

To whom it may concern,

Based on the Product Category Rules Requirements on the Environmental Product Declarations (EPD) for Windows and Doors, version 1.4: 2021, VELUX has created separate EPDs for the windows and the electrical motors/devices connected to the windows.

This documentation has been prepared to facilitate the consolidation of two EPDs to accommodate the electric and solar roof window variants as single units.

The provided kg CO₂ eq./m² values represent the cumulative values derived from the relevant EPDs outlined in subsequent sections.

It should be noted that the scaling factor also includes the weight of the motor. However, in reality, the motor does not scale in the same way as the window. Testing has shown that this does not significantly affect the CO₂ results.

A handwritten signature in blue ink that reads "Ugne Krikstanaite".

Ugne Krikstanaite

Market Sustainability Specialist
Standardization & Technical Performance
VELUX A/S
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ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804+A2

Owner of the Declaration	VELUX Group
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-VEL-20220032-CBE4-EN
Issue date	24.05.2022
Valid to	23.05.2027

VELUX PUR roof windows (62 triple glazing configuration)
VELUX Group

www.ibu-epd.com | <https://epd-online.com>



General Information**VELUX Group****Programme holder**

IBU – Institut Bauen und Umwelt e.V.
Hegelplatz 1
10117 Berlin
Germany

Declaration number

EPD-VEL-20220032-CBE4-EN

This declaration is based on the product category rules:

Windows and doors , 01.08.2021
(PCR checked and approved by the SVR)

Issue date

24.05.2022

Valid to

23.05.2027



Dipl.-Ing. Hans Peters
(Chairman of Institut Bauen und Umwelt e.V.)



Florian Pronold
(Managing Director Institut Bauen und Umwelt e.V.)

VELUX PUR roof windows (62 triple glazing configuration)**Owner of the declaration**

VELUX Group
Ådalsvej 99
2970 Hørsholm
Denmark

Declared product / declared unit

The declared unit is a PUR roof window of one square meter (m²) with the triple glazing configuration 62.
The declared unit is based on the configuration of a standard size window measuring 1.23 m * 1.48 m.

Scope:

The EPD is a representative EPD covering VELUX PUR roof windows as specified in more detail in the product description. The products are manufactured by the VELUX Group at production sites in different locations in Europe for sale throughout Europe.

The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.

The EPD was created according to the specifications of EN 15804+A2. In the following, the standard will be simplified as *EN 15804*.

Verification

The standard EN 15804 serves as the core PCR	
Independent verification of the declaration and data according to ISO 14025:2011	
<input type="checkbox"/>	internally
<input checked="" type="checkbox"/>	externally



Juliane Franze,
(Independent verifier)

Product






Product description/Product definition

The VELUX polyurethane (PUR) roof windows are skylight window products for sale in the European market. The product family covers a range of product varieties as specified in the table on page 3. All the windows have a PUR frame/sash with a wooden core. Some windows can be opened (venting), while others cannot be opened (fixed). Some of the window varieties can be used in conjunction with electronic devices for automatic opening and closing, while other windows are opened and closed manually. The calculations are based on the representative window type named GPU. In the LCA, the GPU

was assessed to be a conservative choice for a representative window type.

The glass panes are with triple glazing configuration 62 with a glass thickness of 17 mm. The glass panes have cavities filled with Krypton gas.

Only the window modules are included, which means that any applied electronics, additional equipment, engines etc. are not part of the EPD.

Window type			Description
GPU		GPU -K-- -0--	White lacquered top-hung window with manual bottom operation, ventilation flap and integrated handlebar along the top sash and pivot-hinge for cleaning.
GGU		GGU -K-- -0--	White lacquered pivot-hinged window with manual top operation and ventilation flap with integrated handlebar along the top sash.
GGU Integra Mains		GGU -K-- -0--21	White lacquered GGU window with remote operation – mains motor.
VIU		VIU -K-- -0--	White lacquered vertical extension fixed window.
GIU		GIU -K-- -0--	White lacquered sloped extension fixed window.

