ENVIRONMENTAL PRODUCT DECLARATION

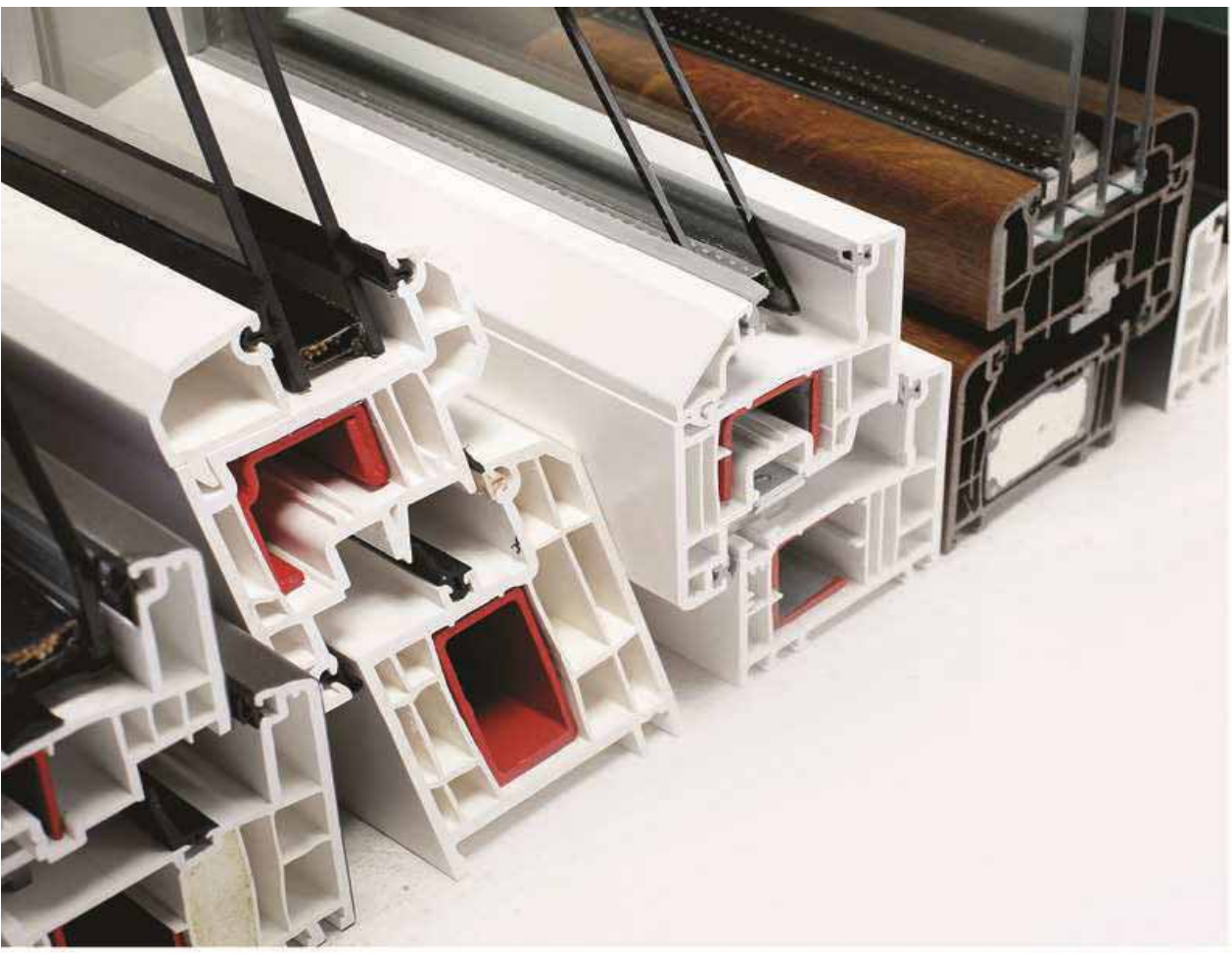
as per ISO 14025 and EN 15804

Owner of the Declaration	QKE Qualitätsverband Kunststofferzeugnisse e.V. EPPA European PVC Window Profiles and Related Building Products Association ivzw
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
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PVC-U plastic windows
with the dimensions 1.23 x 1.48 m
and insolated double-glazing
QKE e.V.
EPPA ivzw

www.bau-umwelt.com / https://epd-online.com

Institut Bauen und Umwelt e.V.



ECO PLATFORM EPD EN 15804 VERIFIED



Presented by

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EPPA

QUALITÄTSVERBAND KUNSTSTOFFERZEUGNISSE E.V.
FÜR LANGLEBIGE KUNSTSTOFFPRODUKTE

1. General Information

QKE - EPPA

Window (1.23 m x 1.48 m) with insolated double-glazing

Programme holder
IBU - Institut Bauen und Umwelt e.V.
Panoramastr. 1
10178 Berlin
Germany

Owner of the Declaration
QKE - Qualitätsverband Kunststofferzeugnisse e.V.
Am Hofgarten 1-2; 53113 Bonn
Germany

EPPA - European PVC Window Profiles and Related Building Products Association ivzw
Avenue de Cortenbergh 71; 1000 Brussels
Belgium

Declaration number
EPD-QKE-20150313-IBG1-EN

Declared product / Declared unit
PVC-U single-sash window, with the dimensions 1.23 m x 1.48 m, insulated double-glazing and variable profile surface (white, painted, laminated with PVC foil or coated with PMMA).

All planned replacements of the components - sealings, fittings and glazing - are included in the declared unit.

This Declaration is based on the Product Category Rules:
Windows and doors, 11.2015
(PCR tested and approved by the SVR)

Scope:
This EPD is an association EPD. The weighted average from the manufacturers' specifications submitted by eleven member companies from 21 sites in seven countries was used as the data basis for the manufacture of plastic profiles. The recorded production volume represents a share of approximately 70% of the production of all system houses affiliated with the QKE and EPPA associations and therefore nearly 60% of European production.

The scope covers different configurations of both profile reinforcement and surface treatment. Window constructions using glazing blocks as well as bonded glazing systems are included. This EPD thus covers all designs for PVC-U windows that conform to the stated requirements. This document is translated from the German Environmental Product Declaration into English. It is based on the German original version EPD-QKE20130313-IBG1-DE. The verifier has no influence on the quality of the translation.

Issue date
17.03.2016

Valid to
16.03.2021

The following companies were involved in the collection of data:

System houses:
aluplast GmbH, D - Karlsruhe
Deceuninck nv, B – Hooglede-Gits
GEALAN Fenster-Systeme GmbH, D- Oberkotzau
Internorm Bauelemente GmbH, A – Traun
hapa AG, D - Herrieden
L.B. Profile GmbH, D – Herbstein
profine GmbH, D – Pirmasens
Rehau AG + Co., D – erlangen
Schüco Polymer Technologies KG – Weißenfels
Stöckel GmbH, D - Vechtel
VEKA AG, D – Sendenhorst

Window manufacturers:
BE Bauelemente GmbH, D – Leopoldshöhe-Greste
Internorm Bauelemente GmbH, A – Traun
Stöckel GmbH, D - Vechtel
TMP Fenster + Türen GmbH, D – Bad Langensalza
WERU GmbH, D – Rudersberg
Wirus Fenster GmbH & Co. KG, D – Rietberg



Prof. Dr.-Ing. Horst J. Bossenmayer
(President of Institut Bauen und Umwelt e.V.)



Dr. Burkhart Lehmann
(Managing Director IBU)

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.

Verification

The CEN Norm /EN 15804/ serves as the core PCR
Independent verification of the declaration according to /ISO 14025/
☐ internally ☒ externally



Dr. Eva Schmincke
(Independent verifier appointed by SVR)

2. Product

2.1 Product description

The declared product is a single-sash tilt & turn window with the dimensions 1.23 x 1.48 m and insulated double-glazing.

The windows consist of a PVC frame profle with a transparent glass filling. A variety of materials are used to reinforce the frame profiles: profiles made from steel or aluminium, polyurethane foam or glass fibre extruded into the PVC-U material.

The surface of the frame can vary in design: laminated with PVC foil, coated with PMMA (polymethyl metha acrylate) or painted. These can produce white or coloured, textured or smooth surfaces.

The seals are made from plasticised PVC, EPDM (ethylene propylene diene monomers) or TPE (thermoplatic elastomers), the fittings from steel.

For the window a reference service life of 40 years is assumed. The respective useful lives of the components - glazing, seals and fittings - is shorter, however, which means that these will need replacing during the reference service life of the window unit. These planned replacements of individual components are also included in the declared unit.

This EPD does not relate to a specific product from one manufacuturer, but confirms the average environmental quality for all PVC-U windows from member companies of the EPPA und QKE associations.

Further specific data can be found in the relevant manufacturer's product description.

2.2 Application

Windows are used in the outer shell of buildings for lighting, ventilation and protection from the elements.

2.3 Technical Data

Technical construction data

Name	Value	Unit
Pane construction	4 / 16 / 4	mm
Heat transfer coefficient glass Ug according to /EN 674/, /EN 675/	11	W/(m²K)
Total enegry transmittance g	62	%
Heat transfer coefficient window Uw according to /EN 674/, /EN 675/	13	W/(m²K)
Watertightness according to /EN 1027/, /EN 12208/	4A - 9A	Class
Mechanical stress (Durability) according to /EN 1191/, /EN 12400/	10 000 - 20 000	Cycles

For further technical construction data, only the minimum requirements that apply to quality-assured windows according to /RAL-GZ 695/ are cited below.

Depending on the design of frame, seals and fittings, considerably higher performance classes can be achieved by the windows produced.

- Min. air permeability according to /EN 1026/, /EN 12207/: Class 2
- Min. resistance to wind load according to /EN 12211/, /EN 12210/: Class B1

Further specific data can be found in the relevant manufacturer's product description.

2.4 Application rules

Placing on the market within EU/EFTA (with the exception of Switzerland) is subject to the /Construction Products Regulation/ (EU) Nr. 305/2011. The products must have a declaration of performance compliant with the harmonized product standard /EN14351-1/ and the CE marking.

Usage is governed by the relevant national rules.

2.5 Delivery status

This EPD relates to plastic windows with the dimensions 1.23 x 1.48 m. The face area is 1.82 m².

2.6 Base materials / Ancillary materials

The base materials of the declared unit are:

Name	Value	Unit
Glazing	47.1	mass%
Frame material PVC-U	28.2	mass%
Reinforcement steel	18.9	mass%
Fittings steel	4.5	mass%
Seals PVC	1.0	mass%
Glazing blogs / screws	0.3	mass%

The raw materials and additives used to manufacture the PVC-U frame material can be found in the following overview:

PVC formulation

- 81.0 mass% PVC
- 8.1 mass% Filler (chalk)
- 4.9 mass% Impact resistance modifiers
- 2.8 mass% Calcium/zinc stabilisers
- 3.2 mass% Pigment titanium oxide (TiO_2)

Recycled material obtained from used windows is used to manufacture proprietary profiles. These profiles can contain more than 0.1 % lead compounds. These are treated as SVHC (Substances of Very High Concern) in accordance with /REACH/.

2.7 Manufacture

Plastic windows are made from a variety of individual components: each window consists of a PVC-U frame with seals, the glazing, the fittings and, where required, the reinforcement.

PVC-U profiles for window frames are manufactured in an extrusion process from a mixture of PVC powder and additives. These protect the PVC from damage during processing and give the profile the necessary properties (impact resistance, colour, weathering stabiblity etc.).

The PVC powder used to manufacutre the frames is a widely used bulk plastic and is obtained through polymerisation. Due to its chemical structure, PVC contains a high proportion of the halogen chlorine.

The majority of window frames are made from white rigid PVC-U profiles. Some frames are manufactured from profiles that are also laminated with PVC film, coated with PMMA or painted.

Seals are generally attached to the window profiles in a coextrusion process and consist of plasticised PVC, EPDM or TPE.

The window profiles are delivered in standard lengths to the window manufacturers, where they are sawn to the length actually required for the particular window. Where necessary, steel reinforcement is inserted and screwed in.The profiles are then welded, the fittings attached and the pane and glass retaining strips fitted. the window can now be supplied and fitted.

The steel for manufacturing fittings is largely optained from iron ores in a blast furnace process by means of reduction with coke.

The basic raw material for manufaturing the glazing is quartz sand to which various fluxing agents and oxidants (Soda ash, sodium sulphate, potash etc.) havebeen added. In a further proceeding step, the molten raw glass is floated on molten tin, from which a flat strip of glass can be continously produced (float glass process).

Quality monitoring

The member companies of QKE e.V. are subject to external quality monitoring within the framework of voluntary self-regulation. Plastic window systems that bear the RAL quality mark according to /RAL-GZ 716/ are listed on the website at gkfp.de.

2.8 Environment and health during manufacturing

Of all the constituents of PVC formulations, only the calcium/zinc stabilisers have to be classified and marked as follows in accordance with /GHS/:

H302: Harmful if swallowed
H318: Causes serious eye damage
H317: May cause an allergic skin reaction
Pictogram: Corrosive and irritating

2.9 Product processing/Installation

The finished windows are transported to the construction site and installed. Screws made from zinc-plated steel and polyurethane foam are required for each window unit for installation.

2.10 Packaging

The profiles – if they are not going to be processed further at the same site – are transported to the window manufacturer, usually on reusable steel pallets. Disposable wooden pallets are used in isolated cases. Cardboard, PE film and foam pads are also used when transporting the individual components to the window manufacturer.

Polyethylene foam pads, a cardboard edge protector, polypropylene load retaining straps, aluminium or steel clamps and PE stretch film are used as packaging materials for each window unit for assembly.

2.11 Condition of use

Plastic windows are durable and long lasting. There is no change in the material composition while the product is being used.

2.12 Environment and health during use

PVC-U frame materials do not have a negative influence on the environment and health. If the use of solvent-free components is ensured further down the supply chain, this also applies for the final window product.

2.13 Reference service life

The reference service life of the declared PVC-U plastic window is 40 years according to /BBSR/. The technical life of certain individual components is thus exceeded; as a result, there will be three replacements of seals and one replacement of fittings and glazing during service life.

2.14 Extraordinary effects

Fire

Plastic windows are classified in classes B - E for fire behaviour (depending on the surface characteristics), s3 for smoke gas development and d0 for burning droplets in accordance with /EN 13501-1/.

Fire protection

Name	Value
Building material class	B - E
Burning droplets	d0
Smoke gas development	s3

Plastic windows therefore meet the requirements of B2 "normal combustibility" according /DIN 4102-1/ as a minimum.

Water

No negative effects on the environment are to be expected in the event of unforeseen exposure to water, such as in the case of flooding.

Mechanical destruction

No negative effects on the environment are to be expected in the event of unforeseen mechanical destruction.

2.15 Re-use phase

The most important processes in the reuse phase of PVC-U are the recycling of materials and landfilling. In addition, PVC can also be thermally utilised.

A large amount of the steel used in the fittings and reinforcement is also recycled for materials.

Glazing can also be recycled very well. Otherwise it is mostly disposed of in landfill sites, but a small amount is also sent for incineration.

2.16 Disposal

The individual components of the window can be disposed of after use as a nonhazardous waste. The waste codes according to European Waste Catalogue /EWC/ are as follows:

- 17 02 02 Glass
- 17 02 03 Plastic
- 17 04 05 Iron and steel

2.17 Further information

Possible sources for further information are available from the associations' websites

www.qke-bonn.de
www.eppa-profiles.eu

and the websites of the system houses and window manufacurers.

3. LCA: Calculation rules

3.1 Declared Unit

The declared unit is a window 1.23 x 1.48 m (reference window in accordance with /EN 14351-1/) with a mass of 55 kg.The frame proportion is 25.7%. Planned replacements of the glazing, fittings and seals during a service life from 40 years are included.

Declared unit

Name	Value	Unit
Declared unit	55 kg	Reference window 1.23m x 1.48m, frame portion 25% to 35%

3.2 System boundary

The entire life cycle of the product "from cradle to grave" is considered.

Manufacture

The aggregate view in the form of modules A1-A3 is used for manufacturing. This includes the supply of raw materials, the manufacture of the steel reinforcement, flat glass, fittings and PVC-U profile, all transportation to the window manufacturer, the energy requirements for constructing the windows, and any production waste generated. In particular, consumption for the heating and illumination of production rooms and their adjacent premises is also included.Capital goods (machinery, buildings etc.) are not considered.

Transportation from the manufacturer's gate to the construction site is taken into account in module A4. All processes relating related to the installation of the window in the building are considered in module A5.

Usage

The transmission heat losses occurring during the usage phase are taken into account in module B1. The measures described in 2.13 for replacing window components are taken into account in module B4.

Disposal

All processes relating to the removal, dismantling or demolition of the window from the building, including an initial sorting on the construction site, are accounted for in module C1.

Redistribution transportation from the construction site for the recovery of heat, recycling of materials and disposal in landfill are considered in module C2. Module C3 considers waste treatment, including sorting for recycling.

Landfilling and thermal recycling fall under module C4.

Credit

Finally, module D shows the potential for re-use, recovery and recycling derived from modules C3 and C4.

3.3 Estimates and assumptions

Apart from the assumptions and estimates described in section 4, no further assumptions or estimates are made that will impact or influence the outcome.

3.4 Cut-off criteria

The disregarded input flows are smaller than 1% of both the total mass and the total flow of primary energy. Taken together, they form less than 5% of the total mass or 5% of the total energy.

3.5 Background data

The primary data for profile extrusion and window manufacturing were provided by the members of the declaring associations (see Scope).The background data for raw materials as well as the manufacturing of the PVC, glazing and fittings and all other data originate from the /ecoinvent 2.2/ database.

This database does not allow calculation of the net flows for fresh water consumptions, so the assumptions are based on the /Ecological Scarcity Method/.

3.6 Data quality

The data for the products examined was collected through analyses of internal production and environmental data, by collating LCA-related data within the supply chain for 2013, and on the basis of average data submitted by the associations. The data collected was checked for plausibility and consistency.

The quality of the background data for glass production is considered to be of the greatest importance because the manufacture of glass makes a significant contribution to the production stage A1-A3.

3.7 Period under review

All primary data was collected in 2013.

3.8 Allocation

The data from profilextrusion and window manufacturing is based on the average weighted by production volume.

3.9 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.

4. LCA: Scenarios and additional technical information

The following technical information forms the basis for the declared modules, or can be used to develop specific scenarios in the context of a building assessment if modules are not declared (MND).

Usage (B1) see Chapter 3.2 Usage

The net heat losses caused by the window are taken into account here. These consist of the transmission heat losses and the solar heat gains from the window. The impacts in the use phase depend to a very large extent on the actual climatic and technical circumstances of a specific building. The calculations off the heat losses and gains and the results of the impact assessment are based on parameters for average Central European conditions.

The energy demand during the use phase at the reference location is calculated from the transmission heat losses and the solar heat gains according to /DIN V 18599-2/.

Name	Value	Unit
degree day factor Central Europe	3641	K*d
Solar irradiation	209	kWh/m2

The provision of heating energy was modeled according to the data for German heating requirements: 49% gas, 30% heating oil and 13% district heating. The remaining 8% are added in equal shares to the cited energy sources.

Replacement (B4), renovation (B5)

The replacement of individual components that have reached the end of their technical life according to /BBSR/ is considered in module B4.

Name	Value	Unit
Replacement cycle glazing	1	Number/RSL
seals	3	Number/RSL
fittings	1	Number/RSL

Reference service life

The reference service life of the window as well as the technical service life of individual components according to /BBSR/ is set as follows:

Name	Value	Unit
Reference service life window unit	40	a
isolated glazing	30	a
fittings	25	a
seals	12	a

End of lifetime (C1-C4)

At the end of their useful life windows and window components can be easily collected, sorted and recycled. Otherwise they are disposed of in landfill or in waste incineration plants for heat recovery.

Recycling rates and disposal methods are country specific and vary widely between European countries. For module C four scenarios in total are assessed:
C-0 present average recovery
C-a priority landfill
C-b priority incineration
C-c priority recyling

For C-a und C-b the rates of material recycling of glass and metal are assumed to be the same as today C-0), while the remaining share is not led for recycling is allocated completely to landfill (C-a) and incineration (C-b). The result for scenarios a-c are presented in chapter 6.4.

Rates for collecting and recovery for C-0:

Name	Value	Unit
Collection rate for all materials	95	%
* thereof are recycled	-	
glass	65	%
PVC	59	%
steel/aluminium	92	%
others	0	%
* incineration quote of the material to be disposed	-	
glass	25	%
PVC	35	%
steel / aluminium	0	%
others	20	%

Re-use, recovery and recycling potential (D), relevant scenario

The energy (thermal energy and electricity) respectively the recycled material resulting from thermal and material utilization are credited here.

5. LCA: Results

The results apply to all kind of profile reinforcements and surfaces listed in the scope for window systems with glazing blocks as well as bonded glazing systems.

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

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	X	X	X	MND	MND	X	MND	MND	MND	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: window (1,23 x 1,48 m) with insulated double glazing

Parameter	Unit	A1-A3	A4	A5	B1	B4	C1	C2	C3	C4	D
GWP	[kg CO_2-Eq.]	1.16E+2	8.18E-1	1.96E+0	7.18E+2	6.87E+1	0.00E+0	2.56E+0	8.08E-1	7.32E+0	-3.48E+1
ODP	[kg CFC11-Eq.]	7.30E-6	1.34E-7	2.49E-8	1.06E-4	6.54E-6	0.00E+0	4.22E-7	1.07E-7	1.56E-7	-1.05E-6
AP	[kg SO_2-Eq.]	5.67E-1	3.21E-3	7.84E-3	9.95E-1	4.46E-1	0.00E+0	1.01E-2	5.79E-3	8.93E-3	-1.18E-1
EP	[kg $(PO_4)^{3-}$-Eq.]	6.46E-2	6.55E-4	1.59E-3	1.14E-1	4.93E-2	0.00E+0	2.07E-3	1.25E-3	2.40E-3	-1.41E-2
POCP	[kg ethene-Eq.]	3.14E-2	1.06E-4	4.44E-4	7.83E-2	1.95E-2	0.00E+0	3.38E-4	1.59E-4	6.15E-4	-1.32E-2
ADPE	[kg Sb-Eq.]	1.14E-3	2.48E-6	1.28E-5	1.49E-4	1.06E-3	0.00E+0	7.86E-6	6.12E-7	2.16E-5	-1.19E-4
ADPF	[MJ]	1.85E+3	1.31E+1	3.27E+1	1.13E+4	9.42E+2	0.00E+0	4.13E+1	1.20E+1	2.26E+1	-6.09E+2

Caption	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

RESULTS OF THE LCA - RESOURCE USE: window (1,23 x 1,48 m) with insulated double glazing

Parameter	Unit	A1-A3	A4	A5	B1	B4	C1	C2	C3	C4	D
PERE	[MJ]	1.11E+2	1.78E-1	1.70E+0	5.01E+1	6.34E+1	0.00E+0	5.48E-1	2.30E-1	1.90E+0	-1.88E+1
PERM	[MJ]	1.28E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
PERT	[MJ]	1.12E+2	1.78E-1	1.70E+0	5.01E+1	6.34E+1	0.00E+0	5.48E-1	2.30E-1	1.90E+0	-1.88E+1
PENRE	[MJ]	1.91E+3	1.39E+1	3.81E+1	1.15E+4	1.06E+3	0.00E+0	4.38E+1	1.32E+1	3.26E+1	-5.13E+2
PENRM	[MJ]	3.01E+2	0.00E+0	0.00E+0	0.00E+0	3.42E+1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-2.23E+2
PENRT	[MJ]	2.21E+3	1.39E+1	3.81E+1	1.15E+4	1.09E+3	0.00E+0	4.38E+1	1.32E+1	3.26E+1	-7.36E+2
SM	[kg]	3.92E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
RSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
NRSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
FW	[m^3]	4.57E-1	5.12E-4	8.71E-3	9.79E-2	1.20E-1	0.00E+0	1.64E-3	3.43E-4	8.43E-3	-2.49E-1

Caption	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 – OUTPUT FLOWS AND WASTE CATEGORIES: window (1,23 x 1,48 m) with insulated double glazing

Parameter	Unit	A1-A3	A4	A5	B1	B4	C1	C2	C3	C4	D
HWD	[kg]	1.31E+1	1.03E-2	1.07E-1	1.71E+0	1.23E+1	0.00E+0	3.36E-2	5.77E-3	2.67E+0	-2.00E+0
NHWD	[kg]	2.92E+1	1.31E-1	2.11E-1	1.18E+1	2.95E+1	0.00E+0	4.31E-1	4.35E-2	1.54E+1	-7.97E+0
RWD	[kg]	2.97E-3	1.07E-5	2.10E-5	2.96E-3	2.01E-3	0.00E+0	3.25E-5	1.57E-5	1.41E-4	-2.42E-4
CRU	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MFR	[kg]	2.78E+0	0.00E+0	0.00E+0	0.00E+0	1.77E+1	0.00E+0	0.00E+0	3.55E+1	0.00E+0	0.00E+0
MER	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
EEE	[MJ]	1.22E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	4.76E+0	-4.89E+0
EET	[MJ]	3.78E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.48E+1	-1.51E+1

Caption	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; EEE = Exported thermal energy

6. LCA: Interpretation

6.1 Summary

The parameters of global warming potential (GWP) and the use of non-renewable primary energy (PENRT) represent the indicators of environmental impacts and use of resources. They are dominated by the use-phase-based provision of energy to compensate for the transmission heat losses caused by installing the window (module B1). If the use phase is taken out of the equation, virtually all environmental impacts are caused by modules A1-A3 (manufacturing) and B4 (replacements, particularly of the glazing). By contrast, the impact of the end of life stage (modules C1-C4), covering demolition and waste treatment, is negligible. The recycling potential and the combustion process in the end-of-life scenario and the resulting credit of electricity and thermal energy lead on paper to negative values in the effects categories of module D.

