Environmental Product Declaration (EPD)

Declaration code EPD-RQH-GB-76.0

Roto
Das Dachfenster.

Roto Frank DST Produktions-GmbH

Roof windows

Wooden roof window RotoQ

Basis:

DIN EN ISO 14025
EN 15804 + A2

Company EPD
Environmental
Product **D**eclaration

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Declaration code	EPD-RQH-GB-76.0
Designation of declared product	Wooden roof window RotoQ
Scope	Pitched roof windows allow a view to the outside, effective ventilation of the attic and provide access to natural daylight.
Basis	This EPD was prepared on the basis of EN ISO 14025:2011 and DIN EN 15804:2012+A2:2019. In addition, the "Allgemeiner Leitfaden zur Erstellung von Typ III Umweltproduktdeklarationen" (General guideline for preparation of Type III Environmental Product Declarations) applies. The Declaration is based on the PCR documents “PCR Part A” PCR-A-0.3:2018 and "Windows, flat roof windows, rooflights and light bands" PCR-FE-3.0:2023 as well as EN 17213 „PCR for Windows and Doors.”
Validity	Publication date: 04.12.2023 / Last revision: 15.01.2024 / Valid until: 04.12.2028 This verified Company Environmental Product Declaration (company EPD) 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 DIN EN ISO 14040 and DIN EN ISO 14044. The data are based on both the data compiled from two production sites of Roto Frank DST Produktions-GmbH and the generic data derived from the “LCA for Experts 10” database. LCA calculations were carried out for the included “cradle to grave” including all upstream chains (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.

Christian Kehrer Head of Certification and Surveillance Body	Dr. Torsten Mielecke Chairman of Expert Committee ift-EPD and PCR	Susanne Volz External Verifier

1 General Product Information

Product definition

The EPD relates to the product group Roof windows and applies to:

1 m² Wooden roof window RotoQ
of company Roto Frank DST Produktions-GmbH

They are subdivided into following product groups (PG):
[1] Bold = Reference products

Product group	Designation[1]	Reference size
PG 1 Q4 Wood double glazing	Q42C H200 Q42C H2E_ Q42C H2EF Q42C H2SF Q42C H2RA Q42P H200 **Q42P H2E_** **Q42P H2EF** **Q42P H2SF**	1.23 m * 1.48 m
PG 2 Q4 Wood triple glazing	Q43C H200 **Q43C H2E_** **Q43C H2EF** **Q43C H2SF** Q43C H2RA Q43P H200 Q43P H2E_ Q43P H2EF Q43P H2SF	1.23 m * 1.48 m
PG 3 Q4 Wood acoustic glazing	Q43A H200 **Q43A H2E_** **Q43A H2EF** **Q43A H2SF**	1.23 m * 1.48 m
Abbreviations: Material: “H” – wood Drive unit: "00" - without drive; "E_" - wired drive; "EF" - radio-controlled drive; "SF" - solar drive Other: "RA" - smoke outlet, sensor-controlled		

Table 1: Product groups

The declared unit is obtained by summing up:

PG	Assessed product[2]	Declared unit	Surface weight	Thickness
PG 1	**Q42P H2E_** **Q42P H2EF** **Q42P H2SF**	1 m²	36.79 kg/m²	176.62 mm
PG 2	**Q43C H2E_** **Q43C H2EF** **Q43C H2SF**	1 m²	44.31 kg/m²	176.62 mm
PG 3	**Q43A H2E_** **Q43A H2EF** **Q43A H2SF**	1 m²	55.90 kg/m²	176.62 mm

[2] The balanced products per PG are identical in terms of their material costs and differ only in the integrated drive unit. This was considered separately (see Table 10)

Table 2 Functional unit per reference product

The average unit is declared as follows:
Directly used material flows are determined using standardized sizes (1.23 m * 1.48 m) and allocated to the declared unit. All other inputs and outputs in the production were scaled to the declared unit in their entirety since no direct assignment to the standardized size is possible. The reference period is the year 2022.

The validity of the EPD is restricted to the series listed in Table 1.

Product description

Wooden roof window with central horizontal pivot axis for pitched roofs.

Overall frame dimensions (mm)	Overall insulation block dimension (mm)	Frame clear dimension (mm)	Inner lining clear dimension (mm)
550/774 - 1,340/1,596	610/834 - 1,400/1,656	--	495/719 - 1,285/1,541
Overall casement dimensions plastic (mm)	Casement clear dimension (mm)	Light area (m²)	Ventilation area (m² with 600 mm opening width)
467/688 - 1,257/1,510	381/571 - 1,171/1,393	0.22 - 1.63	0.72 - 1.42
Type of opening / opening direction	Frame material	Construction type	Surface
Central horizontal pivot axis	Solid pine wood	Horizontal pivot casements	Wooden window optionally available in white lacquered
Sealing systems			
2x sash gaskets, sealants made of TPE and TPV			

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

Product manufacture

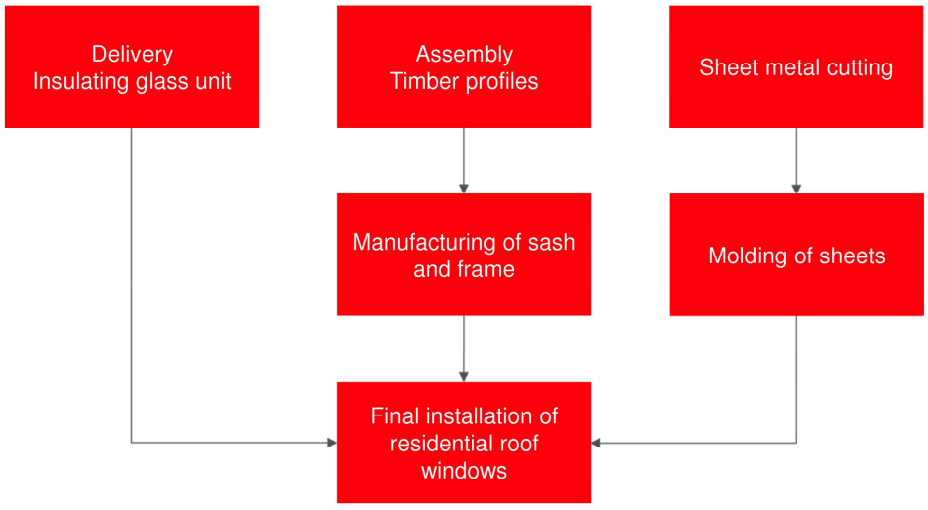


Illustration 1 Product manufacture of wooden windows

Application

Wooden roof windows for installation in pitched roofs with a roof inclination of 15° to 79°. With its central horizon tal pivot axis, the roof window guarantees effective ventilation of the attic and provides access to natural daylight.

Management systems

The following management systems are held:

- Quality management system according to DIN EN ISO 9001:2015

Additional information

For additional verifications of applicability or conformity refer to the CE marking and the documents accompanying the product, if applicable.

Wooden roof window RotoQ fulfill the following building physics performance characteristics*:

Thermal insulation value of window (UW value as per DIN EN ISO 10077, DIN EN ISO 12567-2)	Sound reduction index in dB (RWP value (C; Ctr) as per EN ISO 20140-3, EN ISO 717-1)
0.84	42 (-2;-5) dB
Sound reduction class / sound reduction grade (as per VDI guideline 2719) 52	Air permeability class (as per DIN EN 12207)
4	4
Thermal insulation value of pane1 (Ug-value as per DIN EN 673)	Total solar energy transmittance (g-value in % as per DIN EN 410)
0.6	37
Light transmittance (TL value in % as per DIN EN 410)	Resistance to wind load (as per DIN EN 12210)
56	C5
Resistance to snow (permanent load)	Reaction to fire (as per DIN EN 13501-1)
TSG4/12/TSG4/12/LSG6	C-s1,d0
Resistance to external fire (as per DIN EN 13501-5)	Watertightness (as per DIN EN 12208)
Broof(t1)	E 1200
Impact resistance class (as per DIN EN 13049)	Load-bearing capacity of safety devices (as per DIN EN 14609:2004)
3 - 450 mm	350 N

* The performance characteristics listed here vary from product to product. The values given are the maximum performance achieved within the product group.

2 Materials used

Primary materials

The raw materials used can be found in Section 6.2 Inventory analysis (Inputs).
The primary materials used are listed in the LCA (see Section 6).

Declarable substances

No substances according to REACH candidate list are included (declaration of 06.11.2023).

All relevant safety data sheets can be obtained from company Roto Frank DST Produktions-GmbH.

3 Construction process stage

Processing recommendations, installation

Operating and maintenance instructions can be found at https://www.roto-frank.com/de/dst/profi/bedienungs-und-wartungsanleitungen.

4 Use stage

Emissions to the environment

No emissions to water and soil are known. A test report for the assessment of emissions of Volatile Organic Compounds (VOC) according to ISO 16000 is available. Test results were taken into account in the life cycle assessment (see Annex/B1).

Reference service life (RSL)

The RSL information was provided by the manufacturer. The RSL must be established under specified reference conditions of use and relate to the declared technical and functional performance of the product within the building. It must be determined according to all specific rules given in European product standards or, if none are available, according to a c-PCR. It must also take into account ISO 15686-1, -2, -7 and -8. If there is guidance on deriving RSLs from European Product Standards or a c-PCR, then such guidance must take precedence.
If it is not possible to determine the service life as the RSL in accordance with ISO 15686, the BBSR table “Nutzungsdauer von Bauteilen zur Lebenszyklusanalyse nach BNB” (service life of building components for life cycle assessment in accordance with the sustainable construction evaluation system) can be used. For further information and explanations refer to www.nachhaltigesbauen.de.

For this EPD the following applies:
For a "cradle to grave" EPD and Module D (A + B + C + D), a reference service life (RSL) must be specified.
The service life of the Wooden roof window RotoQ of company Roto Frank DST Produktions-GmbH is specified with 40 years according to the manufacturer.

The service life is dependent on the characteristics of the product and in-use conditions.

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

5 End-of-life stage

Possible end-of-life stages

The Wooden roof window RotoQ are sent to central collection points. There the products are usually shredded and sorted into their constituents. The end-of-life stage depends on the site where the products are used and is therefore subject to the local regulations. Observe the locally applicable regulatory requirements.

In this EPD, the modules of after-use are presented according to the market situation (according to EN 17213).
Specific components of metals and glass are recycled. Plastics and wood are thermally recycled, residual fractions are sent to landfill.

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.

As a basis for this, life cycle assessments were prepared for Wooden roof window RotoQ. These LCAs are in conformity with the requirements set out in DIN 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

Aim

The goal of the LCA is to demonstrate the environmental impacts of the products. 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. Environmental impacts for "pure windows" and drive units are stated separately.