For the placing on the market of the product in the European Union/European Free Trade Association (EU/EFTA) (with the exception of Switzerland) Regulation (EU) No. 305/2011 (CPR) applies. The product needs a declaration of performance taking into consideration *EN 14351-1:2006+A2:2016*, Windows and doors - Product standard, performance characteristics - Part 1: Windows and external pedestrian doorsets. For the application and use, the respective national provisions apply.

specific values can be selected at the bottom of the above-mentioned download page.

Constructional data (Reference product GPU incl. pane variant 62. For other variation, see velux.com/ce)

Application

VELUX PUR roof windows are used in renovation and new build. Either installed as a single window or in a combination of multiple windows.

Technical Data

The Declaration of Performance including relevant technical specifications and test methods/test standards can be downloaded from the website www.velux.com/ce.

The performance values are specific for each PUR roof window variant covered by the EPD.

The declared values in the table relate to the reference product incl. an average pane. For other covered product variants,

Name	Value	Unit
Fire resistance class § 4.4.1	D-s2.d2	class
Air permeability , § 4.14	4	class
Resistance to wind load, § 4.2 (for window width >1140 mm or height > 1398 mm no performance is determined)	C3	class
Resistance to snow loads, § 4.3	8 mm toughened - 11 mm - 3 mm heat strengthened - 11 mm - 6.8 mm laminated float	mm
Watertightness, § 4.5	E900	class
Impact resistance, § 4.7 (for window width <550 mm or height <778 mm no performance is determined)	3	class
Load-bearing capacity of safety devices, § 4.8	test is passed	-
Acoustic performance, § 4.11	42 (-2; -5)	-
Thermal transmittance, § 4.12 , 90 degree installation acc. to EN 10077-1/2	0,96	W/(m ² K)
Solar factor, § 4.13	0.47	-
Light transmittance, § 4.13	0.68	-

Product performance data in accordance with *DS/EN 14351-*

1:2006+A2:2016, Windows and doors - Product standard, performance characteristics - Part 1: Windows and external pedestrian doorsets.

Base materials/Ancillary materials

Name	Value	Unit
Glazing unit	57	%
PUR/wooden frame	20	%
Galvanized steel components	15	%
Other materials	8	%

This product/article/at least one partial article contains substances listed in the *candidate list* (date: 07.03.2022) exceeding 0.1 percentage by mass: **NO**.

Recycled content

Name	Value	Unit
Glass	12	%
Others	0	%

The values stated in the table relate to the recycled material streams in VELUX production.

Reference service life

No reference service life (RSL) is defined for the roof windows because the use stage modules are not included in the EPD.

LCA: Calculation rules

Declared Unit

Multiple product dimensions are represented by this EPD as specified in the product description.

The declared unit is 1 m² window calculated based on one representative window module measuring 1.23 m * 1.48 m (reference window based on *EN 14351-1*) with triple glazed window panes.

Declared unit

Name	Value	Unit
conversion factor	57.7	-
Declared unit	1	m ²

A data quality and a sensitivity analysis show that the results are robust with regard to data quality and appropriateness. There is low variability of production processes and product variations have a limited influence on the results.

System boundary

Type of EPD: Cradle to gate - with options. The following life cycle phases were considered:

Product stage:

- A1 - Raw material supply: extraction and processing, production of the pre-products (e.g. laminated glass, brackets, sealant...) and packaging components (primarily cardboard)
- A2 - Transport: Transport of pre-products and packaging components to the manufacturing sites
- A3 - Manufacturing: The PUR profiles and the panes are produced internally at VELUX production sites. Subsequently, the final production and assembly of the

windows take place, which involves shortening of profiles, drilling of holes, clamping and glueing, mounting of gaskets, brackets, panes etc. as well as stacking on pallets.

End of life stage:

- C1 - De-construction/demolition: de-construction of the window with the use of an electric screwdriver
 - C2 - Transport: transport of window materials to incineration and recycling
 - C3 - Waste processing: sorting of glass waste, incineration of plastic and rubber parts
 - C4 - Disposal: disposal of all materials
- Benefits and loads beyond the system boundaries:

- D - Reuse, recovery and recycling potential: benefits from plastic incineration processes and material recycling of metal and glass.

