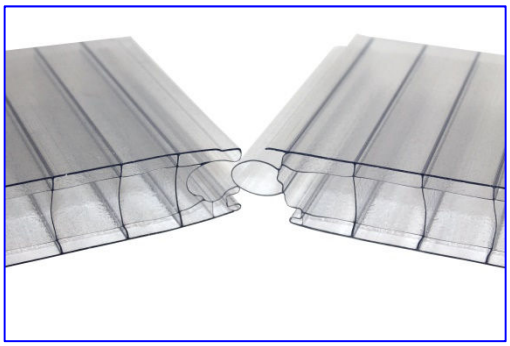
Environmental Product Declaration (EPD)

Declaration Code: EPD-RLE-33.0



Rodeca GmbH

Transparent building elements

Translucent building elements

Basis:

DIN EN ISO 14025
EN15804

Company EPD
Environmental
Product **D**eclaration

Publication date:
22.02.2019

Next revision:
22.02.2024

www.ift-rosenheim.de/
published EPDs

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Declaration Code: EPD-RLE-33.0

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Declaration holder	Rodeca GmbH Freiherr-vom-Stein-Straße 165 45473 Mülheim an der Ruhr		
Declaration code	EPD-RLE-33.0		
Designation of declared product	Translucent building elements		
Scope	Rodeca translucent building elements made of polycarbonate are suitable for use in façades and roofs and can also be used as internal partitions in exhibition stand construction and as room dividers in large offices. They are translucent and thermally insulating and are dimensionally and colour-resistant to hail and solar radiation. The translucent building elements are available in 30 mm, 40 mm, 50 mm and 60 mm thicknesses.		
Basis	This EPD was prepared on the basis of EN ISO 14025:2011 and EN 15804:2012+A1:2013. In addition, the "Allgemeiner Leitfaden zur Erstellung von Typ II Umweltproduktdeklarationen" (Guidance on preparing Type III Environmental Product Declarations) applies. The declaration is based on the PCR documents “PCR Part A” PCR-A-0.1:2018 and “Façades and roofs made of glass and plastic” PCR-FA-3.1:2018.		
Validity	Publication date: 22.02.2019	Last revision: 22.02.2019	Next revision: 22.02.2024
	This verified Company Environmental Product Declaration (company EPD) applies solely to the specified products and is valid for a period of 5 years from the date of publication in accordance with DIN EN 15804.		
LCA basis	The LCA was prepared in accordance with DIN EN ISO 14040 and DIN EN ISO 14044. The base data includes both the data collected at the production site of Rodeca GmbH and the generic data derived from the "GaBi 8“ database. LCA calculations were carried out for the included “cradle to gate life cycle with options” (cradle to gate with options) including all upstream processes (e.g. raw material extraction, etc.).		
Notes	The “Conditions and Guidance on the Use of ift Test Documents” apply. The declaration holder assumes full liability for the underlying data, certificates and verifications.		

Prof. Ulrich Sieberath Director of Institute	Susanne Volz External Verifier

1 General product information

Product definition

The EPD relates to the product group “Transparent building elements” and applies to:

1 m² of **Translucent building elements made by Rodeca GmbH**.

Four thicknesses of the translucent building elements made by Rodeca GmbH are available:

- 30 mm
- 40 mm
- 50 mm
- 60 mm

Only one version each of thicknesses 30 mm, 50 mm and 60 mm is available, therefore there is no worst case. However, a worst case is developed for translucent building elements of 40 mm thickness. Rodeca offers the following versions of 40 mm translucent building elements:

No.	Panel	Weight kg/m².*
1	2540-4	4.0
2	2540-4 MC	4.0
3	2540-6	4.2
4	2540-7	4.3
5	2540-10	4.2

* (excl. frame system and packaging)

Due to the fact that the models do not differ in the composition of the input materials but only in mass, the worst case is based on the heaviest model (2540-7 with a weight of 4.3 kg/ m²).

The reference period is the year 2017.

Product description

LBE 30mm (PC 2530-4)
The 30 mm thick panels have a building width of 333 mm. Due to the thickness and the building width, they are used mainly for smaller continuous wall lights and cold halls, e.g. agricultural halls.

LBE 40 mm (PC 2540-XX)
The 40 mm thick panels with reliable tongue and groove connection are 500 mm wide. The panels differ in structure due to the different number of insulating air cavities which has a significant influence on the U-value.

The U-values of these panels range from 1.4 to approx. 1.0 W/m²K (according to DIN EN ISO 10077-2) depending on the chosen product and the installation location.
The perimeter frame profiles of the panels are available as thermal break and non-thermal break versions. The panels are not only optimally suited for integration in façades but also provide optimal and long lasting solutions for sloped roof glazing.

LBE 50 mm (PC 2550-10)
The 50 mm thick panels with a building width of 495 mm have 10 layers and achieve an Ucw-value of approx. 1.0 W/m²K (according to DIN EN ISO 10077-2), depending on installation location. The translucent façade system has also been granted a German national technical approval including thermal break frame profiles.
The panel is available in the standard colours crystal and opal. From a clearly defined minimum quantity the panel can also be produced body tinted in one colour or in the two-colour “duocolor” version.

