv.	6.05E+01	2.70E+00	5.95E-01	-	-	-	-	-	-	-	-	1.58E-01	0,00	5.67E-01	2.24E+00
ODP	kg CFC-11-equiv.	4.20E-08	4.40E-16	1.07E-15	-	-	-	-	-	-	-	-	2.61E-17	0,00	3.12E-15	2.67E-09
AP	kg SO_2-equiv.	2.09E-01	6.13E-03	1.51E-04	-	-	-	-	-	-	-	-	9.15E-04	0,00	3.61E-03	3.67E-03
EP	kg PO_4^{3-}-equiv.	3.22E-02	1.45E-03	3.23E-05	-	-	-	-	-	-	-	-	2.31E-04	0,00	4.05E-04	7.10E-04
POCP	kg Ethen-equiv.	1.32E-02	-2.12E-03	8.55E-06	-	-	-	-	-	-	-	-	-4.13E-04	0,00	2.73E-04	2.85E-04
ADPE	kg Sb-equiv.	4.65E-05	1.97E-07	1.19E-08	-	-	-	-	-	-	-	-	1.17E-08	0,00	5.72E-08	1.59E-07
ADPF	MJ	7.75E+02	3.64E+01	5.65E-01	-	-	-	-	-	-	-	-	2.16E+00	0,00	8.03E+00	1.63E+01
Use of ressources																
PERE	MJ	1.19E+02	2.06E+00	2.88E-01	-	-	-	-	-	-	-	-	1.22E-01	0,00	1.08E+00	-4.29E+00
PERM	MJ	9.79E+00	0,00	-9.79E+00	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0,00
PERT	MJ	1.29E+02	2.06E+00	-9.50E+00	-	-	-	-	-	-	-	-	1.22E-01	0,00	1.08E+00	-4.29E+00
PENRE	MJ	9.10E+02	3.66E+01	8.10E-01	-	-	-	-	-	-	-	-	2.17E+00	0,00	8.28E+00	1.88E+01
PENRM	MJ	2.21E-02	0,00	-2.21E-02	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0,00
PENRT	MJ	9.10E+02	3.66E+01	7.87E-01	-	-	-	-	-	-	-	-	2.17E+00	0,00	8.28E+00	1.88E+01
SM	kg	3.24E+00	0,00	0,00	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0,00
RSF	MJ	0,00	0,00	0,00	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0,00
NRSF	MJ	0,00	0,00	0,00	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0,00
FW	m³	1.69E-01	2.38E-03	1.53E-03	-	-	-	-	-	-	-	-	1.41E-04	0,00	2.09E-03	3.65E-03
Waste categories																
HWD	kg	2.09E-06	1.70E-06	4.02E-09	-	-	-	-	-	-	-	-	1.01E-07	0,00	1.26E-07	3.63E-08
NHWD	kg	1.26E+00	5.60E-03	2.63E-02	-	-	-	-	-	-	-	-	3.32E-04	0,00	4.16E+01	6.98E-02
RWD	kg	4.03E-02	4.53E-05	9.58E-05	-	-	-	-	-	-	-	-	2.69E-06	0,00	9.41E-05	-1.50E-04
Output material flows																
CRU	kg	0,00	0,00	0,00	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0,00
MFR	kg	2.42E+00	0,00	3.53E-01	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0,00
MER	kg	0,00	0,00	0,00	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0,00
EEE	MJ	1.76E-01	0,00	7.42E-01	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0,00
EET	MJ	3.95E-01	0,00	1.29E+00	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0,00