Geographic Representativeness

Land or region, in which the declared product system is manufactured, used or handled at the end of the product's lifespan: Europe

Comparability

Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to *EN 15804* and the building context, respectively the product-specific characteristics of performance, are taken into account.

LCA: Scenarios and additional technical information

Characteristic product properties of biogenic carbon

6.9 kg of wood is used in the core window frames and 3.1 kg of cardboard packaging is used per declared unit.

Information describing the biogenic Carbon Content at factory gate

Name	Value	Unit
Biogenic carbon content in product	3.6	kg C
Biogenic carbon content in accompanying packaging	2.5	kg C

Note: 1 kg of biogenic carbon is equivalent to 44/12 kg of CO₂.

The construction process stage and the use stage modules are not declared. However, the quantity of packaging generated in module A5 is declared as scenario information.

Installation into the building (A5)

Name	Value	Unit
Cardboard packaging for waste treatment	3.1	kg
Plastic packaging (primarily EPS) for waste treatment	0.3	kg

End of life (C1-C4)

Name	Value	Unit
Collected as mixed construction waste	58	kg
Recycling	21	kg
Energy recovery	13	kg
Landfilling	24	kg

Reuse, recovery and/or recycling potentials (D), relevant scenario information

The recycling efficiency for all materials is maximum 90 % in accordance with EN 17213. This means that only 90 % of the recycled materials substitute primary materials. Secondary materials in the windows do not substitute primary materials in the end-of-life scenario. The recycled glass is used as container glass in the end-of-life scenario.

Name	Value	Unit
Glass recycled	30	%
Metal recycled	95	%
Plastic incinerated with energy recovery	95	%

LCA: Results

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE OR INDICATOR NOT DECLARED; MNR = MODULE NOT RELEVANT)

Product stage			Construction process stage		Use stage							End of life stage				Benefits and loads beyond the system boundaries
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MND	MND	MND	MND	MNR	MNR	MNR	MND	MND	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 m2 Roof windows with triple glazing

Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
GWP-total	kg CO ₂ eq	1.7E+02	3.84E+00	1.57E+01	1.84E-03	1.63E-01	2.73E+01	1.23E+00	-4.04E+01
GWP-fossil	kg CO ₂ eq	1.88E+02	3.82E+00	1.31E+01	1.82E-03	1.62E-01	1.5E+01	4.8E-01	-4.03E+01
GWP-biogenic	kg CO ₂ eq	-1.81E+01	-4.86E-03	2.52E+00	1.55E-05	-2.06E-04	1.24E+01	7.49E-01	-7.29E-02
GWP-luluc	kg CO ₂ eq	1.3E-01	3.12E-02	1.85E-02	2.58E-06	1.33E-03	6.44E-04	1.66E-03	-1.52E-02
ODP	kg CFC11 eq	5.7E-06	4.87E-16	6.46E-11	4.36E-17	2.07E-17	9.46E-09	1.51E-15	-1.13E-13
AP	mol H ⁺ eq	8.3E-01	1.23E-02	3.94E-02	3.79E-06	5.21E-04	5.07E-03	2.98E-03	-1.44E-01
EP-freshwater	kg P eq	1.49E-02	1.13E-05	1.36E-04	4.88E-09	4.8E-07	2.34E-05	7.49E-06	-2.54E-05
EP-marine	kg N eq	1.54E-01	5.66E-03	1.25E-02	9E-07	2.4E-04	1.78E-03	8.42E-04	-3.14E-02
EP-terrestrial	mol N eq	1.75E+00	6.32E-02	1.27E-01	9.44E-06	2.69E-03	2.45E-02	9.14E-03	-3.48E-01
POCP	kg NMVOC eq	4.68E-01	1.1E-02	3.41E-02	2.44E-06	4.69E-04	4.84E-03	2.62E-03	-8.23E-02
ADPE	kg Sb eq	2.55E-03	2.9E-07	3.88E-06	5.35E-10	1.23E-08	3.37E-07	4.24E-08	-2.4E-05
ADPF	MJ	2.81E+03	5.07E+01	2.03E+02	3.24E-02	2.15E+00	8.94E+00	6.42E+00	-5.18E+02
WDP	m ³ world eq deprived	2.05E+01	3.31E-02	1.25E+00	2.92E-04	1.41E-03	2.83E+00	4.08E-02	-2.65E+00

GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources; WDP = Water (user) deprivation potential

RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A2: 1 m2 Roof windows with triple glazing

Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
PERE	MJ	2.77E+02	2.83E+00	1.04E+02	1.49E-02	1.2E-01	1.15E+02	7.39E-01	-9.69E+01
PERM	MJ	1.22E+02	0	6.21E+01	0	0	-1.14E+02	0	0
PERT	MJ	3.99E+02	2.83E+00	1.66E+02	1.49E-02	1.2E-01	1.68E+00	7.39E-01	-9.69E+01
PENRE	MJ	2.56E+03	5.08E+01	1.89E+02	3.24E-02	2.16E+00	1.48E+02	6.42E+00	-5.2E+02
PENRM	MJ	2.52E+02	0	1.44E+01	0	0	-1.4E+02	0	0
PENRT	MJ	2.81E+03	5.08E+01	2.03E+02	3.24E-02	2.16E+00	8.95E+00	6.42E+00	-5.2E+02
SM	kg	7.49E+00	0	1.37E-03	0	0	0	0	0
RSF	MJ	0	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0	0
FW	m ³	9.22E-01	3.24E-03	7.95E-02	1.45E-05	1.38E-04	6.67E-02	1.29E-03	-2.08E-01

PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; 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 = Use of net fresh water

RESULTS OF THE LCA - WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A2: 1 m2 Roof windows with triple glazing

Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
HWD	kg	4.71E-03	2.56E-09	2.73E-04	8.56E-12	1.09E-10	1.45E-09	6.88E-10	-6.46E-08
NHWD	kg	5.94E+00	7.54E-03	5.03E-01	2.3E-05	3.2E-04	2.57E+01	2.39E+01	-3.63E+00
RWD	kg	4.02E-02	6.14E-05	1.61E-02	4.82E-06	2.61E-06	3.5E-04	5.94E-05	-2.25E-02
CRU	kg	0	0	0	0	0	0	0	0
MFR	kg	3.52E-02	0	2E+00	0	0	2E+01	0	0
MER	kg	0	0	0	0	0	1.27E+01	0	0
EEE	MJ	5.38E-02	0	0	0	0	0	0	4.99E+01
EET	MJ	7.85E-02	0	0	0	0	0	0	9.07E+01

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 OF THE LCA – additional impact categories according to EN 15804+A2-optional: 1 m² Roof windows with triple glazing

Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
PM	Disease incidence	9.24E-06	6.62E-08	4.5E-07	3.19E-11	2.81E-09	4.05E-08	3.47E-08	-1.37E-06
IR	kBq U235 eq	1.12E+01	8.79E-03	1.9E+00	7.91E-04	3.74E-04	6.21E-02	6.64E-03	-4.08E+00
ETP-fw	CTUe	3.97E+03	3.66E+01	1.22E+02	1.36E-02	1.56E+00	5.36E+00	4.28E+00	-2.34E+02
HTP-c	CTUh	1.26E-06	7.39E-10	6.14E-09	3.86E-13	3.14E-11	3.06E-10	4.4E-10	-2.78E-08
HTP-nc	CTUh	3.4E-06	4.35E-08	5.52E-07	1.45E-11	1.85E-09	2.31E-08	4.78E-08	-3.21E-07
SQP	SQP	1.69E+03	1.74E+01	8.34E+02	1.02E-02	7.4E-01	3.37E+00	1.32E+00	-3.59E+01

PM = Potential incidence of disease due to PM emissions; IR = Potential Human exposure efficiency relative to U235; ETP-fw = Potential comparative Toxic Unit for ecosystems; HTP-c = Potential comparative Toxic Unit for humans (cancerogenic); HTP-nc = Potential comparative Toxic Unit for humans (not cancerogenic); SQP = Potential soil quality index

Disclaimer 1 – for the indicator IRP. 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 or radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, radon and (from) some construction materials is also not measured by this indicator.