LBE 60 mm (PC 2560-12)
The 60 mm thick panels with a building width of 500 mm have 10 air cavities and achieve an Ucw-value of approx. 0.87 W/m²K (according to DIN EN ISO 10077-2). This system is particularly suitable for premium industrial glazing and roof glazing with the required minimum pitch, as well as for any applications with high requirements for thermal insulation. Verification of stability compliant with the German general technical approval guarantees product safety even under extreme weather conditions. Depending on the project brief you can choose between different versions of UV protection, promoting a long service life of the product. The classification as a fire-rated construction product with reaction to fire class B-s1, d0 in accordance with DIN EN 13501 guarantees a wide range of applications and ensures active building protection.
The panel is available in the standard colours crystal and opal. From a minimum quantity of 300 m² it can also be produced body tinted in one colour.

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

Product manufacture

Application

Rodeca translucent building elements made of polycarbonate are suitable for use in façades and roofs and can also be used as internal partitions in exhibition stand construction and as room dividers in large offfices. They are translucent and thermally insulating and are dimensionally and colour-resistant to solar radiation and hail. The translucent building elements are available in 30 mm, 40 mm, 50 mm and 60 mm thicknesses.

Evidence (optional)

The following national technical approvals are held:

- Z-10.1-327
  "PC 2540", "PC 2540 AF 50", "PC 2540 AF100" and "PC2600-40-7-U AF 49404000" as well as "PC 1540", "PC1540 AF 50", "PC 1540 AF100"and "PC 1600-40-7-U AF 49404000"
- Z-10.1-466
  "PC 2550-10", "PC 2550-10 AF 60" and "PC 2550-10 AF 120"
- Z-10.1-656
  "PC 2560-12", "PC 2560-12 AF 60" and "PC 2560-12 AF 120"

Additional information

For further information refer to the website www.rodeca.de.

2 Materials used

Primary materials

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

Declarable substances

The polycarbonate products used do not contain any any substances from the REACH candidate list (declaration dated 10.01.2019).

All relevant safety data sheets are available from Rodeca GmbH .

3 Construction process stage

Processing recommendations, installation

Observe the instructions for assembly/installation, operation, service/maintenance and disassembly. See www.rodeca.de

4 Use stage

Emissions to the environment

No emissions to indoor air, water and soil are known (if applicable, VOC emissions).

Reference service life (RSL)

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

For this EPD the following applies:
The reference service life (RSL) can be determined for a "cradle to gate - with options" EPD only if all of the modules A1- A3 and B1-B5 are specified.
The manufacturer states that the Translucent building elements manufactured by Rodeca GmbH can be specified for a service life of 30 years.

The service life is dependent on the characteristics of the product and the in-use conditions. The characteristics described in the EPD are applicable, in particular the characteristics listed below:

- Outdoor environment: climatic influences may have a negative impact on the reference service life
- Indoor environment: no influences known that have a negative impact on the reference service life

The service life solely applies to the characteristics specified in this EPD or the corresponding references.
The reference service life (RSL) does not reflect the actual life span, which is usually determined by the service life and the refurbishment of a building. It does not give any information on the useful life, warranty referring to performance characteristics or guarantee.

5 End-of-life stage

Possible end-of-life stages

At the end of their service life the translucent building elements are separated into polycarbonate and aluminium as well as nylon, polypropylene and thermoplastic elastomers. Aluminium is recycled in line with standard practice. Nylon, polypropylene and thermoplastic elastomers are disposed of separately in a waste incineration plant. The amount of energy recovered should be considered as a by-product of the disposal process. The end-of-waste status is reached with the disposal of slag and ash as residual waste. Two scenarios are considered for the disposal of polycarbonate. In scenario 1 the polycarbonate fractions of the translucent building elements are regranulated into polycarbonate granules. In scenario 2 polycarbonate is incinerated at the end of its service life in a waste incineration plant.

Disposal routes

The LCA includes the average disposal routes.

All life cycle scenarios are detailed in the Annex.

6 Life Cycle Assessment (LCA)

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

Such a life cycle assessment was developed as the basis for Translucent building elements. The LCA is in conformity with EN 15804 and 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 Translucent building elements. In accordance with 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/presented.

Data quality, data availability and geographical and time-related system boundaries	The specific data originate exclusively from the fiscal year 2017. They were collected on-site at the plant located in Mülheim and originate in parts from company records and partly from values directly obtained by measurement. The generic data originate from various data bases of the GaBi 8.7 software. The current versions of the data bases were used. More ancient data originate also from this database and are partly more than 10 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 8" for the development of Life Cycle Assessments.
Scope / system boundaries	The system boundaries refer to the supply of raw materials and purchased parts, manufacture/production and end-of-life stage of Translucent building elements (cradle to gate with options). The product stage covers the production of the necessary raw materials including all upstream processes (A1) as well as the necessary transport for procurement (A2). The production of the declared unit includes also the necessary ancillary materials and consumables and their upstream processes (A3). The system boundaries of module A1-3 cover all raw material extraction processes, both for material and energy flows, from cradle to gate, their further processing into pre- and intermediate products up to manufacture. Transport is covered by generic data sets: the input-related system boundary of truck transport is the upstream processes of the fuels while the output-related system boundary is the emissions generated (exhaust gases).
Cut-off criteria	All data collected from the parts list were taken into account where possible. This meant that material flows with a mass ratio of less than 1% could also be included in the calculation. The tables below show the substances that could not be taken into account: The cut off criteria (< 1%, total <5%) were complied with. This LCA does not include the plants/facilities and infrastructure required for manufacture. The wooden pallets used for packaging were cut off because they are reused. Only the weight is taken into account for transport, the remainder is cut off. The aluminium frames are supplied by an external company. There is no information on the manufacturing process (offcuts, energy demand, etc.). For the frame, the model uses the aluminium extrusion profile (AlMgSi) data set at the quantity of frame purchased and used without losses.