It should be pointed out that the itemisation of module B1 for windows is optional. However, due to its significant influence on the building's overall energy consumption, a balancing of its use phase is reasonable. For optimisation of the environmental performance of the window it is clear from an overall consideration that the priority is to reduce transmission heat losses which, in turn, depend on the heat transfer coefficient Uf. Furthermore, solar gains (for example by orientation and shadowing) must be optimized. By contrast, the choice of the frame material is of minor significance.

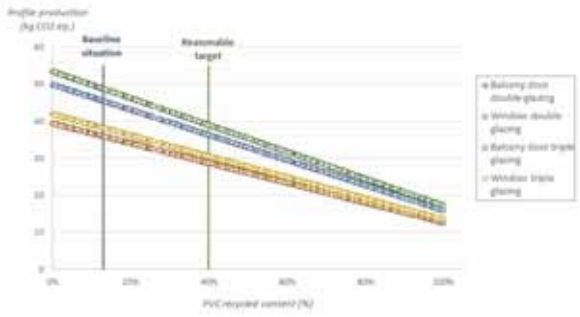
6.2 Production stage

Apart from the production of PVC raw material, production of the insulating glass and fittings accounts for the largest shares in all impact categories. Approximately 45% of the environmental impacts of the production stage are caused by manufacturing of the insulating glass and fittings components.

6.3 Sensitivity concerning the use of recycled PVC

In the manufacture of PVC-U window profiles PVC raw material is partly replaced by recycled material obtained from old windows. A sensitivty analysis made for the profile production shows that due to the reduction of raw material the emission of CO2 and therefore the global warming potential GWP is reduced significantly (see figure 1).

However, the input of material from old windows is limited. Firstly, the amount of available recycled material is limited, and secondly the use of virgin material is necessary due to product performance requirements. Accordingly, a maximum proportion of 40% of recycled material relative to the annual production tonnage of PVC-U window profiles is likely to be the practical limit. For profile manufacture this means a potential GWP saving of a further 22% (compared with an approximate 28% saving compared with the use of pure vigin material).



Figures 1

6.4 Scenarios for EoL / rates of disposal

In addition to the basic variant three other scenarios were assessed to specify the influence of thermal and material recycling (see chapter 4).

Rates for C-a:	Recycling	Incineration	Landfill
Glass	62%	-	38%
PVC-U	-	-	100%
Steel/aluminium	87%	-	13%
Others	-	-	100%

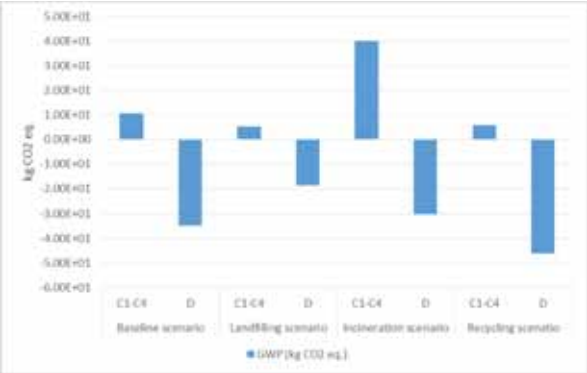
Rates for C-b:	Recycling	Incineration	Landfill
Glass	62%	9%	29%
PVC-U	-	100%	-
Steel/aluminium	87%	-	13%
Others	-	100%	-

Rates for C-c:	Recycling	Incineration	Landfill
Glass	100%	-	-
PVC-U	100%	-	-
Steel/aluminium	100%	-	-
Others	100%	-	-

The results for selected indicators are shown in the table below:

ausgewählte Parameter	C-a Schwerpunkt Deponie		C-b Schwerpunkt Verbrennung		C-c vollständiges Recycling	
	C1-C4	D	C1-C4	D	C1-C4	D
GWP	5.33E+00	-1.88E+01	4.03E+01	-3.01E+01	5.75E+00	-4.62E+01
ODP	5.31E-07	-5.12E-07	1.18E-06	-1.82E-06	7.06E-07	-1.16E-06
AP	1.58E-02	-6.45E-02	6.28E-02	-8.08E-02	2.09E-02	-1.63E-01
EP	4.54E-03	-8.16E-03	1.06E-02	-1.02E-02	5.42E-03	-1.90E-02
POCP	9.02E-04	-1.00E-02	2.56E-03	-1.12E-02	9.02E-04	-1.66E-02
ADPe	7.45E-06	-3.20E-05	1.46E-04	-3.40E-05	1.15E-05	-1.86E-04
ADPf	5.33E+01	-2.84E+02	1.65E+02	-4.53E+02	7.10E+01	-8.45E+02
PENRT	5.68E+01	-3.17E+02	2.31E+02	-5.07E+02	7.60E+01	-1.04E+03

In figure 2 the values of GWP are compared for all scenarios.



Figures 2

C-a (landfill scenario)
Compared with the basic scenario both debits and credits are lower due to there being no incineration.

C-b (incineration scenario)
The values of all impacts increase due to incineration. On the other hand, the energy generation carried by waste incineration delivers a large credit.

C-c (recycling scenario)
The largest credits are achieved by comprehensive material recovery.

6.5 Individual consideration for the impact indicators and their influence factors

6.5.1 Environmental impacts

Global warming potential (GWP)
95% of GWP is contributed by CO2 emissions. Most of it occurs from energy consumption during the in-use phase (B1) as well as raw material production (glazing, PVC-U, steel). The remaining contribution relates to methane emissions likewise associated with energy consumption from the use phase (B1).

Depletion potential of the stratospheric ozone layer (ODP)
The halon 1391 that is produced in the production of gas and heating oil as fuels makes up the bulk of this indicator (use phase B1).

Acidification potential (AP)
This category is 70% dominated by SOx emissions and 27% by NOx emissions. Their main sources are energy production (B4) and the production of raw materials (mostly glass, PVC, steel, A1-A3).

Eutrophication potential (EP)
Eutrophication potential mainly reflects NOx emissions (64%), phosphate (17%) and COD (10%). Most important contributions are heat production (B1) and glazing production (A1).

Formation potential of tropospheric ozone photochemical oxidants (POCP)
This indicator mainly comes from emissions of SOX (45%) from fossil fuels combustion (B1) and glazing production (A1). Other contributions reflect VOC emissions from fossil fuel consumption and raw material production (glass, steel and PVC)

Abiotic depletion potential for non-fossil resources (ADPE)
This refers to the consumption of rare elements. The main contributions come from the consumption of zinc (35%), chromium (18%) and tin (11%) associated with the production of zinc and tin plated stee for fittings (A1-A3).

Abiotic depletion potential for fossil resources (ADPF)
This potential refers to the consuption of natural gas, crude oil and hard coal (82%) associated with the heat generated in the use phase (B1). The other contributions come from natural gas and crude oil consumption associated with glass production (for the provision of energy) and PVC production (as both energy and raw material).

6.5.2 Use of resources

Use of renewable primary energy as energy (PERE) and as raw material (PERM)
The use of renewable energy is low on the whole. It includes the use of wood as a raw material used to build pallets, the consumption of electricity generated from renewable energy (hydropower, wind power) and heat generated by some companies from the combustion of wood od residues from their own manufacturing to produce heat.

Use of non-renewable primary energy as energy (PENRE) and as a raw material (PENRM)
Apart from the in-use phase, the main non-renewable energy consumption occurs during raw material production for glazing, PVC and steel. By contrast, profile production and window manufacturing both have a much limited consumption.
The consumption of non-renewable energy for production covers the raw materials used to generate the plastics (PVC, coatings, LDPE films, seals).

Use of secondary material (SM)
Secondary material is primarily used in profile production in the form of recycled PVC-U from old windows. A small quantity of waste paper/cardboard is also used to produce packaging materials.

Use of secondary fuels (RSF, NRSF)
There is no use of secondary fuels.

Use of net fresh water (FW)
The main consumption of water comes in the manufacture of glass and PVC.

6.5.3 Output flows and waste categories

Components for re-use (CRU)
No output.

Materials for recycling (MFR)
The significant amount of materials for recycling in waste processing stems from the recycled PVC-U, glass, aluminium and steel (reinforcement and fittings). A small contribution comes from the recycling of packaging in the production stage.

Materials for energy recovery (MER)
Like with the waste flows for recycling, the combustion of old window materials accounts for the bulk of the share. The small contribution from the modules A1-A3 relates to the incineration of packaging material (cardboard and wooden pallets) at the end of its life.

Exported energy (EE)
Energy recovery in incineration most occurs – as described above – in the processing of waste (C3) and to a smaller extent at the end-of-life of packaging material (A1 – A3).

7. Requisite evidence

Fire

Fire tests on several test elements from different manufacturers using the SBI test method according to /EN 13823/ by Efectis Nederland BV, project number 2012-Efectis-R0205

Result: In accordance with the average parameters identified, plastic windows meet the following classification criteria according to /EN 13501-1:2007+A1:2009/:

Building material class: B - E
Smoke emissions: s3
Burning droplets: d0

VOC (volatile organic compounds)

Research project into VOC emissions in building products; German Federal Office for Building and Regional Planning as part of the Building the Future research initiative, file reference Z6-10.08.18.7-08.20/II2-F20-08-005; December 2010

Result: In terms of the indoor exposure, the VOC emissions fall largely well below the requirements of the assessment by the German Committee for Health-related Evaluation of Building Products /AgBB/.

8. References

AgBB: Evaluation scheme of emissions of Volatile Organic Compounds from building products; Committee for the Health-related Evaluation of Builduing Products; Germany, February 2015

BBSR: Useful lives of building components for life-cycle analysis according to BNB; Federal Institute for Construction,Urban and Regional Research; Germany, 2011

Construction Products Regulation: Regulation (EU) No 305/2011 of the European Parliament and of the council of March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC

DIN 4102-1: Fire behaviour of building materials and building components - Part 1: Building materials; concepts, requirements and tests; DIN 4102-1:1998

DIN V 18599-2: Energy efficiency of buildings - Calculation of the net, final and primary energy demand for heating, cooling, ventilation, domestic hot water and lighting - Part 2: Net energy demand for heating and cooling of building zones;
DIN V 18599-2:2011

EN 674: Glass in building. Determination of thermal transmittance (U value). Guarded hot plate method;
EN 674:2011

EN 675: Glass in building. Determination of thermal transmittance (U value). Heat flow meter method;
EN 675:2011

EN 1026: Windows and doors - Air permeability - Test method; EN 1026:2000

EN 1027: Windows and doors - Watertightness - Test method; EN 1027:2000

EN 1191: Windows and doors - Resistance to repeated opening and closing - Test method; EN 1191:2012

EN 12207: Windows and doors - Air permeability - Classification; EN 12207:1999

EN 12208: Windows and doors - Watertightness - Classification; EN 12208:1999

EN 12210: Windows and doors - Resistance to wind load - Classification; EN 12210:1999+AC:2002

EN 12211: Windows and doors - Resistance to wind load - Test method; EN 12211:2000

EN 12400: Windows and pedestrian doors - Mechanical durability - Requirements and classification; EN 12400:2002

EN 13501-1: Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests;
EN 13501-1:2007+A1:2009

EN 13823: Reaction to fire tests for building products - Building products excluding floorings exposed to the thermal attack by a single burning item;
EN 13823:2010

EN 14351-1: Windows and doors - Product standard, performance characteristics - Part 1: Windows and external pedestrian doorsets without resistance to fire and/or smoke leakage characteristics;
EN 14351-1:2006+A1:2010

ecoinvent 2.2: Ecoinvent database, v. 2.2; Swiss Centre for Life Cycle Inventories (pub.); Duebendorf, Switzerland, 2010

Ecological Scarcity Method: Swiss Eco-Factors 2013 according to the Ecological Scarcity Method - Methodological fundamentals and their application in Switzerland; Frischknecht & Büsser Knöpfel; 2013

EWC: European Waste Catalogue, established by Decision 2000/532/EC of European Commission

GHS: Globally Harmonized System of Classification and Labelling of Chemicals

RAL-GZ 695: Quality assurance of windows, doors, facades and winter gardens

RAL-GZ 716: General Quality and Test Requirements, System Description and Suitability Testing of Plastic Window and Door Profile Systems

REACH: Regulation (EC) No 1907/2006 of the European Parliment and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals

Institut Bauen und Umwelt
Institut Bauen und Umwelt e.V., Berlin(pub.): Generation of Environmental Product Declarations (EPDs);

General principles
for the EPD range of Institut Bauen und Umwelt e.V. (IBU), 2013/04
www.bau-umwelt.de

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

EN 15804
EN 15804:2012-04+A1 2013: Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products

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UMWELT-PRODUKTDEKLARATION

nach ISO 14025 und EN 15804

Deklarationsinhaber	QKE Qualitätsverband Kunststofferzeugnisse e.V. EPPA European PVC Window Profiles and Related Building Products Association ivzw
Herausgeber	Institut Bauen und Umwelt e.V. (IBU)
Programmhalter	Institut Bauen und Umwelt e.V. (IBU)
Deklarationsnummer	EPD-QKE-20170001-IBG1-DE
ECO EPD Ref. No.	ECO-00000039
Ausstellungsdatum	27.04.2017
Gültig bis	26.04.2022

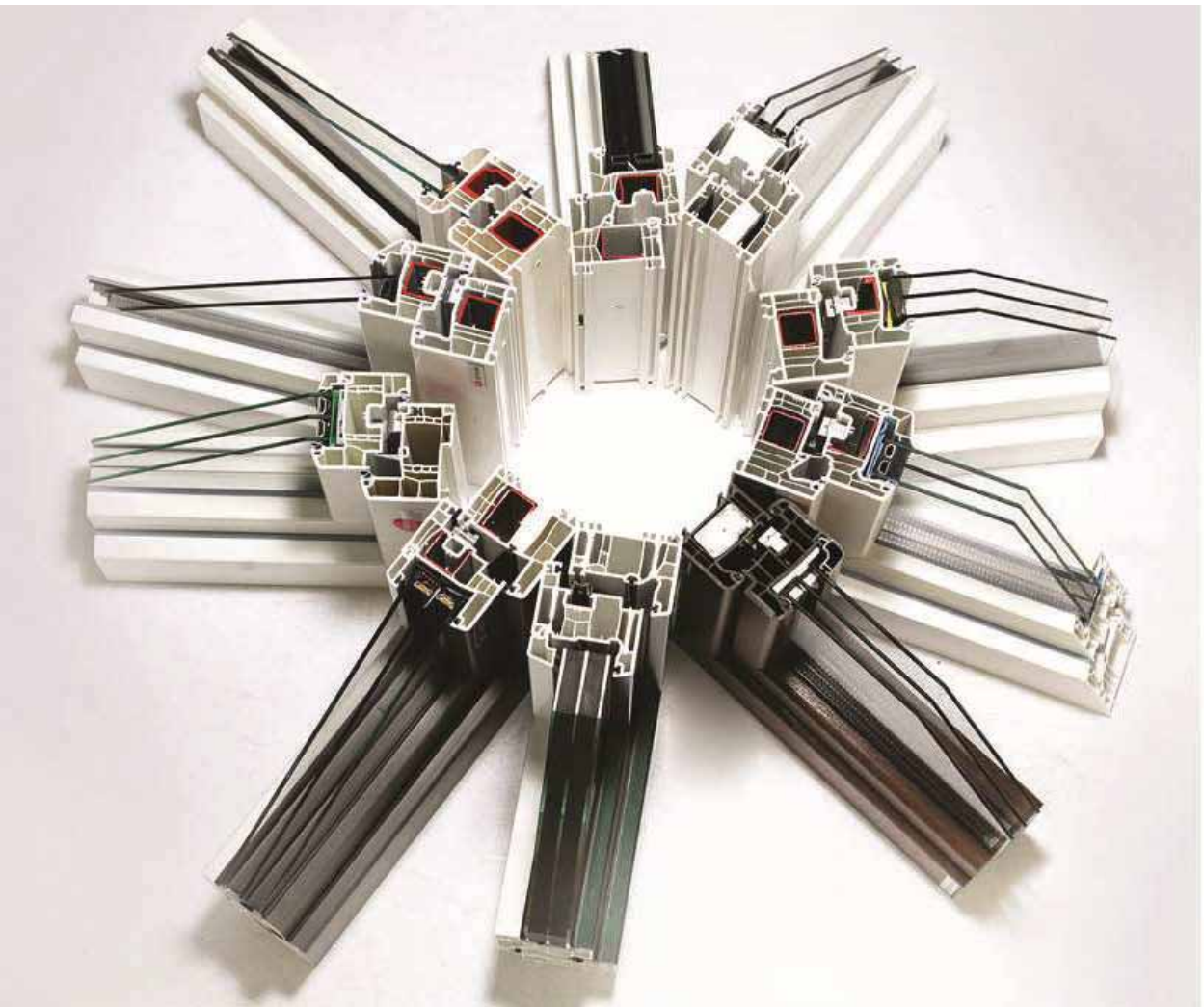
Kunststofffenster aus PVC-U

mit den Maßen 1,23 x 1,48 m
und einer 3-Scheiben-Isolierverglasung

QKE e.V.
EPPA ivzw

www.ibu-epd.com / https://epd-online.com

Institut Bauen und Umwelt e.V.



ECO PLATFORM EPD EN 15804 VERIFIED



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deceuninck

EPPA

QUALITÄTSVERBAND KUNSTSTOFFERZEUGNISSE E.V.
FÜR LANGLEBIGE KUNSTSTOFFPRODUKTE

1. Allgemeine Angaben

QKE - EPPA

Programmhalter

IBU - Institut Bauen und Umwelt e.V.
Panoramastr. 1
10178 Berlin
Deutschland

Deklarationsnummer

EPD-QKE-20170001-IBG1-DE

Diese Deklaration basiert auf den Produktkategorien-regeln:

Fenster und Türen, 11.2015
(PCR geprüft und zugelassen durch den unabhängigen Sachverständigenrat (SVR))

Ausstellungsdatum

27.04.2017

Gültig bis

26.04.2022

Fenster (1,23 x 1,48 m) mit 3-Scheiben-Isolierverglasung

Inhaber der Deklaration

QKE - Qualitätsverband Kunststofferzeugnisse e.V.
Am Hofgarten 1-2; 53113 Bonn
Deutschland

EPPA - European PVC Window Profiles and Related Building Products Association ivzw
Avenue de Cortenbergh 71; 1000 Brüssel
Belgien

Deklariertes Produkt/deklarierte Einheit

Einflügeliges Fenster aus PVC-U, mit den Abmessungen 1,23 m x 1,48 m, 3-Scheiben-Isolierverglasung und variabler Oberfläche (weiß, lackiert, mit PVC-Folie kaschiert oder mit PMMA beschichtet).

Alle planmäßigen Austausche der Einzelkomponenten Dichtung, Beschlag und Verglasung sind in der deklarierten Einheit mit berücksichtigt.

Gültigkeitsbereich:

Es handelt sich bei dieser EPD um eine Verbands-EPD. Als Datenbasis für die Herstellung der Kunststoff-Fensterprofile wurde das gewichtete Mittel der Angaben von zwölf Mitgliedsunternehmen mit 22 Produktionsstätten in sieben Ländern herangezogen. Die erfassten Produktionsmengen entsprechen ca. 70 % der Menge aller in den Verbänden QKE und EPPA organisierten Systemhäuser und damit annähernd 60 % der europäischen Produktion.

Der Geltungsbereich umfasst verschiedene Profilverstärkungs- wie auch Oberflächenvarianten. Es sind sowohl konventionell verklotzte wie auch verklebte Fensterkonstruktionen einbezogen. Diese EPD deckt mithin alle Bauformen für PVC-Fenster ab, die den angegebenen Eigenschaften entsprechen.

Folgende Unternehmen waren an der Datenerhebung beteiligt:

Systemhäuser:
aluplast GmbH, D – Karlsruhe
Deceuninck nv, B – Hooglede-Gits
GEALAN Fenster-Systeme GmbH, D – Oberkotzau
Internorm Bauelemente GmbH, A – Traun
hapa AG, D – Herrieden
L.B. Profile GmbH, D – Herbstein
profine GmbH, D – Pirmasens
Rehau AG + Co., D – Erlangen
Salamander Industrie-Produkte GmbH, D – Türkheim
Schüco Polymer Technologies KG – Weißenfels
Stöckel GmbH, D – Vechtel
VEKA AG, D – Sendenhorst

Fensterbau:
BE Bauelemente GmbH, D – Leopoldshöhe-Greste
Internorm Bauelemente GmbH, A – Traun
Stöckel GmbH, D – Vechtel
TMP Fenster + Türen GmbH, D – Bad Langensalza
WERU GmbH, D – Rudersberg
Wirus Fenster GmbH & Co. KG, D – Rietberg

Der Inhaber der Deklaration haftet für die zugrundeliegenden Angaben und Nachweise; eine Haftung des IBU in Bezug auf Herstellerinformationen, Ökobilanzdaten und Nachweise ist ausgeschlossen.

Verifizierung

Die CEN Norm /EN 15804/ dient als Kern-PCR
Verifizierung der EPD durch eine/n unabhängige/n Dritte/n gemäß /ISO 14025/
☐ intern ☒ extern



Prof. Dr.-Ing. Horst J. Bossenmayer
(Präsident des Instituts Bauen und Umwelt e.V.)



Dr.-Ing. Burkhart Lehmann
(Geschäftsführer IBU)



Dr. Eva Schmincke,
Unabhängige/r Verifizierer/in vom SVR bestellt

2. Produkt

2.1 Produktbeschreibung/Produktdefinition

Bei dem deklarierten Produkt handelt es sich um einflügelige Dreh-Kipp-Fenster mit den Maßen 1,23 x 1,48 m und einer 3-Scheiben-Isolierverglasung.

Die Fenster bestehen aus verstärkten PVC-Rahmenprofilen mit transparenter Glasfüllung. In den Rahmenprofilen kommen als Verstärkung verschiedene Materialien zum Einsatz: Stahl- oder Aluminiumprofile, Polyurethan-Schaum wie auch in das PVC-Material einextrudierte Glasfasern. Die Rahmenoberfläche kann unterschiedlich ausgeführt sein: Kaschiert durch den Einsatz von PVC-Folie, beschichtet mit PMMA (Polymethylmethacrylat) oder lackiert. Dadurch ergeben sich weiße oder beschichtete, strukturierte oder glatte Oberflächen. Die Dichtungen bestehen aus Weich-PVC, EPDM (Ethylen-Propylen-Dien-Monomer) oder TPE (thermoplastisches Elastomer), die Beschläge überwiegend aus Stahl.

Es wird für das Fenster eine Referenzlebensdauer von 40 Jahren angenommen. Die angenommene technische Lebensdauer der Komponenten Verglasung, Dichtung und Beschlag ist kürzer, so dass diese während der Referenzlebensdauer der Fenstereinheit ausgetauscht werden müssen. Diese planmäßigen Austausche der Einzelkomponenten sind ebenfalls in der deklarierten Einheit berücksichtigt.

Diese EPD bezieht sich nicht auf ein spezifisches Produkt eines Herstellers sondern deklariert die durchschnittliche Umweltqualität für alle PVC-Fenster von Mitgliedsunternehmen der Verbände EPPA und QKE. Detaillierte Daten sind den spezifischen Produktbeschreibungen des jeweiligen Herstellers zu entnehmen.

Für das Inverkehrbringen in der EU/EFTA (mit Ausnahme der Schweiz) gilt die Verordnung (EU) Nr. 305/2011 - /Bauproduktenverordnung/. Die Produkte benötigen eine Leistungserklärung unter Berücksichtigung der harmonisierten Produktnorm /DIN EN 14351-1/ sowie die CE-Kennzeichnung.