Legend:
GWP – global warming potential **ODP** – ozone depletion potential **AP** - acidification potential **EP** - eutrophication potential **POCP** - photochemical ozone formation potential **ADPE** - abiotic depletion potential – non fossil resources **ADPF** - abiotic depletion potential – fossil resources **PERE** - Use of renewable primary energy **PERM** - use of renewable primary energy resources **PERT** - total use of renewable primary energy resources **PENRE** - use of non-renewable primary energy **PENRM** - use of non-renewable primary energy resources **PENRT** - total use of non-renewable primary energy resources **SM** - use of secondary material **RSF** - use of renewable secondary fuels **NRSF** - use of non-renewable secondary fuels **FW** - net use of fresh water **HWD** - hazardous waste disposed **NHWD** - non-hazardous waste disposed **RWD** - radioactive waste disposed **CRU** - components for re-use **MFR** - materials for recycling **MER** - materials for energy recovery **EEE** - exported electrical energy **EET** - exported thermal energy

Results per 1 m² Pyrobel 25

	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Core environmental impacts																
GWP	kg CO_2-equiv.	9.81E+01	4.09E+00	8.99E-01	-	-	-	-	-	-	-	-	2.40E-01	0,00	8.61E-01	3.26E+00
ODP	kg CFC-11-equiv.	6.47E-08	6.68E-16	1.63E-15	-	-	-	-	-	-	-	-	3.97E-17	0,00	4.74E-15	3.87E-09
AP	kg SO_2-equiv.	3.21E-01	9.31E-03	2.27E-04	-	-	-	-	-	-	-	-	1.39E-03	0,00	5.48E-03	5.30E-03
EP	kg PO_4^{3-}-equiv.	4.96E-02	2.20E-03	4.80E-05	-	-	-	-	-	-	-	-	3.51E-04	0,00	6.16E-04	1.02E-03
POCP	kg Ethen-equiv.	2.02E-02	-3.21E-03	1.35E-05	-	-	-	-	-	-	-	-	-6.27E-04	0,00	4.15E-04	4.12E-04
ADPE	kg Sb-equiv.	7.68E-05	3.00E-07	1.79E-08	-	-	-	-	-	-	-	-	1.78E-08	0,00	8.69E-08	2.25E-07
ADPF	MJ	1.25E+03	5.54E+01	8.50E-01	-	-	-	-	-	-	-	-	3.28E+00	0,00	1.22E+01	2.34E+01
Use of ressources																
PERE	MJ	2.24E+02	3.12E+00	4.36E-01	-	-	-	-	-	-	-	-	1.85E-01	0,00	1.65E+00	-6.52E+00
PERM	MJ	1.46E+01	0,00	-1.46E+01	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0,00
PERT	MJ	2.38E+02	3.12E+00	-1.41E+01	-	-	-	-	-	-	-	-	1.85E-01	0,00	1.65E+00	-6.52E+00
PENRE	MJ	1.49E+03	5.56E+01	1.22E+00	-	-	-	-	-	-	-	-	3.30E+00	0,00	1.26E+01	2.70E+01
PENRM	MJ	2.21E-02	0,00	-2.21E-02	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0,00
PENRT	MJ	1.49E+03	5.56E+01	1.20E+00	-	-	-	-	-	-	-	-	3.30E+00	0,00	1.26E+01	2.70E+01
SM	kg	4.68E+00	0,00	0,00	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0.00
RSF	MJ	0,00	0,00	0,00	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0,00
NRSF	MJ	0,00	0,00	0,00	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0,00
FW	m³	2.96E-01	3.62E-03	2.31E-03	-	-	-	-	-	-	-	-	2.15E-04	0,00	3.17E-03	5.22E-03
Waste categories																
HWD	kg	3.43E-06	2.59E-06	5.88E-09	-	-	-	-	-	-	-	-	1.54E-07	0,00	1.92E-07	5.19E-08
NHWD	kg	2.04E+00	8.51E-03	3.89E-02	-	-	-	-	-	-	-	-	5.05E-04	0,00	6.33E+01	1.01E-01
RWD	kg	7.49E-02	6.88E-05	1.45E-04	-	-	-	-	-	-	-	-	4.08E-06	0,00	1.43E-04	-2.33E-04
Output material flows																
CRU	kg	0,00	0,00	0,00	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0,00
MFR	kg	4.45E+00	0,00	5.20E-01	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0,00
MER	kg	0,00	0,00	0,00	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0,00
EEE	MJ	3.51E-01	0,00	1.12E+00	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0,00
EET	MJ	3.95E-01	0,00	1.29E+00	-	-	-	-	-	-	-	-	0,00	0,00	0,00	0,00