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 Translucent building elements. The product stage “A1 – A3”, construction process stage “A4 – A5”, end-of-life stage "C2 – C3" and the benefits and loads beyond the system boundaries “D” were taken into consideration.

Benefits

The below benefits have been defined as per EN 15804:

- Benefits from recycling
- Benefits (thermal and electrical) from incineration

Allocation procedures Allocation of co-products

The manufacture of Translucent building elements does not produce any allocations.

Allocations for re-use, recycling and recovery

If the Translucent building elements are reused/recycled and recovered during the product stage (rejects), the components are shredded and then sorted into their original pure components, if necessary. The system boundaries of the Translucent building elements were set following their disposal with reaching their end-of-waste status.

Allocations beyond life cycle boundaries

Manufacture of the translucent building elements uses secondary material in the form of polycarbonate regranulate (13%) and secondary aluminium (54%). The system boundary set for the recycled material refers to collection.

Secondary material

The use of secondary material in module A3 by the company Rodeca GmbH was considered. Secondary material is used.

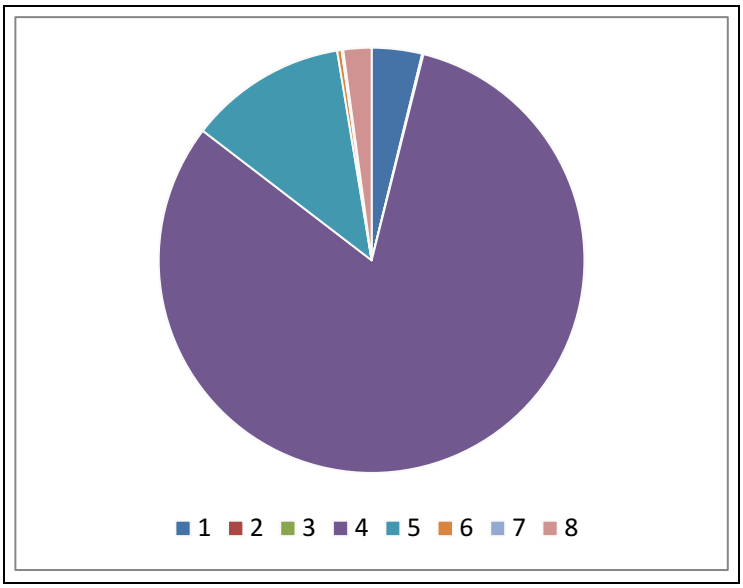
Inputs

The LCA includes the following production-relevant inputs:

Energy
The electricity mix is based on “Strommix Ökostrom” (ecological electricity mix), the recyclate production is based on the electricity mix of the local electricity suppler.
Part of the process heat is used for space heating at the production site. However this cannot be quantified, so a “worst case” figure was used for the product.

Water
The individual process steps for the manufacture of Translucent building elements consume only a small amount of water which was allocated to the products.
The consumption of fresh water specified in Section 6.3 originates among others from the upstream processes of the pre-products.

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



No.	Material	Mass in %
1	Aluminium	3.83%
2	Polycarbonate ground material	0.08%
3	PA66	0.02%
4	Polycarbonate granules	81.49%
5	Polycarbonate regranulate	11.99%
6	Polypropylene, silicone neutrally cross-linked	0.33%
7	Water	0.13%
8	Other	2.13%

Ancillary materials and consumables
The ancillary materials and consumables required for the manufacture of Translucent building elementss are included in the life cycle assessment.

Product packaging
The amounts used for product packaging are as follows:

No.	Material	Mass in kg			
		30mm	40mm	50mm	60mm
1	Protective film	0.004	0.004	0.004	0.004
2	Wooden palette	0.091	0.091	0.091	0.091
3	PP-sheets	0.007	0.007	0.007	0.007
4	Shrink wrap	0.005	0.005	0.005	0.005
3	Edge protection	0.003	0.003	0.003	0.003
4	Other small parts	0.001	0.001	0.001	0.001

Outputs

The LCA includes the production-relevant outputs per 1 m² of Translucent building elements:

No.	Material	Mass in kg			
		30mm	40mm	50mm	60mm
1	Product incl. packaging	3.746	4.646	5.346	6.146
2	Waste	0.649	0.822	0.955	1.108
3	PC offcuts	0.622	0.787	0.915	1.061
4	Ground material	0.003	0.004	0.005	0.006
3	Packaging	0.007	0.009	0.010	0.012
4	Waste water	0.017	0.022	0.025	0.029