Für die Verwendung gelten die jeweiligen nationalen Bestimmungen.

2.2 Anwendung

Fenster werden in der äußeren Gebäudehülle zur Belichtung, Belüftung und zum Witterungsschutz eingesetzt.

2.3 Technische Daten

Für die jeweilige in den Verkehr gebrachte Fenstereinheit gelten die Daten entsprechend ihrer Leistungserklärung nach der harmonisierten Produktnorm /DIN EN 14351-1/. Als Datenbasis für die Berechnungen wurden folgende bautechnische Daten verwendet:

Bezeichnung	Wert	Einheit
Scheibenaufbau	4 /16 /4 /16 / 4	mm
Wärmedurchgangskoeffizient Glas Ug nach /DIN EN 674/, /DIN EN 675/	0,6	W/(m^{2}K)
Gesamtenergiedurchlassgrad g	50	%
Wärmedurchgangskoeffizient Fenster Uw nach /DIN EN 674/, /DIN EN 675/	0,92	W/(m^{2}K)
Schlagregendichtheit nach /DIN EN 1027/, /DIN EN 12208/	4A - 9A	Klasse
Mechanische Beanspruchung (Dauerfunktion) nach /DIN EN 1191/, /DIN EN 12400/	10.000 - 20.000	Zyklen

Für weitere bautechnische Daten sind im Folgenden lediglich die Mindestanforderungen, die für RAL-gütegesicherte Fenster nach /RAL-GZ 695/ gelten, genannt. Je nach Ausführung der Rahmen, Beschläge und Dichtungen werden durch die gefertigten Fenster weitaus höhere Leistungsklassen erreicht.

- min. Luftdurchlässigkeit nach /DIN EN 1026/, /DIN EN 12207/: Klasse 2
- min. Widerstandsfähigkeit gegen Windlast nach /DIN EN 12211/, /DIN EN 12210/: Klasse B1

Weitere spezifische Daten sind der jeweiligen Produktbeschreibung der Hersteller zu entnehmen.

2.4 Lieferzustand

Diese EPD bezieht sich auf Kunststofffenster mit den Maßen 1,23 x 1,48 m. Die Ansichtsfläche beträgt 1,82 m².

2.5 Grundstoffe/Hilfsstoffe

Die Grundstoffe der deklarierten Einheit sind:

Bezeichnung	Wert	Einheit
Verglasung	58,7	M-%
Rahmenmaterial PVC	22,9	M-%
Armierung Stahl	13,9	M-%
Beschläge Stahl	3,4	M-%
Dichtungen PVC	0,9	M-%
Verschraubungen / Verklotzung	0,2	M-%

Die für die Herstellung des PVC-Rahmenmaterials verwendeten Rohstoffe und Additive sind der folgenden Übersicht zu entnehmen:

PVC-Rezeptur

- 81,0 M-% PVC
- 8,1 M-% Füllstoff (Kreide)
- 4,9 M-% Schlagzähmodifikatoren
- 2,8 M-% Calcium-Zink-Stabilisatoren
- 3,2 M-% Pigment Titanoxid (TiO_2)

Bei der Herstellung einiger Profile wird rezykliertes Altfenstermaterial eingesetzt. In diesen Profilen können mehr als 0,1 % Bleiverbindungen enthalten sein. Diese werden gemäß /REACH/ als SVHC-Stoffe (Substances of Very High Concern) behandelt.

2.6 Herstellung

Kunststofffenster werden aus verschiedenen Einzelkomponenten gefertigt: Jedes Fenster besteht aus einem PVC-Rahmen mit Dichtungen, der Verglasung, Beschlägen und falls erforderlich einer Armierung.

PVC-Profile für Fensterrahmen werden im Extrusionsverfahren aus einer Mischung von PVC-Pulver und Additiven hergestellt. Diese schützen das PVC vor Schädigungen während der Verarbeitung und verleihen dem Profil die erforderlichen Eigenschaften wie z.B. Schlagzähigkeit, Farbe, Witterungsstabilität.

Das PVC-Pulver zur Herstellung des Rahmens ist ein weit verbreiteter Massenkunststoff und wird durch Polymerisation hergestellt. Aufgrund seiner chemischen Struktur enthält PVC einen erheblichen Anteil des Halogens Chlor.

Die meisten Fensterrahmen werden aus weißen Hart-PVC-Profilen gefertigt. Einige Rahmen werden aus Profilen hergestellt, die zusätzlich mit PVC-Folie kaschiert, mit PMMA beschichtet oder lackiert sind.

Dichtungen werden i.d.R. im Coextrusionsverfahren an die Fensterprofile angebracht und bestehen überwiegend aus Weich-PVC, aber auch EPDM oder TPE kommen zum Einsatz.

Die Fensterprofile werden in Standardlängen an den Fensterhersteller geliefert. Dort werden die für das jeweilige Fenster erforderlichen Längen gesägt. Soweit erforderlich werden Stahlarmierungen eingeschoben und verschraubt. Anschließend werden die Profile geschweißt, die Beschläge angebracht und die Glasscheibe sowie die Glashalteleisten eingesetzt. Das Fenster kann nun ausgeliefert und montiert werden.

Der Stahl zur Herstellung der Beschläge wird im Wesentlichen aus Eisenerzen im Hochofenprozess durch Reduktion mit Koks gewonnen.

Die Rohstoffbasis für die Herstellung der Verglasung bildet Quarzsand unter Zugabe verschiedener Fluss- und Oxidationsmittel (Sodaasche, Natriumsulfat, Kaliumcarbonat etc.). In einem weiteren Veredelungsschritt wird das geschmolzene Rohglas in eine Zinnschmelze gegeben, aus der kontinuierlich ein flaches Glasband abgezogen werden kann (Floatglasverfahren).

Güteüberwachung

Die Mitgliedsunternehmen des QKE e.V. unterliegen im Rahmen der freiwilligen Selbstverpflichtung einer externen Güteüberwachung. Diejenigen Kunststoff-Fensterprofilsysteme, die mit dem RAL-Gütezeichen nach /RAL-GZ 716/ gekennzeichnet werden dürfen, sind auf der Website gkfp.de gelistet.

2.7 Umwelt und Gesundheit während der Herstellung

Von den PVC-Rezepturbestandteilen sind nach /GHS/ lediglich die Calcium-Zink-Stabilisatoren wie folgt einzustufen und zu kennzeichnen:

H302: Gesundheitsschädlich bei Verschlucken
H318: Verursacht schwere Augenschäden
H317: Kann allergische Hautreaktionen verursachen
Piktogramm: ätzend und reizend

2.8 Produktverarbeitung/Installation

Die fertigen Fenster werden zur Baustelle transportiert und eingebaut. Für die Montage werden Schrauben aus galvanisch verzinktem Stahl sowie Montageschaum (Polyurethan) benötigt.

2.9 Verpackung

Die Profile werden - sofern sie nicht am gleichen Standort weiterverarbeitet werden - zumeist in Mehrwegpaletten aus Stahl zum Fensterhersteller transportiert. Vereinzelt kommen Einweg-Holzpaletten zum Einsatz. Weiterhin sind für den Transport der Einzelkomponenten zum Fensterhersteller Pappe, PE-Folie und -Schaumpads im Gebrauch.

Für die Auslieferung der Kunststofffenstern werden Schaumpads aus Polyethylen, Pappe, Ladungssicherungsbänder aus Polypropylen, Alu- oder Stahlklammern sowie PE-Stretchfolie als Verpackungsmaterialien verwendet.

2.10 Nutzungszustand

Kunststofffenster sind sehr langlebig und dauerhaft. Die stoffliche Zusammensetzung ändert sich während der Nutzung nicht.

2.11 Umwelt & Gesundheit während der Nutzung

Umwelt und Gesundheit werden durch das PVC-Rahmenmaterial nicht negativ beeinflusst. Sofern in der weiteren Lieferkette die Verwendung lösemittelfreier Komponenten gewährt wird, gilt dies ebenso für das Endprodukt Fenster.

2.12 Referenz-Nutzungsdauer

Die Referenznutzungsdauer RSL der deklarierten Kunststofffenster aus PVC-U ist nach /BBSR/ mit 40 Jahren anzusetzen. Hierbei wird die technische Lebensdauer einzelner Komponenten überschritten, weshalb für die LCA der dreimalige Austausch von Dichtungen sowie der einmalige Austausch von Beschlägen und Verglasung berücksichtigt wird.

2.13 Außergewöhnliche Einwirkungen

Brand

Hinsichtlich des Brandverhaltens sind Kunststofffenster nach /DIN EN 13501-1/ in die Klasse B – E (in Abhängigkeit von der Oberflächenbeschaffenheit), Rauchgasentwicklung s3, brennendes Abtropfen d0 eingestuft.

Brandschutz

Bezeichnung	Wert
Baustoffklasse	B - E
Brennendes Abtropfen	d0
Rauchgasentwicklung	s3

Kunststofffenster erfüllen somit mindestens die Anforderung B2 "normalentflammbar" nach /DIN 4102-1/ bzw. die Klasse E nach /DIN EN 13501-1/.

Wasser

Bei unvorhergesehener Wassereinwirkung wie z.B. Hochwasser sind keine nachteiligen Auswirkungen auf die Umwelt zu erwarten.

Mechanische Zerstörung

Bei unvorhergesehener mechanischer Zerstörung treten keine negativen Folgen für die Umwelt auf.

2.14 Nachnutzungsphase

Die wichtigsten Prozesse in der Nachnutzungsphase von PVC sind die stoffliche Verwertung und die Deponierung. Daneben wird auch die thermische Verwertung praktiziert.

Der in Beschlägen und Armierung verwendete Stahl wird in einem hohen Maß stofflich verwertet.

Verglasungen können ebenfalls sehr gut stofflich verwertet werden. Ansonsten erfolgt zumeist eine Deponierung, zu einem geringeren Teil aber auch die Mitverbrennung in Müllverbrennungsanlagen.

2.15 Entsorgung

Die einzelnen Komponenten des Kunststofffensters können nach der Nutzung als nicht gefährlicher Abfall entsorgt werden. Die Abfallcodes gemäß Abfallverzeichnis-Verordnung /AVV/ sind:

- 17 02 02 Glas
- 17 02 03 Kunststoff
- 17 04 05 Eisen und Stahl

2.16 Weitere Informationen

Bezugsmöglichkeit für weitere Informationen bestehen über die Webseiten der Verbände

www.qke-bonn.de
www.eppa-profiles.eu

sowie die Webseiten der Systemhäuser und Fensterhersteller.

3. LCA: Rechenregeln

3.1 Deklarierte Einheit

Die deklarierte Einheit ist ein Fenster mit der Größe 1,23 x 1,48 m (Referenzfenster in Anlehnung an /DIN EN 14351-1/) und einer Masse von 71,9 kg. Der auf die Gesamtfläche bezogende Rahmenanteil F_F beträgt 33 %. Der planmäßige Ersatz von Verglasung, Beschlägen und Dichtungen innerhalb der 40-jährigen Nutzungsdauer ist eingeschlossen.

Deklarierte Einheit

Bezeichnung	Wert	Einheit
Deklarierte Einheit	71,9 kg	Referenzfenster 1,23m x 1,48m, Rahmenanteil zwischen 25% und 35%

3.2 Systemgrenze

Für die deklarierte Einheit wird der komplette Lebenszyklus "von der Wiege bis zur Bahre" betrachtet.

Herstellung

Für die Herstellung findet die aggregierte Darstellung in Form von A1-A3 Verwendung. Darunter fallen die Rohstoffversorgung, die Herstellung von Stahlarmierung, Verglasung, Beschlägen und des PVC Profils, alle Transporte zum Fensterhersteller, die beim Fensterbau benötigten Energieverbräuche sowie jegliche anfallenden Produktionsabfälle. Insbesondere werden auch die Verbräuche für die Beheizung der Produktionsstätten sowie ihrer angeschlossener Räumlichkeiten berücksichtigt. Investitionsgüter (Maschinen, Gebäude etc.) bleiben dagegen unberücksichtigt.

In Modul A4 werden die Transporte vom Fensterbauer zur Baustelle berücksichtigt. In Modul A5 werden jegliche im Zusammenhang mit dem Einbau des Fensters in das Gebäude zusammenhängenden Prozesse berücksichtigt.

Nutzung

Die auftretenden Transmissionswärmeverluste während der Nutzungsphase werden in Modul B1 berücksichtigt. Die in 2.13 genannten Ersatzmaßnahmen von Fensterbauteilen werden in Modul B4 berechnet.

Entsorgung

Alle Prozesse, die Ausbau, Abbau oder Abbruch des Fensters aus dem Gebäude betreffen, einschließlich einer ersten Sortierung auf der Baustelle, werden in Modul C1 eingerechnet.

Redistributionstransporte von der Baustelle zur thermischen und stofflichen Verwertung sowie zur Deponierung fallen in das Modul C2. In Modul C3 wird die Abfallbehandlung berücksichtigt. Hierzu gehört auch die Sortierung für die Wiederverwertung.

Die Deponierung wie auch die thermische Verwertung fallen dem Modul C4 zu.

Gutschriften

Abschließend zeigt das Modul D die sich aus den Modulen C3 und C4 ergebenden Wiederverwendungs-, Rückgewinnungs- und Recyclingpotentiale auf.

3.3 Abschätzungen und Annahmen

Es werden – abgesehen von den unter 4 beschriebenen – keine weiteren Annahmen und Abschätzungen getroffen, die sich auf das Ergebnis auswirken.

3.4 Abschneideregeln

Die vernachlässigten Input-Flüsse liegen jeweils unter 1 % der Gesamtmasse und des Gesamtflusses der Primärenergie. In Summe ergeben sie jeweils weniger als 5 % der Gesamtmasse bzw. 5 % der Gesamtenergie.

3.5 Hintergrunddaten

Die Primärdaten der Profilextrusion und der Fensterfertigung wurden von Mitgliedern der deklarierenden Verbände bereitgestellt (s. Gültigkeitsbereich). Die Hintergrunddaten für die Rohstoffe sowie die Herstellung von PVC, Verglasung, Beschlägen und alle übri-gen Daten entstammen der Datenbank /ecoinvent 2.2/.

Da diese Datenbank keine Berechnung der Nettoströme für Frischwasserverbrauch ermöglicht, erfolgt hierfür eine Abschätzung nach /Ecological Scarcity Method/.

3.6 Datenqualität

Die Datenerfassung erfolgte anhand von Auswertungen der internen Produktions- und Umweltdaten und der Erhebung LCA-relevanter Daten innerhalb der Lieferantenkette für das Jahr 2013 sowie auf Basis von Durchschnittsinformationen der Verbände. Die erhobenen Daten wurden auf Plausibiliät und Konsistenz überprüft.

Von den Hintergrunddaten kommt denen der Glasproduktion die größte Bedeutung zu, da die Herstellung der Verglasung in der Herstellungsphase A1-A3 einen wesentlichen Beitrag liefert.

3.7 Betrachtungszeitraum

Alle Primärdaten wurden in 2013 erhoben.

3.8 Allokation

Für die Produktionsdaten der Profilextrusion und des Fensterbaus wurden die mit dem Produktionsvolumen gewichteten Mittelwerte angesetzt.

3.9 Vergleichbarkeit

Grundsätzlich ist eine Gegenüberstellung oder die Bewertung von EPD Daten nur möglich, wenn alle zu vergleichenden Datensätze nach /EN 15804/ erstellt wurden und der Gebäudekontext, bzw. die produktspezifischen Leistungsmerkmale, berücksichtigt werden.

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4. LCA: Szenarien und weitere technische Informationen

Die folgenden technischen Informationen sind Grundlage für die deklarierten Module oder können für die Entwicklung von spezifischen Szenarien im Kontext einer Gebäudebewertung genutzt werden, wenn Module nicht deklariert werden (MND).

Nutzung (B1)

Hier werden die durch das Fenster bedingten Netto-Wärmeverluste berücksichtigt. Diese setzten sich zusammen aus den Transmissionswärmeverlusten und den solaren Gewinnen des Fensters. Es ist zu berücksichtigen, dass die Wirkungen in der Nutzungsphase sehr stark von den tatsächlichen klimatischen und technischen Gegebenheiten eines realen Gebäudes abhängen.

Die Berechnungen zu Wärmeverlusten und -gewinnen sowie die Ergebnisse der Wirkungsabschätzung basieren auf Parametern durchschnittlicher mitteleuropäischer Bedingungen:

Der Energiebedarf während der Nutzungsphase am Referenzstandort wird nach /DIN V 18599-2/ berechnet aus den Transmissionswärmeverlusten und den solaren Wärmegewinnen.

Bezeichnung	Wert	Einheit
Gradtagszahlfaktor Zentraleuropa	3641	K*d
Solare Einstrahlung	209	kWh/m²

Die Bereitstellung der Heizenergie wurde mit den deutschen Heizenergiebedarf-Daten modelliert: 49 % Gas, 30 % Heizöl und 13 % Fernwärme. Die verbleibenden 8 % werden aliquot auf die genannten Energieträger aufgeteilt.

Ersatz (B4), Umbau/Erneuerung (B5)

Der Austausch einzelner Komponenten nach Erreichen ihrer nach /BBSR/ angegebenen technischen Lebensdauer wird in diesem Modul berücksichtigt.

Bezeichnung		Wert	Einheit
Ersatzzyklus	Verglasung	1	Anzahl/RSL
	Dichtungen	3	Anzahl/RSL
	Beschläge	1	Anzahl/RSL

Referenznutzungsdauer

Die Referenznutzungsdauer RSL des Fensters sowie die technische Lebensdauer seiner Einzelkomponenten werden nach /BBSR/ wie folgt angesetzt:

Bezeichnung	Wert	Einheit
Referenz Nutzungsdauer Fenstereinheit	40	a
Nutzungsdauer Mehrscheiben-isolierverglasung	30	a
Nutzungsdauer Drehkippbeschlag	25	a
Nutzungsdauer Dichtungen	12	a

Ende des Lebenswegs (C1-C4)

Am Ende der Nutzungszeit können die Fenster bzw. Fensterkomponenten sehr gut gesammelt, getrennt und stofflich verwertet werden. Andernfalls erfolgt die Entsorgung auf der Deponie oder in der Müllverbrennungsanlage zur thermischen Verwertung.

Die Recyclingquoten und Entsorgungswege sind länderspezifisch und weichen im europäischen Raum stark voneinander ab. Es werden für das Modul C insgesamt vier Szenarien betrachtet
C-0 durchschnittliche heutige Verwertung
C-a Schwerpunkt Deponie
C-b Schwerpunkt Verbrennung
C-c Vollständgies Recycling

Bei C-a und C-b wird die stoffliche Verwertung von Glas und Metalle analog zu den heutigen Quoten (C-0) angenommen, wobei der nicht dem Recycling zugeführte Anteil vollständig der Deponie (C-a) bzw. Verbrennung (C-b) zugerechnet wird. Die sich aus diesen Szenarien a-c ergebenden Quoten sowie die Ergebnisse der LCA werden in Abschnitt 6.4 dargestellt.

Sammel- und Entsorgungsquoten zu C-0:

Bezeichnung	Wert	Einheit
Sammelquote über alle Materialien	95	%
* davon zum Recycling	-	
Glas	65	%
PVC	59	%
Stahl/Aluminium	92	%
Sonstiges	0	%
* vom zu entsorgenden Material zur Verbrennung	-	
Glas	25	%
PVC	35	%
Stahl/Aluminium	0	%
Sonstiges	20	%

Wiederverwendungs- Rückgewinnungs- und Recyclingpotential (D), relevante Szenarioangaben

Hier werden die aus der thermischen und stofflichen Verwertung der Abfälle resultierende Energien (thermische Energie und Strom) bzw. das entstehende Recyclingmaterial gut geschrieben.

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5. LCA: Ergebnisse

Die Ergebnisse gelten für alle im Geltungsbereich benannten Profilverstärkungs- und Oberflächenvarianten sowohl für konventionell verklotzte wie auch verklebte Fensterkonstruktionen. Für das Entsorgungsstadium C1 bis C4 gelten die Recyclingquoten nach durchschnittlicher heutiger Verwertung (Szenario C-0).

ANGABE DER SYSTEMGRENZEN (X = IN ÖKOBILANZ ENTHALTEN; MND = MODUL NICHT DEKLARIERT)

Produktionsstadium			Stadium der Errichtung des Bauwerks		Nutzungsstadium							Entsorgungsstadium				Gutschriften und Lasten außerhalb der Systemgrenze
Rohstoffversorgung	Transport	Herstellung	Transport vom Hersteller zum Verwendungsort	Montage	Nutzung / Anwendung	Instandhaltung	Reparatur	Ersatz	Erneuerung	Energieeinsatz für das Betreiben des Gebäudes	Wassereinsatz für das Betreiben des Gebäudes	Rückbau / Abriss	Transport	Abfallbehandlung	Beseitigung	Wiederverwendungs-, Rückgewinnungs- oder Recyclingpotenzial
A1	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
X	X	X	X	X	X	MND	MND	X	MND	MND	MND	X	X	X	X	X

ERGEBNISSE DER ÖKOBILANZ UMWELTAUSWIRKUNGEN: Fenster 1,23 x1,48 m mit Doppelverglasung

Parameter	Einheit	A1-A3	A4	A5	B1	B4	C1	C2	C3	C4	D
GWP	[kg CO_2-Äq.]	1,58E+2	1,07E+0	1,96E+0	4,01E+2	1,12E+2	0,00E+0	3,31E+0	8,47E-1	7,82E+0	-3,67E+1
ODP	[kg CFC11-Äq.]	1,05E-5	1,75E-7	2,49E-8	5,91E-5	1,01E-5	0,00E+0	5,46E-7	1,14E-7	1,80E-7	-1,10E-6
AP	[kg SO_2-Äq.]	8,25E-1	4,20E-3	7,84E-3	5,56E-1	7,12E-1	0,00E+0	1,31E-2	5,97E-3	1,00E-2	-1,25E-1
EP	[kg $(PO_4)^{3-}$-Äq.]	9,17E-2	8,57E-4	1,59E-3	6,39E-2	7,83E-2	0,00E+0	2,68E-3	1,28E-3	2,66E-3	-1,48E-2
POCP	[kg Ethen-Äq.]	4,14E-2	1,39E-4	4,44E-4	4,38E-2	3,04E-2	0,00E+0	4,37E-4	1,67E-4	6,67E-4	-1,35E-2
ADPE	[kg Sb-Äq.]	1,31E-3	3,24E-6	1,28E-5	8,32E-5	1,24E-3	0,00E+0	1,02E-5	7,67E-7	2,30E-5	-1,31E-4
ADPF	[MJ]	2,40E+3	1,71E+1	3,27E+1	6,31E+3	1,49E+3	0,00E+0	5,35E+1	1,27E+1	2,54E+1	-6,51E+2

Legende	GWP = Globales Erwärmungspotenzial; ODP = Abbau Potential der stratosphärischen Ozonschicht; AP = Versauerungspotenzial von Boden und Wasser; EP = Eutrophierungspotenzial; POCP = Bildungspotential für troposphärisches Ozon; ADPE = Potenzial für den abiotischen Abbau nicht fossiler Ressourcen; ADPF = Potenzial für den abiotischen Abbau fossiler Brennstoffe

ERGEBNISSE DER ÖKOBILANZ RESSOURCENEINSATZ: Fenster 1,23 x1,48 m mit Doppelverglasung

Parameter	Einheit	A1-A3	A4	A5	B1	B4	C1	C2	C3	C4	D
PERE	[MJ]	1,51E+2	2,32E-1	1,70E+0	2,80E+1	1,03E+2	0,00E+0	7,09E-1	2,74E-1	2,03E+0	-1,96E+1
PERM	[MJ]	1,35E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0
PERT	[MJ]	1,52E+2	2,32E-1	1,70E+0	2,80E+1	1,03E+2	0,00E+0	7,09E-1	2,74E-1	2,03E+0	-1,96E+1
PENRE	[MJ]	2,60E+3	1,82E+1	3,81E+1	6,43E+3	1,77E+3	0,00E+0	5,66E+1	1,41E+1	3,61E+1	-5,43E+2
PENRM	[MJ]	3,20E+2	0,00E+0	0,00E+0	0,00E+0	3,69E+1	0,00E+0	0,00E+0	0,00E+0	0,00E+0	-2,48E+2
PENRT	[MJ]	2,92E+3	1,82E+1	3,81E+1	6,43E+3	1,81E+3	0,00E+0	5,66E+1	1,41E+1	3,61E+1	-7,91E+2
SM	[kg]	4,05E-2	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0
RSF	[MJ]	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0
NRSF	[MJ]	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0
FW	[m^3]	5,53E-1	6,69E-4	8,71E-3	5,47E-2	2,00E-1	0,00E+0	2,12E-3	3,86E-4	9,22E-3	-2,74E-1

Legende	PERE = Erneuerbare Primärenergie als Energieträger; PERM = Erneuerbare Primärenergie zur stofflichen Nutzung; PERT = Total erneuerbare Primärenergie; PENRE = Nicht-erneuerbare Primärenergie als Energieträger; PENRM = Nicht-erneuerbare Primärenergie zur stofflichen Nutzung; PENRT = Total nicht erneuerbare Primärenergie; SM = Einsatz von Sekundärstoffen; RSF = Erneuerbare Sekundärbrennstoffe; NRSF = Nicht erneuerbare Sekundärbrennstoffe; FW = Einsatz von Süßwasserressourcen

ERGEBNISSE DER ÖKOBILANZ OUTPUT-FLÜSSE UND ABFALLKATEGORIEN: Fenster 1,23 x1,48 m mit Doppelverglasung

Parameter	Einheit	A1-A3	A4	A5	B1	B4	C1	C2	C3	C4	D
HWD	[kg]	1,47E+1	1,35E-2	1,07E-1	9,55E-1	1,54E+1	0,00E+0	4,35E-2	6,29E-3	4,16E+0	-2,08E+0
NHWD	[kg]	6,53E+1	1,71E-1	2,11E-1	6,60E+0	7,09E+1	0,00E+0	5,58E-1	5,22E-2	2,05E+1	-7,89E+0
RWD	[kg]	5,27E-3	1,39E-5	2,10E-5	1,65E-3	4,36E-3	0,00E+0	4,21E-5	1,86E-5	1,51E-4	-2,55E-4
CRU	[kg]	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0
MFR	[kg]	3,64E+0	0,00E+0	0,00E+0	0,00E+0	2,78E+1	0,00E+0	0,00E+0	4,57E+1	0,00E+0	0,00E+0
MER	[kg]	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0
EEE	[MJ]	1,28E-1	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	5,06E+0	-5,19E+0
EET	[MJ]	3,98E-1	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	1,57E+1	-1,61E+1

Legende	HWD = Gefährlicher Abfall zur Deponie; NHWD = Entsorgter nicht gefährlicher Abfall; RWD = Entsorgter radioaktiver Abfall; CRU = Komponenten für die Wiederverwendung; MFR = Stoffe zum Recycling; MER = Stoffe für die Energierückgewinnung; EEE = Exportierte Energie elektrisch; EET = Exportierte Energie thermisch

6. LCA: Interpretation

6.1 Zusammenfassung

Die Parameter Treibhauspotential GWP bzw. Verbrauch nicht-erneuerbarer Primärenergie PENRT stehen repräsentativ für die Indikatoren der Umweltauswirkungen bzw. des Ressourceneinsatz. Sie werden durch die in der Nutzungsphase bilanzierte Bereitstellung der Energie zum Ausgleich der durch den Fenstereinbau bedingten Transmissionswärmeverluste (Modul B1) dominiert. Wird die Nutzungsphase nicht betrachtet, fallen nahezu alle Umweltwirkungen den Modulen A1-A3 (Herstellung) und B4 (Austausche, hier insbesondere der Verglasung) zu. Demgegenüber vernachlässigbar sind die Einflüsse der End-of-Life Phase (Module C1–C4), die Abbruch und Abfallbehandlung abdeckt. Durch das Recyclingpotential sowie den Verbrennungsprozess im End-of-Life-Szenario und der daraus resultierenden Gutschrift von Strom und thermischer Energie kommt es rechnerisch zu negativen Werten in den Wirkungskategorien des Modul D.