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

The specific data originate exclusively from the 2022 fiscal year. They were collected on-site at the plant located in Lubartów and originate in parts from company records and partly from values directly obtained by measurement. Validity of the data was checked by the ift Rosenheim.

The generic data originates from the professional database and building materials database software “LCA for Experts 10”. The last update of both databases was in 2023. Data from before this date originate also from these databases and are not more than eight years old. No other generic data were used for the calculation.

Generic data are selected as accurately as possible in terms of geographic reference. If no country-specific data sets are available or if the regional reference cannot be determined, European or globally valid data sets are used.

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 “LCA for Experts” for the development of life cycle assessments.

The data quality complies with the requirements of prEN 15941:2022.

Scope / system boundaries

The system boundaries refer to the supply of raw materials and purchased parts, manufacture/production, use and end-of-life stage of the Wooden roof window RotoQ.
For float glass (FG), laminated safety glass (LSG) and separately issued environmental impacts for drive units, additional specific data for production at the pre-suppliers was taken into account (FG: M-EPD-FEV-002000; LSG: M-EPD-MIG-002000; drive units: M-EPD-AZR-103).
No additional data from pre-suppliers or other sites were taken into consideration.

Cut-off criteria

All company data collected, i.e. all commodities/input and raw materials used, the thermal energy and electricity consumption, were taken into consideration.

The boundaries cover only the product-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 used were taken into consideration as a function of 100% of the mass of the products.
The transport distances for auxiliary materials are not recorded in the company, but are mapped in the LCA assuming a transport mix. The transport mix is consisted as follows and is derived from the research project "EPDs for transparent components":

- Truck, 26 – 28 t total weight / 18.4 t payload, Euro 6, freight, 85% capacity used, 100 km,
- Truck-trailer, 28 – 34 t total weight / 22 t payload, Euro 6, 50% capacity used, 50 km,
- Freight train, electrical and diesel driven; D 60%, E 51% capacity used, 50 km,
- Seagoing vessel, consumption mix, 50 km.

No transportation routes for waste recycling in A3 were taken into account.

The criteria for the exclusion of inputs and outputs as set out in DIN EN 15804 are fulfilled. From the data analysis it can be assumed that the total of negligible processes per life cycle stage does not exceed 1% of the mass/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

Aim

All material and energy flows are described below. The processes covered are presented as input and output parameters and refer to the declared units.

Life cycle stages

The complete life cycle of Wooden roof window RotoQ is shown in the annex. The product stage "A1 – A3", construction process stage "A4 – A5", use stage "B1 – B7", end-of-life stage "C1 – C4" and the 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 (thermal and electrical) from incineration

Allocation of co-products

Allocations occur during production.
The allocation was based on production costs (economic value).

Allocations for re-use, recycling and recovery

If the products are reused/recycled and recovered during the product stage (rejects), the elements are shredded, if necessary and then sorted into their constituents. This is done by various process plants, e.g. magnetic separators.
The system boundaries were set following their disposal, reaching the end-of-waste status.

Allocations beyond life cycle boundaries

The use of recycled materials in the manufacturing process was 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 recycling (recyclate).
Secondary materials that enter the production process as input are calculated in module A1 as input without loads. No benefits are assigned to Module D, but consumption to Modules C3 and C4 (worst case consideration).
The system boundary set for the recycled material refers to collection.

Secondary material

The use of secondary material in module A3 was examined at the company Roto Frank DST Produktions-GmbH. Secondary materials are used.

Inputs

The LCA includes the following production-relevant inputs per 1 m² Wooden roof window RotoQ:

Energy
The "electricity mix Poland" is used for the electricity mix in plant 21-100 Lubartów. For self-generated electricity (solar energy), "electricity from photovoltaic Poland" is used.
"Thermal energy from biomass (solid) Poland" is assumed for conventional, self-generated heat and "District heating mix Europe" is assumed for district heating.

A portion of the process heat is used for space heating. This can, however, not be quantified, hence a “worst case” figure was taken into account for the product.

Water
In the individual process steps for production, the water consumption is 19 l (Q42P H2E), 63 l (Q43C H2E) as well as 93 l (Q43A H2E) per m² element.
The consumption of fresh water specified in Section 6.3 originates (among others) from the process chain of the pre-products and the process water for cooling.

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

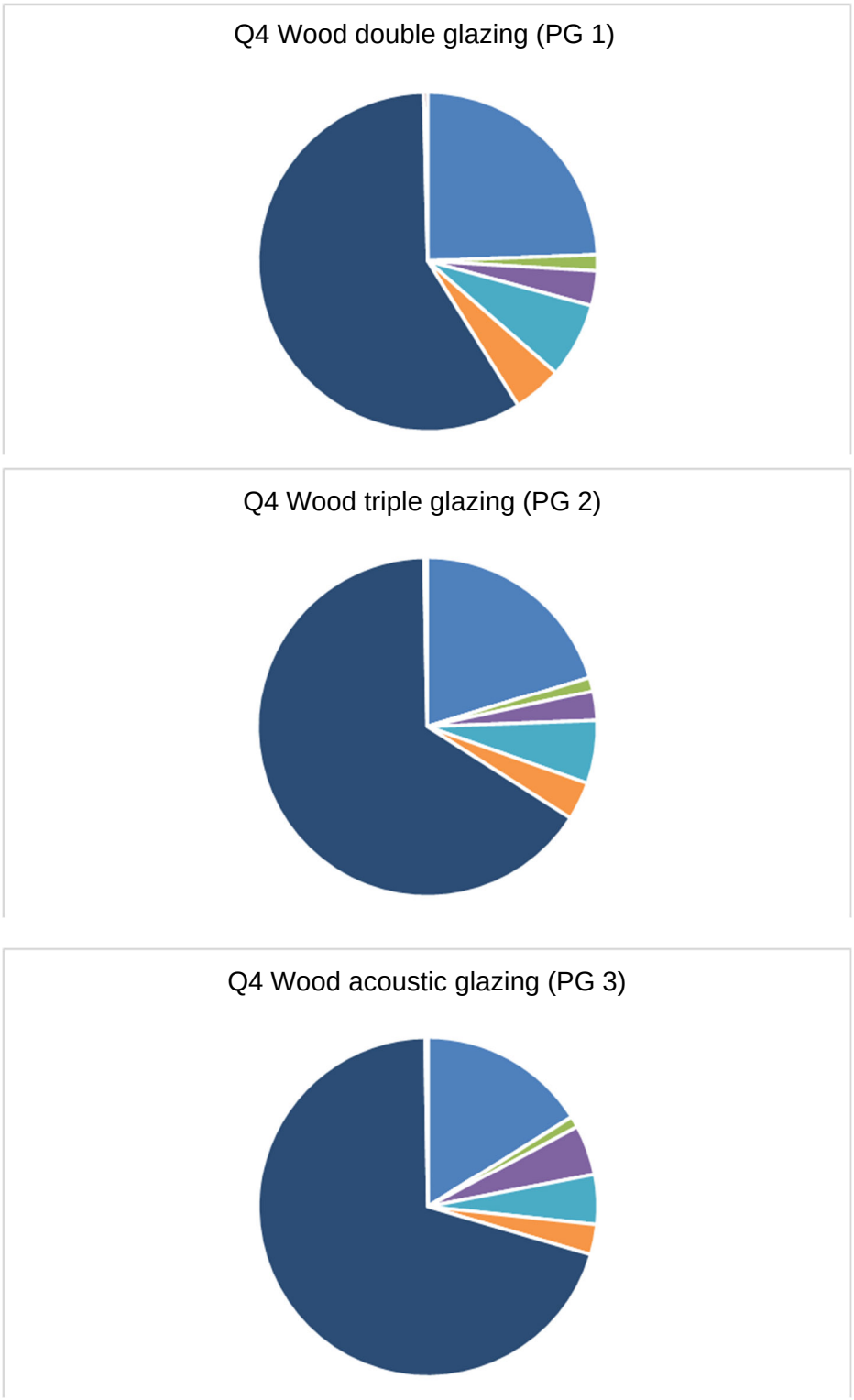


Illustration 2 Percentage of individual materials of the window variants per declared unit

No.	Material	Mass in %		
		PG 1	PG 2	PG 3
1	Wood (sash and frame)	24	20	16
2	Plastic (sash and frame)	0	0	0
3	Plastics (sealants)	2	1	1
4	Plastics (other)	3	3	5
5	Metals (hardware components)	7	6	5
6	Metals (other)	5	4	3
7	Glazing	59	66	70
8	Others	0	0	0

Table 3 Percentage of individual materials of the window variants in % per declared unit

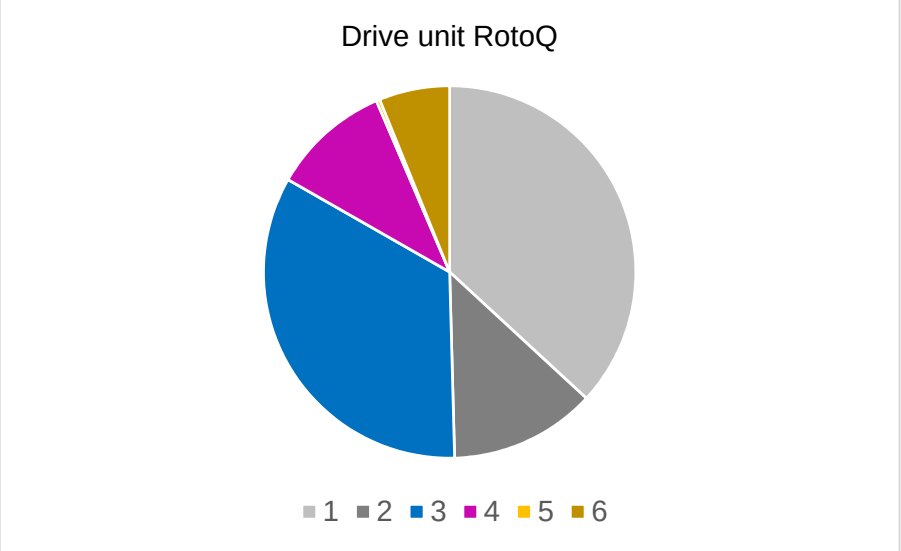


Illustration 3 Percentage of individual materials of the individual materials of drive unit per declared unit

No.	Material	Mass in %
		Drive unit Q4
1	Drive unit D+H	37
2	Other electrical components	13
3	Metals	34
4	Plastics	10
5	Wood	< 1
6	Paper/cardboard	6

Table 4 Percentage of individual materials of drive unit in % per declared unit

Ancillary materials and consumables
There are 15 g (PG 1), 50 g (PG 2) and 74 g (PG 3) of ancillary materials and consumables.