Disclaimer 2 – for the indicators ADPE, ADPF, WDP, ETP-fw, HTP-c, HTP-nc, SQP. 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.

References

IBU PCR Part A

IBU PCR Part A: Institut Bauen und Umwelt e.V., Product Category Rules for Building-Related Products and Services. Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report according to EN 15804+A2:2019.

IBU PCR Part B

IBU PCR Part B: Institut Bauen und Umwelt e.V., Requirements on the EPD for Windows and doors, version 1.4: 2021.

IBU 2021

IBU 2021 Institut Bauen und Umwelt e.V.: General Instructions for the EPD programme of Institut Bauen und Umwelt e.V. Version 2.0, Berlin: Institut Bauen und Umwelt e.V., 2021. www.ibu-epd.com.

EN 13501-1

EN 13501-1 EN13501-1, 2018: Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests.

ISO 14025

DIN EN ISO 14025:2011-10, Environmental labels and declarations - Type III environmental declarations - Principles and procedures.

EN 14351-1

EN 14351-1:2006+A2:2016, Windows and doors - Product standard, performance characteristics - Part 1: Windows and external pedestrian doorsets.

EN 15804

EN 15804+A2+AC:2021, Sustainability of construction works - Environmental Product Declarations - Core rules for the product category of construction products.

EN 17213

EN 17213:2020, Windows and doors – Environmental Product Declarations – Product category rules for windows and pedestrian doorsets.

Candidate list

ECHA Candidate list of substances of very high concern, status 07.03.2022.

ISO 10077-1

ISO 10077-1:2017, Thermal performance of windows, doors and shutters - Calculation of thermal transmittance - Part 1: General.

ISO 10077-2

ISO 10077-2:2017, Thermal performance of windows, doors and shutters - Calculation of thermal transmittance - Part 2: Numerical method for frames.

GaBi LCA software and database

The LCA modelling software is GaBi program version 9.5.2.49 with corresponding databases from Sphera Solutions GmbH. Documentation hyperlink www.gabi-software.com/support/gabi.



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ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804+A2

Owner of the Declaration	VELUX Group
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-VEL-20230051-IBA2-EN
Issue date	11.05.2023
Valid to	10.05.2028

**Window operator for VELUX pivot hinged windows (KMG 100K)
and control system (KUX 110), mains connected
VELUX Group**

www.ibu-epd.com | <https://epd-online.com>



General Information**VELUX Group****Programme holder**

IBU – Institut Bauen und Umwelt e.V.
Hegelplatz 1
10117 Berlin
Germany

Declaration number

EPD-VEL-20230051-IBA2-EN

This declaration is based on the product category rules:

Drive systems for automatic doors and gates, 01.08.2021
(PCR checked and approved by the SVR)

Issue date

11.05.2023

Valid to

10.05.2028



Dipl.-Ing. Hans Peters
(Chairman of Institut Bauen und Umwelt e.V.)



Florian Pronold
(Managing Director Institut Bauen und Umwelt e.V.)

Window operator for VELUX pivot hinged windows (KMG 100K) and control system (KUX 110), mains connected**Owner of the declaration**

VELUX Group
Ådalsvej 99
2970 Hørsholm
Denmark

Declared product / declared unit

The declared unit is one piece of electrical window operator.

Scope:

The EPD is a specific EPD covering VELUX electrical window operator for the mains connected pivot hinged windows. The operator consists of a chain operator, a rain sensor, a control system and a remote. The products are manufactured by the VELUX Group at a production site in the Czech Republic.

The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.

The EPD was created according to the specifications of EN 15804+A2. In the following, the standard will be simplified as *EN 15804*.