Legend:
GWP – global warming potential **ODP** – ozone depletion potential **AP** - acidification potential **EP** - eutrophication potential **POCP** - photochemical ozone formation potential **ADPE** - abiotic depletion potential – non fossil resources **ADPF** - abiotic depletion potential – fossil resources **PERE** - Use of renewable primary energy **PERM** - use of renewable primary energy resources **PERT** - total use of renewable primary energy resources **PENRE** - use of non-renewable primary energy **PENRM** - use of non-renewable primary energy resources **PENRT** - total use of non-renewable primary energy resources **SM** - use of secondary material **RSF** - use of renewable secondary fuels **NRSF** - use of non-renewable secondary fuels **FW** - net use of fresh water **HWD** - hazardous waste disposed **NHWD** - non-hazardous waste disposed **RWD** - radioactive waste disposed **CRU** - components for re-use **MFR** - materials for recycling **MER** - materials for energy recovery **EEE** - exported electrical energy **EET** - exported thermal energy

Results per 1 m² Pyrobel 54 EG																
	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Core environmental impacts																
GWP	kg CO_2-equiv.	2.24E+02	8.95E+00	1.96E+00	-	-	-	-	-	-	-	-	5.24E-01	0.00	1.98E+00	6.52E+00
ODP	kg CFC-11-equiv.	1.39E-07	1.46E-15	3.55E-15	-	-	-	-	-	-	-	-	8.68E-17	0.00	1.06E-14	7.69E-09
AP	kg SO_2-equiv.	6.81E-01	2.04E-02	4.90E-04	-	-	-	-	-	-	-	-	3.04E-03	0.00	1.21E-02	1.04E-02
EP	kg PO_4^{3-}-equiv.	1.06E-01	4.80E-03	1.02E-04	-	-	-	-	-	-	-	-	7.67E-04	0.00	1.67E-03	2.02E-03
POCP	kg Ethen-equiv.	4.44E-02	-7.03E-03	3.05E-05	-	-	-	-	-	-	-	-	-1.37E-03	0.00	9.33E-04	8.11E-04
ADPE	kg Sb-equiv.	1.72E-04	6.55E-07	3.91E-08	-	-	-	-	-	-	-	-	3.89E-08	0.00	1.97E-07	4.28E-07
ADPF	MJ	2.91E+03	1.21E+02	1.84E+00	-	-	-	-	-	-	-	-	7.19E+00	0.00	2.81E+01	4.56E+01
Use of ressources																
PERE	MJ	5.54E+02	6.83E+00	9.50E-01	-	-	-	-	-	-	-	-	4.05E-01	0.00	3.69E+00	3.69E+00
PERM	MJ	3.12E+01	0.00	-3.12E+01	-	-	-	-	-	-	-	-	0.00	0.00	0.00	0.00
PERT	MJ	5.85E+02	6.83E+00	-3.03E+01	-	-	-	-	-	-	-	-	4.05E-01	0.00	3.69E+00	3.69E+00
PENRE	MJ	3.42E+03	1.22E+02	2.65E+00	-	-	-	-	-	-	-	-	7.22E+00	0.00	2.90E+01	2.90E+01
PENRM	MJ	5.10E+01	0.00	-2.21E-02	-	-	-	-	-	-	-	-	0.00	0.00	-5.10E+01	0.00
PENRT	MJ	3.47E+03	1.22E+02	2.63E+00	-	-	-	-	-	-	-	-	7.22E+00	0.00	-2.19E+01	2.90E+01
SM	kg	9.27E+00	0.00	0.00	-	-	-	-	-	-	-	-	0.00	0.00	0.00	0.00
RSF	MJ	0.00	0.00	0.00	-	-	-	-	-	-	-	-	0.00	0.00	0.00	0.00
NRSF	MJ	0.00	0.00	0.00	-	-	-	-	-	-	-	-	0.00	0.00	0.00	0.00
FW	m³	7.79E-01	7.91E-03	5.03E-03	-	-	-	-	-	-	-	-	4.69E-04	0.00	6.87E-03	6.87E-03
Waste categories																
HWD	kg	8.34E-06	5.66E-06	1.23E-08	-	-	-	-	-	-	-	-	3.36E-07	0.00	4.21E-07	9.96E-08
NHWD	kg	4.51E+00	1.86E-02	8.26E-02	-	-	-	-	-	-	-	-	1.10E-03	0.00	1.38E+02	2.01E-01
RWD	kg	1.83E-01	1.51E-04	3.17E-04	-	-	-	-	-	-	-	-	8.93E-06	0.00	3.31E-04	-5.30E-04
Output material flows																
CRU	kg	0.00	0.00	0.00	-	-	-	-	-	-	-	-	0.00	0.00	0.00	0.00
MFR	kg	1.13E+01	0.00	1.10E+00	-	-	-	-	-	-	-	-	0.00	0.00	0.00	0.00
MER	kg	0.00	0.00	0.00	-	-	-	-	-	-	-	-	0.00	0.00	0.00	0.00
EEE	MJ	8.78E-01	0.00	2.44E+00	-	-	-	-	-	-	-	-	0.00	0.00	0.00	0.00
EET	MJ	1.98E+00	0.00	4.26E+00	-	-	-	-	-	-	-	-	0.00	0.00	0.00	0.00