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

No.	Material	Mass in kg		
		PG 1	PG 2	PG 3
1	Styrofoam	0.57	1.91	2.81
2	Cardboard	4.97	16.66	24.49
3	Pallets	5.72	19.16	28.17

Table 5 Weight in kg of packaging per declared unit

No additional packaging is required for balanced drive units and (electrical) components.

Biogenic carbon content
According to EN 16449, the following amounts of biogenic carbon are generated:

No.	Part	Content in kg C per m²		
		PG 1	PG 2	PG 3
1	In product	3.79	3.79	3.79
2	In the associated packaging	4.34	14.54	21.37

Table 6 Biogenic carbon content in product and packaging at the factory gate

Outputs

The LCA includes the following production-relevant outputs per 1 m² Wooden roof window RotoQ:

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

Waste water
During production, 19 l (PG 1), 63 l (PG 2) and 93 l (PG 3) of wastewater is generated.

6.3 Impact assessment

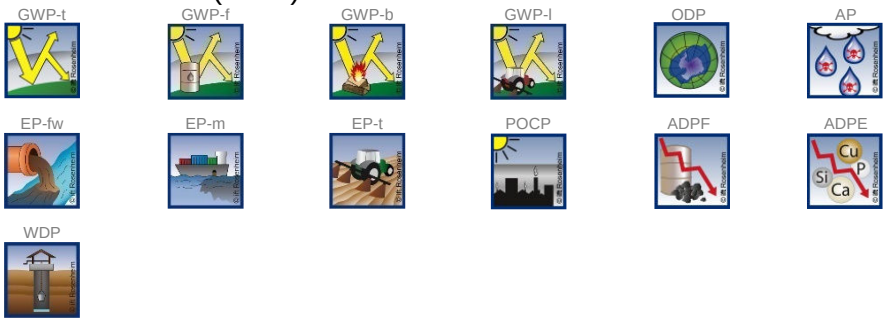
Aim

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

Core indicators

The models for impact assessment were applied as described in DIN EN 15804-A2.
The core indicators presented in the EPD are as follows:

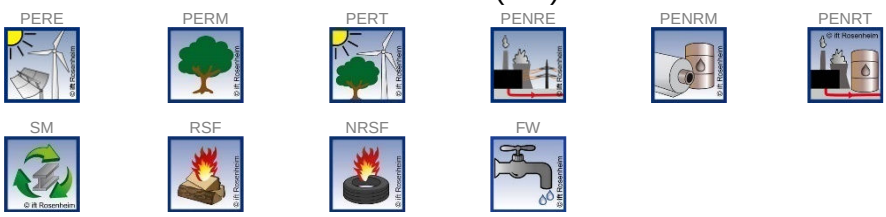
- Climate change - total (GWP-t)
- Climate change - fossil (GWP-f)
- Climate change - biogenic (GWP-b)
- Climate change - land use & land use change (GWP-l)
- Ozone depletion (ODP)
- Acidification (AP)
- Eutrophication freshwater (EP-fw)
- Eutrophication salt water (EP-m)
- Eutrophication land (EP-t)
- Photochemical ozone creation (POCP)
- Depletion of abiotic resources - fossil fuels (ADPF)
- Depletion of abiotic resources - minerals and metals (ADPE)
- Water use (WDP)



Resource management

The models for impact assessment were applied as described in DIN EN 15804-A2.
The following resource use indicators are presented in the EPD:

- Renewable primary energy as energy source (PERE)
- Renewable primary energy for material use (PERM)
- Total use of renewable primary energy (PERT)
- Non-renewable primary energy as energy source (PENRE)
- Renewable primary energy for material use (PENRM)
- Total use of non-renewable primary energy (PENRT)
- Use of secondary materials (SM)
- Use of renewable secondary fuels (RSF)
- Use of non-renewable secondary fuels (NRSF)
- Net use of freshwater resources (FW)

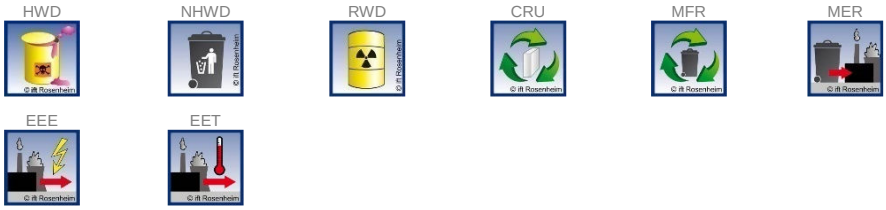


Waste

The waste generated during the production of 1 m² Wooden roof window RotoQ 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.

The models for impact assessment were applied as described in DIN EN 15804-A2.
The following waste categories and indicators for output closures are presented in the EPD:

- Disposed hazardous waste (HWD)
- Non-hazardous waste disposed (NHWD)
- Radioactive waste disposed (RWD)
- Components for re-use (CRU)
- Materials for recycling (MFR)
- Materials for energy recovery (MER)
- Exported electrical energy (EEE)
- Exported thermal energy (EET)



Additional environmental impact indicators

The models for impact assessment were applied as described in DIN EN 15804-A2.
The additional impact categories presented in the EPD are as follows:

- Particulate matter emissions (PM)
- Ionizing radiation, human health (IRP)
- Ecotoxicity – freshwater (ETP-fw)
- Human toxicity, carcinogenic effects (HTP-c)
- Human toxicity, non-carcinogenic effects (HTP-nc)
- Impacts associated with land use/soil quality (SQP)

Results per 1 m² Q4 double wood (PG 1)																
	Unit	**A1-A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Core indicators																
GWP-t	kg CO_2 equivalent	75.64	1.27	3.58	0.00	2.75	0.00	2.06	0.00	0.00	0.00	0.00	0.12	21.00	0.23	-35.20
GWP-f	kg CO_2 equivalent	91.85	1.27	1.47	0.00	2.73	0.00	2.02	0.00	0.00	0.00	0.00	0.12	5.52	0.23	-35.10
GWP-b	kg CO_2 equivalent	-16.33	-1.76E-02	2.10	0.00	1.43E-02	0.00	2.97E-02	0.00	0.00	0.00	0.00	-1.60E-03	15.50	-7.78E-03	-8.16E-02
GWP-l	kg CO_2 equivalent	8.17E-02	1.16E-02	3.55E-05	0.00	1.34E-03	0.00	2.34E-03	0.00	0.00	0.00	0.00	1.06E-03	7.77E-05	7.28E-04	-7.18E-03
ODP	kg CFC-11-eq.	6.36E-08	1.63E-13	5.42E-13	0.00	7.33E-10	0.00	1.59E-09	0.00	0.00	0.00	0.00	1.48E-14	5.85E-12	5.96E-13	-1.18E-10
AP	mol H^+-eq.	0.54	1.52E-03	7.71E-04	0.00	1.21E-02	0.00	1.23E-02	0.00	0.00	0.00	0.00	1.34E-04	5.38E-03	1.66E-03	-0.18
EP-fw	kg P-eq.	2.82E-04	4.58E-06	1.57E-07	0.00	5.85E-06	0.00	6.78E-06	0.00	0.00	0.00	0.00	4.17E-07	1.35E-06	4.72E-07	-3.06E-05
EP-m	kg N-eq.	0.11	5.23E-04	2.65E-04	0.00	2.45E-03	0.00	2.39E-03	0.00	0.00	0.00	0.00	4.52E-05	1.83E-03	4.30E-04	-4.13E-02
EP-t	mol N-eq.	1.21	6.14E-03	3.51E-03	0.00	2.80E-02	0.00	2.75E-02	0.00	0.00	0.00	0.00	5.32E-04	2.58E-02	4.73E-03	-0.47
POCP	kg NMVOC-eq.	0.32	1.34E-03	7.11E-04	2.75E-06	7.75E-03	0.00	7.23E-03	0.00	0.00	0.00	0.00	1.17E-04	4.77E-03	1.30E-03	-0.10
ADPF*²	MJ	1509.20	17.00	1.32	0.00	62.50	0.00	31.08	0.00	0.00	0.00	0.00	1.55	7.91	3.12	-527.00
ADPE*²	kg Sb equivalent	2.54E-05	8.24E-08	4.88E-09	0.00	6.28E-07	0.00	4.53E-07	0.00	0.00	0.00	0.00	7.51E-09	5.20E-08	1.08E-08	-1.24E-05
WDP*²	m^3 world-eq. deprived	11.14	1.51E-02	0.40	0.00	0.35	0.00	0.31	0.00	0.00	0.00	0.00	1.38E-03	2.12	2.57E-02	-2.27
Resource management																
PERE	MJ	309.83	1.24	146.16	0.00	5.23	0.00	14.05	0.00	0.00	0.00	0.00	0.11	102.08	73.08	-89.00
PERM	MJ	316.93	0.00	-145.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-98.51	-72.58	0.00
PERT	MJ	626.76	1.24	0.32	0.00	5.23	0.00	14.05	0.00	0.00	0.00	0.00	0.11	3.57	0.51	-89.00
PENRE	MJ	1453.48	17.10	45.15	0.00	62.50	0.00	31.08	0.00	0.00	0.00	0.00	1.56	14.65	8.08	-528.00
PENRM	MJ	55.52	0.00	-43.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-6.73	-4.96	0.00
PENRT	MJ	1509.00	17.10	1.32	0.00	62.50	0.00	31.08	0.00	0.00	0.00	0.00	1.56	7.92	3.12	-528.00
SM	kg	5.60	0.00	0.00	0.00	2.36E-02	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.20
RSF	MJ	0.00	0.00	0.00	0.00	5.53E-22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-4.71E-21
NRSF	MJ	0.00	0.00	0.00	0.00	6.48E-21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-5.54E-20
FW	m^3	0.53	1.36E-03	9.50E-03	0.00	1.56E-02	0.00	1.30E-02	0.00	0.00	0.00	0.00	1.24E-04	5.02E-02	7.88E-04	-0.11
Categories of waste																
HWD	kg	4.66E-06	5.30E-11	2.65E-11	0.00	2.93E-08	0.00	-1.00E-06	0.00	0.00	0.00	0.00	4.83E-12	-1.83E-10	6.80E-11	-4.49E-05
NHWD	kg	27.61	2.61E-03	0.20	0.00	0.64	0.00	1.05	0.00	0.00	0.00	0.00	2.38E-04	0.24	15.60	-7.88
RWD	kg	8.16E-02	3.20E-05	5.88E-05	0.00	1.88E-03	0.00	1.65E-03	0.00	0.00	0.00	0.00	2.92E-06	6.72E-04	3.55E-05	-2.05E-02
Output material flows																
CRU	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MFR	kg	3.34	0.00	0.00	0.00	0.64	0.00	0.35	0.00	0.00	0.00	0.00	0.00	10.50	0.00	0.00
MER	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EEE	MJ	1.17	0.00	5.85	0.00	5.68E-02	0.00	0.89	0.00	0.00	0.00	0.00	0.00	28.60	0.00	0.00
EET	MJ	2.73	0.00	10.50	0.00	0.10	0.00	1.87	0.00	0.00	0.00	0.00	0.00	61.60	0.00	0.00