Verification

The standard EN 15804 serves as the core PCR	
Independent verification of the declaration and data according to ISO 14025:2011	
<input type="checkbox"/>	internally
<input checked="" type="checkbox"/>	externally



Dr.-Ing. Nikolay Minkov,
(Independent verifier)

Product

Product description/Product definition

EPD covering VELUX electrical window operator for the mains connected pivot hinged windows. The operator consists of a chain operator, a rain sensor, a control system and a remote. The products are manufactured by the VELUX Group at a production site in the Czech Republic.

For the placing on the market of the product in the European Union/European Free Trade Association (EU/EFTA) (with the exception of Switzerland) *Regulation (EU) No. 305/2011 (CPR)* applies. The products are in compliance with the *Machinery Directive 2006/42/EC*, the *Radio Equipment Directive 2014/53/EU* and the *RoHS Directive 2011/65/EU*. A declaration of conformity is available from the manufacturer.

Application

The VELUX electrical window operator is sold separately for retrofitting.

Technical Data

The CE marking for electrical window operators does not specify the need for a Declaration of Performance. Instead, a Declaration of Conformity is required.

The performance values relevant for the product are specified in the table below.

Constructional data

Name	Value	Unit
Protection class	IP 44	class
Voltage	230	V

Base materials/Ancillary materials

Product content

Name	Value	Unit
Other plastic components	34	%
Cables	20	%
Other metal components	16	%
PCBA	6	%
Motor	4	%
Battery	1	%
Other (butyl sealant, epoxy, paper)	18	%

Packaging materials include 0,46 kg cardboard and paper, 0,14 kg polystyren (EPS) and 0,03 kg low density polyethylen (LDPE) per declared unit.

This product/article/at least one partial article contains substances listed in the *candidate list* (date: 08.06.2022) exceeding 0.1 percentage by mass: **NO**.

Reference service life

No reference service life (RSL) is defined for the operators as the use stage modules are not included in the EPD. There is no generally acknowledged or common way to assess the RSL for this type of product. Furthermore, the lifetime of the products depends greatly on the use pattern and environmental conditions in use, which differs for different users and which is difficult to predict at the time of sale.

LCA: Calculation rules

Declared Unit

The declared unit is one piece. This corresponds to an electrical window operator system, including a chain operator, a control system, a rain sensor and a remote.

Name	Value	Unit
Declared unit	1	pce.
Weight	1,93	kg
Conversion factor to kg	0,52	-

Other declared units are allowed if the conversion is shown transparently.

A data quality and a sensitivity analysis show that the results are robust with regard to data quality and appropriateness. There is low variability of production processes and product variations have a limited influence on the results.

System boundary

Type of EPD:

Cradle to gate - with options. The following life cycle phases were considered:

Product stage:

A1 - Raw material supply: extraction and processing, production of the pre-products (e.g. motor suspension, PCB, battery...). Production of packaging: cardboard boxes, paper labels, EPS and plastic film.

A2 - Transport: Transport of pre-products and packaging components to the manufacturing sites.

A3 - Manufacturing: The products are produced/assembled at the VELUX production site, where the finished window operator is ready for shipment.

End of life stage:

C1 - De-construction/demolition: de-construction of the product with the use of manual hand tools.

C2 - Transport: transport of the product to waste treatment including to and from sorting and shredding facilities.

C3 - Waste processing: includes sorting, shredding, incineration and recycling processes.

C4 - Disposal: disposal of all materials

Benefits and loads beyond the system boundaries:

D - Reuse, recovery and recycling potential: benefits from plastic incineration processes and material recycling. End of life includes all activities from when the product reaches the end of its service life and no longer provides any functionality until all materials and components are processed for reuse/recycling/energy recovery or are disposed of.

The applied end-of-life scenario follows the requirements in the PCR Part A, chapter 6.2 regarding complex products, with a combination of recycling, thermal waste treatment and landfilling. 100% of the material is considered in the end-of-life scenario. Generally metals, cables, batteries and polychlorinated biphenyl (PCB)'s are recycled, plastic parts are incinerated with energy recovery and magnets are landfilled.