Legend:
GWP – global warming potential **ODP** – ozone depletion potential **AP** - acidification potential **EP** - eutrophication potential **POCP** - photochemical ozone formation potential **ADPE** - abiotic depletion potential – non fossil resources **ADPF** - abiotic depletion potential – fossil resources **PERE** - Use of renewable primary energy **PERM** - use of renewable primary energy resources **PERT** - total use of renewable primary energy resources **PENRE** - use of non-renewable primary energy **PENRM** - use of non-renewable primary energy resources **PENRT** - total use of non-renewable primary energy resources **SM** - use of secondary material **RSF** - use of renewable secondary fuels **NRSF** - use of non-renewable secondary fuels **FW** - net use of fresh water **HWD** - hazardous waste disposed **NHWD** - non-hazardous waste disposed **RWD** - radioactive waste disposed **CRU** - components for re-use **MFR** - materials for recycling **MER** - materials for energy recovery **EEE** - exported electrical energy **EET** - exported thermal energy

6.4 Interpretation, LCA presentation and critical verification

Evaluation

Interpretation covers four products:

- The one with the lowest environmental impacts: Pyrobelite 7
- The one with the highest environmental impacts: Pyrobel 54 EG
- The two ones with the biggest market shares: Pyrobel 16 and Pyrobel 25

As regards the environmental impacts analysis, the raw material production is the main contribution to all environmental impacts studied. For most of the indicators float glass contributes to more than 60% of total impact.
Intumescent layer processing also contribute significantly to the total impacts, especially the energy consumption (electricity and natural gas) used to cook the intumescent layer. This steps account for 15 to 35%.
End of life scenario considered is a worst case (100% landfilling), which has limited environmental impacts except for non-hazardous wastes production. Results for alternative end of life scenario are provided, considering a 100% downcycling of glass as aggregates or a 100% recycling of glass in closed loop. In the second case, module D provides significant benefits up to 25% of the production stage.

Comparison with former EPD shows significant differences, some of them being methodological changes in the modelling, some others reflecting changes of production. Source of differences are listed below from the most influent to the least influent:

1. Evolution of float glass data
2. Methodology – Change in allocation of fire resistant glass processing
3. Consideration of losses from production process
4. Energy data (national electricity and natural gas mix)

The breakdown of the major environmental impacts is shown in the diagram below.