Key:

GWP-t – Global warming potential – total **GWP-f** – global warming potential fossil fuels **GWP-b** – global warming potential - biogenic **GWP-l** – global warming potential - land use and land use change **ODP** – ozone depletion potential **AP** - acidification potential **EP-fw** - eutrophication potential - aquatic freshwater **EP-m** - eutrophication potential - aquatic marine **EP-t** - feutrophication potential - terrestrial **POCP** - photochemical ozone formation potential **ADPF*²** - abiotic depletion potential – fossil resources **ADPE*²** - abiotic depletion potential – minerals&metals **WDP*²** – Water (user) deprivation potential **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 Q4 double wood (PG 1)															
	Unit	**A1-A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Additional environmental impact indicators																
PM	Disease incidence	7.23E-06	1.08E-08	5.42E-09	0.00	1.07E-07	0.00	1.67E-07	0.00	0.00	0.00	0.00	9.73E-10	2.69E-08	2.04E-08	-1.62E-06
IRP*[1]	kBq U235-eq.	13.14	4.78E-03	8.85E-03	0.00	0.30	0.00	0.27	0.00	0.00	0.00	0.00	4.35E-04	6.75E-02	4.10E-03	-2.92
ETP-fw*[2]	CTUe	1629.40	12.10	0.71	2.37E-05	48.00	0.00	38.36	0.00	0.00	0.00	0.00	1.10	3.20	1.70	-477.00
HTP-c*[2]	CTUh	1.44E-07	2.48E-10	3.97E-11	0.00	3.68E-09	0.00	2.12E-09	0.00	0.00	0.00	0.00	2.26E-11	1.98E-10	2.62E-10	-1.27E-07
HTP-nc*[2]	CTUh	1.01E-06	1.32E-08	2.83E-09	1.71E-13	3.45E-08	0.00	2.21E-08	0.00	0.00	0.00	0.00	1.20E-09	6.06E-09	2.88E-08	-3.35E-07
SQP*[2]	dimensionless	3927.60	7.12	0.35	0.00	4.45	0.00	97.64	0.00	0.00	0.00	0.00	0.65	2.96	0.76	-47.00

Key:
PM – particulate matter emissions potential **IRP*[1]** – ionizing radiation potential – human health **ETP-fw*[2]** - Ecotoxicity potential – freshwater **HTP-c*[2]** - Human toxicity potential – cancer effects **HTP-nc*[2]** - Human toxicity potential – non-cancer effects **SQP*[2]** – soil quality potential

Disclaimers:

*1 This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

*2 The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

Table 7 Overall results table Q4 double wood (PG 1)

Results per 1 m² Q4 triple wood (PG 2)																
	Unit	**A1-A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Core indicators																
GWP-t	kg CO_2 equivalent	114.26	2.16	12.00	0.00	2.93	0.00	3.17	0.00	0.00	0.00	0.00	0.14	21.40	0.30	-43.40
GWP-f	kg CO_2 equivalent	134.65	2.17	4.94	0.00	2.90	0.00	3.12	0.00	0.00	0.00	0.00	0.14	5.96	0.31	-43.30
GWP-b	kg CO_2 equivalent	-20.22	-3.00E-02	7.05	0.00	1.43E-02	0.00	5.53E-02	0.00	0.00	0.00	0.00	-1.93E-03	15.50	-1.04E-02	-0.11
GWP-l	kg CO_2 equivalent	0.11	1.98E-02	1.19E-04	0.00	1.43E-03	0.00	3.25E-03	0.00	0.00	0.00	0.00	1.27E-03	1.36E-04	9.69E-04	-1.04E-02
ODP	kg CFC-11-eq.	9.97E-08	2.78E-13	1.82E-12	0.00	7.08E-10	0.00	2.49E-09	0.00	0.00	0.00	0.00	1.79E-14	6.36E-12	7.93E-13	-1.45E-10
AP	mol H^+-eq.	0.75	2.60E-03	2.58E-03	0.00	1.46E-02	0.00	1.74E-02	0.00	0.00	0.00	0.00	1.62E-04	5.33E-03	2.21E-03	-0.26
EP-fw	kg P-eq.	5.33E-04	7.81E-06	5.27E-07	0.00	5.98E-06	0.00	1.30E-05	0.00	0.00	0.00	0.00	5.02E-07	1.51E-06	6.28E-07	-4.14E-05
EP-m	kg N-eq.	0.15	8.93E-04	8.87E-04	0.00	2.93E-03	0.00	3.46E-03	0.00	0.00	0.00	0.00	5.44E-05	1.78E-03	5.72E-04	-5.62E-02
EP-t	mol N-eq.	1.70	1.05E-02	1.18E-02	0.00	3.35E-02	0.00	3.91E-02	0.00	0.00	0.00	0.00	6.41E-04	2.53E-02	6.29E-03	-0.65
POCP	kg NMVOC-eq.	0.44	2.28E-03	2.38E-03	2.75E-06	9.00E-03	0.00	1.02E-02	0.00	0.00	0.00	0.00	1.41E-04	4.65E-03	1.73E-03	-0.14
ADPF*²	MJ	2081.70	29.10	4.41	0.00	65.25	0.00	44.16	0.00	0.00	0.00	0.00	1.87	9.02	4.15	-675.00
ADPE*²	kg Sb equivalent	3.08E-05	1.41E-07	1.64E-08	0.00	6.98E-07	0.00	5.42E-07	0.00	0.00	0.00	0.00	9.04E-09	5.65E-08	1.44E-08	-1.62E-05
WDP*²	m^3 world-eq. deprived	12.60	2.58E-02	1.35	0.00	0.37	0.00	0.37	0.00	0.00	0.00	0.00	1.66E-03	2.17	3.43E-02	-3.11
Resource management																
PERE	MJ	178.43	2.12	146.90	0.00	5.15	0.00	20.42	0.00	0.00	0.00	0.00	0.14	308.30	269.33	-108.00
PERM	MJ	718.97	0.00	-145.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-304.47	-268.65	0.00
PERT	MJ	897.40	2.12	1.06	0.00	5.15	0.00	20.42	0.00	0.00	0.00	0.00	0.14	3.83	0.68	-108.00
PENRE	MJ	1992.75	29.20	53.28	0.00	65.50	0.00	44.14	0.00	0.00	0.00	0.00	1.88	29.84	22.52	-676.00
PENRM	MJ	88.05	0.00	-48.87	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-20.81	-18.36	0.00
PENRT	MJ	2080.80	29.20	4.41	0.00	65.50	0.00	44.14	0.00	0.00	0.00	0.00	1.88	9.03	4.16	-676.00
SM	kg	14.80	0.00	0.00	0.00	3.08E-02	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.38
RSF	MJ	0.00	0.00	0.00	0.00	7.25E-22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-9.16E-21
NRSF	MJ	0.00	0.00	0.00	0.00	8.53E-21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1.08E-19
FW	m^3	0.69	2.32E-03	3.18E-02	0.00	1.60E-02	0.00	1.73E-02	0.00	0.00	0.00	0.00	1.49E-04	5.13E-02	1.05E-03	-0.13
Categories of waste																
HWD	kg	5.84E-06	9.05E-11	8.89E-11	0.00	3.50E-08	0.00	-9.71E-07	0.00	0.00	0.00	0.00	5.81E-12	-1.88E-10	9.05E-11	-4.50E-05
NHWD	kg	35.67	4.45E-03	0.66	0.00	0.82	0.00	1.40	0.00	0.00	0.00	0.00	2.86E-04	0.56	20.80	-12.80
RWD	kg	7.95E-02	5.47E-05	1.97E-04	0.00	1.83E-03	0.00	1.50E-03	0.00	0.00	0.00	0.00	3.51E-06	7.02E-04	4.73E-05	-2.49E-02
Output material flows																
CRU	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MFR	kg	6.63	0.00	0.00	0.00	0.82	0.00	0.48	0.00	0.00	0.00	0.00	0.00	12.60	0.00	0.00
MER	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EEE	MJ	3.91	0.00	19.60	0.00	5.98E-02	0.00	1.31	0.00	0.00	0.00	0.00	0.00	29.00	0.00	0.00
EET	MJ	9.17	0.00	35.30	0.00	0.11	0.00	2.67	0.00	0.00	0.00	0.00	0.00	62.40	0.00	0.00

Key:

GWP-t – Global warming potential – total **GWP-f** – global warming potential fossil fuels **GWP-b** – global warming potential - biogenic **GWP-l** – global warming potential - land use and land use change **ODP** – ozone depletion potential **AP** - acidification potential **EP-fw** - eutrophication potential - aquatic freshwater **EP-m** - eutrophication potential - aquatic marine **EP-t** - feutrophication potential - terrestrial **POCP** - photochemical ozone formation potential **ADPF*²** - abiotic depletion potential – fossil resources **ADPE*²** - abiotic depletion potential – minerals&metals **WDP*²** – Water (user) deprivation potential **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 Q4 triple wood (PG 2)														
	Unit	**A1-A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Additional environmental impact indicators																
PM	Disease incidence	9.19E-06	1.85E-08	1.82E-08	0.00	1.30E-07	0.00	2.15E-07	0.00	0.00	0.00	0.00	1.17E-09	3.02E-08	2.72E-08	-2.28E-06
IRP*[1]	kBq U235-eq.	11.85	8.16E-03	2.97E-02	0.00	0.29	0.00	0.23	0.00	0.00	0.00	0.00	5.24E-04	7.10E-02	5.46E-03	-3.33
ETP-fw*[2]	CTUe	2655.90	20.70	2.36	2.37E-05	56.50	0.00	63.59	0.00	0.00	0.00	0.00	1.33	3.96	2.27	-727.00
HTP-c*[2]	CTUh	1.97E-07	4.23E-10	1.33E-10	0.00	4.80E-09	0.00	2.90E-09	0.00	0.00	0.00	0.00	2.72E-11	2.29E-10	3.49E-10	-1.76E-07
HTP-nc*[2]	CTUh	1.64E-06	2.26E-08	9.50E-09	1.71E-13	3.63E-08	0.00	3.79E-08	0.00	0.00	0.00	0.00	1.45E-09	9.11E-09	3.84E-08	-4.08E-07
SQP*[2]	dimensionless	5227.00	12.20	1.17	0.00	4.43	0.00	129.97	0.00	0.00	0.00	0.00	0.78	3.20	1.01	-61.60