6.3 Impact assessment

Goal

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

Impact categories

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

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

Waste

The waste generated during the production of 1 m² of Translucent building elements is evaluated and shown separately for the fractions 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 of Translucent building elements - 30mm										
Environmental impacts	**Unit**	**A1-A3**	**A4**	**A5**	**C2/1**	**C2/2**	**C3/1**	**C3/2**	**D/1**	**D/2**
Global warming potential	kg CO_2-equiv.	14.0	0.028	0.054	0.15	0.028	1.74	9.58	-13.10	-4.41
Depletion potential of stratospheric ozone layer	kg R11-equiv.	6.77E-10	7.62E-16	7.01E-16	4.10E-15	7.43E-16	1.43E-09	1.42E-09	-2.32E-10	-2.33E-10
Acidification potential of soil and water	kg SO_2-equiv.	0.023	2.43E-05	4.04E-06	1.18E-04	2.37E-05	4.63E-03	7.56E-04	-0.02	-9.90E-03
Eutrophication potential	kg PO_4^{3-}-equiv.	3.50E-03	5.41E-06	8.43E-07	2.54E-05	5.28E-06	4.34E-04	1.38E-04	-3.06E-03	-8.80E-04
Formation potential of tropospheric ozone	kg C_2H_4-equiv.	2.08E-03	-7.43E-07	3.80E-07	1.31E-06	-7.25E-07	2.96E-04	7.18E-05	-2.47E-03	-6.96E-04
Depletion of abiotic resources (ADP elements)	kg Sb-equiv.	4.47E-05	3.01E-09	3.74E-10	1.62E-08	2.93E-09	9.64E-07	1.92E-07	-4.25E-05	-2.03E-06
Depletion of abiotic resources (ADP fossil fuels)	MJ	283.0	0.38	6.05E-03	2.04	0.37	18.20	2.60	-270.00	-58.0
Use of resources	**Unit**	**A1-A3**	**A4**	**A5**	**C2/1**	**C2/2**	**C3/1**	**C3/2**	**D/1**	**D/2**
Renewable primary energy as energy source	MJ	45.50	0.026	0.052	0.14	0.025	10.8	0.26	-30.7	-16.8
Renewable primary energy for material use	MJ	0.05	0.00	-0.05	0.00	0.00	0.00	0.00	0.00	0.00
Total use of renewable primary energy	MJ	45.6	0.026	1.18E-03	0.14	0.025	10.8	0.26	-30.7	-16.8
Non-renewable primary energy as energy source	MJ	214	0.38	0.69	2.04	0.37	31.3	89.7	-285.0	-73.2
Renewable primary energy for material use	MJ	87.4	0.00	-0.68	0.00	0.00	-1.07	-86.7	0.00	0.00
Total use of non-renewable primary energy	MJ	301	0.38	7.27E-03	2.04	0.37	30.3	2.94	-285.0	-73.2
Use of secondary materials	kg	0.62	0.00	0.00	0.00	0.00	0,0E+00	0.00	3.05	0.09
Renewable secondary fuels	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-renewable secondary fuels	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Use of fresh water resources	m^3	0.074	2.99E-05	1.21E-04	1.61E-04	2.91E-05	0.015	0.019	-0.054	-0.028
Waste categories and output material flows	**Unit**	**A1-A3**	**A4**	**A5**	**C2/1**	**C2/2**	**C3/1**	**C3/2**	**D/1**	**D/2**
Disposed hazardous waste	kg	5.31E-07	2.42E-08	5.79E-12	1.30E-07	2.36E-08	1.34E-08	7.09E-10	-2.52E-07	-3.68E-08
Disposed non-hazardous waste	kg	0.37	2.98E-05	1.65E-04	1.60E-04	2.90E-05	0.042	0.031	-0.34	-0.26
Radioactive waste	kg	7.11E-03	5.99E-07	4.85E-07	3.22E-06	5.84E-07	4.79E-03	1.40E-04	-6.23E-03	-6.01E-03
Components for further use	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Materials for recycling	kg	0.00	0.00	0.00	0.00	0.00	3.61	0.21	0.00	0.00
Materials for energy recovery	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exported electrical energy	MJ	0.00	0.00	0.11	0.00	0.00	0.15	15.3	0.00	0.00
Exported thermal energy	MJ	0.00	0.00	0.2	0.00	0.00	0.31	27.4	0.00	0.00