Es sei darauf hingewiesen, dass die Ausweisung des Moduls B1 für Fenster optional ist. Da diese jedoch einen signifikanten Einfluss auf den Energiehaushalt eines Gebäudes haben, ist die Bilanzierung ihrer Nutzungsphase sinnvoll. Aus der Gesamtbetrachtung wird deutlich, dass es für die Optimierung der Umweltqualität für Fenster gilt, die durch den Wärmedurchgangskoeffizienten Uf bestimmten Transmissionswärmeverluste zu reduzieren und die solaren Gewinne (z. B. durch Ausrichtung und Beschattung) zu optimieren. Die Auswahl des Rahmenmaterials ist demgegenüber von untergeordneter Bedeutung.

6.2 Herstellungsphase

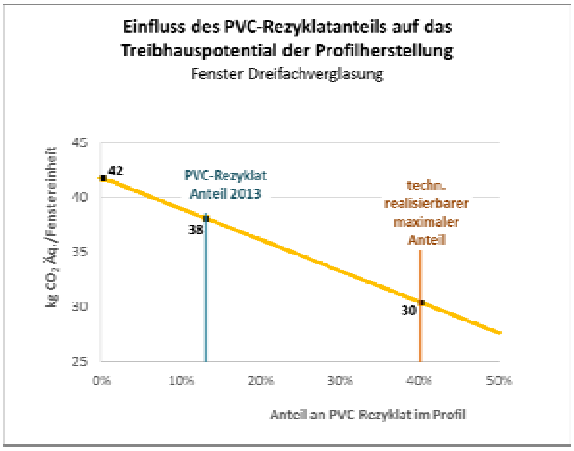
Die Herstellung des Isolierglases und der Beschläge stellen neben der Erzeugung des PVC-Rohstoffes die größten Anteile in allen Wirkungskategorien. Über 50 % der Umwelteinflüsse in der Herstellungsphase des Fensterelementes fallen der Produktion der Komponenten Isolierglas und Beschlag zu.

6.3 Sensitivität zum Einsatz von PVC-Rezyklat

Bei der Herstellung der PVC-Fensterprofile wird zum Teil PVC-Rohstoff durch rezykliertes Altfenstermaterial ersetzt. Allerdings ist die Verwendung von Altfenstermaterial für die Profilproduktion nach oben begrenzt: Zum einen steht nicht unbegrenzt Recyclingmaterial zur Verfügung, zum anderen machen konstruktionsbedingte Anforderungen den Einsatz von Frischmaterial notwendig. Ein Maximalanteil von 40 % PVC-Rezyklat - bezogen auf die Jahrestonnage der PVC-Fensterprofilproduktion - erscheint unter diesen Gesichtspunkten sinnvoll.

Anhand der Sensitivitätsbetrachtung für die Profilherstellung wird deutlich, dass durch die Rohstoffeinsparung eine signifikante Reduktion der CO2-Emissionen und damit des Treibhauspotentials GWP erreicht wird (Abbildung 1). Im Jahr der Datenerhebung betrug der Rezyklatanteil rund 13 %, wodurch das GWP um knapp 10 % reduziert werden konnte. Bei einem Rezyklatanteil von 40 % ergibt sich ein Einsparpotential für GWP in der Profilherstellung von insgesamt rund 28 %.

Abb. 1



6.4 Szenarien zu EoL / Entsorgungsquoten

Es werden - neben der Basisvariante - drei Szenarien betrachtet, um den Einfluss der stofflichen und thermischen Verwertung zu erfassen (vergl. Erläuterungen in Abschnitt 4).

C-a Schwerpunkt Deponie

Quoten für	Recycling	Verbrennung	Deponie
Glas	62%	-	38 %
PVC	-	-	100 %
Stahl/Aluminium	87 %	-	13 %
Sonstiges	-	-	100 %

C-b Schwerpunkt Verbrennung

Quoten für	Recycling	Verbrennung	Deponie
Glas	62 %	9 %	29 %
PVC	-	100 %	-
Stahl/Aluminium	87 %	-	13 %
Sonstiges	-	100 %	-

C-c Vollständiges Recycling

Quoten für	Recycling	Verbrennung	Deponie
Glas	100%	-	-
PVC	100 %	-	-
Stahl/Aluminium	100 %	-	-
Sonstiges	100 %	-	-

Nachfolgend sind einige Ergebnisse für ausgewählte Indikatoren gegenüber gestellt:

ausgewählte Parameter	C-a Schwerpunkt Deponie		C-b Schwerpunkt Verbrennung		C-c Schwerpunkt Recycling	
	C1-C4	D	C1-C4	D	C1-C4	D
GWP	6,26E+00	-1,97E+01	4,35E+01	-3,17E+01	6,96E+00	-4,87E+01
ODP	6,74E-07	-5,34E-07	1,36E-06	-1,92E-06	8,95E-07	-1,22E-06
AP	1,92E-02	-6,80E-02	6,95E-02	-8,53E-02	2,55E-02	-1,72E-01
EP	5,30E-03	-8,53E-03	1,18E-02	-1,07E-02	6,42E-03	-2,00E-02
POCP	1,04E-03	-1,01E-02	2,81E-03	-1,13E-02	1,07E-03	-1,70E-02
ADPe	9,90E-06	-3,92E-05	1,57E-04	-4,13E-05	1,50E-05	-2,03E-04
ADPf	6,71E+01	-3,06E+02	1,87E+02	-4,85E+02	8,94E+01	-8,99E+02
PENRT	7,16E+01	-3,47E+02	2,57E+02	-5,48E+02	9,59E+01	-1,11E+03

Dieser Vergleich verdeutlicht den Einfluss des Entsorgungsweges auf die Umweltwirkungen:

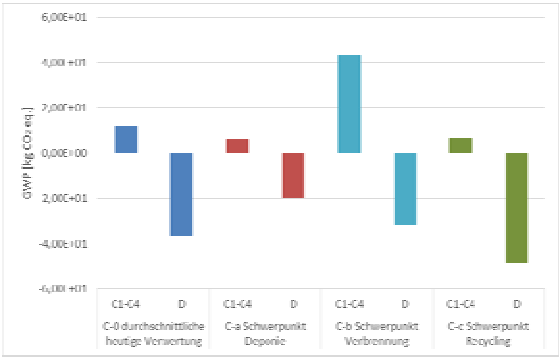
C-a: Gegenüber der Basisvariante sind sowohl die Belastungen als auch die Gutschriften geringer, da keine Verbrennung stattfindet.

C-b: Die Verbrennung verursacht deutlich höhere Werte für alle Umweltauswirkungen. Die Gutschrift durch die bei der Müllverbrennung erfolgte Energiegewinnung ist geringer als die in der Basisvariante erzielte Gutschriften durch stoffliche Verwertung.

C-c: Die über alle Szenarien größten Gutschriften werden durch die umfassende stoffliche Verwertung erzielt.

In Abbildung 2 sind die Werte für das Treibhauspotential GWP beispielhaft für alle Szenarien gegenüber gestellt.

Abb. 2



6.5 Einzelbetrachtung zu den Wirkungsindikatoren und deren Einflussfaktoren

6.5.1 Umweltauswirkungen

Globales Erwärmungspotential (GWP)
Das Treibhauspotential wird zu rund 92 % durch die CO2-Emissionen bestimmt, die größtenteils den Energieverbräuchen in der Nutzungsphase (B1) sowie für die Rohstoffproduktion (Glas, PVC, Stahl) zuzuordnen sind. Den restlichen Beitrag steuern Methanemissionen bei, die ebenfalls dem Energieverbrauch der Nutzungsphase (B1) zuzuordnen sind.

Abbaupotential der stratosphärischen Ozonschicht (ODP)
Das bei der Herstellung der Brennstoffe Heizöl und Gas entstehende Halon 1391 liefert zu diesem Indikator den Hauptanteil.

Versauerungspotential von Boden und Wasser (AP)
Die Wirkungskategorie wird zu 71 % durch SOx- und zu 27 % durch NOx-Emissionen bestimmt. Hauptemissionsquellen sind die Energieproduktion in der Nutzungsphase sowie die Produktion der Rohstoffe (hauptsächlich Verglasung, PVC und Stahl).

Eutrophierungspotential (EP)
Das Eutrophierungspotential spiegelt vor allem NOx-Emissionen (62 %), Phosphat (22 %) und chemischen Sauerstoffbedarf (7 %) wider. Die größten Beiträge liefern die Wärmeerzeugung (B1) und die Glasproduktion (A1).

Bildungspotential für troposphärisches Ozon (POCD)
Das Sommersmogpotential wird zu 55 % verursacht durch das bei der Verbrennung fossiler Energieträger sowie der Glasherstellung entstehende SOx (B1 und A1). Weitere Beiträge liefern VOC-Emissionen, verursacht durch den Verbrauch fossiler Brennstoffe und der Produktion der Rohstoffe (Glas, Stahl, PVC).

Potential für den abiotischen Abbau nicht-fossiler Ressourcen (ADPE)
Der Verbrauch seltener Elemente (hier insbesondere Zink 31 %, Chrom 18 %) ist hauptsächlich der Herstellung von verzinkten Stählen für die Beschläge zuzuschlagen (A1–A3).

Potential für den abiotischen Abbau fossiler Brennstoffe (ADPF)
Zu 65 % wird diese Wirkungskategorie bestimmt durch den Verbrauch der Energieträger Erdgas, Erdöl und Steinkohle für die Erzeugung von Heizwärme in der Nutzungsphase (B1). Weiterhin fließen der Erdgas- und Erdölverbrauch sowohl bei der Glasproduktion (zur Bereitstellung der Energie) wie auch bei der Produktion von PVC (als Energie und auch als Rohstoff) ein.

6.5.2 Ressourceneinsatz

Erneuerbare Primärenergie als Energieträger (PERE) und zur stofflichen Nutzung (PERM)
Der Einsatz erneuerbarer Energie ist insgesamt gering. Hierunter fallen die Nutzung von Holzrohstoffen für das Verpackungsmaterial (Paletten), der Verbrauch des aus erneuerbarer Energie hergestellten Stroms (Wind- und Wasserkraft) sowie bei einigen Unternehmen die Wärmeerzeugung durch die Verbrennung von Holzabfällen aus der Produktion.

Nicht-erneuerbare Primärenergie als Energieträger (PENRE) und zur stofflichen Nutzung (PENRM)
Der größte Verbrauch nicht-erneuerbarer Energie findet - neben der Nutzungsphase - bei der Produktion der Rohstoffe für Verglasung, PVC und Stahl statt. Demgegenüber weisen die Profilextrusion und der Fensterbau einen deutlich geringeren Verbrauch auf. Der Verbrauch der nichterneuerbaren Energie zur stofflichen Nutzung ist zurückzuführen auf den Rohstoffeinsatz bei der Erzeugung der Kunststoffe (PVC-Rahmen, Beschichtungen, Folien, Dichtungen).

Einsatz von Sekundärstoffen (SM)
Sekundärmaterial kommt vorrangig bei der Profilproduktion in Form von recyceltem PVC aus Altfenstermaterial zum Einsatz. Darüber hinaus kommt eine geringe Menge Altpapier/-pappe für die Herstellung von Verpackungsmaterial zur Verwendung.

Sekundärbrennstoffen (RSF, NRSF)
Sekundärbrennstoffen werden nicht eingesetzt.

Einsatz von Süßwasserresourcen (FW)
Der größte Verbrauch von Wasser erfolgt in der Glas- und PVC-Herstellung.

6.5.3 Output-Flüsse und Abfallkategorien

Komponenten für die Wiederverwendung (CRU)
Kein Aufkommen

Stoffe zum Recycling (MFR)
Den größten Anteil für das Recycling in der Abfallverarbeitung liefern PVC-Rahmenmaterial, Verglasung und Stahl (Verstärkung, Beschlag). Ein geringer Anteil bezieht sich auf das Verpackungsrecycling in der Produktionsphase.

Stoffe für die Energierückgewinnung (MER)
Analog zu den Abfallströmen zum Recycling liefert hier die Verbrennung des Altfenstermaterials den größten Anteil. Hinzu kommt aus den Modulen A1 – A3 ein kleiner Anteil aus der Verbrennung von Verpackungsmaterial (Pappe und Holzpaletten) am Ende seiner Lebensdauer.

Exportierte Energie (EE)
Die Energierückgewinnung bei der Verbrennung entstammt – wie zuvor beschrieben - zum größten Teil aus der Abfallverarbeitung (C3) und zu einem kleineren Teil aus Verpackungsmaterial (A1–A3).

7. Nachweise

Brand

Brandversuche an mehreren Prüfelementen verschiedener Hersteller nach SBI-Testverfahren nach /DIN EN 13823/ durch Fa. Efectis Nederland BV, Projektnummer 2012-Efectis-R0205

Ergebnis: Gemäß den durchschnittlich ermittelten Parametern erfüllen Kunststofffenster die Klassifizierungskriterien nach /DIN EN 13501-1:2007+A1:2009/ wie folgt:

Brandverhalten: B - E
Rauchentwicklung: s3
brennendes Abtropfen: d0

VOC (flüchtige organische Verbindungen)

Forschungsprojekt VOC-Emissionen in Bauprodukten; Bundesamt für Bauwesen und Raumordnung im Rahmen der Forschungsinitiative Zukunft Bau Aktenzeichen Z6-10.08.18.7-08.20/II2-F20-08-005; Dezember 2010

Ergebnis: Bezüglich der Innenraumbelastung werden die „Anforderungen der Bewertung durch das /AgBB-Schema/ [...] größtenteils deutlich unterschritten."

8. Literaturhinweise

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AVV: Verordnung über das Europäische Abfallverzeichnis vom 10. Dezember 2001

Bauproduktenverordnung: Verordnung (EU) Nr. 305/2011 des europäischen Parlaments und des Rates vom 9. März 2011 zur Festlegung harmonisierter Bedingungen für die Vermarktung von Bauprodukten und zur Aufhebung der Richtlinie 89/106/EWG des Rates

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DIN 4102-1: Brandverhalten von Baustoffen und Bauteilen - Teil 1: Baustoffe; Begriffe, Anforderungen und Prüfungen

DIN EN 674: Glas im Bauwesen - Bestimmung des Wärmedurchgangskoeffizienten (U-Wert) - Verfahren mit dem Plattengerät; Deutsche Fassung EN 674:2011

DIN EN 675: Glas im Bauwesen - Bestimmung des Wärmedurchgangskoeffizienten (U-Wert) - Wärmestrommesser-Verfahren; Deutsche Fassung EN 675:2011

DIN EN 1026: Fenster und Türen - Luftdurchlässigkeit - Prüfverfahren; Deutsche Fassung EN 1026:2000

DIN EN 1027: Fenster und Türen - Schlagregendichtheit - Prüfverfahren; Deutsche Fassung EN 1027:2000

DIN EN 1191: Fenster und Türen - Dauerfunktionsprüfung - Prüfverfahren; Deutsche Fassung EN 1191:2012

DIN EN 12207: Fenster und Türen - Luftdurchlässigkeit - Klassifizierung; Deutsche Fassung EN 12207:1999

DIN EN 12208: Fenster und Türen - Schlagregendichtigkeit - Klassifizierung; Deutsche Fassung EN 12208:1999

DIN EN 12210: Fenster und Türen - Widerstandsfähigkeit bei Windlast - Klassifizierung; Deutsche Fassung EN 12210:1999 + AC 2002

DIN EN 12211: Fenster und Türen - Widerstandsfähigkeit bei Windlast - Prüfverfahren; Deutsche Fassung EN 12211:2000

DIN EN 12400: Fenster und Türen - Mechanische Beanspruchung - Anforderungen und Einteilung; Deutsche Fassung EN 12400:2002

DIN EN 13501-1: Klassifizierung von Bauprodukten und Bauarten zu ihrem Brandverhalten - Teil 1: Klassifizierung mit den Ergebnissen aus den Prüfungen zum Brandverhalten von Bauprodukten; Deutsche Fassung EN 13501-1:2007+A1:2009

DIN EN 13823: Prüfungen zum Brandverhalten von Bauprodukten - Thermische Beanspruchung durch einen einzelnen brennenden Gegenstand für Bauprodukte mit Ausnahme von Bodenbelägen; Deutsche Fassung EN 13823:2010

DIN EN 14351-1: "Fenster und Türen - Produktnorm, Leistungseigenschaften - Teil 1: Fenster und Außentüren"; Deutsche Fassung EN 14351-1: 2006+A2:2016

DIN V 18599-2:
DIN V 18599-2:2011-12, Energetische Bewertung von Gebäuden - Berechnung des Nutz-, End- und Primärenergiebedarfs für Heizung, Kühlung, Lüftung, Trinkwarmwasser und Beleuchtung - Teil 2: Nutzenergiebedarf für Heizen und Kühlen von Gebäudezonen

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Ecological Scarcity Method: Swiss Eco-Factors 2013 according to the Ecological Scarcity Method - Methodological fundamentals and their application in Switzerland; Frischknecht & Büsser Knöpfel; 2013

GHS: Global Harmonisiertes System zur Einstufung und Kennzeichnung von Chemikalien

RAL-GZ 695: Fenster, Haustüren, Fassaden und Wintergärten – Gütesicherung

RAL-GZ 716: Allgemeine Güte- und Prüfbestimmungen, Systembeschreibung und Eignungsnachweis für Kunststoff-Fenster- und Türsysteme

REACH: Verordnung (EG) Nr. 1907/2006 des Europäischen Parlaments und des Rates vom 18. Dezember 2006 zur Registrierung, Bewertung, Zulassung und Beschränkung chemischer Stoffe

Institut Bauen und Umwelt e.V., Berlin (Hrsg.):
Erstellung von Umweltproduktdeklarationen (EPDs);

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

EN 15804
EN 15804:2012-04+A1 2013, Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products.

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Folgende Unternehmen waren an der Datenerhebung beteiligt:

ENVIRONMENTAL PRODUCT DECLARATION

as per /ISO 14025/ and /EN 15804/

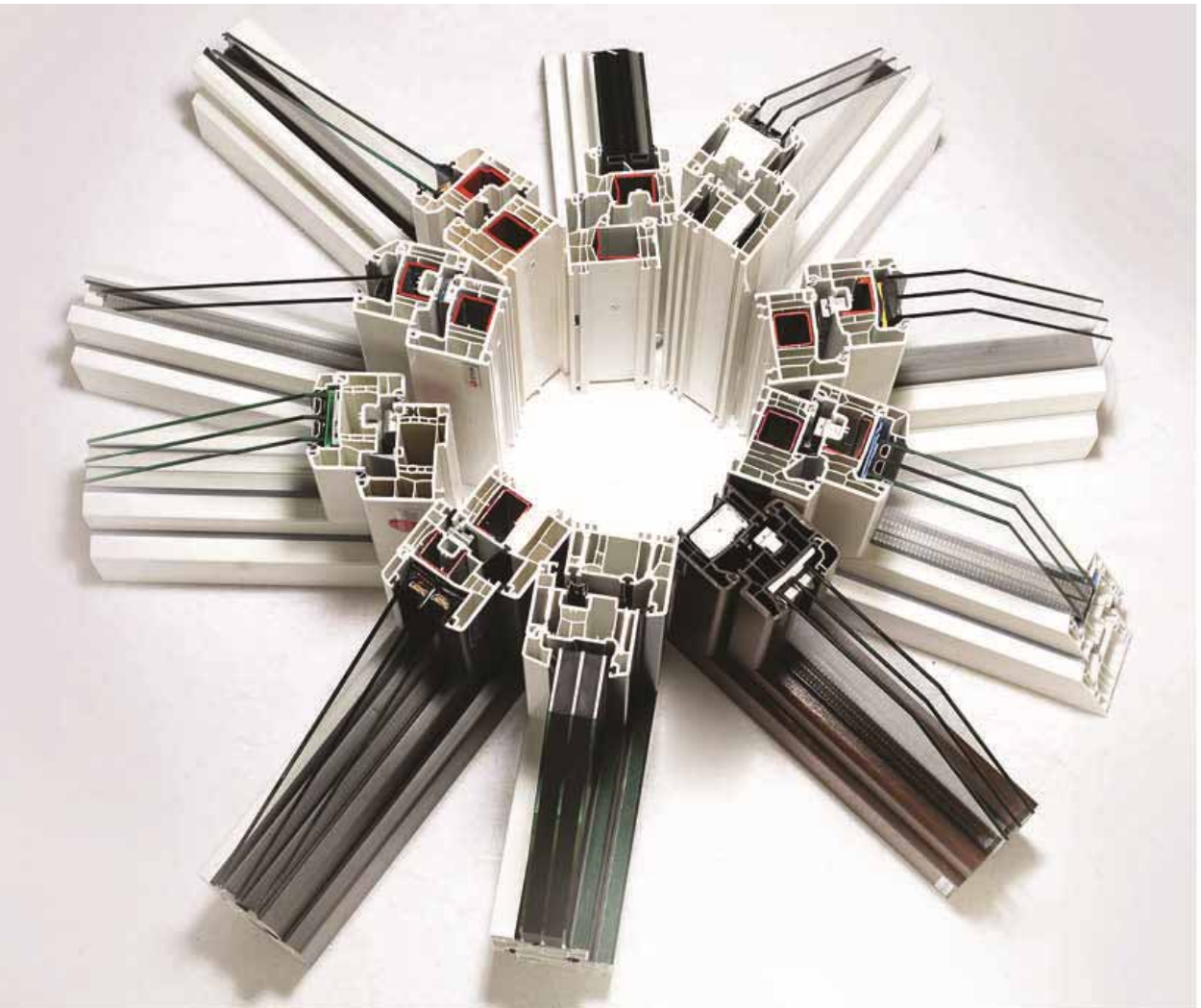
Owner of the Declaration	QKE Qualitätsverband Kunststofferzeugnisse e.V. EPPA European PVC Window Profiles and Related Building Products Association ivzw
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-QKE-20170001-IBG1-EN
ECO EPD Ref. No.	ECO-00000039
Issue date	27.04.2017
Valid to	26.04.2022

PVC-U plastic windows
with the dimensions 1.23 x 1.48 m
and insolated triple-glazing

QKE e.V.
EPPA ivzw

www.ibu-epd.com / https://epd-online.com

Institut Bauen und Umwelt e.V.