Key:
PM – particulate matter emissions potential **IRP*[1]** – ionizing radiation potential – human health **ETP-fw*[2]** - Ecotoxicity potential – freshwater **HTP-c*[2]** - Human toxicity potential – cancer effects **HTP-nc*[2]** - Human toxicity potential – non-cancer effects **SQP*[2]** – soil quality potential

Disclaimers:
*1 This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

*2 The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

Table 8 Overall results table Q4 double wood (PG 2)

	Results per 1 m² Q4 acoustic wood (PG 3)															
	Unit	**A1-A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Core indicators																
GWP-t	kg CO_2 equivalent	188.83	2.93	17.60	0.00	4.15	0.00	5.18	0.00	0.00	0.00	0.00	0.18	25.30	0.41	-51.90
GWP-f	kg CO_2 equivalent	211.02	2.95	7.27	0.00	4.13	0.00	5.10	0.00	0.00	0.00	0.00	0.18	9.82	0.42	-51.80
GWP-b	kg CO_2 equivalent	-22.49	-4.08E-02	10.40	0.00	2.32E-02	0.00	8.16E-02	0.00	0.00	0.00	0.00	-2.43E-03	15.50	-1.39E-02	-0.14
GWP-l	kg CO_2 equivalent	0.18	2.69E-02	1.75E-04	0.00	2.70E-03	0.00	5.27E-03	0.00	0.00	0.00	0.00	1.60E-03	1.80E-04	1.30E-03	-8.98E-03
ODP	kg CFC-11-eq.	1.49E-07	3.77E-13	2.67E-12	0.00	1.76E-09	0.00	3.72E-09	0.00	0.00	0.00	0.00	2.25E-14	6.82E-12	1.06E-12	-1.94E-10
AP	mol H^+-eq.	1.13	3.53E-03	3.80E-03	0.00	2.21E-02	0.00	2.66E-02	0.00	0.00	0.00	0.00	2.04E-04	5.78E-03	2.97E-03	-0.26
EP-fw	kg P-eq.	8.78E-04	1.06E-05	7.74E-07	0.00	1.02E-05	0.00	2.16E-05	0.00	0.00	0.00	0.00	6.33E-07	1.67E-06	8.42E-07	-4.79E-05
EP-m	kg N-eq.	0.23	1.21E-03	1.30E-03	0.00	4.28E-03	0.00	5.25E-03	0.00	0.00	0.00	0.00	6.86E-05	1.91E-03	7.66E-04	-6.40E-02
EP-t	mol N-eq.	2.52	1.42E-02	1.73E-02	0.00	4.90E-02	0.00	5.89E-02	0.00	0.00	0.00	0.00	8.08E-04	2.75E-02	8.43E-03	-0.73
POCP	kg NMVOC-eq.	0.65	3.10E-03	3.50E-03	2.75E-06	1.29E-02	0.00	1.53E-02	0.00	0.00	0.00	0.00	1.78E-04	5.02E-03	2.31E-03	-0.15
ADPF*²	MJ	3367.50	39.50	6.48	0.00	87.25	0.00	74.71	0.00	0.00	0.00	0.00	2.36	10.10	5.57	-801.00
ADPE*²	kg Sb equivalent	4.89E-05	1.91E-07	2.40E-08	0.00	1.09E-06	0.00	9.99E-07	0.00	0.00	0.00	0.00	1.14E-08	6.08E-08	1.93E-08	-1.57E-05
WDP*²	m³ world-eq. deprived	22.75	3.51E-02	1.98	0.00	0.60	0.00	0.64	0.00	0.00	0.00	0.00	2.09E-03	2.50	4.59E-02	-3.35
Resource management																
PERE	MJ	329.20	2.88	147.40	0.00	10.68	0.00	30.45	0.00	0.00	0.00	0.00	0.17	426.95	420.48	-141.00
PERM	MJ	988.26	0.00	-145.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-422.85	-419.57	0.00
PERT	MJ	1317.46	2.88	1.56	0.00	10.68	0.00	30.45	0.00	0.00	0.00	0.00	0.17	4.10	0.91	-141.00
PENRE	MJ	3227.20	39.70	88.30	0.00	87.25	0.00	74.70	0.00	0.00	0.00	0.00	2.37	39.00	34.25	-801.00
PENRM	MJ	139.40	0.00	-81.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-28.90	-28.68	0.00
PENRT	MJ	3366.60	39.70	6.48	0.00	87.25	0.00	74.70	0.00	0.00	0.00	0.00	2.37	10.10	5.57	-801.00
SM	kg	21.40	0.00	0.00	0.00	4.45E-02	0.00	0.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.18
RSF	MJ	0.00	0.00	0.00	0.00	1.04E-21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-4.32E-21
NRSF	MJ	0.00	0.00	0.00	0.00	1.22E-20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-5.07E-20
FW	m³	1.15	3.15E-03	4.68E-02	0.00	2.46E-02	0.00	2.93E-02	0.00	0.00	0.00	0.00	1.88E-04	5.93E-02	1.41E-03	-0.15
Categories of waste																
HWD	kg	7.25E-06	1.23E-10	1.31E-10	0.00	5.38E-08	0.00	-9.36E-07	0.00	0.00	0.00	0.00	7.33E-12	-1.75E-10	1.21E-10	-4.49E-05
NHWD	kg	50.73	6.05E-03	0.97	0.00	1.18	0.00	1.96	0.00	0.00	0.00	0.00	3.61E-04	0.81	27.90	-8.95
RWD	kg	0.18	7.42E-05	2.90E-04	0.00	4.28E-03	0.00	3.94E-03	0.00	0.00	0.00	0.00	4.43E-06	7.48E-04	6.34E-05	-3.26E-02
Output material flows																
CRU	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MFR	kg	11.74	0.00	0.00	0.00	1.14	0.00	0.68	0.00	0.00	0.00	0.00	0.00	15.60	0.00	0.00
MER	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EEE	MJ	5.75	0.00	28.80	0.00	5.98E-02	0.00	1.74	0.00	0.00	0.00	0.00	0.00	34.90	0.00	0.00
EET	MJ	13.50	0.00	52.00	0.00	0.11	0.00	3.46	0.00	0.00	0.00	0.00	0.00	73.00	0.00	0.00

Key:

GWP-t – Global warming potential – total **GWP-f** – global warming potential fossil fuels **GWP-b** – global warming potential - biogenic **GWP-l** – global warming potential - land use and land use change **ODP** – ozone depletion potential **AP** - acidification potential **EP-fw** - eutrophication potential - aquatic freshwater **EP-m** - eutrophication potential - aquatic marine **EP-t** - feutrophication potential - terrestrial **POCP** - photochemical ozone formation potential **ADPF*²** - abiotic depletion potential – fossil resources **ADPE*²** - abiotic depletion potential – minerals&metals **WDP*²** – Water (user) deprivation potential **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 Q4 acoustic wood (PG 3)															
	Unit	**A1-A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Additional environmental impact indicators																
PM	Disease incidence	1.26E-05	2.51E-08	2.67E-08	0.00	1.96E-07	0.00	2.99E-07	0.00	0.00	0.00	0.00	1.48E-09	3.52E-08	3.65E-08	-2.08E-06
IRP*[1]	kBq U235-eq.	27.85	1.11E-02	4.36E-02	0.00	0.69	0.00	0.62	0.00	0.00	0.00	0.00	6.61E-04	7.78E-02	7.32E-03	-4.31
ETP-fw*[2]	CTUe	3985.80	28.10	3.47	2.36E-05	79.75	0.00	96.14	0.00	0.00	0.00	0.00	1.68	4.61	3.04	-683.00
HTP-c*[2]	CTUh	2.14E-07	5.74E-10	1.95E-10	0.00	5.05E-09	0.00	3.47E-09	0.00	0.00	0.00	0.00	3.43E-11	2.65E-10	4.68E-10	-1.63E-07
HTP-nc*[2]	CTUh	2.41E-06	3.07E-08	1.40E-08	1.71E-13	4.53E-08	0.00	5.70E-08	0.00	0.00	0.00	0.00	1.83E-09	1.13E-08	5.14E-08	-4.79E-07
SQP*[2]	dimensionless	6287.70	16.50	1.72	0.00	9.00	0.00	156.29	0.00	0.00	0.00	0.00	0.99	3.49	1.35	-82.60

Key:
PM – particulate matter emissions potential **IRP*[1]** – ionizing radiation potential – human health **ETP-fw*[2]** - Ecotoxicity potential – freshwater **HTP-c*[2]** - Human toxicity potential – cancer effects **HTP-nc*[2]** - Human toxicity potential – non-cancer effects **SQP*[2]** – soil quality potential

Disclaimers:
*1 This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

*2 The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

Table 9 Overall results table Q4 double wood (PG 3)

Addition: Overall results table for drive units and (electrical) components for (optional) drive-controlled window variants with designation code E_, EF, SF:

Results for drive units and (electrical) components used per 1 m² Windows of the model series Q4																
	Unit	**A1-A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Core indicators																
GWP-t	kg CO_2 equivalent	12.01	6.28E-02	0.00	0.00	5.40E-03	0.00	0.20	0.00	0.38	0.00	0.00	7.46E-03	0.74	1.04E-02	-5.05
GWP-f	kg CO_2 equivalent	12.31	6.31E-02	0.00	0.00	6.20E-03	0.00	0.20	0.00	0.37	0.00	0.00	7.50E-03	0.58	1.07E-02	-5.06
GWP-b	kg CO_2 equivalent	-0.27	-8.72E-04	0.00	0.00	-8.25E-04	0.00	-2.69E-03	0.00	3.95E-03	0.00	0.00	-1.04E-04	0.16	-3.55E-04	1.79E-02
GWP-l	kg CO_2 equivalent	1.69E-02	5.75E-04	0.00	0.00	4.38E-06	0.00	2.89E-04	0.00	4.18E-05	0.00	0.00	6.84E-05	2.03E-05	3.32E-05	-6.17E-03
ODP	kg CFC-11-eq.	1.59E-09	8.08E-15	0.00	0.00	3.35E-11	0.00	2.43E-11	0.00	7.70E-12	0.00	0.00	9.61E-16	3.23E-12	2.72E-14	-1.42E-09
AP	mol H^+-eq.	6.41E-02	7.57E-05	0.00	0.00	2.23E-05	0.00	9.98E-04	0.00	1.18E-03	0.00	0.00	8.70E-06	6.51E-04	7.58E-05	-2.55E-02
EP-fw	kg P-eq.	1.87	2.27E-07	0.00	0.00	4.08E-02	0.00	2.84E-02	0.00	1.58E-06	0.00	0.00	2.70E-08	6.70E-07	2.15E-08	-1.71
EP-m	kg N-eq.	9.33E-03	2.60E-05	0.00	0.00	4.05E-06	0.00	1.48E-04	0.00	2.04E-04	0.00	0.00	2.93E-06	1.37E-04	1.96E-05	-3.69E-03
EP-t	mol N-eq.	9.85E-02	3.05E-04	0.00	0.00	4.33E-05	0.00	1.57E-03	0.00	2.14E-03	0.00	0.00	3.45E-05	1.67E-03	2.15E-04	-3.90E-02
POCP	kg NMVOC-eq.	2.81E-02	6.63E-05	0.00	0.00	1.20E-05	0.00	4.50E-04	0.00	5.60E-04	0.00	0.00	7.58E-06	3.70E-04	5.91E-05	-1.09E-02
ADPF*²	MJ	159.43	0.85	0.00	0.00	9.53E-02	0.00	2.55	0.00	7.85	0.00	0.00	0.10	3.36	0.14	-64.20
ADPE*²	kg Sb equivalent	1.12E-03	4.09E-09	0.00	0.00	5.83E-07	0.00	1.63E-05	0.00	7.60E-08	0.00	0.00	4.87E-10	3.17E-08	4.92E-10	-4.81E-04
WDP*²	m^3 world-eq. deprived	2.97	7.50E-04	0.00	0.00	5.30E-06	0.00	4.91E-02	0.00	7.20E-02	0.00	0.00	8.93E-05	9.28E-02	1.17E-03	-1.10
Resource management																
PERE	MJ	50.74	6.16E-02	0.00	0.00	2.95E-02	0.00	0.93	0.00	5.40	0.00	0.00	7.32E-03	4.08	0.64	-19.10
PERM	MJ	2.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1.84	-0.61	0.00
PERT	MJ	53.20	6.16E-02	0.00	0.00	2.95E-02	0.00	0.93	0.00	5.40	0.00	0.00	7.32E-03	2.24	2.32E-02	-19.10
PENRE	MJ	154.40	0.85	0.00	0.00	9.55E-02	0.00	2.55	0.00	7.85	0.00	0.00	0.10	7.13	1.40	-64.20
PENRM	MJ	5.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-3.77	-1.26	0.00
PENRT	MJ	159.43	0.85	0.00	0.00	9.55E-02	0.00	2.55	0.00	7.85	0.00	0.00	0.10	3.36	0.14	-64.20
SM	kg	0.28	0.00	0.00	0.00	0.00	0.00	6.95E-03	0.00	0.00	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	0.00	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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FW	m^3	0.11	6.74E-05	0.00	0.00	1.87E-07	0.00	1.82E-03	0.00	2.38E-03	0.00	0.00	8.02E-06	2.46E-03	3.59E-05	-3.79E-02
Categories of waste																
HWD	kg	9.23E-06	2.63E-12	0.00	0.00	1.36E-10	0.00	1.42E-07	0.00	-7.40E-10	0.00	0.00	3.13E-13	-2.98E-10	3.10E-12	-3.53E-06
NHWD	kg	1.65	1.29E-04	0.00	0.00	3.78E-03	0.00	4.31E-02	0.00	7.08E-03	0.00	0.00	1.54E-05	1.70E-02	0.71	-0.68
RWD	kg	5.24E-03	1.59E-06	0.00	0.00	5.50E-06	0.00	7.81E-05	0.00	1.24E-03	0.00	0.00	1.89E-07	5.09E-04	1.62E-06	-2.77E-03
Output material flows																
CRU	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MFR	kg	8.24E-03	0.00	0.00	0.00	1.93E-02	0.00	3.44E-02	0.00	0.00	0.00	0.00	0.00	1.37	0.00	-7.53E-03
MER	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EEE	MJ	0.00	0.00	0.00	0.00	0.00	0.00	2.39E-02	0.00	0.00	0.00	0.00	0.00	0.96	0.00	0.00
EET	MJ	0.00	0.00	0.00	0.00	0.00	0.00	5.20E-02	0.00	0.00	0.00	0.00	0.00	2.08	0.00	0.00

Key:
GWP-t – Global warming potential – total **GWP-f** – global warming potential fossil fuels **GWP-b** – global warming potential - biogenic **GWP-l** – global warming potential - land use and land use change **ODP** – ozone depletion potential **AP** - acidification potential **EP-fw** - eutrophication potential - aquatic freshwater **EP-m** - eutrophication potential - aquatic marine **EP-t** - feutrophication potential - terrestrial **POCP** - photochemical ozone formation potential **ADPF*²** - abiotic depletion potential – fossil resources **ADPE*²** - abiotic depletion potential – minerals&metals **WDP*²** – Water (user) deprivation potential **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 for drive units and (electrical) components used per 1 m² Windows of the model series Q4																
	Unit	**A1-A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Additional environmental impact indicators																
PM	Disease incidence	6.83E-07	5.38E-10	0.00	0.00	3.20E-10	0.00	1.07E-08	0.00	1.04E-08	0.00	0.00	6.30E-11	5.14E-09	9.32E-10	-2.68E-07
IRP*[1]	kBq U235-eq.	0.79	2.37E-04	0.00	0.00	9.33E-04	0.00	1.02E-02	0.00	0.12	0.00	0.00	2.82E-05	4.78E-02	1.87E-04	-0.45
ETP-fw*[2]	CTUe	88.73	0.60	0.00	0.00	3.10E-04	0.00	1.49	0.00	3.18	0.00	0.00	7.15E-02	1.36	7.76E-02	-31.20
HTP-c*[2]	CTUh	7.89E-08	1.23E-11	0.00	0.00	1.47E-12	0.00	1.10E-09	0.00	1.39E-10	0.00	0.00	1.46E-12	6.25E-11	1.19E-11	-3.51E-08
HTP-nc*[2]	CTUh	2.77E-07	6.56E-10	0.00	0.00	5.65E-11	0.00	4.49E-09	0.00	2.93E-09	0.00	0.00	7.80E-11	1.52E-09	1.31E-09	-1.02E-07
SQP*[2]	dimensionless	68.41	0.35	0.00	0.00	4.33E-02	0.00	1.43	0.00	3.55	0.00	0.00	4.21E-02	1.50	3.45E-02	-14.30

Key:
PM – particulate matter emissions potential **IRP*[1]** – ionizing radiation potential – human health **ETP-fw*[2]** - Ecotoxicity potential – freshwater **HTP-c*[2]** - Human toxicity potential – cancer effects **HTP-nc*[2]** - Human toxicity potential – non-cancer effects **SQP*[2]** – soil quality potential

Disclaimers:
*1 This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

*2 The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

Table 10 Overall results table for drive units and (electrical) components across all life cycle phases - model series Q4

The results presented serve as an initial orientation for estimating the additional environmental impacts of drive-controlled window variants. The environmental impact of installed drive units is based on M-EPD-AZR-103. Purchased electrical components were recognized exclusively through the cost of materials.

Optional drive units are installed for all window variants with designation code E_, EF or SF. For these, the values of the determined environmental impacts from Table 10 must be added. Solar and line-operated drive units are installed (see legend Table 1). The worst case was determined in a preliminary study (for model series Q4: drive variant solar radio “SF", see background report, Section 3.3.2), so the environmental impacts from Table 10 cover all named drive variants. The drives and other electrical components and other components associated with the drive unit were included in the balance.

6.4 Interpretation, LCA presentation and critical review

Evaluation

The environmental impacts of

- Q4 double wood (PG 1)
- Q4 triple wood (PG 2)
- Q4 acoustic wood (PG 3)
- Drive unit Q4 (worst case: drive variant solar radio “SF")

differ considerably from each other. The differences lie primarily in the varying use of flat and laminated safety glass and the energy used for production. However, the effect of the various pre-products and raw materials used and their different weights should not be neglected, nor should the resulting significant differences in product weight.

In the area of production, the environmental impact of all roof windows results primarily from the use of laminated safety glass (LSG) and its upstream chains. In addition, the quantity of flat glass used, followed by externally sourced electricity, has a significant impact on the environment. Further marginal shares are attributable to the aluminum used and the cardboard packaging used and their respective upstream chains.
For drive units and (electrical) components in the case of drive-controlled window variants, built-in circuit boards and the copper and aluminum used are particularly important drivers. Here, even small differences in mass result in significant deviations in the environmental impact.
Furthermore, cleaning processes with a glass cleaner containing isopropanol and ethanol during the 50-year utilisation phase are relevant in terms of environmental impact. Other significant values in the utilisation phase come from the repair of worn parts. For all products, this is in particular the replacement of laminated safety glass, followed by flat glass and hardware.
The one-off replacement of windows over a period of 50 years also plays an important role.

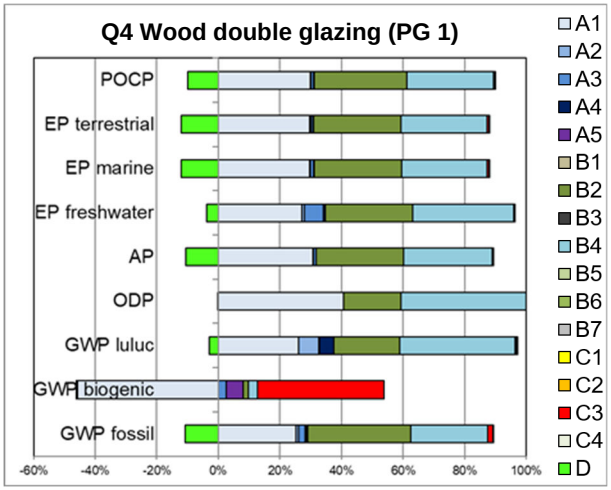
In scenario C4, only marginal expenditures for the physical pretreatment and the landfill operation are to be expected.
In the disposal phase, glass recycling (downcycling to container glass) can be credited with around 1% of the life cycle environmental impacts of the core indicators without WDP in scenario D. In addition, there is approximately 1% each for the recycling of aluminum and steel.