Results per 1 m² of Translucent building elements - 40mm										
Environmental impacts	**Unit**	**A1-A3**	**A4**	**A5**	**C2/1**	**C2/2**	**C3/1**	**C3/2**	**D/1**	**D/2**
Global warming potential	kg CO_2-equiv.	17.4	0.035	0.054	0.19	0.035	2.16	12.10	-16.30	-5.35
Depletion potential of stratospheric ozone layer	kg R11-equiv.	6.79E-10	9.45E-16	7.01E-16	5.18E-15	9.26E-16	1.43E-09	1.42E-09	-2.34E-10	-2.35E-10
Acidification potential of soil and water	kg SO_2-equiv.	0.027	3.01E-05	4.04E-06	1.49E-04	2.95E-05	5.81E-03	9.06E-04	-0.025	-0.012
Eutrophication potential	kg PO_4^{3-}-equiv.	4.32E-03	6.71E-06	8.43E-07	3.20E-05	6.58E-06	5.44E-04	1.70E-04	-3.81E-03	-1.05E-03
Formation potential of tropospheric ozone	kg C_2H_4-equiv.	2.56E-03	-9.22E-07	3.80E-07	1.67E-06	-9.04E-07	3.70E-04	8.60E-05	-3.06E-03	-8.20E-04
Depletion of abiotic resources (ADP elements)	kg Sb-equiv.	5.59E-05	3.73E-09	3.74E-10	2.04E-08	3.65E-09	1.18E-06	2.07E-07	-5.35E-05	-2.30E-06
Depletion of abiotic resources (ADP fossil fuels)	MJ	354.0	0.47	6.05E-03	2.57	0.46	22.60	2.87	-339.0	-71.0
Use of resources	**Unit**	**A1-A3**	**A4**	**A5**	**C2/1**	**C2/2**	**C3/1**	**C3/2**	**D/1**	**D/2**
Renewable primary energy as energy source	MJ	56.30	0.032	0.052	0.18	0.032	13.6	0.32	-37.6	-20.0
Renewable primary energy for material use	MJ	0.05	0.00	-0.05	0.00	0.00	0.00	0.00	0.00	0.00
Total use of renewable primary energy	MJ	56.4	0.032	1.18E-03	0.18	0.032	13.6	0.32	-37.6	-20.0
Non-renewable primary energy as energy source	MJ	266.0	0.47	0.69	2.58	0.46	38.9	113.0	-358.0	-89.6
Renewable primary energy for material use	MJ	110.0	0.00	-0.68	0.00	0.00	-1.07	-109.0	0,000E+00	0.00
Total use of non-renewable primary energy	MJ	376	0.47	7.27E-03	2.58	0.46	37.8	3.28	-358.0	-89.6
Use of secondary materials	kg	0.76	0.00	0.00	0.00	0.00	0,0E+00	0.00	3.83	0.09
Renewable secondary fuels	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-renewable secondary fuels	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Use of fresh water resources	m^3	0.09	3.71E-05	1.21E-04	2.03E-04	3.63E-05	0.019	0.024	-0.066	-0.032
Waste categories and output material flows	**Unit**	**A1-A3**	**A4**	**A5**	**C2/1**	**C2/2**	**C3/1**	**C3/2**	**D/1**	**D/2**
Disposed hazardous waste	kg	6.61E-07	3.00E-08	5.79E-12	1.64E-07	2.94E-08	1.70E-08	8.95E-10	-3.16E-07	-4.35E-08
Disposed non-hazardous waste	kg	0.40	3.69E-05	1.65E-04	2.02E-04	3.62E-05	0.048	0.033	-0.38	-0.26
Radioactive waste	kg	8.67E-03	7.42E-07	4.85E-07	4.07E-06	7.28E-07	6.04E-03	1.63E-04	-7.69E-03	-7.42E-03
Components for further use	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Materials for recycling	kg	0.00	0.00	0.00	0.00	0.00	4.51	0.21	0.00	0.00
Materials for energy recovery	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exported electrical energy	MJ	0.00	0.00	0.11	0.00	0.00	0.15	19.4	0.00	0.00
Exported thermal energy	MJ	0.00	0.00	0.2	0.00	0.00	0.31	34.5	0.00	0.00

Results per 1 m² of Translucent building elements - 50mm										
Environmental impacts	**Unit**	**A1-A3**	**A4**	**A5**	**C2/1**	**C2/2**	**C3/1**	**C3/2**	**D/1**	**D/2**
Global warming potential	kg CO_2-equiv.	20.0	0.041	0.054	0.22	0.04	2.48	14.0	-18.80	-6.08
Depletion potential of stratospheric ozone layer	kg R11-equiv.	6.80E-10	1.09E-15	7.01E-16	6.01E-15	1.07E-15	1.43E-09	1.42E-09	-2.35E-10	-2.37E-10
Acidification potential of soil and water	kg SO_2-equiv.	0.03	3.47E-05	4.04E-06	1.73E-04	3.41E-05	6.72E-03	1.02E-03	-0.028	-0.013
Eutrophication potential	kg PO_4^{3-}-equiv.	4.97E-03	7.72E-06	8.43E-07	3.72E-05	7.59E-06	6.30E-04	1.95E-04	-4.39E-03	-1.18E-03
Formation potential of tropospheric ozone	kg C_2H_4-equiv.	2.93E-03	-1.06E-06	3.80E-07	1.95E-06	-1.04E-06	4.27E-04	9.71E-05	-3.52E-03	-9.17E-04
Depletion of abiotic resources (ADP elements)	kg Sb-equiv.	6.46E-05	4.29E-09	3.74E-10	2.37E-08	4.22E-09	1.36E-06	2.19E-07	-6.21E-05	-2.51E-06
Depletion of abiotic resources (ADP fossil fuels)	MJ	409.0	0.54	6.05E-03	2.98	0.53	26.0	3.09	-392.0	-81.0
Use of resources	**Unit**	**A1-A3**	**A4**	**A5**	**C2/1**	**C2/2**	**C3/1**	**C3/2**	**D/1**	**D/2**
Renewable primary energy as energy source	MJ	64.70	0.037	0.052	0.21	0.037	15.8	0.36	-43.0	-22.4
Renewable primary energy for material use	MJ	0.05	0.00	-0.05	0.00	0.00	0.00	0.00	0.00	0.00
Total use of renewable primary energy	MJ	64.8	0.037	1.18E-03	0.21	0.037	15.8	0.36	-43.0	-22.4
Non-renewable primary energy as energy source	MJ	306.0	0.54	0.69	3.0	0.53	44.8	131.0	-414.0	-102.0
Renewable primary energy for material use	MJ	128.0	0.00	-0.68	0.00	0.00	-1.07	-127.0	0.00	0.00
Total use of non-renewable primary energy	MJ	434.0	0.54	7.27E-03	3.0	0.53	43.7	3.54	-414.0	-102.0
Use of secondary materials	kg	0.87	0.00	0.00	0.00	0.00	0.00	0.00	4.44	0.09
Renewable secondary fuels	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-renewable secondary fuels	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Use of fresh water resources	m^3	0.10	4.26E-05	1.21E-04	2.36E-04	4.19E-05	0.022	0.028	-0.074	-0.035
Waste categories and output material flows	**Unit**	**A1-A3**	**A4**	**A5**	**C2/1**	**C2/2**	**C3/1**	**C3/2**	**D/1**	**D/2**
Disposed hazardous waste	kg	7.62E-07	3.45E-08	5.79E-12	1.91E-07	3.40E-08	1.97E-08	1.04E-09	-3.66E-07	-4.87E-08
Disposed non-hazardous waste	kg	0.42	4.25E-05	1.65E-04	2.35E-04	4.18E-05	0.052	0.035	-0.40	-0.27
Radioactive waste	kg	9.89E-03	8.54E-07	4.85E-07	4.72E-06	8.40E-07	7.01E-03	1.80E-04	-8.83E-03	-8.51E-03
Components for further use	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Materials for recycling	kg	0.00	0.00	0.00	0.00	0.00	5.21	0.21	0.00	0.00
Materials for energy recovery	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exported electrical energy	MJ	0.00	0.00	0.11	0.00	0.00	0.15	22.5	0.00	0.00
Exported thermal energy	MJ	0.00	0.00	0.2	0.00	0.00	0.31	40.2	0.00	0.00