Geographic Representativeness

Land or region, in which the declared product system is manufactured, used or handled at the end of the product's lifespan: Europe

Comparability

Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to *EN 15804* and the building context, respectively the product-specific characteristics of performance, are taken into account. The used background software and database is *GaBi (DB version 2021.2)*

LCA: Scenarios and additional technical information

Characteristic product properties of biogenic carbon

The product does not contain biogenic carbon.

Information on describing the biogenic Carbon Content at factory gate

Name	Value	Unit
Biogenic carbon content in product	-	kg C
Biogenic carbon content in accompanying packaging	0.37	kg C

Assembly (A5)

Name	Value	Unit
Cardboard for recycling	0.46	kg
EPS packaging for incineration	0.14	kg
Plastic packaging for incineration (LDPE)	0.03	kg

No Reference Service Life (RFL) is declared, because the use stage modules are not declared.

End of life (C1-C4)

Name	Value	Unit
Collected separately waste type Electronics	1.9	kg
Recycling	0.89	kg
Energy recovery	1.01	kg
Landfilling	0.03	kg

Reuse, recovery and/or recycling potentials (D), relevant scenario information

Name	Value	Unit
Replaced materials	0.18	kg
Replaced thermal energy	4.8	MJ
Replaced electricity	2.6	MJ

LCA: Results

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE OR INDICATOR NOT DECLARED; MNR = MODULE NOT RELEVANT)

Product stage			Construction process stage		Use stage							End of life stage				Benefits and loads beyond the system boundaries
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MND	MND	MND	MND	MNR	MNR	MNR	MND	MND	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 pcs window operator

Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
GWP-total	kg CO ₂ eq	1.15E+01	4.49E-01	7.33E-01	0	8.85E-03	1.67E+00	1.47E-05	-1.36E+00
GWP-fossil	kg CO ₂ eq	1.16E+01	4.48E-01	1.36E+00	0	8.79E-03	1.67E+00	1.51E-05	-1.36E+00
GWP-biogenic	kg CO ₂ eq	-1.32E-01	1.89E-04	-6.28E-01	0	-1.12E-05	1.28E-03	-4.39E-07	-5.41E-04
GWP-luluc	kg CO ₂ eq	1.62E-02	1.25E-03	1.19E-03	0	7.19E-05	1.79E-04	4.44E-08	-1.54E-03
ODP	kg CFC11 eq	1.37E-09	4.98E-17	1.95E-11	0	1.12E-18	6.17E-09	5.88E-20	-8.13E-15
AP	mol H ⁺ eq	5.13E-02	1.13E-02	4.07E-03	0	2.75E-05	1.9E-03	1.08E-07	-4.21E-03
EP-freshwater	kg P eq	1.59E-04	5.16E-07	1.56E-05	0	2.61E-08	1.03E-05	2.54E-11	-1.36E-06
EP-marine	kg N eq	8.78E-03	3.09E-03	1.29E-03	0	1.26E-05	8.79E-04	2.8E-08	-7.15E-04
EP-terrestrial	mol N eq	9.27E-02	3.39E-02	1.31E-02	0	1.41E-04	9.69E-03	3.07E-07	-7.7E-03
POCP	kg NMVOC eq	2.77E-02	8.46E-03	3.78E-03	0	2.47E-05	2.25E-03	8.47E-08	-2.13E-03
ADPE	kg Sb eq	8.84E-04	2.04E-08	2.01E-07	0	6.69E-10	2.08E-07	1.43E-12	-4.03E-05
ADPF	MJ	1.77E+02	5.6E+00	2.73E+01	0	1.17E-01	2.48E+00	2.01E-04	-1.9E+01
WDP	m ³ world eq deprived	4.88E+00	1.77E-03	1.67E-01	0	7.63E-05	5.03E-01	1.62E-06	-2.7E-01

GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources; WDP = Water (user) deprivation potential

RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A2: 1 pcs window operator

Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
PERE	MJ	2.94E+01	1.25E-01	1.73E+01	0	6.53E-03	7.77E-01	2.7E-05	-4.05E+00
PERM	MJ	0	0	0	0	0	0	0	0
PERT	MJ	2.94E+01	1.25E-01	1.73E+01	0	6.53E-03	7.77E-01	2.7E-05	-4.05E+00
PENRE	MJ	1.53E+02	5.61E+00	1.91E+01	0	1.17E-01	2.01E+01	2.01E-04	-1.9E+01
PENRM	MJ	2.33E+01	0	8.24E+00	0	0	-1.76E+01	0	0
PENRT	MJ	1.77E+02	5.61E+00	2.73E+01	0	1.17E-01	2.48E+00	2.01E-04	-1.9E+01
SM	kg	1.79E-01	0	0	0	0	0	0	0
RSF	MJ	0	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0	0
FW	m ³	1.29E-01	1.49E-04	7.85E-03	0	7.47E-06	1.21E-02	4.95E-08	-1.13E-02

PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; 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 = Use of net fresh water

RESULTS OF THE LCA - WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A2:

1 pcs window operator

Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
HWD	kg	2.58E-04	1.3E-10	1.35E-04	0	5.9E-12	5.5E-10	2.13E-14	-2.97E-09
NHWD	kg	6.17E-01	6.6E-04	3.61E-02	0	1.74E-05	1.23E-01	1E-03	-5.13E-02
RWD	kg	3.17E-03	6.43E-06	1.33E-03	0	1.42E-07	2.29E-04	2.11E-09	-9.03E-04
CRU	kg	0	0	0	0	0	0	0	0
MFR	kg	0	0	0	0	0	6.96E-01	0	0
MER	kg	0	0	0	0	0	6.71E-01	0	0
EEE	MJ	0	0	0	0	0	0	0	2.63E+00
EET	MJ	0	0	0	0	0	0	0	4.75E+00

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 OF THE LCA – additional impact categories according to EN 15804+A2-optional:

1 pcs window operator

Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
PM	Disease incidence	6.66E+01	3.94E+00	9.61E+00	0	8.21E-02	9.99E+00	1.07E-04	-4.29E+00
IR	kBq U235 eq	3.58E+01	6.94E-02	2.41E+01	0	1.59E-03	1.57E+00	6.15E-06	-1.91E+00
ETP-fw	CTUe	4.36E-01	3.58E-02	8.08E-02	0	7.89E-04	5.79E-02	8.69E-07	-4.31E-02
HTP-c	CTUh	2.85E-19	1.33E-21	5.91E-20	0	2.93E-23	5.92E-20	1.85E-25	-2.53E-19
HTP-nc	CTUh	3.83E-09	7.6E-11	1.96E-10	0	1.67E-12	7.89E-10	1.64E-14	-8.92E-10
SQP	SQP	7.45E-08	1.71E-12	9.33E-11	0	3.9E-14	2.74E-11	4.93E-16	-3.85E-10

PM = Potential incidence of disease due to PM emissions; IR = Potential Human exposure efficiency relative to U235; ETP-fw = Potential comparative Toxic Unit for ecosystems; HTP-c = Potential comparative Toxic Unit for humans (cancerogenic); HTP-nc = Potential comparative Toxic Unit for humans (not cancerogenic); SQP = Potential soil quality index

Disclaimer 1 – for the indicator 'Potential Human exposure efficiency relative to U235'. 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 or radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, radon and from some construction materials is also not measured by this indicator.

Disclaimer 2 – for the indicators 'abiotic depletion potential for non-fossil resources', 'abiotic depletion potential for fossil resources', 'water (user) deprivation potential, deprivation-weighted water consumption', 'potential comparative toxic unit for ecosystems', 'potential comparative toxic unit for humans – cancerogenic', 'Potential comparative toxic unit for humans - not cancerogenic', 'potential soil quality index'. The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high as there is limited experience with the indicator.

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Directive 2006/42/EC

DIRECTIVE 2006/42/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 May 2006 on machinery.

Candidate list

Candidate List of substances of very high concern for Authorisation, 08.06.2022.

GaBi LCA software and database

The LCA modelling software is GaBi program version 10.5.1.124 with corresponding databases from Sphera Solutions GmbH. Documentation hyperlink www.gabi-software.com/support/gabi.





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