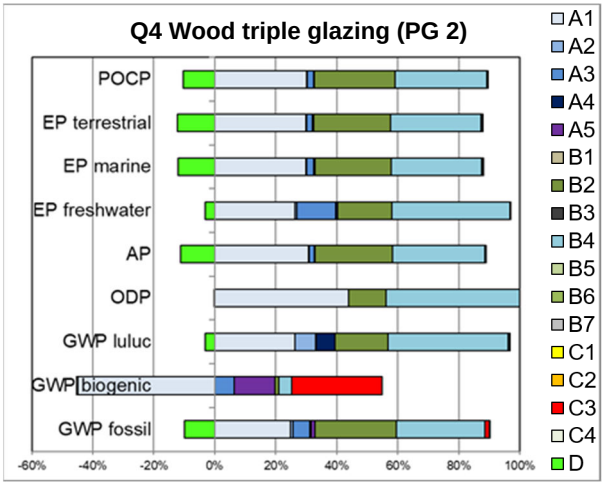
The charts below show the allocation of the main environmental impacts.

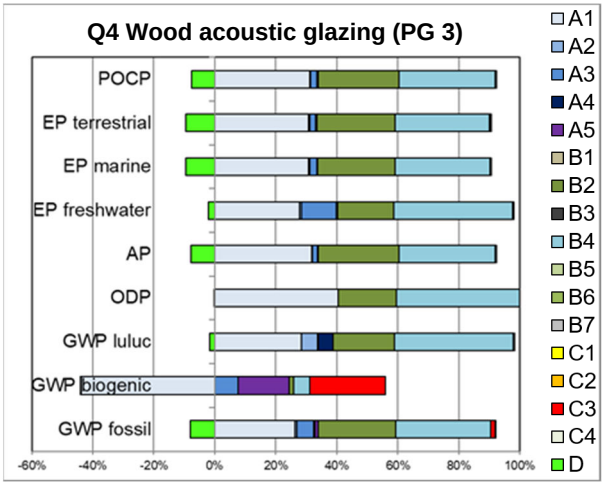
The values obtained from the LCA calculation are suitable for the certification of buildings.

Diagrams

The diagrams below show the B modules with reference to the specified RSL within the building service life of 50 years.







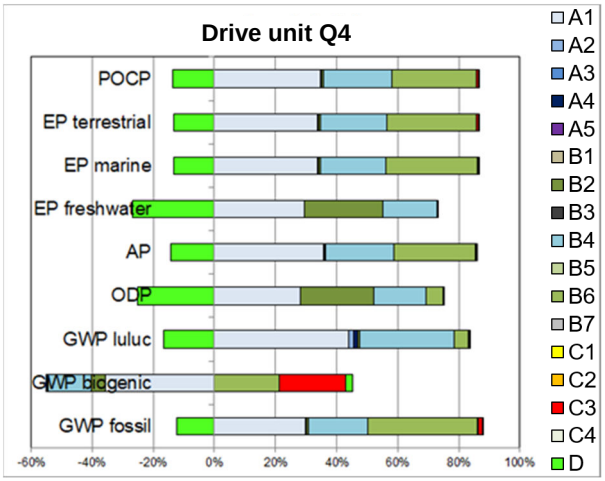


Illustration 4 Percentage of the modules in selected environmental impact indicators

Report

The LCA report 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 deposited with 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 and was carried out by the external verifier Susanne Volz, M.Sc. (Graduate Business Lawyer).

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 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.

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 15942:2012 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 ift "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 PCR documents “PCR Part A” PCR-A-0.3:2018 and "Windows, flat roof windows, rooflights and light bands" PCR-FE-3.0:2023 as well as EN 17213 „PCR for Windows and Doors.”

The European standard EN 15804 serves as the core PCR [a)]
Independent verification of the declaration and statement according to EN ISO 14025:2010
Independent third party verifier: [b)] Susanne Volz
[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	Person in charge	Verifier
1	04.12.2023	External verification	Pscherer	Volz
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9 Annex

Description of life cycle scenarios for Wooden roof window RotoQ

Table 11 Overview of applied life cycle stages

Product stage			Con-struction process stage		Use stage*							End-of-life stage				Benefits and loads beyond system boundaries
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw material supply	Transport	production	Transport	Construction/installation process	Use	maintenance	Repair	replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction/demolition	Transport	Waste processing	Disposal	Reuse Recovery Recycling potential
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

* For declared B-modules, the calculation of the results is performed taking into account the specified RSL related to one year

The scenarios were calculated taking into account the defined RSL (see 4 Use stage).

The scenarios were furthermore based on the research project “EPDs for transparent building components” (1) and on EN 17213 (2).

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.	Scenario	Description
A4.1	**Direct delivery Germany**	**40 t truck (Euro 0-6 mix), diesel, 27 t payload, full load[1] 180 km and 180 km return journey 25 % load[1]; total 360 km.**
A4.2	Small series via distributors	40 t truck (Euro 0-6 Mix), diesel, 27 t payload, full load[1] 150 km and 150 km return trip empty; 7.5 t truck (Euro 0-6 Mix), diesel, 2.7 t payload, 20 % load[1], 50 km one way and 50 km return trip empty. A total of 400 km.

[1] Capacity used: utilized loading capacity of the truck

A4 Transport to the construction site[2]	Transport weight [kg/m²]	Net density [kg/m³]	Thickness [mm]
PG 1: Q4 Wood double glazing	48.05	278.52	176.62
PG 2: Q4 Wood triple glazing	82.04	310.27	176.62
PG 3: Q4 Wood acoustic glazing	111.36	381.00	176.62
Drive unit Q4	2.38	--	--

[2] The volume utilization factor is not stated due to uncertain determination.

The scenarios were calculated per kg and can be scaled to the product group using the above masses. The values in the overall results table are shown per 1 m².

A4 Transport to construction site	Unit	A4.1	A4.2
Core indicators			
GWP-t	kg CO_2 equivalent	2.63E-02	0.19
GWP-f	kg CO_2 equivalent	2.65E-02	0.19
GWP-b	kg CO_2 equivalent	-3.66E-04	-2.63E-03
GWP-l	kg CO_2 equivalent	2.41E-04	1.74E-03
ODP	kg CFC-11-eq.	3.39E-15	2.44E-14
AP	mol H^+-eq.	3.17E-05	5.52E-04
EP-fw	kg P-eq.	9.52E-08	6.85E-07
EP-m	kg N-eq.	1.09E-05	2.47E-04
EP-t	mol N-eq.	1.28E-04	2.78E-03
POCP	kg NMVOC-eq.	2.78E-05	5.12E-04
ADPF	MJ	0.36	2.55
ADPE	kg Sb equivalent	1.72E-09	1.23E-08
WDP	m^3 world-eq. deprived	3.15E-04	2.27E-03
Resource management			
PERE	MJ	2.58E-02	0.19
PERM	MJ	0.00	0.00
PERT	MJ	2.58E-02	0.19
PENRE	MJ	0.36	2.56
PENRM	MJ	0.00	0.00
PENRT	MJ	0.36	2.56
SM	kg	0.00	0.00
RSF	MJ	0.00	0.00
NRSF	MJ	0.00	0.00
FW	m^3	2.83E-05	2.04E-04
Categories of waste			
HWD	kg	1.10E-12	7.94E-12
NHWD	kg	5.43E-05	3.91E-04
RWD	kg	6.67E-07	4.80E-06

Output material flows			
CRU	kg	0.00	0.00
MFR	kg	0.00	0.00
MER	kg	0.00	0.00
EEE	MJ	0.00	0.00
EET	MJ	0.00	0.00
Additional environmental impact indicators			
PM	Disease incidence	2.26E-10	4.11E-09
IRP	kBq U235-eq.	9.94E-05	7.15E-04
ETPfw	CTUe	0.25	1.81
HTPc	CTUh	5.16E-12	3.72E-11
HTPnc	CTUh	2.75E-10	2.16E-09
SQP	dimensionless	0.15	1.07

A5 Construction/Installation

No.	Scenario	Description
A5	**Manual**	**According to the manufacturer, the elements are installed without mechanical handling. Packaging materials are recycled.**

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

Ancillary materials, consumables, use of energy and water, other resource use, material losses, direct emissions as well as waste / output materials during construction / installation are negligible.

It is assumed that the packaging material in the Module construction / installation is sent to waste handling. Waste is only thermally recycled in line with the conservative approach: Benefits from A5 are specified in module D. Benefits from waste incineration: Benefits from waste incineration: electricity replaces electricity mix (RER); thermal energy replaces thermal energy from European natural gas (RER).
Transport to the recycling plants is not taken into account.

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

B1 Use

Test reports are available for the evaluation of emissions of volatile organic compounds according to ISO 16000. The following additional information is part of the life cycle assessment. The values result from a test over 28 days.

No.	Scenario	Description
B1	**Normal intended use**	**Release of substances (indoors or outdoors) into the indoor air. VOC emissions [µg/m³ (TVOC)]: 210.0**

Emissions to soil and water cannot be quantified. See EN 15804 Clause 5.4.4 and Clause 6.3.5.4.2. There are no horizontal standards with harmonized test methods.

Since this is a single scenario, the results are shown in the summary table. There, the results were related to one year, taking into account the reference service life.

B2 Cleaning, maintenance and repair

B2.1 Cleaning

No.	Scenario	Description
B2.1	**Rarely, manual**	**Height of less than 2.5 m or industrial climber, manually using suitable cleaning agents and, if necessary, an (extension) pole; annually. (2)** **2.5 l consumed per m² and cleaning (125 l / 50 yr). (1)**

Ancillary materials, consumables, use of energy and water, material losses and waste as well as transport distances during cleaning are negligible.

Since this is a single scenario, the results are shown in the summary table. There, the results were related to one year, taking into account the reference service life.

B2.2 Maintenance and repair

No.	Scenario	Description
B2.2	Lubrication: **Low utilisation** **(e.g. residential construction)**	**Biennially: Functional test, visual inspection, lubrication/greasing of the building hardware, checking for damage and carrying out maintenance work* if necessary. (2)** **0.125 kg lubricant per 50 years. (1)**
	Replacement of worn parts: **Normal use and heavy use**	**According to BBSR table:** **One-time replacement*: Hardware, glazing, sealing.** **According to EN 17213:** **One-time replacement*: Drive units. (2)**
	Surface treatment: **Glazing coating, softwood**	**Low resin, normal direct external exposure, every 10 years on the inside*. (1)**

* Assumptions for evaluation of possible environmental impacts; statements made do not constitute any guaranty or warranty of performance.

For updated information refer to the respective instructions for assembly/installation, operation and maintenance from Roto Frank DST Produktions-GmbH.

The service life of the Wooden roof window RotoQ of company Roto Frank DST Produktions-GmbH is specified as 40 years. For scenario B2, the respective components of the building elements whose useful life is less than the specified RSL are accounted for. The results were based on one year, taking into account the RSL.

It is assumed that the replaced components will be recycled in the maintenance module. Metals and glass into the melt (material recycling), plastics to incineration plants. Drive units are partially recycled, residual materials are sent to landfill (see recycling C3). Benefits from B3 are specified in module D. Benefits from waste incineration: Benefits from waste incineration: electricity replaces electricity mix (RER); thermal energy replaces thermal energy from European natural gas (RER).
Transport to the recycling plants is not taken into account.