ECO PLATFORM EPD EN 15804 VERIFIED



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EPPA

QUALITÄTSVERBAND KUNSTSTOFFERZEUGNISSE E.V.
FÜR LANGLEBIGE KUNSTSTOFFPRODUKTE

1. General Information

QKE - EPPA

Window (1.23 m x 1.48 m) with insolated triple-glazing

Programme holder
IBU - Institut Bauen und Umwelt e.V.
Panoramastr. 1
10178 Berlin
Germany

Owner of the Declaration
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Am Hofgarten 1-2; 53113 Bonn
Germany

EPPA - European PVC Window Profiles and Related Building Products Association ivzw
Avenue de Cortenbergh 71; 1000 Brussels
Belgium

Declaration number
EPD-QKE-20170001-IBG1-EN

Declared product / Declared unit
PVC-U single-sash window, with the dimensions 1.23 m x 1.48 m, insulated triple-glazing and variable profile surface (white, painted, laminated with PVC foil or coated with PMMA).

All planned replacements of the components - sealings, fittings and glazing - are included in the declared unit.

This Declaration is based on the Product Category Rules:
Windows and doors, 11.2015
(PCR tested and approved by the SVR)

Issue date
27.04.2017

Valid to
26.04.2022

Scope:
This EPD is an association EPD. The weighted average from the manufacturers' specifications submitted by twelve member companies from 22 sites in seven countries was used as the data basis for the manufacture of plastic profiles. The recorded production volume represents a share of approximately 70% of the production of all system houses affiliated with the QKE and EPPA associations and therefore nearly 60% of European production.

The scope covers different configurations of both profile reinforcement and surface treatment. Window constructions using glazing blocks as well as bonded glazing systems are included. This EPD thus covers all designs for PVC-U windows that conform to the stated requirements.

The following companies were involved in the collection of data:

Systemhouses
aluplast GmbH, D – Karlsruhe
Deceuninck nv, B – Hooglede-Gits
GEALAN Fenster-Systeme GmbH, D – Oberkotzau
Internorm Bauelemente GmbH, A – Traun
hapa AG, D – Herrieden
L.B. Profile GmbH, D – Herbstein
profine GmbH, D – Pirmasens
Rehau AG + Co., D – Erlangen
Salamander Industrie-Produkte GmbH, D – Türkheim
Schüco Polymer Technologies KG – Weißenfels
Stöckel GmbH, D – Vechtel
VEKA AG, D – Sendenhorst

Window manufacturers:
BE Bauelemente GmbH, D – Leopoldshöhe-Greste
Internorm Bauelemente GmbH, A – Traun
Stöckel GmbH, D – Vechtel
TMP Fenster + Türen GmbH, D – Bad Langensalza
WERU GmbH, D – Rudersberg
Wirus Fenster GmbH & Co. KG, D – Rietberg

This document is translated from the German Environmental Product Declaration into English. It is based on the German original version EPD-QKE20130313-IBG1-DE. The verifier has no influence on the quality of the translation.

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.

Verification

The CEN Norm /EN 15804/ serves as the core PCR
Independent verification of the declaration according to /ISO 14025/
☐ internally ☒ externally

Prof. Dr.-Ing. Horst J. Bossenmayer
(President of Institut Bauen und Umwelt e.V.)

Dr. Burkhart Lehmann
(Managing Director IBU)

Dr. Eva Schmincke
(Independent verifier appointed by SVR)

2. Product

2.1 Product description / Product definition

The declared product is a single-sash tilt & turn window with the dimensions 1.23 x 1.48 m and insulated triple-glazing. The windows consist of PVC frame profles with a transparent glass filling. A variety of materials are used to reinforce the frame profiles: profiles made from steel or aluminium, polyurethane foam or glass fibre extruded into the PVC-U material.

The surface of the frame can vary in design: laminated with PVC foil, coated with PMMA (polymethyl metha acrylate) or painted. These can produce white or coloured, textured or smooth surfaces.

The seals are made from plasticised PVC, EPDM (ethylene propylene diene monomers) or TPE (thermoplastic elastomers), the fittings from steel.

For the window a reference service life of 40 years is assumed. The respective useful lives of the components - glazing, seals and fittings - is shorter, however, which means that these will need replacing during the reference service life of the window unit. These planned replacements of individual components are also included in the declared unit.

This EPD does not relate to a specific product from one manufacturer, but confirms the average environmental quality for all PVC-U windows from member companies of the EPPA und QKE associations.

Further specific data can be found in the relevant manufacturer's product description.

Placing on the market within EU/EFTA (with the exception of Switzerland) is subject to the /Construction Products Regulation/ (EU) No. 305/2011. The products must have a declaration of performance compliant with the harmonized product standard /EN14351-1/ and the CE marking. Usage is governed by the relevant national rules.

2.2 Application

Windows are used in the outer shell of buildings for lighting, ventilation and protection from the elements.

2.3 Technical Data

The data of the declaration of performance according to the harmonized product standard /EN 14351-1/ has to be applied to each window unit placed on the market respectively. The basis for the calculation is the following technical data:

Name	Value	Unit
Heat transfer coefficient glass Ug according to /EN 674/, /EN 675/	0.6	W/(m²K)
Pane construction	4/16/4/16/4	mm
Total energy transmittance g	50	%
Heat transfer coefficient window Uw according to /EN 674/, /EN 675/	0.92	W/(m²K)
Watertightness according to /EN 1027/, /EN 12208/	4A - 9A	class
Mechanical stress (durability) according to /EN 1191/, /EN 12400/	10,000 - 20,000	cycles

For further technical construction data, only the minimum requirements that apply to quality-assured windows according to /RAL-GZ 695/ are cited below. Depending on the design of frame, seals and fittings, considerably higher performance classes can be achieved by the windows produced.

- Min. air permeability according to /EN 1026/, /EN 12207/: Class 2
- Min. resistance to wind load according to /EN 12211/, /EN 12210/: Class B1

Further specific data can be found in the relevant manufacturer's product description.

2.4 Delivery status

This EPD relates to plastic windows with the dimensions 1.23 x 1.48 m. The face area is 1.82 m².

2.5 Base materials / Ancillary materials

The base materials of the declared unit are:

Name	Value	Unit
Glazing	58.7	mass %
Frame material PVC-U	22.9	mass %
Reinforcement steel	13.9	mass %
Fittings steel	3.4	mass %
Seals PVC	0.9	mass %
Glazing blogs / screws	0.2	mass %

The raw materials and additives used to manufacture the PVC-U frame material can be found in the following overview:

PVC formulation

- 81.0 mass % PVC
- 8.1 mass % Filler (chalk)
- 4.9 mass % Impact resistance modifiers
- 2.8 mass % Calcium/zinc stabilisers
- 3.2 mass % Pigment titanium oxide (TiO_2)

Recycled material obtained from used windows is used to manufacture proprietary profiles. These profiles can contain more than 0.1 % lead compounds. These are treated as SVHC (Substances of Very High Concern) in accordance with /REACH/.

2.6 Manufacture

Plastic windows are made from a variety of individual components: each window consists of a PVC-U frame with seals, the glazing, the fittings and, where required, the reinforcement.

PVC-U profiles for window frames are manufactured in an extrusion process from a mixture of PVC powder and additives. These protect the PVC from damage during processing and give the profile the necessary properties (impact resistance, colour, weathering stabiblity etc.).
The PVC powder used to manufacutre the frames is a widely used bulk plastic and is obtained through polymerisation. Due to its chemical structure, PVC contains a high proportion of the halogen chlorine.

The majority of window frames are made from white rigid PVC profiles. Some frames are manufactured from profiles that are also laminated with PVC film, coated with PMMA or painted.

Seals are generally attached to the window profiles in a coextrusion process and consist of plasticised PVC, but also EPDM or TPE are used.

The window profiles are delivered in standard lengths to the window manufacturers, where they are sawn to the length actually required for the particular window. Where necessary, steel reinforcement is inserted and screwed in. The profiles are then welded, the fittings attached and the pane and glass retaining strips fitted. the window can now be supplied and fitted.

The steel for manufacturing fittings is largely optained from iron ores in a blast furnace process by means of reduction with coke.

The basic raw material for manufacturing the glazing is quartz sand to which various fluxing agents and oxidants (Soda ash, sodium sulphate, potash etc.) have been added. In a further proceeding step, the molten raw glass is floated on molten tin, from which a flat strip of glass can be continuously produced (float glass process).

Quality monitoring

The member companies of QKE e.V. are subject to external quality monitoring within the framework of voluntary self-regulation. Plastic window systems that bear the RAL quality mark according to /RAL-GZ 716/ are listed on the website at gkfp.de.

2.7 Environment and health during manufacturing

Of all the constituents of PVC formulations, only the calcium/zinc stabilisers have to be classified and marked as follows in accordance with /GHS/:

H302: Harmful if swallowed
H318: Causes serious eye damage
H317: May cause an allergic skin reaction
Pictogram: Corrosive and irritating

2.8 Product processing/Installation

The finished windows are transported to the construction site and installed. Screws made from zinc-plated steel and polyurethane foam are required for each window unit for installation.

2.9 Packaging

The profiles – if they are not going to be processed further at the same site – are transported to the window manufacturer, usually on reusable steel pallets. Disposable wooden pallets are used in isolated cases. Cardboard, PE film and foam pads are also used when transporting the individual components to the window manufacturer.

Polyethylene foam pads, a cardboard edge protector, polypropylene load retaining straps, aluminium or steel clamps and PE stretch film are used as packaging materials for each window unit for assembly.

2.10 Condition of use

Plastic windows are durable and long lasting. There is no change in the material composition while the product is being used.

2.11 Environment and health during use

PVC-U frame materials do not have a negative influence on the environment and health. If the use of solvent-free components is ensured further down the supply chain, this also applies for the final window product.

2.12 Reference service life

The reference service life of the declared PVC-U plastic window is 40 years according to /BBSR/. The technical life of certain individual components is thus exceeded; as a result, there will be three replacements of seals and one replacement of fittings and glazing during service life.

2.13 Extraordinary effects

Fire

Plastic windows are classified in classes B - E for fire behaviour (depending on the surface characteristics), s3 for smoke gas development and d0 for burning droplets in accordance with /EN 13501-1/.

Fire protection

Name	Value
Building material class	B - E
Burning droplets	d0
Smoke gas development	s3

Plastic windows therefore meet the requirements of B2 "normal combustibility" according /DIN 4102-1/ respectively class E according /EN 13501-1/ as a minimum.

Water

No negative effects on the environment are to be expected in the event of unforeseen exposure to water, such as in the case of flooding.

Mechanical destruction

No negative effects on the environment are to be expected in the event of unforeseen mechanical destruction.

2.14 Re-use phase

The most important processes in the reuse phase of PVC-U are the recycling of materials and landfilling. In addition, PVC can also be thermally utilised.

A large amount of the steel used in the fittings and reinforcement is also recycled for materials.

Glazing can also be recycled very well. Otherwise it is mostly disposed of in landfill sites, but a small amount is also sent for incineration.

2.15 Disposal

The individual components of the window can be disposed of after use as a nonhazardous waste. The waste codes according to European Waste Catalogue /EWC/ are as follows:

- 17 02 02 Glass
- 17 02 03 Plastic
- 17 04 05 Iron and steel

2.16 Further information

Possible sources for further information are available from the associations' websites

www.qke-bonn.de
www.eppa-profiles.eu

and the websites of the system houses and window manufacturers.

3. LCA: Calculation rules

3.1 Declared Unit

The declared unit is a window 1.23 x 1.48 m (reference window in accordance with /EN 14351-1/) with a mass of 71.9 kg.The frame portion F_F in relation of the overall area is 33 %. Planned replacements of the glazing, fittings and seals during a service life from 40 years are included.

Declared unit

Name	Value	Unit
Declared unit	71.9 kg	Reference window 1.23m x 1.48m, frame portion 25% to 35%

3.2 System boundary

The entire life cycle of the product "from cradle to grave" is considered.

Manufacture

The aggregate view in the form of modules A1-A3 is used for manufacturing. This includes the supply of raw materials, the manufacture of the steel reinforcement, flat glass, fittings and PVC-U profile, all transportation to the window manufacturer, the energy requirements for constructing the windows and any production waste generated. In particular, consumption for the heating and illumination of production rooms and their adjacent premises is also included. Capital goods (machinery, buildings etc.) are not considered.

Transportation from the manufacturer's gate to the construction site is taken into account in module A4. All processes relating to the installation of the window in the building are considered in module A5.

Usage

The transmission heat losses occurring during the usage phase are taken into account in module B1. The measures described in 2.13 for replacing window components are taken into account in module B4.

Disposal

All processes relating to the removal, dismantling or demolition of the window from the building, including an initial sorting on the construction site, are accounted for in module C1.

Redistribution transportation from the construction site for the recovery of heat, recycling of materials and disposal in landfill are considered in module C2. Module C3 considers waste treatment, including sorting for recycling.

Landfilling and thermal recycling fall under module C4.

Credit

Finally, module D shows the potential for re-use, recovery and recycling derived from modules C3 and C4.

3.3 Estimates and assumptions

Apart from the assumptions and estimates described in section 4, no further assumptions or estimates are made that will impact or influence the outcome.

3.4 Cut-off criteria

The disregarded input flows are smaller than 1% of both the total mass and the total flow of primary energy. Taken together, they form less than 5% of the total mass or 5% of the total energy.

3.5 Background data

The primary data for profile extrusion and window manufacturing were provided by the members of the declaring associations (see Scope).The background data for raw materials as well as the manufacturing of the PVC, glazing and fittings and all other data originate from the /ecoinvent 2.2/ database.

This database does not allow calculation of the net flows for fresh water consumptions, so the assumptions are based on the /Ecological Scarcity Method/.

3.6 Data quality

The data for the products examined was collected through analyses of internal production and environmental data, by collating LCA-related data within the supply chain for 2013, and on the basis of average data submitted by the associations. The data collected was checked for plausibility and consistency.

The quality of the background data for glass production is considered to be of the greatest importance because the manufacture of glass makes a significant contribution to the production stage A1-A3.

3.7 Period under review

All primary data was collected in 2013.

3.8 Allocation

The data from profile extrusion and window manufacturing is based on the average weighted by production volume.

3.9 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.
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4. LCA: Scenarios and additional technical information

The following technical information forms the basis for the declared modules, or can be used to develop specific scenarios in the context of a building assessment if modules are not declared (MND).

Usage (B1) see Chapter 3.2 Usage

The net heat losses caused by the window are taken into account here. These consist of the transmission heat losses and the solar heat gains from the window. The impacts in the use phase depend to a very large extent on the actual climatic and technical circumstances of a specific building.

The calculations off the heat losses and gains and the results of the impact assessment are based on parameters for average Central European conditions:

The energy demand during the use phase at the reference location is calculated from the transmission heat losses and the solar heat gains according to /DIN V 18599-2/.

Name	Value	Unit
Degree day factor Central Europe	3641	K*d
Solar irradiation	209	kWh/m²

The provision of heating energy was modeled according to the data for German heating requirements: 49% gas, 30% heating oil and 13% district heating. The remaining 8% are added in equal shares to the cited energy sources.

Replacement (B4), renovation (B5)

The replacement of individual components that have reached the end of their technical life according to /BBSR/ is considered in module B4.

Name	Value	Unit
Replacement cycle glazing	1	Number/RSL
seals	3	Number/RSL
fittings	1	Number/RSL

Reference service life

The reference service life of the window as well as the technical service life of individual components according to /BBSR/ is set as follows:

Name	Value	Unit
Reference service life window unit	40	a
Reference service life isolated glazing	30	a
Reference service life fittings	25	a
Reference service life seals	12	a

End of lifetime (C1-C4)

At the end of their useful life windows and window components can be easily collected, sorted and recycled. Otherwise they are disposed of in landfill or in waste incineration plants for heat recovery. Recycling rates and disposal methods are country specific and vary widely between European countries. For module C four scenarios in total are assessed:
C-0 present average recovery
C-a priority landfill
C-b priority incineration
C-c priority recycling

For C-a und C-b the rates of material recycling of glass and metal are assumed to be the same as today (C-0), while the remaining share is not led for recycling is allocated completely to landfill (C-a) and incineration (C-b). The result of these scenarios a - c and of LCA are presented in chapter 6.4.

Rates for collecting and recovery for C-0

Name	Value	Unit
Collection rate for all materials	95	%
* thereof are recycled	-	
glass	65	%
PVC	59	%
steel/aluminium	92	%
others	0	%
* incineration quote of the material to be disposed	-	
glass	25	%
PVC	35	%
steel/aluminium	0	%
others	20	%

Re-use, recovery and recycling potential (D), relevant scenario

The energy (thermal energy and electricity) respectively the recycled material resulting from thermal and material utilization are credited here.

5. LCA: Results

The results apply to all kind of profile reinforcements and surfaces listed in the scope for window systems with glazing blocks as well as bonded glazing systems. The present average rates for recycling (scenario C-0) appley to the end of life stages C1 to C4.

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

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	X	X	X	MND	MND	X	MND	MND	MND	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: window (1,23 x 1,48 m) with insulated double glazing

Parameter	Unit	A1-A3	A4	A5	B1	B4	C1	C2	C3	C4	D
GWP	[kg CO_2-Eq.]	1.58E+2	1.07E+0	1.96E+0	4.01E+2	1.12E+2	0.00E+0	3.31E+0	8.47E-1	7.82E+0	-3.67E+1
ODP	[kg CFC11-Eq.]	1.05E-5	1.75E-7	2.49E-8	5.91E-5	1.01E-5	0.00E+0	5.46E-7	1.14E-7	1.80E-7	-1.10E-6
AP	[kg SO_2-Eq.]	8.25E-1	4.20E-3	7.84E-3	5.56E-1	7.12E-1	0.00E+0	1.31E-2	5.97E-3	1.00E-2	-1.25E-1
EP	[kg $(PO_4)^{3-}$-Eq.]	9.17E-2	8.57E-4	1.59E-3	6.39E-2	7.83E-2	0.00E+0	2.68E-3	1.28E-3	2.66E-3	-1.48E-2
POCP	[kg ethene-Eq.]	4.14E-2	1.39E-4	4.44E-4	4.38E-2	3.04E-2	0.00E+0	4.37E-4	1.67E-4	6.67E-4	-1.35E-2
ADPE	[kg Sb-Eq.]	1.31E-3	3.24E-6	1.28E-5	8.32E-5	1.24E-3	0.00E+0	1.02E-5	7.67E-7	2.30E-5	-1.31E-4
ADPF	[MJ]	2.40E+3	1.71E+1	3.27E+1	6.31E+3	1.49E+3	0.00E+0	5.35E+1	1.27E+1	2.54E+1	-6.51E+2

Caption	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

RESULTS OF THE LCA - RESOURCE USE: window (1,23 x 1,48 m) with insulated double glazing

Parameter	Unit	A1-A3	A4	A5	B1	B4	C1	C2	C3	C4	D
PERE	[MJ]	1.51E+2	2.32E-1	1.70E+0	2.80E+1	1.03E+2	0.00E+0	7.09E-1	2.74E-1	2.03E+0	-1.96E+1
PERM	[MJ]	1.35E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
PERT	[MJ]	1.52E+2	2.32E-1	1.70E+0	2.80E+1	1.03E+2	0.00E+0	7.09E-1	2.74E-1	2.03E+0	-1.96E+1
PENRE	[MJ]	2.60E+3	1.82E+1	3.81E+1	6.43E+3	1.77E+3	0.00E+0	5.66E+1	1.41E+1	3.61E+1	-5.43E+2
PENRM	[MJ]	3.20E+2	0.00E+0	0.00E+0	0.00E+0	3.69E+1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-2.48E+2
PENRT	[MJ]	2.92E+3	1.82E+1	3.81E+1	6.43E+3	1.81E+3	0.00E+0	5.66E+1	1.41E+1	3.61E+1	-7.91E+2
SM	[kg]	4.05E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
RSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
NRSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
FW	[m^3]	5.53E-1	6.69E-4	8.71E-3	5.47E-2	2.00E-1	0.00E+0	2.12E-3	3.86E-4	9.22E-3	-2.74E-1

Caption	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 – OUTPUT FLOWS AND WASTE CATEGORIES: window (1,23 x 1,48 m) with insulated double glazing

Parameter	Unit	A1-A3	A4	A5	B1	B4	C1	C2	C3	C4	D
HWD	[kg]	1.47E+1	1.35E-2	1.07E-1	9.55E-1	1.54E+1	0.00E+0	4.35E-2	6.29E-3	4.16E+0	-2.08E+0
NHWD	[kg]	6.53E+1	1.71E-1	2.11E-1	6.60E+0	7.09E+1	0.00E+0	5.58E-1	5.22E-2	2.05E+1	-7.89E+0
RWD	[kg]	5.27E-3	1.39E-5	2.10E-5	1.65E-3	4.36E-3	0.00E+0	4.21E-5	1.86E-5	1.51E-4	-2.55E-4
CRU	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MFR	[kg]	3.64E+0	0.00E+0	0.00E+0	0.00E+0	2.78E+1	0.00E+0	0.00E+0	4.57E+1	0.00E+0	0.00E+0
MER	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
EEE	[MJ]	1.28E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	5.06E+0	-5.19E+0
EET	[MJ]	3.98E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.57E+1	-1.61E+1

Caption	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; EEE = Exported thermal energy

6. LCA: Interpretation

6.1 Summary

The parameters of global warming potential (GWP) and the use of non-renewable primary energy (PENRT) represent the indicators of environmental impacts and use of resources. They are dominated by the use-phase-based provision of energy to compensate for the transmission heat losses caused by installing the window (module B1). If the use phase is taken out of the equation, virtually all environmental impacts are caused by modules A1-A3 (manufacturing) and B4 (replacements, particularly of the glazing). By contrast, the impact of the end of life stage (modules C1-C4), covering demolition and waste treatment, is negligible. The recycling potential and the combustion process in the end-of-life scenario and the resulting credit of electricity and thermal energy lead on paper to negative values in the effects categories of module D.

It should be pointed out that the itemisation of module B1 for windows is optional. However, due to its significant influence on the building's overall energy consumption, a balancing of its use phase is reasonable. For optimisation of the environmental performance of the window it is clear from an overall consideration that the priority is to reduce transmission heat losses which, in turn, depend on the heat transfer coefficient Uw. Furthermore, solar gains (for example by orientation and shadowing) must be optimized. By contrast, the choice of the frame material is of minor significance.

6.2 Production stage

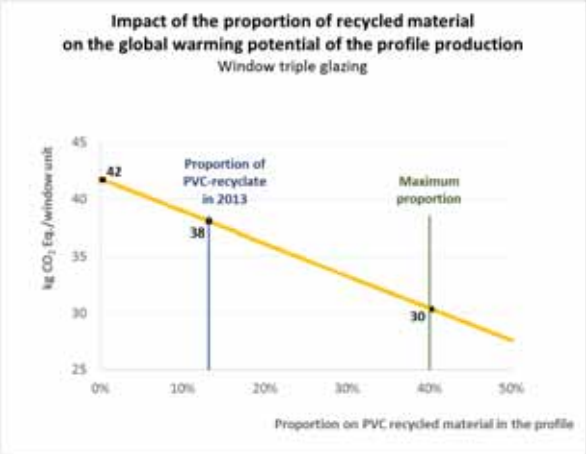
Apart from the production of PVC raw material, production of the insulating glass and fittings accounts for the largest shares in all impact categories. Approximately 50 % of the environmental impacts of the production stage are caused by manufacturing of the insulating glass and fittings components.