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

Diagram

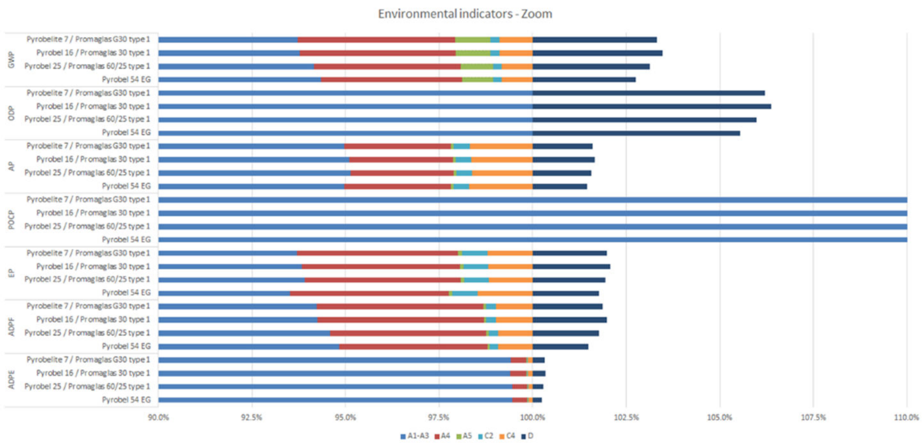


Figure 2: Total environmental impact categories – landfill scenario

Report

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

Critical review

The critical review of the LCA and the report took place in the course of verification of the EPD by the external verifier Patrick Wortner, MBA and Eng., Dipl.-Ing. (FH).

7 General information regarding the EPD

Comparability

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

Communication

The communications format of this EPD meets the requirements of EN 15942:2011 and is therefore the basis for B2B communication. Only the nomenclature has been changed according to DIN EN 15804.

Verification

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

This Declaration is based on the ift PCR documents DIN EN 17074 “PCR for Flat glass products”, “PCR Teil A” (Part A) PCR-A-0.2:2018 and “Flachglas im Bauwesen” (Flat Glass in Building) PCR-FG-1.4:2016.

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

Revisions of this document

No.	Date	Note	LCA-Practitioner	Verifier
1	11.03.2021	External verification	Zwick	Wortner
2	28.05.2021	Review	Zwick	Wortner

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9 Annex A

EPD results for all products listed in the table below can be requested from the manufacturer:

AGC Glass Europe	Structure	Nominal thickness (mm)	Total mass (kg)	Of which glass (kg)	Of which intumescent layer (kg)	Of which PVB (kg)
Pyrobelite 7	3/3	7.9	18.9	15	3.9	0
Pyrobelite 12	3/3/3	12.3	29.1	22.5	6.6	0
Pyrobel 8 EG	3//3:3	13.1	30.0	22.5	6.6	0.88
Pyrobel 16	3/8/3	17.3	41.6	35	6.6	0
Pyrobel 16 EG	3/8/3:3	21.1	49.4	42.5	6.0	0.88
Pyrobel 25	3/3/8/3/3	26.6	63.2	50	13.2	0
Pyrobel 25 EG	3/3/8/3/3:3	30.4	71.6	57.5	13.2	0.88
Pyrobel 30EG2	3:3/3/3/3/3/3/3:3	37.5	88.5	67.5	19.2	1.77
Pyrobel 35	2/2/3/2/2:2/2/3/2/2	34.7	79.9	55	24.0	0.88
Pyrobel 35 EG	2/2/3/2/2:2/2/3/2/2:315	38.5	88.3	62.5	24.0	1.77
Pyrobel 37	3/3/3:3/3/3:3/3/3	38.5	87.3	67.5	18	1.77
Pyrobel 37 EG	3/3/3:3/3/3:3/3/3:3	42.3	95.7	75	18	2.65
Pyrobel 43	3/8/3/3:3/3/8/3	44.7	103.9	85	18	0.88
Pyrobel 43EG	3/8/3/3:3/3/8/3:3	48.4	112.3	92.5	15	1.77
Pyrobel 43 EG2	3:3/8/3/3:3/3/8/3:3	52.2	120.7	100.0	18	2.65
Pyrobel 54	3/3/3/3/3:3/3/3/3/3/3	54	129.9	90.0	39.0	0.88
Pyrobel 54 EG	3/3/3/3/3:3/3/3/3/3/3:3	57.8	138.3	97.5	39.0	1.77