Ancillary materials, consumables, use of energy and water, waste, material losses and transport distances during maintenance are negligible.

Since this is a single scenario, the results are shown in the summary table. The replacement of the drive units is shown in a separate overall results table. There, the results were related to one year, taking into account the reference service life.

B3 Repair (not relevant)

No.	Scenario	Description*
B3	**Normal use**	**As the installation location is unknown, the repair of accidental damage according to EN 17213 must not be taken into account.**

* Assumptions for evaluation of possible environmental impacts; statements made do not constitute any guaranty or warranty of performance.

For updated information refer to the relevant manufacturer instructions for assembly/installation, operation and maintenance

Ancillary materials, consumables, use of energy and water, waste, material losses and transport distances during maintenance are negligible.

Since this is a single scenario, the results are shown in the summary table. There, the results were related to one year, taking into account the reference service life.

B4 Exchange/replacement

No.	Scenario	Description
B4	**Normal, high and exceptional loads**	**One-time replacement after 40 years (RSL)*: The product-specific RSL of 25 years is taken into account for drive units. The environmental impacts of the selected scenario originate from the product, construction and disposal phases. Ancillary materials, consumables, use of energy and water, material losses, waste as well as transport distances are taken into account. (Addition of A modules, C modules and module D)**

*Assumptions for evaluation of possible environmental impacts; statements made do not constitute any guaranty or warranty of performance.

The statements made in this EPD are only informative to allow evaluation at the building level.

It is assumed that a one-time replacement will be necessary during the 40-year reference service life for windows according to BBSR table and/or 25-year reference service life for the drive units according to EN 17213 and the 50-year building service life.

For updated information refer to the relevant manufacturer “instructions for assembly/installation, operation and maintenance”.

Since this is a single scenario, the results are shown in the summary table. The replacement of the drive units and (electrical) components is shown in a separate overall results table. Results in the overall results tables were based on one year, taking into account the RSL.

Insofar as no replacement is planned, the selected scenario does not result in any relevant inputs/outputs or environmental impacts. Ancillary materials, consumables, use of energy and water, material losses, waste as well as transport distances are negligible.

B5 Improvement/modernisation (not relevant)
According to the manufacturer, the elements are not included in the improvement / modernisation activities for buildings.

For updated information refer to the respective instructions for assembly/installation, operation and maintenance of company Roto Frank DST Produktions-GmbH.

Ancillary materials, consumables, use of energy and water, material losses, waste as well as transport distances during replacement are negligible.

Since this is a single scenario, the results are shown in the summary table. There, the results were related to one year, taking into account the reference service life.

B6 Operational energy use

No.	Scenario	Description
B6.1	**Manual**	**No energy consumed when used.**
B6.2	Power-operated normal use	For window variants with drive unit, the energy consumption is taken into account as follows: per 40 years: 3.4 Wh/cycle, 1 cycle per day*. 49.07 kWh/RSL electricity (including standby mode) Electricity mix (RER). Worst case assumption via drive unit Q4 including all additional electrical system parts (control unit, sensors, buttons, etc.).

* Frequencies, times of use, number of users, cycles, etc. as specified by the manufacturer

There is no transport consumption for energy use in buildings. Ancillary materials, consumables and water, waste materials and other scenarios are negligible.

In the following table, the results were based on one year, taking into account the RSL.

B6 Operational energy use	Unit	B6.1	B6.2
Core indicators			
GWP-t	kg CO_2 equivalent	0.00	0.38
GWP-f	kg CO_2 equivalent	0.00	0.37
GWP-b	kg CO_2 equivalent	0.00	3.95E-03
GWP-l	kg CO_2 equivalent	0.00	4.18E-05
ODP	kg CFC-11-eq.	0.00	7.70E-12
AP	mol H^+-eq.	0.00	1.18E-03
EP-fw	kg P-eq.	0.00	1.58E-06
EP-m	kg N-eq.	0.00	2.04E-04

EP-t	mol N-eq.	0.00	2.14E-03
POCP	kg NMVOC-eq.	0.00	5.60E-04
ADPF	MJ	0.00	7.85
ADPE	kg Sb equivalent	0.00	7.60E-08
WDP	m³ world-eq. deprived	0.00	7.20E-02

Resource management			
PERE	MJ	0.00	5.40
PERM	MJ	0.00	0.00
PERT	MJ	0.00	5.40
PENRE	MJ	0.00	7.85
PENRM	MJ	0.00	0.00
PENRT	MJ	0.00	7.85
SM	kg	0.00	0.00
RSF	MJ	0.00	0.00
NRSF	MJ	0.00	0.00
FW	m³	0.00	2.38E-03
Categories of waste			
HWD	kg	0.00	-7.40E-10
NHWD	kg	0.00	7.08E-03
RWD	kg	0.00	1.24E-03
Output material flows			
CRU	kg	0.00	0.00
MFR	kg	0.00	0.00
MER	kg	0.00	0.00
EEE	MJ	0.00	0.00
EET	MJ	0.00	0.00
Additional environmental impact indicators			
PM	Disease incidence	0.00	1.04E-08
IRP	kBq U235-eq.	0.00	0.12
ETPfw	CTUe	0.00	3.18
HTPc	CTUh	0.00	1.39E-10
HTPnc	CTUh	0.00	2.93E-09
SQP	dimensionless	0.00	3.55

B7 Operational water use

No water consumption when used as intended. Water consumption for cleaning is specified in Module B2.1.

There is no transport consumption for water use in buildings. Ancillary materials, consumables, waste materials and other scenarios are negligible.

Since this is a single scenario, the results are shown in the summary table. There, the results were related to one year, taking into account the reference service life.

C1 Deconstruction

No.	Scenario	Description
C1	**Deconstruction**	**According to EN 17213 (Figure B.3) (2) Wooden roof window RotoQ: Deconstruction 95% for non-glass content Deconstruction 30% for glass Remainder to landfill.**

		The worst-case scenario is assumed for drive units: **Deconstruction 75%** **Remainder to landfill.** **Further deconstruction rates are possible, give adequate reasons.**

No relevant inputs or outputs apply to the scenario selected. The energy consumed for deconstruction is negligible. Any arising consumption is marginal.

In case of deviating consumption the removal of the products forms part of site management and is covered at the building level.

C2 Transport

No.	Scenario	Description
C2	**Transport**	**Transport to collection point using 40 t truck (Euro 0-6 Mix), Diesel, 27t payload, 80% capacity used[1], 50 km. (1)**

[1] Capacity used: utilized loading capacity of the truck

C2 Transport to recycling centre[2]	Transport weight [kg/m²]	Thickness [mm]
PG 1: Q4 Wood double glazing	36.79	176.62
PG 2: Q4 Wood triple glazing	44.31	176.62
PG 3: Q4 Wood acoustic glazing	55.90	176.62
Drive unit Q4	2.38	--

[2] The volume utilization factor is not stated due to uncertain determination.

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

C3 Waste management

No.	Scenario	Description
C3	**Current market situation**	**Share for recirculation of materials (2)** **Wooden roof window RotoQ:** • **100% metals in melt** • **100% glass in melt** • **Wood 100 % thermal recycling in incineration plant** • **Plastics 100% thermal recycling in incineration plant** **Drive units and (electrical) components** • **Electrical components (drive unit, circuit board, control unit, sensors, buttons, etc.) 87%** (based on waste electrical equipment 87%; UBA, 2018) • **100% metals in melt** • **Plastics 100% thermal recycling in incineration plants** • **Wood 100 % thermal recycling in incineration plant** • **Cardboard/paper 100 % thermal recycling in incineration plant** • **Remainder to landfill.**

Electricity consumption of recycling plant: 1.8 kWh/product.

As the products are placed on the European market, the disposal scenario is based on average European data sets.

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.

C3 Disposal window variants	Unit	C3		
		PG 1	PG 2	PG 3
Collection process, collected separately	kg	21.18	23.54	28.06
Collection process, collected as mixed construction waste	kg	15.60	20.77	27.84
Recovery system, for re-use	kg	0.00	0.00	0.00
Recovery system, for recycling	kg	10.49	12.62	15.61
Recovery system, for energy recovery	kg	10.69	10.92	12.45
Disposal	kg	15.60	20.77	27.84

The 100 % scenarios differ from today's average utilization (in background report C3.1). The evaluation of each scenario is described in the background report.

For the separate presentation of drive units including electrical components, only the current market situation is shown.

C3 Disposal Drive Unit Q4	Unit	C3
Collection process, collected separately	kg	1.79
Collection process, collected as mixed construction waste	kg	0.60
Recovery system, for re-use	kg	0.00
Recovery system, for recycling	kg	1.37
Recovery system, for energy recovery	kg	0.30
Disposal	kg	0.71

Since this is a single scenario, the results are shown in the corresponding overall results tables. There, the results were related to one year, taking into account the reference service life.

C4 Disposal

No.	Scenario	Description
C4	**Disposal**	**The non-recordable amounts and losses within the re-use/recycling chain (C1 and C3) are modelled as “disposed” (RER).**

The 100% scenarios differ from the current average recovery shown here (in background report C4.1). The evaluation of each scenario is described in the background report.

The consumption in scenario C4 results from physical pre-treatment, waste recycling and management 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.

For the separate presentation of drive units including electrical components, only the current market situation is shown. Since this is a single scenario, the results are shown in the overall results table. There, the results were related to one year, taking into account the reference service life.

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

D Benefits and loads from beyond the system boundaries

No.	Scenario	Description
D	**Recycling potential (current market situation)**	**Aluminum scrap from C3 excluding the scrap used in A3 replaces 60% of Aluminum ingots; Steel scrap from C3 excluding the scrap used in A3 replaces 60% of steel; Stainless steel scrap from C3 excluding the scrap used in A3 replaces 60% of stainless steel; Glass recyclate from C3 excluding the glass shards used in A3 replace 60% of container glass; Electrical scrap from C3 excluding the scrap used in A3 replaces 60% of the respective electrical component.** **Benefits from incineration plant: Benefits from waste incineration: electricity replaces electricity mix (RER); thermal energy replaces thermal energy from European natural gas (RER).**

The values in Module D result from recycling of the packaging material in Module A5 and from deconstruction at the end of service life.

The 100% scenarios differ from the current average recovery shown here (in background report D1). The evaluation of each scenario is described in the background report.

For the separate presentation of drive units including electrical components, only the current market situation is shown. Since this is a single scenario, the results are shown in the overall results table. There, the results were related to one year, taking into account the reference service life.

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

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