6.3 Sensitivity concerning the use of recycled PVC

In the manufacture of PVC-U window profiles PVC raw material is partly replaced by recycled material obtained from old windows. However, the input of material from old windows is capped: Firstly, the amount of available recycled material is limited, and secondly the use of virgin material is necessary due to product performance requirements. Accordingly, a maximum proportion of 40% of recycled material - relative to the annual production tonnage of PVC-U window profiles - is likely to be the practical limit.

A sensitivty analysis made for the profile production clearly shows that due to the reduction of raw material the emission of CO2 and therefore the global warming potential GWP is reduced significantly (see figure 1). The rate of recycling in the year of data collection was around 13 %, thus causes a 10 % decrease in GWP. For profile manufacturing a recycing proportion of 40 % means a total potential GWP saving of approximate 28%.

Figure 1



6.4 Scenarios for EoL / rates of disposal

In addition to the basic variant three other scenarios were assessed to specify the influence of thermal and material recycling (note the explanations in chapter 4).

Rates for C-a:	Recycling	Incineration	Landfill
Glass	62%	-	38%
PVC-U	-	-	100%
Steel/aluminium	87%	-	13%
Others	-	-	100%

Rates for C-b:	Recycling	Incineration	Landfill
Glass	62%	9%	29%
PVC-U	-	100%	-
Steel/aluminium	87%	-	13%
Others	-	100%	-

Rates for C-c:	Recycling	Incineration	Landfill
Glass	100%	-	-
PVC-U	100%	-	-
Steel/aluminium	100%	-	-
Others	100%	-	-

Some results for selected indicators are shown in the table below:

choosen parameters	C-a priority landfill		C-b priority incineration		C-c priority recycling	
	C1-C4	D	C1-C4	D	C1-C4	D
GWP	6,26E+00	-1,97E+01	4,35E+01	-3,17E+01	6,96E+00	-4,87E+01
ODP	6,74E-07	-5,34E-07	1,36E-06	-1,92E-06	8,95E-07	-1,22E-06
AP	1,92E-02	-6,80E-02	6,95E-02	-8,53E-02	2,55E-02	-1,72E-01
EP	5,30E-03	-8,53E-03	1,18E-02	-1,07E-02	6,42E-03	-2,00E-02
POCP	1,04E-03	-1,01E-02	2,81E-03	-1,13E-02	1,07E-03	-1,70E-02
ADPe	9,90E-06	-3,92E-05	1,57E-04	-4,13E-05	1,50E-05	-2,03E-04
ADPf	6,71E+01	-3,06E+02	1,87E+02	-4,85E+02	8,94E+01	-8,99E+02
PENRT	7,16E+01	-3,47E+02	2,57E+02	-5,48E+02	9,59E+01	-1,11E+03

This comparison shows the influence of the disposal method on environmental effects:

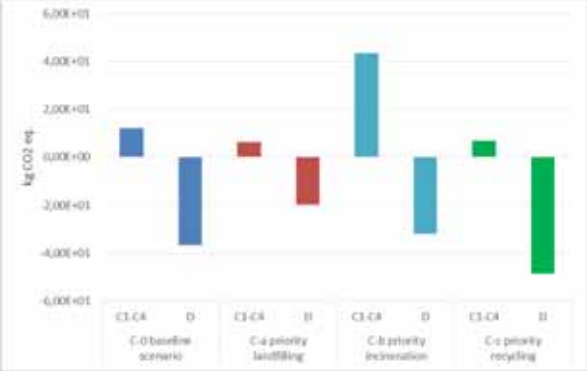
C-a (landfill scenario)
Compared with the basic scenario both debits and credits are lower due to there being no incineration.

C-b (incineration scenario)
The values of all impacts increase due to incineration. Dieser Absatz ist neu bzw. umgeschrieben on the other hand, the energy generation carried by waste incineration delivers a large credit.

C-c (recycling scenario)
The largest credits across all scenarios are achieved by comprehensive material recovery.

In figure 2 the values of the global warming potential GWP are compared for all scenarios.

Figure 2



6.5 Individual consideration for the impact indicators and their influence factors

6.5.1 Environmental impacts

Global warming potential (GWP)
92% of the global warming potential is contributed by CO2 emissions. Most of it occurs from energy consumption during the in-use phase (B1) as well as raw material production (glazing, PVC-U, steel). The remaining contribution relates to methane emissions likewise associated with energy consumption from the use phase (B1).

Depletion potential of the stratospheric ozone layer (ODP)
The halon 1391 that is produced in the production of gas and heating oil as fuels makes up the bulk of this indicator (use phase B1).

Acidification potential (AP)
This category is 71% dominated by SOx emissions and 27% by NOx emissions.Their main sources are energy production during the use phase and the production of raw materials (mostly glass, PVC and steel).

Eutrophication potential (EP)
Eutrophication potential mainly reflects NOx emissions (62%), phosphate (22%) and chemical oxygen demand (7%). Most important contributions are heat production (B1) and glazing production (A1).

Formation potential of tropospheric ozone photochemical oxidants (POCP)
Photochemical ozone creation potential mainly comes from emissions of SOX (55%) developed by fossil fuels combustion (B1) and glazing production (A1). Other contributions reflect VOC emissions from fossil fuel consumption and raw material production (glass, steel, PVC)

Abiotic depletion potential for non-fossil resources (ADPE)
The main consumption of rare elements (in particular zinc 31%, chromium 18%) is associated with the production of zinc and tin plated stee for fittings (A1-A3).

Abiotic depletion potential for fossil resources (ADPF)
This potential refers to the consuption of natural gas, crude oil and hard coal (65%) associated with the heat generated in the use phase (B1). The other contributions come from natural gas and crude oil consumption associated with glass production (for the provision of energy) and PVC production (as both energy and raw material).

6.5.2 Use of resources

Use of renewable primary energy as energy (PERE) and as raw material (PERM)
The use of renewable energy is low on the whole. It includes the use of wood as a raw material used to build pallets, the consumption of electricity generated from renewable energy (hydropower, wind power) and heat generated by some companies from the combustion of wood od residues from their own manufacturing to produce heat.

Use of non-renewable primary energy as energy (PENRE) and as a raw material (PENRM)
Apart from the use phase, the main non-renewable energy consumption occurs during raw material production for glazing, PVC and steel. By contrast, profile production and window manufacturing both have a much limited consumption.
The consumption of non-renewable energy for production covers the raw materials used to generate the plastics (PVC, coatings, LDPE films, seals).

Use of secondary material (SM)
Secondary material is primarily used in profile production in the form of recycled PVC-U from old windows. A small quantity of waste paper/cardboard is also used to produce packaging materials.

Use of secondary fuels (RSF, NRSF)
There is no use of secondary fuels.

Use of net fresh water (FW)
The main consumption of water comes in the manufacture of glass and PVC.

6.5.3 Output flows and waste categories

Components for re-use (CRU)
No output.

Materials for recycling (MFR)
The significant amount of materials for recycling in waste processing stems from the recycled PVC-U, glass, aluminium and steel (reinforcement and fittings). A small contribution comes from the recycling of packaging in the production stage.

Materials for energy recovery (MER)
Like with the waste flows for recycling, the combustion of old window materials accounts for the bulk of the share. The small contribution from the modules A1 - A3 relates to the incineration of packaging material (cardboard and wooden pallets) at the end of its life.

Exported energy (EE)
Energy recovery in incineration most occurs – as described above – in the processing of waste (C3) and to a smaller extent at the end-of-life of packaging material (A1 – A3).

7. Requisite evidence

Fire

Fire tests on several test elements from different manufacturers using the SBI test method according to /EN 13823/ by Efectis Nederland BV, project number 2012-Efectis-R0205

Result: In accordance with the average parameters identified, plastic windows meet the following classification criteria according to /EN 13501-1:2007+A1:2009/:

Building material class: B - E
Smoke emissions: s3
Burning droplets: d0

VOC (volatile organic compounds)

Research project into VOC emissions in building products; German Federal Office for Building and Regional Planning as part of the Building the Future research initiative, file reference Z6-10.08.18.7-08.20/II2-F20-08-005; December 2010

Result: In terms of the indoor exposure, the VOC emissions fall largely well below the requirements of the assessment by the German Committee for Health-related Evaluation of Building Products /AgBB/.

8. References

AgBB: Evaluation scheme of emissions of Volatile Organic Compounds from building products; Committee for the Health-related Evaluation of Builduing Products; Germany, February 2015

BBSR: Useful lives of building components for life-cycle analysis according to BNB; Federal Institute for Construction,Urban and Regional Research; Germany, 2011

Construction Products Regulation: Regulation (EU) No 305/2011 of the European Parliament and of the council of March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC

DIN 4102-1: Fire behaviour of building materials and building components - Part 1: Building materials; concepts, requirements and tests; DIN 4102-1:1998

DIN V 18599-2: Energy efficiency of buildings - Calculation of the net, final and primary energy demand for heating, cooling, ventilation, domestic hot water and lighting - Part 2: Net energy demand for heating and cooling of building zones;
DIN V 18599-2:2011

EN 674: Glass in building. Determination of thermal transmittance (U value). Guarded hot plate method;
EN 674:2011

EN 675: Glass in building. Determination of thermal transmittance (U value). Heat flow meter method;
EN 675:2011

EN 1026: Windows and doors - Air permeability - Test method; EN 1026:2000

EN 1027: Windows and doors - Watertightness - Test method; EN 1027:2000

EN 1191: Windows and doors - Resistance to repeated opening and closing - Test method; EN 1191:2012

EN 12207: Windows and doors - Air permeability - Classification; EN 12207:1999

EN 12208: Windows and doors - Watertightness - Classification; EN 12208:1999

EN 12210: Windows and doors - Resistance to wind load - Classification; EN 12210:1999+AC:2002

EN 12211: Windows and doors - Resistance to wind load - Test method; EN 12211:2000

EN 12400: Windows and pedestrian doors - Mechanical durability - Requirements and classification; EN 12400:2002

EN 13501-1: Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests;
EN 13501-1:2007+A1:2009

EN 13823: Reaction to fire tests for building products - Building products excluding floorings exposed to the thermal attack by a single burning item;
EN 13823:2010

EN 14351-1: Windows and doors - Product standard, performance characteristics - Part 1: Windows and external pedestrian doorsets without resistance to fire and/or smoke leakage characteristics;
EN 14351-1:2006+A2:2016

ecoinvent 2.2: Ecoinvent database, v. 2.2; Swiss Centre for Life Cycle Inventories (pub.); Duebendorf, Switzerland, 2010

Ecological Scarcity Method: Swiss Eco-Factors 2013 according to the Ecological Scarcity Method - Methodological fundamentals and their application in Switzerland; Frischknecht & Büsser Knöpfel; 2013

EWC: European Waste Catalogue, established by Decision 2000/532/EC of European Commission

GHS: Globally Harmonized System of Classification and Labelling of Chemicals

RAL-GZ 695: Quality assurance of windows, doors, facades and winter gardens

RAL-GZ 716: General Quality and Test Requirements, System Description and Suitability Testing of Plastic Window and Door Profile Systems

REACH: Regulation (EC) No 1907/2006 of the European Parliment and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals

Institut Bauen und Umwelt
Institut Bauen und Umwelt e.V., Berlin(pub.):
Generation of Environmental Product Declarations (EPDs);
General Principles
for the EPD range of Institut Bauen und Umwelt e.V. (IBU), 2013/04
www.ibu-epd.de

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

/EN 15804/
/EN 15804:2012-04+A1 2013/, Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products

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Following companies were involved in the collection of data:

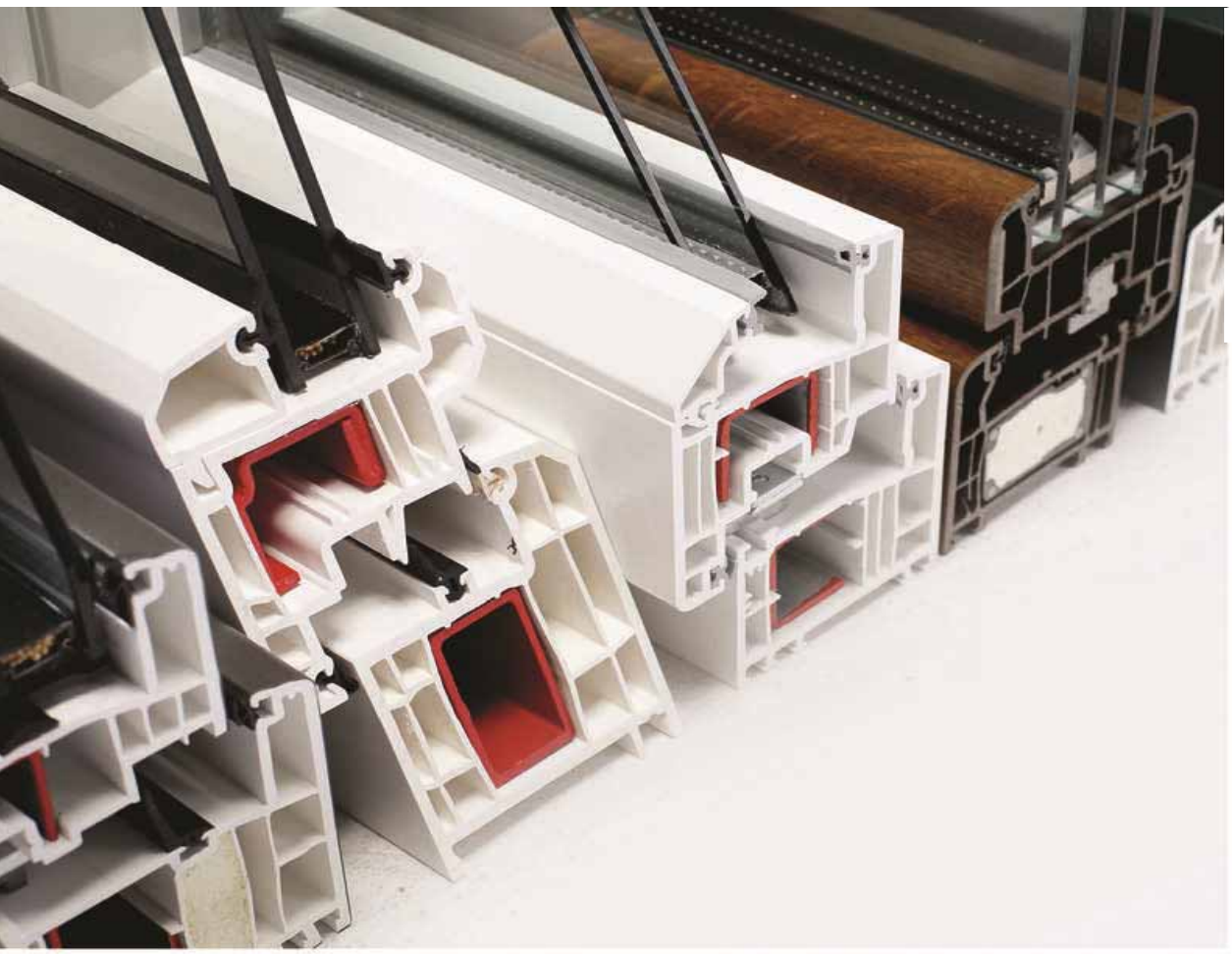
ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

Owner of the Declaration	QKE Qualitätsverband Kunststofferzeugnisse e.V. EPPA European PVC Window Profiles and Related Building Products Association ivzw
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-QKE-20150313-IBG1-EN
ECO EPD Ref. No.	ECO-00000038
Issue date	17.03.2016
Valid to	16.03.2021

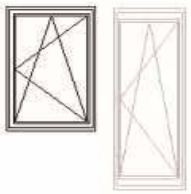
PVC-U plastic windows
with the dimensions 1.23 x 1.48 m
and insolated double-glazing
QKE e.V.
EPPA ivzw

www.bau-umwelt.com / https://epd-online.com



Institut Bauen und Umwelt e.V.

ECO PLATFORM EPD EN 15804 VERIFIED



Presented by

EPPA

QUALITÄTSVERBAND KUNSTSTOFFERZEUGNISSE E.V.
FÜR LANGLEBIGE KUNSTSTOFFPRODUKTE

1. General Information

QKE - EPPA

Window (1.23 m x 1.48 m) with insolated double-glazing

Programme holder
IBU - Institut Bauen und Umwelt e.V.
Panoramastr. 1
10178 Berlin
Germany

Owner of the Declaration
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EPPA - European PVC Window Profiles and Related Building Products Association ivzw
Avenue de Cortenbergh 71; 1000 Brussels
Belgium

Declaration number
EPD-QKE-20150313-IBG1-EN

Declared product / Declared unit
PVC-U single-sash window, with the dimensions 1.23 m x 1.48 m, insulated double-glazing and variable profile surface (white, painted, laminated with PVC foil or coated with PMMA).

All planned replacements of the components - sealings, fittings and glazing - are included in the declared unit.

This Declaration is based on the Product Category Rules:
Windows and doors, 11.2015
(PCR tested and approved by the SVR)

Scope:
This EPD is an association EPD. The weighted average from the manufacturers' specifications submitted by eleven member companies from 21 sites in seven countries was used as the data basis for the manufacture of plastic profiles. The recorded production volume represents a share of approximately 70% of the production of all system houses affiliated with the QKE and EPPA associations and therefore nearly 60% of European production.

The scope covers different configurations of both profile reinforcement and surface treatment. Window constructions using glazing blocks as well as bonded glazing systems are included. This EPD thus covers all designs for PVC-U windows that conform to the stated requirements. This document is translated from the German Environmental Product Declaration into English. It is based on the German original version EPD-QKE20130313-IBG1-DE. The verifier has no influence on the quality of the translation.

Issue date
17.03.2016

Valid to
16.03.2021

The following companies were involved in the collection of data:

System houses:
aluplast GmbH, D - Karlsruhe
Deceuninck nv, B – Hooglede-Gits
GEALAN Fenster-Systeme GmbH, D- Oberkotzau
Internorm Bauelemente GmbH, A – Traun
hapa AG, D - Herrieden
L.B. Profile GmbH, D – Herbstein
profine GmbH, D – Pirmasens
Rehau AG + Co., D – erlangen
Schüco Polymer Technologies KG – Weißenfels
Stöckel GmbH, D - Vechtel
VEKA AG, D – Sendenhorst

Window manufacturers:
BE Bauelemente GmbH, D – Leopoldshöhe-Greste
Internorm Bauelemente GmbH, A – Traun
Stöckel GmbH, D - Vechtel
TMP Fenster + Türen GmbH, D – Bad Langensalza
WERU GmbH, D – Rudersberg
Wirus Fenster GmbH & Co. KG, D – Rietberg



Prof. Dr.-Ing. Horst J. Bossenmayer
(President of Institut Bauen und Umwelt e.V.)



Dr. Burkhart Lehmann
(Managing Director IBU)

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.

Verification

The CEN Norm /EN 15804/ serves as the core PCR
Independent verification of the declaration according to /ISO 14025/
☐ internally ☒ externally



Dr. Eva Schmincke
(Independent verifier appointed by SVR)

2. Product

2.1 Product description

The declared product is a single-sash tilt & turn window with the dimensions 1.23 x 1.48 m and insulated double-glazing.

The windows consist of a PVC frame profle with a transparent glass filling. A variety of materials are used to reinforce the frame profiles: profiles made from steel or aluminium, polyurethane foam or glass fibre extruded into the PVC-U material.

The surface of the frame can vary in design: laminated with PVC foil, coated with PMMA (polymethyl metha acrylate) or painted. These can produce white or coloured, textured or smooth surfaces.

The seals are made from plasticised PVC, EPDM (ethylene propylene diene monomers) or TPE (thermoplatic elastomers), the fittings from steel.

For the window a reference service life of 40 years is assumed. The respective useful lives of the components - glazing, seals and fittings - is shorter, however, which means that these will need replacing during the reference service life of the window unit. These planned replacements of individual components are also included in the declared unit.

This EPD does not relate to a specific product from one manufacuturer, but confirms the average environmental quality for all PVC-U windows from member companies of the EPPA und QKE associations.

Further specific data can be found in the relevant manufacturer's product description.

2.2 Application

Windows are used in the outer shell of buildings for lighting, ventilation and protection from the elements.

2.3 Technical Data

Technical construction data

Name	Value	Unit
Pane construction	4 / 16 / 4	mm
Heat transfer coefficient glass Ug according to /EN 674/, /EN 675/	1.1	W/(m²K)
Total energy transmittance g	62	%
Heat transfer coefficient window Uw according to /EN 674/, /EN 675/	1.3	W/(m²K)
Watertightness according to /EN 1027/, /EN 12208/	4A - 9A	Class
Mechanical stress (Durability) according to /EN 1191/, /EN 12400/	10 000 - 20 000	Cycles

For further technical construction data, only the minimum requirements that apply to quality-assured windows according to /RAL-GZ 695/ are cited below.

Depending on the design of frame, seals and fittings, considerably higher performance classes can be achieved by the windows produced.

- Min. air permeability according to /EN 1026/, /EN 12207/: Class 2
- Min. resistance to wind load according to /EN 12211/, /EN 12210/: Class B1

Further specific data can be found in the relevant manufacturer's product description.

2.4 Application rules

Placing on the market within EU/EFTA (with the exception of Switzerland) is subject to the /Construction Products Regulation/ (EU) Nr. 305/2011. The products must have a declaration of performance compliant with the harmonized product standard /EN14351-1/ and the CE marking.

Usage is governed by the relevant national rules.

2.5 Delivery status

This EPD relates to plastic windows with the dimensions 1.23 x 1.48 m. The face area is 1.82 m².

2.6 Base materials / Ancillary materials

The base materials of the declared unit are:

Name	Value	Unit
Glazing	47.1	mass%
Frame material PVC-U	28.2	mass%
Reinforcement steel	18.9	mass%
Fittings steel	4.5	mass%
Seals PVC	1.0	mass%
Glazing blogs / screws	0.3	mass%

The raw materials and additives used to manufacture the PVC-U frame material can be found in the following overview:

PVC formulation

- 81.0 mass% PVC
- 8.1 mass% Filler (chalk)
- 4.9 mass% Impact resistance modifiers
- 2.8 mass% Calcium/zinc stabilisers
- 3.2 mass% Pigment titanium oxide (TiO_2)

Recycled material obtained from used windows is used to manufacture proprietary profiles. These profiles can contain more than 0.1 % lead compounds. These are treated as SVHC (Substances of Very High Concern) in accordance with /REACH/.

2.7 Manufacture

Plastic windows are made from a variety of individual components: each window consists of a PVC-U frame with seals, the glazing, the fittings and, where required, the reinforcement.

PVC-U profiles for window frames are manufactured in an extrusion process from a mixture of PVC powder and additives. These protect the PVC from damage during processing and give the profile the necessary properties (impact resistance, colour, weathering stabiblity etc.).

The PVC powder used to manufacutre the frames is a widely used bulk plastic and is obtained through polymerisation. Due to its chemical structure, PVC contains a high proportion of the halogen chlorine.

The majority of window frames are made from white rigid PVC-U profiles. Some frames are manufactured from profiles that are also laminated with PVC film, coated with PMMA or painted.

Seals are generally attached to the window profiles in a coextrusion process and consist of plasticised PVC, EPDM or TPE.

The window profiles are delivered in standard lengths to the window manufacturers, where they are sawn to the length actually required for the particular window. Where necessary, steel reinforcement is inserted and screwed in.The profiles are then welded, the fittings attached and the pane and glass retaining strips fitted. the window can now be supplied and fitted.

The steel for manufacturing fittings is largely optained from iron ores in a blast furnace process by means of reduction with coke.

The basic raw material for manufaturing the glazing is quartz sand to which various fluxing agents and oxidants (Soda ash, sodium sulphate, potash etc.) havebeen added. In a further proceeding step, the molten raw glass is floated on molten tin, from which a flat strip of glass can be continously produced (float glass process).

Quality monitoring

The member companies of QKE e.V. are subject to external quality monitoring within the framework of voluntary self-regulation. Plastic window systems that bear the RAL quality mark according to /RAL-GZ 716/ are listed on the website at gkfp.de.

2.8 Environment and health during manufacturing

Of all the constituents of PVC formulations, only the calcium/zinc stabilisers have to be classified and marked as follows in accordance with /GHS/:

H302: Harmful if swallowed
H318: Causes serious eye damage
H317: May cause an allergic skin reaction
Pictogram: Corrosive and irritating

2.9 Product processing/Installation

The finished windows are transported to the construction site and installed. Screws made from zinc-plated steel and polyurethane foam are required for each window unit for installation.

2.10 Packaging

The profiles – if they are not going to be processed further at the same site – are transported to the window manufacturer, usually on reusable steel pallets. Disposable wooden pallets are used in isolated cases. Cardboard, PE film and foam pads are also used when transporting the individual components to the window manufacturer.

Polyethylene foam pads, a cardboard edge protector, polypropylene load retaining straps, aluminium or steel clamps and PE stretch film are used as packaging materials for each window unit for assembly.