Table 1: Reference products

Furthermore, results for alternative end-of-life scenarios (downcycling as aggregates in an open-loop scenario and as cullet in a closed-loop scenario) are provided by the manufacturer and can be obtained.

10 Annex B

Description of life cycle scenarios for PYROBEL und PYROBELite

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

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

✓ Included in the LCA

— Not included in the LCA

A4 Transport to construction site

No.	Usage scenario	Description
A4	Transport from production site to the construction sites	40 t truck, 24.7 t payload, Euro 5, 67.0 % utilised there, 14.7 % utilised back, approx. 1000 km to construction site

Operating supplies and losses of material during transport can be neglected.

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

A5 Construction / Installation

No.	Usage scenario	Description
A5	Manual	The products are installed without the need of additional lifting equipment accoring to the manufacturer

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

Operating supplies and losses of material during construction / installation can be neglected.

It is assumed that the packaging material is fed to the waste treatment in the module "construction / installation". Waste is recycled materially or thermally or landfilled according to the conservative approach. The transport to the treatment plants is not taken into account.
Credits from A5 are shown in module D. Credits from waste incineration plant: electricity replaces electricity mix EU 28; Thermal energy replaces thermal energy from natural gas (EU 28).

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

C2 Transport

No.	Usage scenario	Description
C2	Transport	Transport to the collecting point using a 40 t truck, 22 t payload, Euro 3, 50 % capacity used, 50 km

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

C3 Waste management

No.	Usage scenario	Description
C3	Disposal	Share for the return of materials: • Glass 0 % in melting • Rest in landfill sites A conservative assumption of 100 % landfill is considered as the baseline scenario.

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

C3 disposal	Unit	Pyrobelite 7	Pyrobel 16	Pyrobel 25	Pyrobel 54 EG
Collection process, collected separately	kg	18.9	41.6	63.2	138.3
Collection process, collected as mixed construction waste	kg	0.0	0.0	0.0	0.0
Recovery system, for re-use	kg	0.0	0.0	0.0	0.0
Recovery system, for recycling	kg	0.0	0.0	0.0	0.0
Recovery system, for energy recovery	kg	0.0	0.0	0.0	0.0
Disposal	kg	18.9	41.6	63.2	138.3

Since this is the only scenario, the results are shown in the overall table.

C4 Disposal

No.	Usage scenario	Description
C4	Disposal	The non-measurable quantities and losses of the re-use/recycling chain (C1 and C3) are modelled as "dis-posed".

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

Since this is the only scenario, the results are shown in the overall table.

D Benefits and loads beyond the system boundaries

No.	Usage scenario	Description
D	Recycling potential	Steel scrap from A5 replaces 98 % of steel; Wood recyclate from A5 replaces 44 % wood; Paper / carton waste from A5 replaces 86 % paper and carton; Glass recyclate replaces 100 % of glass; Credits from WtE facility: Electricity replaces EU-28 electricity mix; thermal energy replaces thermal en-ergy out of EU-28 natural gas

The values in module D results from both, the recycling of the packaging material in module A5 and from avoided production of batch raw materials, decarbonisation at the melting furnace and avoided energy consumption in the glass melting process.

Since this is the only scenario, the results are shown in the overall table.

Imprint

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Notes
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