Results per 1 m² of Translucent building elements - 60mm										
Environmental impacts	**Unit**	**A1-A3**	**A4**	**A5**	**C2/1**	**C2/2**	**C3/1**	**C3/2**	**D/1**	**D/2**
Global warming potential	kg CO_2-equiv.	23.0	0.047	0.054	0.26	0.046	2.85	16.2	-21.70	-6.91
Depletion potential of stratospheric ozone layer	kg R11-equiv.	6.82E-10	1.25E-15	7.01E-16	6.96E-15	1.23E-15	1.43E-09	1.42E-09	-2.36E-10	-2.39E-10
Acidification potential of soil and water	kg SO_2-equiv.	0.035	3.99E-05	4.04E-06	2.00E-04	3.93E-05	7.77E-03	1.16E-03	-0.032	-0.014
Eutrophication potential	kg PO_4^{3-}-equiv.	5.71E-03	8.87E-06	8.43E-07	4.31E-05	8.74E-06	7.27E-04	2.23E-04	-5.06E-03	-1.34E-03
Formation potential of tropospheric ozone	kg C_2H_4-equiv.	3.36E-03	-1.22E-06	3.80E-07	2.27E-06	-1.20E-06	4.92E-04	1.10E-04	-4.05E-03	-1.03E-03
Depletion of abiotic resources (ADP elements)	kg Sb-equiv.	7.45E-05	4.93E-09	3.74E-10	2.75E-08	4.86E-09	1.55E-06	2.33E-07	-7.18E-05	-2.74E-06
Depletion of abiotic resources (ADP fossil fuels)	MJ	471.0	0.62	6.05E-03	3.46	0.61	30.0	3.33	-453.0	-92.50
Use of resources	**Unit**	**A1-A3**	**A4**	**A5**	**C2/1**	**C2/2**	**C3/1**	**C3/2**	**D/1**	**D/2**
Renewable primary energy as energy source	MJ	74.30	0.043	0.052	0.24	0.042	18.4	0.41	-49.1	-25.3
Renewable primary energy for material use	MJ	0.05	0.00	-0.05	0.00	0.00	0.00	0.00	0.00	0.00
Total use of renewable primary energy	MJ	74.4	0.043	1.18E-03	0.24	0.042	18.4	0.41	-49.1	-25.3
Non-renewable primary energy as energy source	MJ	352.0	0.62	0.69	3.47	0.61	51.5	151.0	-479.0	-117.0
Renewable primary energy for material use	MJ	148.0	0.00	-0.68	0.00	0.00	-1.07	-147.0	0.00	0.00
Total use of non-renewable primary energy	MJ	500.0	0.62	7.27E-03	3.47	0.61	50.4	3.83	-479.0	-117.0
Use of secondary materials	kg	0.99	0.00	0.00	0.00	0.00	0.00	0.00	5.14	0.09
Renewable secondary fuels	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-renewable secondary fuels	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Use of fresh water resources	m^3	0.12	4.90E-05	1.21E-04	2.73E-04	4.83E-05	0.025	0.032	-0.085	-0.039
Waste categories and output material flows	**Unit**	**A1-A3**	**A4**	**A5**	**C2/1**	**C2/2**	**C3/1**	**C3/2**	**D/1**	**D/2**
Disposed hazardous waste	kg	8.77E-07	3.97E-08	5.79E-12	2.21E-07	3.91E-08	2.29E-08	1.21E-09	-4.22E-07	-5.47E-08
Disposed non-hazardous waste	kg	0.45	4.88E-05	1.65E-04	2.72E-04	4.81E-05	0.056	0.037	-0.43	-0.27
Radioactive waste	kg	1.13E-02	9.82E-07	4.85E-07	5.47E-06	9.67E-07	8.13E-03	2.00E-04	-1.01E-02	-9.76E-03
Components for further use	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Materials for recycling	kg	0.00	0.00	0.00	0.00	0.00	6.01	0.21	0.00	0.00
Materials for energy recovery	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exported electrical energy	MJ	0.00	0.00	0.11	0.00	0.00	0.15	26.1	0.00	0.00
Exported thermal energy	MJ	0.00	0.00	0.2	0.00	0.00	0.31	46.6	0.00	0.00

6.4 Interpretation, LCA presentation and critical review

Evaluation

The following dominance analyses show that modules A1-A3 are the main dominating life cycle stages in all four life cycle assessments. In addition, waste disposal (C3) mainly affects the depletion potential of the stratospheric ozone layer and the global warming potential. Distribution transport (A4) and transport to the waste disposal plants (C2) play a relatively minor role and are negligible. The possible potentials of avoided loads of downstream systems (module D) are beyond the system boundaries under consideration.