2.11 Condition of use

Plastic windows are durable and long lasting. There is no change in the material composition while the product is being used.

2.12 Environment and health during use

PVC-U frame materials do not have a negative influence on the environment and health. If the use of solvent-free components is ensured further down the supply chain, this also applies for the final window product.

2.13 Reference service life

The reference service life of the declared PVC-U plastic window is 40 years according to /BBSR/. The technical life of certain individual components is thus exceeded; as a result, there will be three replacements of seals and one replacement of fittings and glazing during service life.

2.14 Extraordinary effects

Fire

Plastic windows are classified in classes B - E for fire behaviour (depending on the surface characteristics), s3 for smoke gas development and d0 for burning droplets in accordance with /EN 13501-1/.

Fire protection

Name	Value
Building material class	B - E
Burning droplets	d0
Smoke gas development	s3

Plastic windows therefore meet the requirements of B2 "normal combustibility" according /DIN 4102-1/ as a minimum.

Water

No negative effects on the environment are to be expected in the event of unforeseen exposure to water, such as in the case of flooding.

Mechanical destruction

No negative effects on the environment are to be expected in the event of unforeseen mechanical destruction.

2.15 Re-use phase

The most important processes in the reuse phase of PVC-U are the recycling of materials and landfilling. In addition, PVC can also be thermally utilised.

A large amount of the steel used in the fittings and reinforcement is also recycled for materials.

Glazing can also be recycled very well. Otherwise it is mostly disposed of in landfill sites, but a small amount is also sent for incineration.

2.16 Disposal

The individual components of the window can be disposed of after use as a nonhazardous waste. The waste codes according to European Waste Catalogue /EWC/ are as follows:

- 17 02 02 Glass
- 17 02 03 Plastic
- 17 04 05 Iron and steel

2.17 Further information

Possible sources for further information are available from the associations' websites

www.qke-bonn.de
www.eppa-profiles.eu

and the websites of the system houses and window manufacurers.

3. LCA: Calculation rules

3.1 Declared Unit

The declared unit is a window 1.23 x 1.48 m (reference window in accordance with /EN 14351-1/) with a mass of 55 kg.The frame proportion is 25.7%. Planned replacements of the glazing, fittings and seals during a service life from 40 years are included.

Declared unit

Name	Value	Unit
Declared unit	55 kg	Reference window 1.23m x 1.48m, frame portion 25% to 35%

3.2 System boundary

The entire life cycle of the product "from cradle to grave" is considered.

Manufacture

The aggregate view in the form of modules A1-A3 is used for manufacturing. This includes the supply of raw materials, the manufacture of the steel reinforcement, flat glass, fittings and PVC-U profile, all transportation to the window manufacturer, the energy requirements for constructing the windows, and any production waste generated. In particular, consumption for the heating and illumination of production rooms and their adjacent premises is also included.Capital goods (machinery, buildings etc.) are not considered.

Transportation from the manufacturer's gate to the construction site is taken into account in module A4. All processes relating related to the installation of the window in the building are considered in module A5.

Usage

The transmission heat losses occurring during the usage phase are taken into account in module B1. The measures described in 2.13 for replacing window components are taken into account in module B4.

Disposal

All processes relating to the removal, dismantling or demolition of the window from the building, including an initial sorting on the construction site, are accounted for in module C1.

Redistribution transportation from the construction site for the recovery of heat, recycling of materials and disposal in landfill are considered in module C2. Module C3 considers waste treatment, including sorting for recycling.

Landfilling and thermal recycling fall under module C4.

Credit

Finally, module D shows the potential for re-use, recovery and recycling derived from modules C3 and C4.

3.3 Estimates and assumptions

Apart from the assumptions and estimates described in section 4, no further assumptions or estimates are made that will impact or influence the outcome.

3.4 Cut-off criteria

The disregarded input flows are smaller than 1% of both the total mass and the total flow of primary energy. Taken together, they form less than 5% of the total mass or 5% of the total energy.

3.5 Background data

The primary data for profile extrusion and window manufacturing were provided by the members of the declaring associations (see Scope).The background data for raw materials as well as the manufacturing of the PVC, glazing and fittings and all other data originate from the /ecoinvent 2.2/ database.

This database does not allow calculation of the net flows for fresh water consumptions, so the assumptions are based on the /Ecological Scarcity Method/.

3.6 Data quality

The data for the products examined was collected through analyses of internal production and environmental data, by collating LCA-related data within the supply chain for 2013, and on the basis of average data submitted by the associations. The data collected was checked for plausibility and consistency.

The quality of the background data for glass production is considered to be of the greatest importance because the manufacture of glass makes a significant contribution to the production stage A1-A3.

3.7 Period under review

All primary data was collected in 2013.

3.8 Allocation

The data from profilextrusion and window manufacturing is based on the average weighted by production volume.

3.9 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.

4. LCA: Scenarios and additional technical information

The following technical information forms the basis for the declared modules, or can be used to develop specific scenarios in the context of a building assessment if modules are not declared (MND).

Usage (B1) see Chapter 3.2 Usage

The net heat losses caused by the window are taken into account here. These consist of the transmission heat losses and the solar heat gains from the window. The impacts in the use phase depend to a very large extent on the actual climatic and technical circumstances of a specific building. The calculations off the heat losses and gains and the results of the impact assessment are based on parameters for average Central European conditions.

The energy demand during the use phase at the reference location is calculated from the transmission heat losses and the solar heat gains according to /DIN V 18599-2/.

Name	Value	Unit
degree day factor Central Europe	3641	K*d
Solar irradiation	209	kWh/m2

The provision of heating energy was modeled according to the data for German heating requirements: 49% gas, 30% heating oil and 13% district heating. The remaining 8% are added in equal shares to the cited energy sources.

Replacement (B4), renovation (B5)

The replacement of individual components that have reached the end of their technical life according to /BBSR/ is considered in module B4.

Name	Value	Unit
Replacement cycle glazing	1	Number/RSL
seals	3	Number/RSL
fittings	1	Number/RSL

Reference service life

The reference service life of the window as well as the technical service life of individual components according to /BBSR/ is set as follows:

Name	Value	Unit
Reference service life window unit	40	a
isolated glazing	30	a
fittings	25	a
seals	12	a

End of lifetime (C1-C4)

At the end of their useful life windows and window components can be easily collected, sorted and recycled. Otherwise they are disposed of in landfill or in waste incineration plants for heat recovery.

Recycling rates and disposal methods are country specific and vary widely between European countries. For module C four scenarios in total are assessed:
C-0 present average recovery
C-a priority landfill
C-b priority incineration
C-c priority recyling

For C-a und C-b the rates of material recycling of glass and metal are assumed to be the same as today C-0), while the remaining share is not led for recycling is allocated completely to landfill (C-a) and incineration (C-b). The result for scenarios a-c are presented in chapter 6.4.

Rates for collecting and recovery for C-0:

Name	Value	Unit
Collection rate for all materials	95	%
* thereof are recycled	-	
glass	65	%
PVC	59	%
steel/aluminium	92	%
others	0	%
* incineration quote of the material to be disposed	-	
glass	25	%
PVC	35	%
steel / aluminium	0	%
others	20	%

Re-use, recovery and recycling potential (D), relevant scenario

The energy (thermal energy and electricity) respectively the recycled material resulting from thermal and material utilization are credited here.

5. LCA: Results

The results apply to all kind of profile reinforcements and surfaces listed in the scope for window systems with glazing blocks as well as bonded glazing systems.

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

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	X	X	X	MND	MNR	X	MNR	MND	MND	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: window (1,23 x 1,48 m) with insulated double glazing

Parameter	Unit	A1-A3	A4	A5	B1	B4	C1	C2	C3	C4	D
GWP	[kg CO_2-Eq.]	1.16E+2	8.18E-1	1.96E+0	7.18E+2	6.87E+1	0.00E+0	2.56E+0	8.08E-1	7.32E+0	-3.48E+1
ODP	[kg CFC11-Eq.]	7.30E-6	1.34E-7	2.49E-8	1.06E-4	6.54E-6	0.00E+0	4.22E-7	1.07E-7	1.56E-7	-1.05E-6
AP	[kg SO_2-Eq.]	5.67E-1	3.21E-3	7.84E-3	9.95E-1	4.46E-1	0.00E+0	1.01E-2	5.79E-3	8.93E-3	-1.18E-1
EP	[kg $(PO_4)^{3-}$-Eq.]	6.46E-2	6.55E-4	1.59E-3	1.14E-1	4.93E-2	0.00E+0	2.07E-3	1.25E-3	2.40E-3	-1.41E-2
POCP	[kg ethene-Eq.]	3.14E-2	1.06E-4	4.44E-4	7.83E-2	1.95E-2	0.00E+0	3.38E-4	1.59E-4	6.15E-4	-1.32E-2
ADPE	[kg Sb-Eq.]	1.14E-3	2.48E-6	1.28E-5	1.49E-4	1.06E-3	0.00E+0	7.86E-6	6.12E-7	2.16E-5	-1.19E-4
ADPF	[MJ]	1.85E+3	1.31E+1	3.27E+1	1.13E+4	9.42E+2	0.00E+0	4.13E+1	1.20E+1	2.26E+1	-6.09E+2

Caption	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

RESULTS OF THE LCA - RESOURCE USE: window (1,23 x 1,48 m) with insulated double glazing

Parameter	Unit	A1-A3	A4	A5	B1	B4	C1	C2	C3	C4	D
PERE	[MJ]	1.11E+2	1.78E-1	1.70E+0	5.01E+1	6.34E+1	0.00E+0	5.48E-1	2.30E-1	1.90E+0	-1.88E+1
PERM	[MJ]	1.28E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
PERT	[MJ]	1.12E+2	1.78E-1	1.70E+0	5.01E+1	6.34E+1	0.00E+0	5.48E-1	2.30E-1	1.90E+0	-1.88E+1
PENRE	[MJ]	1.91E+3	1.39E+1	3.81E+1	1.15E+4	1.06E+3	0.00E+0	4.38E+1	1.32E+1	3.26E+1	-5.13E+2
PENRM	[MJ]	3.01E+2	0.00E+0	0.00E+0	0.00E+0	3.42E+1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-2.23E+2
PENRT	[MJ]	2.21E+3	1.39E+1	3.81E+1	1.15E+4	1.09E+3	0.00E+0	4.38E+1	1.32E+1	3.26E+1	-7.36E+2
SM	[kg]	3.92E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
RSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
NRSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
FW	[m^3]	4.57E-1	5.12E-4	8.71E-3	9.79E-2	1.20E-1	0.00E+0	1.64E-3	3.43E-4	8.43E-3	-2.49E-1

Caption	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 – OUTPUT FLOWS AND WASTE CATEGORIES: window (1,23 x 1,48 m) with insulated double glazing

Parameter	Unit	A1-A3	A4	A5	B1	B4	C1	C2	C3	C4	D
HWD	[kg]	1.31E+1	1.03E-2	1.07E-1	1.71E+0	1.23E+1	0.00E+0	3.36E-2	5.77E-3	2.67E+0	-2.00E+0
NHWD	[kg]	2.92E+1	1.31E-1	2.11E-1	1.18E+1	2.95E+1	0.00E+0	4.31E-1	4.35E-2	1.54E+1	-7.97E+0
RWD	[kg]	2.97E-3	1.07E-5	2.10E-5	2.96E-3	2.01E-3	0.00E+0	3.25E-5	1.57E-5	1.41E-4	-2.42E-4
CRU	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MFR	[kg]	2.78E+0	0.00E+0	0.00E+0	0.00E+0	1.77E+1	0.00E+0	0.00E+0	3.55E+1	0.00E+0	0.00E+0
MER	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
EEE	[MJ]	1.22E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	4.76E+0	-4.89E+0
EET	[MJ]	3.78E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.48E+1	-1.51E+1

Caption	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; EEE = Exported thermal energy

6. LCA: Interpretation

6.1 Summary

The parameters of global warming potential (GWP) and the use of non-renewable primary energy (PENRT) represent the indicators of environmental impacts and use of resources. They are dominated by the use-phase-based provision of energy to compensate for the transmission heat losses caused by installing the window (module B1). If the use phase is taken out of the equation, virtually all environmental impacts are caused by modules A1-A3 (manufacturing) and B4 (replacements, particularly of the glazing). By contrast, the impact of the end of life stage (modules C1-C4), covering demolition and waste treatment, is negligible. The recycling potential and the combustion process in the end-of-life scenario and the resulting credit of electricity and thermal energy lead on paper to negative values in the effects categories of module D.

It should be pointed out that the itemisation of module B1 for windows is optional. However, due to its significant influence on the building's overall energy consumption, a balancing of its use phase is reasonable. For optimisation of the environmental performance of the window it is clear from an overall consideration that the priority is to reduce transmission heat losses which, in turn, depend on the heat transfer coefficient Uf. Furthermore, solar gains (for example by orientation and shadowing) must be optimized. By contrast, the choice of the frame material is of minor significance.

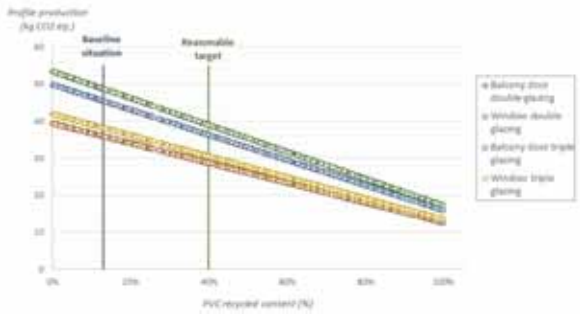
6.2 Production stage

Apart from the production of PVC raw material, production of the insulating glass and fittings accounts for the largest shares in all impact categories. Approximately 45% of the environmental impacts of the production stage are caused by manufacturing of the insulating glass and fittings components.

6.3 Sensitivity concerning the use of recycled PVC

In the manufacture of PVC-U window profiles PVC raw material is partly replaced by recycled material obtained from old windows. A sensitivty analysis made for the profile production shows that due to the reduction of raw material the emission of CO2 and therefore the global warming potential GWP is reduced significantly (see figure 1).

However, the input of material from old windows is limited. Firstly, the amount of available recycled material is limited, and secondly the use of virgin material is necessary due to product performance requirements. Accordingly, a maximum proportion of 40% of recycled material relative to the annual production tonnage of PVC-U window profiles is likely to be the practical limit. For profile manufacture this means a potential GWP saving of a further 22% (compared with an approximate 28% saving compared with the use of pure vigin material).



Figures 1

6.4 Scenarios for EoL / rates of disposal

In addition to the basic variant three other scenarios were assessed to specify the influence of thermal and material recycling (see chapter 4).

Rates for C-a:	Recycling	Incineration	Landfill
Glass	62%	-	38%
PVC-U	-	-	100%
Steel/aluminium	87%	-	13%
Others	-	-	100%

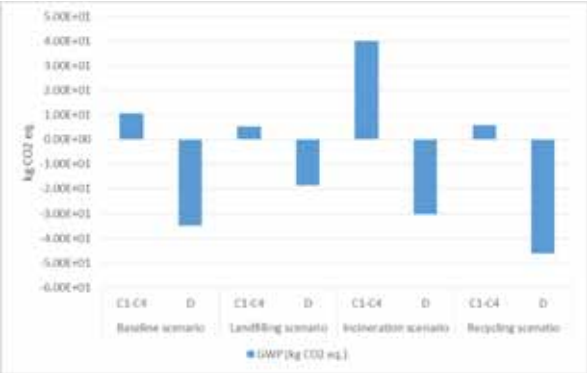
Rates for C-b:	Recycling	Incineration	Landfill
Glass	62%	9%	29%
PVC-U	-	100%	-
Steel/aluminium	87%	-	13%
Others	-	100%	-

Rates for C-c:	Recycling	Incineration	Landfill
Glass	100%	-	-
PVC-U	100%	-	-
Steel/aluminium	100%	-	-
Others	100%	-	-

The results for selected indicators are shown in the table below:

ausgewählte Parameter	C-a Schwerpunkt Deponie		C-b Schwerpunkt Verbrennung		C-c vollständiges Recycling	
	C1-C4	D	C1-C4	D	C1-C4	D
GWP	5.33E+00	-1.88E+01	4.03E+01	-3.01E+01	5.75E+00	-4.62E+01
ODP	5.31E-07	-5.12E-07	1.18E-06	-1.82E-06	7.06E-07	-1.16E-06
AP	1.58E-02	-6.45E-02	6.28E-02	-8.08E-02	2.09E-02	-1.63E-01
EP	4.54E-03	-8.16E-03	1.06E-02	-1.02E-02	5.42E-03	-1.90E-02
POCP	9.02E-04	-1.00E-02	2.56E-03	-1.12E-02	9.02E-04	-1.66E-02
ADPe	7.45E-06	-3.20E-05	1.46E-04	-3.40E-05	1.15E-05	-1.86E-04
ADPf	5.33E+01	-2.84E+02	1.65E+02	-4.53E+02	7.10E+01	-8.45E+02
PENRT	5.68E+01	-3.17E+02	2.31E+02	-5.07E+02	7.60E+01	-1.04E+03

In figure 2 the values of GWP are compared for all scenarios.



Figures 2

C-a (landfill scenario)
Compared with the basic scenario both debits and credits are lower due to there being no incineration.

C-b (incineration scenario)
The values of all impacts increase due to incineration. On the other hand, the energy generation carried by waste incineration delivers a large credit.

C-c (recycling scenario)
The largest credits are achieved by comprehensive material recovery.

6.5 Individual consideration for the impact indicators and their influence factors

6.5.1 Environmental impacts

Global warming potential (GWP)
95% of GWP is contributed by CO2 emissions. Most of it occurs from energy consumption during the in-use phase (B1) as well as raw material production (glazing, PVC-U, steel). The remaining contribution relates to methane emissions likewise associated with energy consumption from the use phase (B1).

Depletion potential of the stratospheric ozone layer (ODP)
The halon 1391 that is produced in the production of gas and heating oil as fuels makes up the bulk of this indicator (use phase B1).

Acidification potential (AP)
This category is 70% dominated by SOx emissions and 27% by NOx emissions. Their main sources are energy production (B4) and the production of raw materials (mostly glass, PVC, steel, A1-A3).

Eutrophication potential (EP)
Eutrophication potential mainly reflects NOx emissions (64%), phosphate (17%) and COD (10%). Most important contributions are heat production (B1) and glazing production (A1).

Formation potential of tropospheric ozone photochemical oxidants (POCP)
This indicator mainly comes from emissions of SOX (45%) from fossil fuels combustion (B1) and glazing production (A1). Other contributions reflect VOC emissions from fossil fuel consumption and raw material production (glass, steel and PVC)

Abiotic depletion potential for non-fossil resources (ADPE)
This refers to the consumption of rare elements. The main contributions come from the consumption of zinc (35%), chromium (18%) and tin (11%) associated with the production of zinc and tin plated stee for fittings (A1-A3).

Abiotic depletion potential for fossil resources (ADPF)
This potential refers to the consuption of natural gas, crude oil and hard coal (82%) associated with the heat generated in the use phase (B1). The other contributions come from natural gas and crude oil consumption associated with glass production (for the provision of energy) and PVC production (as both energy and raw material).

6.5.2 Use of resources

Use of renewable primary energy as energy (PERE) and as raw material (PERM)
The use of renewable energy is low on the whole. It includes the use of wood as a raw material used to build pallets, the consumption of electricity generated from renewable energy (hydropower, wind power) and heat generated by some companies from the combustion of wood od residues from their own manufacturing to produce heat.

Use of non-renewable primary energy as energy (PENRE) and as a raw material (PENRM)
Apart from the in-use phase, the main non-renewable energy consumption occurs during raw material production for glazing, PVC and steel. By contrast, profile production and window manufacturing both have a much limited consumption.
The consumption of non-renewable energy for production covers the raw materials used to generate the plastics (PVC, coatings, LDPE films, seals).

Use of secondary material (SM)
Secondary material is primarily used in profile production in the form of recycled PVC-U from old windows. A small quantity of waste paper/cardboard is also used to produce packaging materials.

Use of secondary fuels (RSF, NRSF)
There is no use of secondary fuels.

Use of net fresh water (FW)
The main consumption of water comes in the manufacture of glass and PVC.

6.5.3 Output flows and waste categories

Components for re-use (CRU)
No output.

Materials for recycling (MFR)
The significant amount of materials for recycling in waste processing stems from the recycled PVC-U, glass, aluminium and steel (reinforcement and fittings). A small contribution comes from the recycling of packaging in the production stage.

Materials for energy recovery (MER)
Like with the waste flows for recycling, the combustion of old window materials accounts for the bulk of the share. The small contribution from the modules A1-A3 relates to the incineration of packaging material (cardboard and wooden pallets) at the end of its life.

Exported energy (EE)
Energy recovery in incineration most occurs – as described above – in the processing of waste (C3) and to a smaller extent at the end-of-life of packaging material (A1 – A3).

7. Requisite evidence

Fire

Fire tests on several test elements from different manufacturers using the SBI test method according to /EN 13823/ by Efectis Nederland BV, project number 2012-Efectis-R0205

Result: In accordance with the average parameters identified, plastic windows meet the following classification criteria according to /EN 13501-1:2007+A1:2009/:

Building material class: B - E
Smoke emissions: s3
Burning droplets: d0

VOC (volatile organic compounds)

Research project into VOC emissions in building products; German Federal Office for Building and Regional Planning as part of the Building the Future research initiative, file reference Z6-10.08.18.7-08.20/II2-F20-08-005; December 2010

Result: In terms of the indoor exposure, the VOC emissions fall largely well below the requirements of the assessment by the German Committee for Health-related Evaluation of Building Products /AgBB/.