Some impact categories are explained in more detail as examples.
Due to the fact that the two scenarios differ only by end-of-life (module C3), the global warming potential is the same for the other modules. In module A1-A3, polycarbonate is the main contributor to the global warming potential. In module C3, scenario 1, recycling of polycarbonate generates a benefit. In scenario 2, however, incineration of polycarbonate components results in a much higher load for module 3. Benefits from incineration are generated in the form of electricity and heat.

The product stage (module A1-A3) and the loads resulting from disposal (C3) dominate on a pro rata basis. Polycarbonate granulate is the main driver of the loads in module A1-A3. The reason for the higher proportion of the GWP load in module C3/2 compared to C3/1 is the incineration of polycarbonate in scenario 2. Aluminium recycling is the driver of the ODP load in module C3. Transport plays a rather minor role.

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

Diagrams

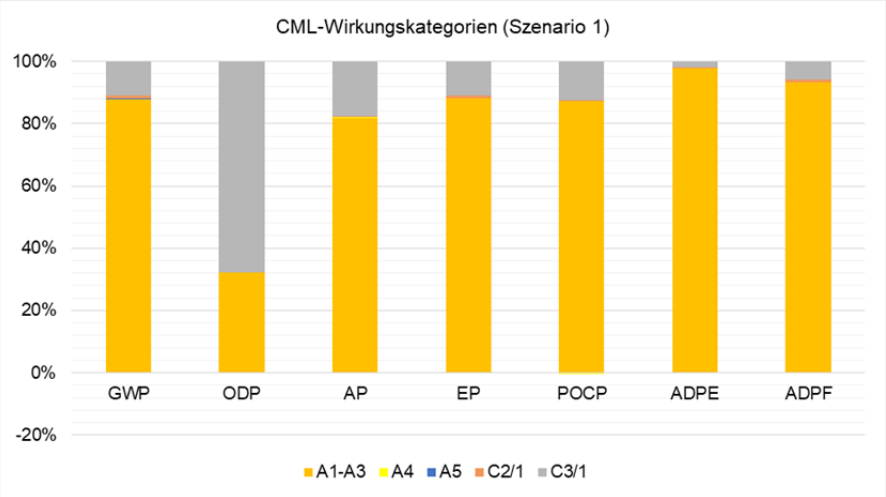


Figure 1: CML results for 1 m² of LBE 40 mm (scenario 1)

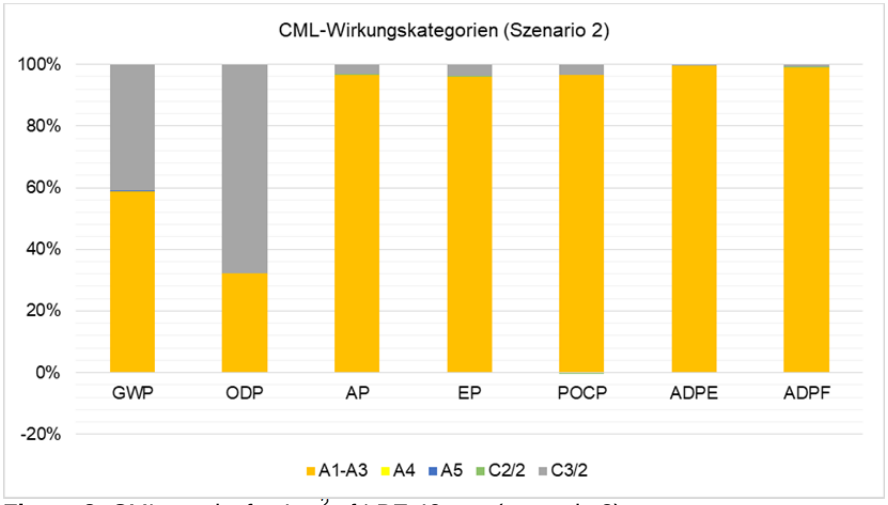


Figure 2: CML results for 1 m^2 of LBE 40 mm (scenario 2)

Report

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

Critical review

The critical review of the LCA took place in the course of verification of the EPD and was carried out by Susanne Volz, an external verifier (M.Sc. Environmental Science)

7 General information regarding the EPD

Comparability

This EPD was prepared in accordance with EN 15804 and is therefore only comparable to those EPDs that also comply with the requirements set out in EN 15804.
Any comparison must refer to the building context and the same boundary conditions of the various life cycle stages.
For comparing EPDs of construction products, the rules set out in EN 15804 (Clause 5.3) apply.
The detailed individual results of the products were summarised on the basis of conservative assumptions and differ from the average results. Identification of the product groups and the resulting variations are documented in the background report.

Communication

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

Verification

Verification of the Environmental Product Declaration is documented in accordance with the ift "Richtlinie zur Erstellung von Typ III Umweltproduktdeklarationen" (Guidance on preparing Type III Environmental Product Declarations) in accordance with the requirements set out in EN ISO 14025.
This Declaration is based on the PCR documents “PCR Part A” PCR-A-0.1:2018 and “Façades and roofs made of glass and plastic” PCR-FA-3.1:2018.

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)] Susanne Volz, M.Sc. Environmental Science Dipl. Business Law (University of Applied Sciences)
[a)] Product category rules [b)] Optional for business-to-business communication, Mandatory for business-to-consumer communication (see EN ISO 14025:2010, 9.4)

Revisions of this document

No.	Date	Note:	Practitioner of the LCA	Verifier
1	22.02.2019	External Verification	F. Stich	S. Volz

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9 Annex

Description of life cycle scenarios for Translucent building elements

Product stage			Con-struction stage		Use stage							End-of-life stage				Benefits and loads from 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, clean-ing	Repair	Exchange / Replacement	Improvement / Modernisation	Operational energy use	Operational water use	Deconstruction	Transport	Waste management	Disposal	Re-use Recovery Recycling potential
✓	✓	✓	✓	✓	—	—	—	—	—	—	—	—	✓	✓	—	✓

Calculation of the scenarios was based on a building service life of 30 years (in accordance with RSL of Section 4 Use stage).

The scenarios were based on information provided by the manufacturer. The scenarios were furthermore based on the research project “EPDs for transparent building components”. (1).

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 the construction site		
No.	**Scenario**	**Description**
A4	**Direct shipment to construction site/branch**	**Transport medium: truck (EURO 6.)** **Transport distance: distance of 100 km with 50% capacity used** **Weight, incl. packaging:** **LBE / 30 mm / 40 mm / 50 mm / 60 mm** **Mass in kg / 3.746 / 4.646 / 5.346 / 6.146**

A5 Construction/Installation		
No.	**Scenario**	**Description**
A5	**Manually**	**Translucent building elements are installed without the use of additional lifting devices!**

The translucent building elements are installed without using any additional environmentally relevant materials: only disposal and recycling of the packaging is required. A 100% collection rate for on-site packaging waste was assumed.
Transport for waste disposal is subject to the same assumptions as in module A4.

In case of deviating consumption during installation/assembly of the products which forms part of the site management, it is covered at the building level.

Benefits from A5 are not allocated to A5.

End-of-life stage

The translucent building elements are separated at the end of their service life into polycarbonate, aluminium as well as nylon, polypropylene and thermoplastic elastomers. Aluminium is recycled according to common practice. Nylon, polypropylene and thermoplastic elastomers are disposed of separately in a waste incineration plant. The amount of energy recovered is to be considered as a by-product of the disposal process. End-of-waste status is reached with the disposal of slag and ash as residual waste (the data sets do not provide for separation of ash disposal; all emissions from the data set are therefore modelled in C3, although disposal should be in module C4). Two scenarios are considered for the disposal of polycarbonate. In scenario 1 the polycarbonate fractions of the translucent building elements are regranulated into polycarbonate regranules. In scenario 2 polycarbonate is incinerated in a waste incineration plant.

C2 Transport

No.	Scenario	Description
C2	Transport	Truck with 24.7 t net payload and EURO 6 Distance of 100 km with 50% capacity used

C3 Waste management

No.	Scenario	Description
C3.1	Scenario 1	Aluminium is recycled according to common practice. Nylon, polypropylene and thermoplastic elastomers are disposed of separately in a waste incineration plant. Scenario 1: the polycarbonate fractions are regranulated into polycarbonate regranules at the end of their life cycle.
C3.2	Scenario 2	Aluminium is recycled according to common practice. Nylon, polypropylene and thermoplastic elastomers are disposed of separately in a waste incineration plant. In scenario 2 polycarbonate is incinerated in a waste incineration plant

The below table presents the disposal processes and their percentage by mass/weight. The calculation is based on the above mentioned shares in percent related to the declared unit of the product system. For calculating the 100% scenarios, the mass proportions of the material groups can be used, as described in Section 6.2.

C3-1 Disposal		30 mm	40 mm	50 mm	60 mm
Scenario 1	**Unit**				
Collection process, collected separately	kg	3.64	4.54	5.24	6.04
Collection process, collected as mixed construction waste	kg	-	-	-	-
Recovery system, for re-use	kg	-	-	-	-
Recovery system, for recycling	kg	3.61	4.51	5.21	6.01
Recovery system, for energy recovery	kg	0.03	0.03	0.03	0.03
Disposal	kg	-	-	-	-
Assumptions for scenario development, e.g. for transport	Appropriate units	-	-	-	-

C3-2 Disposal		30 mm	40 mm	50 mm	60 mm
Scenario 2	**Unit**				
Collection process, collected separately	kg	3.64	4.54	5.24	6.04
Collection process, collected as mixed construction waste	kg	-	-	-	-
Recovery system, for re-use	kg	-	-	-	-
Recovery system, for recycling	kg	0.21	0.21	0.21	0.21
Recovery system, for energy recovery	kg	3.43	4.33	5.03	5.83
Disposal	kg	-	-	-	-
Assumptions for scenario development, e.g. for transport	Appropriate units	-	-	-	-

D Benefits and loads from beyond the system boundaries

No.	Scenario	Description
D	Recycling potential	Module D shows the possible potentials of avoided loads in the downstream systems resulting from material-dependent disposal processes of modules A5 and C3. According to the state of the art, a waste incineration plant in Europe is designed for waste destruction and not for energy recovery. The emissions from the waste incineration process are therefore allocated to the appropriate module (e.g. A5 or C3), and not to D.

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Notes
This EPD is mainly based on the work and findings of the Institut für Fenstertechnik e.V., Rosenheim (ift Rosenheim) and specifically on the ift-Richtlinie NA-01/3 Allgemeiner Leitfaden zur Erstellung von Typ III Umweltproduktdeklarationen. (Guideline NA.01/3 - Guidance on preparing Type III Environmental Product Declarations)

Layout
ift Rosenheim GmbH - 2018

Photographs (front page)
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