8. References

AgBB: Evaluation scheme of emissions of Volatile Organic Compounds from building products; Committee for the Health-related Evaluation of Builduing Products; Germany, February 2015

BBSR: Useful lives of building components for life-cycle analysis according to BNB; Federal Institute for Construction,Urban and Regional Research; Germany, 2011

Construction Products Regulation: Regulation (EU) No 305/2011 of the European Parliament and of the council of March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC

DIN 4102-1: Fire behaviour of building materials and building components - Part 1: Building materials; concepts, requirements and tests; DIN 4102-1:1998

DIN V 18599-2: Energy efficiency of buildings - Calculation of the net, final and primary energy demand for heating, cooling, ventilation, domestic hot water and lighting - Part 2: Net energy demand for heating and cooling of building zones;
DIN V 18599-2:2011

EN 674: Glass in building. Determination of thermal transmittance (U value). Guarded hot plate method;
EN 674:2011

EN 675: Glass in building. Determination of thermal transmittance (U value). Heat flow meter method;
EN 675:2011

EN 1026: Windows and doors - Air permeability - Test method; EN 1026:2000

EN 1027: Windows and doors - Watertightness - Test method; EN 1027:2000

EN 1191: Windows and doors - Resistance to repeated opening and closing - Test method; EN 1191:2012

EN 12207: Windows and doors - Air permeability - Classification; EN 12207:1999

EN 12208: Windows and doors - Watertightness - Classification; EN 12208:1999

EN 12210: Windows and doors - Resistance to wind load - Classification; EN 12210:1999+AC:2002

EN 12211: Windows and doors - Resistance to wind load - Test method; EN 12211:2000

EN 12400: Windows and pedestrian doors - Mechanical durability - Requirements and classification; EN 12400:2002

EN 13501-1: Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests;
EN 13501-1:2007+A1:2009

EN 13823: Reaction to fire tests for building products - Building products excluding floorings exposed to the thermal attack by a single burning item;
EN 13823:2010

EN 14351-1: Windows and doors - Product standard, performance characteristics - Part 1: Windows and external pedestrian doorsets without resistance to fire and/or smoke leakage characteristics;
EN 14351-1:2006+A1:2010

ecoinvent 2.2: Ecoinvent database, v. 2.2; Swiss Centre for Life Cycle Inventories (pub.); Duebendorf, Switzerland, 2010

Ecological Scarcity Method: Swiss Eco-Factors 2013 according to the Ecological Scarcity Method - Methodological fundamentals and their application in Switzerland; Frischknecht & Büsser Knöpfel; 2013

EWC: European Waste Catalogue, established by Decision 2000/532/EC of European Commission

GHS: Globally Harmonized System of Classification and Labelling of Chemicals

RAL-GZ 695: Quality assurance of windows, doors, facades and winter gardens

RAL-GZ 716: General Quality and Test Requirements, System Description and Suitability Testing of Plastic Window and Door Profile Systems

REACH: Regulation (EC) No 1907/2006 of the European Parliment and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals

Institut Bauen und Umwelt
Institut Bauen und Umwelt e.V., Berlin(pub.): Generation of Environmental Product Declarations (EPDs);

General principles
for the EPD range of Institut Bauen und Umwelt e.V. (IBU), 2013/04
www.bau-umwelt.de

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

EN 15804
EN 15804:2012-04+A1 2013: Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products

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UMWELT-PRODUKTDEKLARATION

nach ISO 14025 und EN 15804

Deklarationsinhaber	QKE Qualitätsverband Kunststofferzeugnisse e.V. EPPA European PVC Window Profiles and Related Building Products Association ivzw
Herausgeber	Institut Bauen und Umwelt e.V. (IBU)
Programmhalter	Institut Bauen und Umwelt e.V. (IBU)
Deklarationsnummer	EPD-QKE-20170001-IBG1-DE
ECO EPD Ref. No.	ECO-00000039
Ausstellungsdatum	27.04.2017
Gültig bis	26.04.2022

Kunststofffenster aus PVC-U
mit den Maßen 1,23 x 1,48 m
und einer 3-Scheiben-Isolierverglasung

QKE e.V.
EPPA ivzw

www.ibu-epd.com / https://epd-online.com

Edizione italiana

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ECO PLATFORM EPD EN 15804 VERIFIED





überreicht durch

EPPA

QUALITÄTSVERBAND KUNSTSTOFFERZEUGNISSE E.V. FÜR LANGLEBIGE KUNSTSTOFFPRODUKTE

DICHIARAZIONE AMBIENTALE DI PRODOTTO

ai sensi di ISO 14025 ed EN 15804

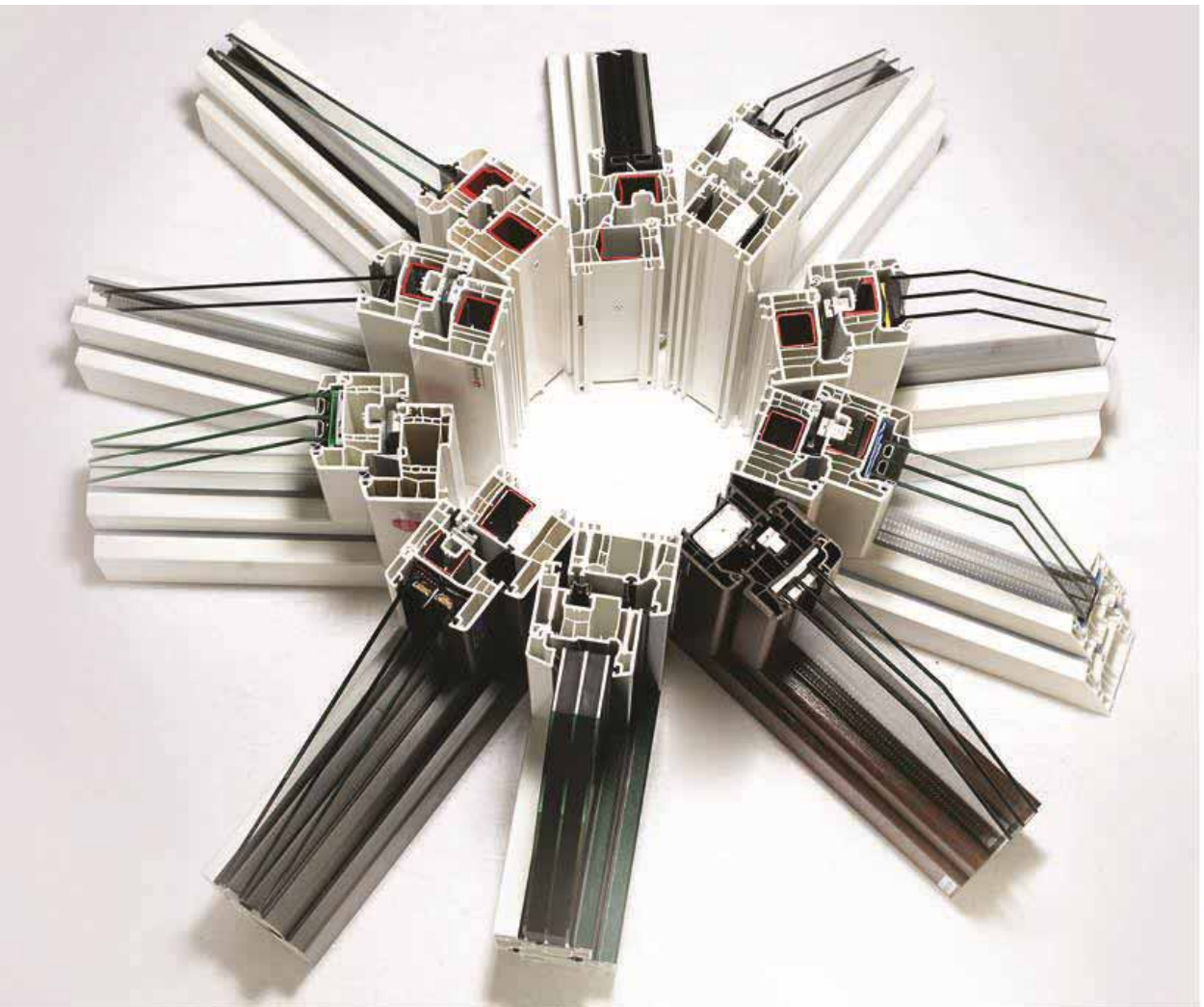
Titolare della dichiarazione	QKE Qualitätsverband Kunststofferzeugnisse e.V. EPPA European PVC Window Profile and related Building Products Association ivzw
Titolare del programma	Institut Bauen und Umwelt e.V. (IBU)
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Finestre in PVC non plastificato
con dimensioni 1,23 m x 1,48 m
e triplo vetro

QKE e.V.
EPPA ivzw

www.ibu-epd.com / https://epd-online.com

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ECO PLATFORM EPD EN 15804 VERIFIED



überreicht durch
presentata da

deceuninck

EPPA

QUALITÄTSVERBAND KUNSTSTOFFERZEUGNISSE E.V.
FÜR LANGLEBIGE KUNSTSTOFFPRODUKTE

1. Informazioni generali

QKE - EPPA

Finestra (1,23 m x 1,48 m)
con triplo vetro

Detentore del programma

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Panoramastr. 1
10178 Berlin
Germania

Titolare della dichiarazione

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Germania

EPPA - European PVC Window Profile and related Building Products Association ivzw
Avenue de Cortenbergh 71; 1000 Brüssel
Belgio

Numero dichiarazione

EPD-QKE-20170001-IBG1-DE

Prodotto dichiarato / Unità funzionale dichiarata

Le finestre in PVC non plastificato ad anta singola, con dimensioni 1,23 m x 1,48 m, triplo vetro e superficie del profilo variabile (bianca, dipinta, laminata con pellicola in PVC o rivestita in PMMA).

Tutti i ricambi pianificati dei componenti - sigillature, giunzioni e ventrature - sono incluse nell'unità dichiarata.

La presente dichiarazione si basa sulle Regole di Categoria di Prodotto:

Finestre e porte, 11.2015
(Regole di PCR (Regole di Categoria di Prodotto) testate e approvate dal SVR (Consiglio di esperti))

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Ambito di applicazione:

Questa EPD è un'EPD associativa. La media ponderata dalle specifiche di produzione presentate da dodici società associate, da 22 siti in sette paesi è stata usata come base dati per la produzione di profili in plastica. Il volume di produzione dichiarato rappresenta una quota di circa il 70% della produzione di tutte le aziende di produzione che fanno parte delle associazioni QKE ed EPPA e, di conseguenza, quasi il 60% della produzione europea.

L'ambito di applicazione comprende diverse configurazioni, sia per il rinforzo dei profili di che per il trattamento della superficie. Sono incluse costruzioni di finestre che impiegano sistemi di vetrazione, così come sistemi di vetri incollati. Quindi, questa EPD copre tutte le tipologie di finestre in PVC non plastificato che sono conformi ai requisiti dichiarati.

Le seguenti società sono state coinvolte nella raccolta dei dati:

Case di produzione
- aluplast GmbH, D – Karlsruhe
- Deceuninck nv, B – Hooglede-Gits
- GEALAN Fenster-Systeme GmbH, D – Oberkotzau
- hapa AG, D – Herrieden
- Internorm Bauelemente GmbH, A – Traun
- L.B. Profile GmbH, D – Herbstein
- profine GmbH, D – Pirmasens
- Rehau AG + Co., D – Erlangen
- Salamander Industrie-Produkte GmbH, D – Türkheim
- Schüco Polymer Technologies KG, D – Weißenfels
- Stöckel GmbH, D – Vechtel
- VEKA AG, D – Sendenhorst

Produttori di finestre:
- BE Bauelemente GmbH, D – Leopoldshöhe-Greste
- Internorm Bauelemente GmbH, A – Traun
- Stöckel GmbH, D – Vechtel
- TMP Fenster + Türen GmbH, D – Bad Langensalza
- WERU GmbH, D – Rudersberg
- Wirus Fenster GmbH & Co. KG, D – Rietberg

Alla traduzione in lingua italiana hanno collaborato PVC Forum Italia e Finstral S.p.A.

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Il titolare della dichiarazione sarà responsabile per le informazioni e le prove di seguito utilizzate; l'IBU non è responsabile delle informazioni, i dati di valutazione del ciclo di vita e le prove del produttore

Verifica

La norma CEN /EN 15804/ costituisce il nucleo delle PCR.
Verifica indipendente della dichiarazione ai sensi di /ISO 14025/
☐ internamente ☒ esternamente

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Edizione italiana :

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Questo documento è idoneo per rispondere alle richieste dei Criteri Ambientali Minimi (CAM), Decreto 11 ottobre 2017 – Criteri ambientali minimi per l' affidamento di servizi di progettazione e lavori per la nuova costruzione e manutenzione di edifici pubblici.

2. Prodotto

2.1 Descrizione del prodotto / Definizione del prodotto

Il prodotto dichiarato è una finestra ad anta singola e a anta ribalta con dimensioni 1,23 m x 1,48 m e triplo vetro. Le finestre sono composte da mobili e telai fissi in PVC e vetri. Sono utilizzati vari materiali per rinforzare i: i profili realizzati in acciaio o alluminio, schiuma di poliuretano o fibre di vetro estruse nel PVC non plastificato.

La superficie del telaio può presentare differenti tipologie: laminata con pellicola di PVC, rivestita con PMMA (polimetacrilato di metile) o verniciata. Questei rivestimenti possono produrre superfici bianche o colorate, ruvide o lisce.

Le guarnizioni sono realizzate in PVC plastificato, EPDM (etilene propilene diene monomero) o TPE (elastomeri termoplastici), le giunzioni di acciaio.

Si presume una vita utile di riferimento di 40 anni per la finestra. Le rispettive vite utili dei componenti - vetratura, sigillature e giunzioni - è, tuttavia, più breve, e ciò significa che questi avranno bisogno di essere sostituiti durante la vita utile di riferimento dell'elemento finestra. Anche questi ricambi dei componenti individuali sono programmati e inclusi nell'unità funzionale dichiarata.

La presente EPD non si riferisce a un prodotto specifico di un produttore, ma conferma la qualità ambientale media per tutte le finestre in PVC non plastificato delle società appartenenti alle associazioni EPPA e QKE.

Ulteriori dati specifici possono essere trovati nella descrizione del prodotto da parte del produttore pertinente.

L'immissione sul mercato all'interno dell'UE/EFTA (con l'eccezione della Svizzera) è soggetta al CPR /regolamento sui prodotti da costruzione/ (UE) n. 305/2011. I prodotti devono disporre di una dichiarazione di prestazione conforme con la norma armonizzata sul prodotto /EN14351-1/ e la marcatura CE. L'utilizzo è regolato dalle rispettive norme nazionali.

2.2 Applicazione

Le finestre sono utilizzate sui tamponamenti esterni degli edifici per garantire illuminazione, aerazione e protezione dagli elementi atmosferici.

2.3 Dati tecnici

I dati della dichiarazione della prestazione (DoP), ai sensi della norma armonizzata sul prodotto /EN 14351-1/ devono essere applicati a ogni elemento finestra immesso sul mercato. La base per il calcolo sono i seguenti dati tecnici:

Nome	Valore	Unità
Costituzione vetratura	4/16/4/16/4	mm
Trasmittanza termica per il vetro Ug, ai sensi di /EN 674/, /EN 675/	0,6	W/(m²K)
Trasmittanza totale di Fattore solare g	50	%
Trasmittanza termica per le finestre Uw, ai sensi di /EN ISO 10077-1/, /EN ISO 10077-2/	0,92	W/(m²K)
Tenuta all'acqua, ai sensi di /EN 1027/, /EN 12208/	4A−9A	classe
Stress meccanico (durata), ai sensi di /EN 1191/, /EN 12400/	10.000−20.000	cicli

Per ulteriori dati sulla costruzione tecnica, sono citati qui sotto solo i requisiti minimi che si applicano a finestre dalla qualità garantita ai sensi di /RAL-GZ 695/. A seconda del progetto del telaio, delle sigillature e delle giunzioni, possono essere ottenute classi di prestazione considerevolmente più alte dalle finestre prodotte.

- Permeabilità all'aria minima ai sensi di /EN 1026/, /EN 12207/: Classe 2
- Resistenza al carico di vento minima ai sensi di / EN 12211/, /EN 12210/: Classe B1

Ulteriori dati specifici possono essere trovati nella descrizione del prodotto da parte del produttore pertinente.

2.4 Stato della consegna

Questa EPD fa riferimento alle finestre in plastica in PVC con dimensioni 1,23 m x 1,48 m. La sezione frontale misura 1,82 m².

2.5 Materiali di base / materiali accessori

I materiali di base dell'unità dichiarata sono:

Nome	Valore	Unità
Vetratura	58,7	massa %
Materiale PVC non plastificato	22,9	massa %
Acciaio di rinforzo	13,9	massa %
Acciaio delle giunzioni	3,4	massa %
PVC delle guarnizioni	0,9	massa %
Viti/elementi di fissaggio della vetratura	0,2	massa %

Le materie prime e gli additivi utilizzati per produrre i materiali per i telai in PVC non plastificato possono essere trovati nella seguente panoramica:

Formula del PVC
- massa 81,0 % PVC
- massa 8,1 % riempitivo (gesso)
- massa 4,9 % modificatori di resistenza all'urto
- massa 2,8 % stabilizzatori al calcio/zinco
- massa 3,2 % pigmenti di ossido di titanio (TiO2)

I materiali riciclati ottenuti da finestre usate sono impiegati nella produzione di profili realizzati dalle singole aziende. Questi profili possono contenere più dello 0,1 % di composti di piombo. Questi composti sono considerati come SVHC (sostanze estremamente problematiche), in conformità con il /REACH/.

2.6 Produzione

Le finestre di plastica sono realizzate con una varietà di componenti individuali: ogni finestra è composta da un telaio mobile e un telaio fisso in PVC non plastificato con guarnizioni, vetratura, giunzioni e, se richiesto, un rinforzo.

I profili in PVC non plastificato per i telai delle finestre sono prodotti con un processo di estrusione di una mescola di polvere di PVC e additivi. Questi proteggono il PVC dai danni durante la lavorazione e conferiscono al profilo le proprietà necessarie (resistenza agli urti, colore, stabilità in caso di agenti atmosferici, ecc.). La polvere di PVC utilizzata per realizzare i telai è un materiale in plastica ampiamente impiegato, ottenuto attraverso la polimerizzazione. Per via della sua struttura chimica, il PVC contiene un'alta percentuale di cloro.

La maggior parte dei telai delle finestre sono realizzati con profili bianchi in PVC. Alcuni telai sono realizzati con profili che sono anche rivestiti con pellicola in PVC, rivestiti con PMMA o verniciati.

Le guarnizioni sono generalmente fissate ai profili delle finestre tramite un processo di co-estrusione e sono composte di PVC plastificato, ma anche di EPDM o TPE.

I profili delle finestre sono consegnati in una lunghezza standard ai produttori di finestre, dove sono adattati alla effettiva lunghezza di una specifica finestra.
Laddove necessario, viene inserito e avvitato un rinforzo in acciaio. I profili vengono poi saldati termicamente, le giunzioni collegate e vengono installati il pannello e i nastri sigillanti per il mantenimento del vetro. Dopo di questo, la finestra può essere consegnata e montata.

L'acciaio utilizzato per la fabbricazione di giunzioni è ottenuto soprattutto da minerali grezzi di ferro, tramite un processo di cottura in altoforno, utilizzando una riduzione di coke.

La materia prima di base per la produzione della vetratura è la sabbia di quarzo, alla quale sono stati aggiunti diversi flussanti e ossidanti (carbonato di sodio, solfato di sodio, potassio, ecc.). Andando avanti nel processo di produzione, il vetro grezzo colato viene fatto scorrere su uno strato liquido di stagno, dal quale può essere continuamente prodotta una lastra piatta di vetro (processo di float glass).

Controllo della qualità

Le società appartenenti alla QKE e. V. sono soggette a un controllo di qualità esterno, nell'ambito dell'autoregolazione volontaria. I sistemi di finestre in plastica che riportano il contrassegno di qualità RAL, ai sensi di /RAL-GZ 716/ sono elencati sul sito internet gkft.de.

2.7 Ambiente e salute durante la produzione

Di tutti i costituenti delle formule di PVC, solo gli stabilizzatori di calcio/zinco devono essere classificati e contrassegnati come segue, ai sensi del /GHS/:

H302: Nocivo per ingestione
H318: Provoca gravi lesioni oculari
H317: Può provocare una reazione allergica cutanea
Pittogramma: Corrosivo e irritante

2.8 Lavorazione prodotto/installazione

Le finestre finite sono trasportate in cantiere e installate. Le viti realizzate in acciaio zincato e schiuma di poliuretano sono richieste per la relativa installazione.

2.9 Imballaggio

I profili - nel caso in cui non vengano ulteriormente lavorati sullo stesso sito - vengono trasportati dal produttore delle finestre, di solito su palette di acciaio riutilizzabile. Palette di legno monouso sono impiegate in casi isolati. Anche cartone, pellicole in polietilene e imbottiture in schiuma sono utilizzati durante il trasporto dei componenti individuali verso il produttore della finestra.

Imbottiture in schiuma di polietilene, protezioni dei bordi in cartone, nastri sigillanti per il mantenimento del carico in polipropilene, pinze in alluminio o acciaio e pellicole elasticizzate in polietilene sono utilizzati come materiali di imballaggio per ogni elemento finestra da assemblare.

2.10 Condizioni d'uso

Le finestre in plastica sono durevoli e resistenti. La composizione dei materiali non cambia durante l'utilizzo del prodotto.

2.11 Ambiente e salute durante l'utilizzo

I materiali per telai in PVC non plastificato non hanno effetti negativi sull'ambiente e sulla salute. Se l'utilizzo di componenti privi di solventi è assicurato per tutta la catena di approvvigionamento, anche la finestra finale non avrà ripercussioni su ambiente e salute.

2.12 Vita utile di riferimento

La vita utile di riferimento della finestra in PVC non plastificato dichiarato è di 40 anni, ai sensi di /BBSR/. La vita tecnica di certi componenti individuali è, perciò, superata; pertanto saranno necessari tre ricambi di guarnizioni e un ricambio di giunzioni e di vetrature durante il ciclo di servizio.

2.13 Effetti straordinari

Fuoco

Le finestre in PVC sono classificate nelle classi B - E per la reazione al fuoco (a seconda delle caratteristiche di superficie), s3 per lo sviluppo di gas e fumo e d0 per il gocciolamento, ai sensi di /EN 13501-1/.

Brandschutz

Nome	Valore
Classe materiali da costruzione	B−E
Gocciolamento	d0
Sviluppo di fumo e gas	s3

Per questo, le finestre in plastica soddisfano rispettivamente i requisiti della classe B2 “combustibilità normale”, ai sensi di /DIN 4102-1/ e la classe E, ai sensi di /EN 13501-1/ come minimo.

Acqua

Non sono da attendersi effetti negativi sull’ambiente nel caso di un’esposizione imprevista all’acqua, come nel caso di un allagamento.

Distruzione meccanica

Non sono da attendersi effetti negativi sull’ambiente nel caso di un’imprevista distruzione meccanica.

2.14 Fase di riutilizzo

I processi più importanti nella fase di riutilizzo del PVC non plastificato sono il riciclo di materiali e lo smaltimento in discarica. In aggiunta, il PVC può anche essere utilizzato termicamente.

Anche una gran parte dell’acciaio utilizzato nella giunzione e nei rinforzi è riciclata per produrre altri manufatti.

Anche le vetrature possono essere riciclate molto bene. Altrimenti, vengono per lo più eliminate in siti di smaltimento, ma una piccola parte viene portata in un inceneritore.

2.15 Smaltimento

I componenti individuali di una finestra possono essere smaltiti dopo l’utilizzo come rifiuto non pericoloso. I codici dei rifiuti ai sensi del catalogo europeo dei rifiuti /CER/ sono i seguenti:

- 17 02 02 Vetro
- 17 02 03 Plastica
- 17 04 05 Ferro e acciaio

2.16 Ulteriori informazioni

Possibili fonti per ulteriori informazioni sono disponibili sui siti internet delle associazioni

www.qke-bonn.de
www.eppa-profiles.eu

e sui siti internet delle case di produzione e dei produttori di finestre.

3. LCA: Regole di calcolo

3.1 Unità funzionale dichiarata

L'unità dichiarata è una finestra 1,23 m x 1,48 m (finestra di riferimento in conformità con /EN 14351-1/) con una massa di 71,9 kg. La porzione di FF in relazione all'area complessiva è del 33%. Sono inclusi ricambi programmati della vetratura, delle giunzioni e delle sigillature nel corso della vita di servizio di 40 anni.

Unità dichiarata

Nome	Valore	Unità
Unità dichiarata	71,9 kg	Finestra di riferimento di 1,23 m x 1,48 m, con porzione di controtelaio dal 25% al 35%

3.2 Confine del sistema

Viene considerato l'intero ciclo di vita del prodotto "dalla culla alla tomba".

Produzione

Viene utilizzata la vista d'insieme nella forma dei moduli A1-A3 per la produzione. Questo include la fornitura di materie prime, la produzione di rinforzi con acciaio, di vetro in lastre, giunzioni e profili in PVC non plastificato, l'intero trasporto al produttore della finestra, i requisiti energetici per la costruzione delle finestre e qualsiasi rifiuto di produzione generato. In particolare, è anche incluso il consumo per il riscaldamento e l'illuminazione per le sale di produzione e i locali adiacenti. Beni strumentali (macchinari, edifici, ecc.) non sono considerati.

Il trasporto dalla sede del produttore al cantiere viene tenuto in considerazione nel modulo A4. Tutti i processi relativi all'installazione della finestra nell'edificio sono considerati secondo il modulo A5.

Utilizzo

Le dispersioni di calore che possono verificarsi durante la fase d'utilizzo sono tenute in considerazione secondo il modulo B1. Le misure descritte nel paragrafo 2.13 riguardanti la sostituzione dei componenti della finestra sono tenute in considerazione secondo il modulo B4.

Smaltimento

Tutti i processi relativi alla rimozione, lo smontaggio o la demolizione della finestra dall'edificio, inclusa una prima cernita dei materiali presso il cantiere, sono tenute in conto secondo il modulo C1.

La redistribuzione del trasporto dal cantiere per il recupero del calore, il riciclo di materiali e lo smaltimento in discarica sono considerati secondo il modulo C2. Il modulo C3 considera il trattamento dei rifiuti, inclusa la loro suddivisione per il riciclo.

Lo smaltimento in discarica e il riciclo termico ricadono sotto il modulo C4.

Meriti

Infine, il modulo D mostra il potenziale per il riutilizzo, il recupero e il riciclo derivato dai moduli C3 e C4.

3.3 Stime e ipotesi

Oltre alle ipotesi e alle stime descritte nella sezione 4, non sono state fatte ulteriori ipotesi e stime che possano avere un impatto o un effetto sul risultato.

3.4 Criteri limite

I flussi d'entrata tralasciati sono minori dell'1%, sia della massa totale che del flusso totale dell'energia primaria. Presi nell'insieme, essi sono pari a meno del 5% della massa totale o del 5% dell'energia totale.

3.5 Dati di fondo

I dati principali per l'estrusione dei profili e la produzione delle finestre sono stati forniti dai membri delle associazioni indicate (vedere Ambito). I dati di fondo delle materie prime, così come quelli riguardanti la fabbricazione del PVC, delle vetrature e delle giunzioni e tutti gli altri dati sono generati dal database /ecoinvent 2.2/.

Questo database non permette un calcolo del flusso netto per i consumi di acqua fresca, quindi le ipotesi si basano sul /Metodo sulla Scarsità Ecologica/.

3.6 Qualità dei dati

I dati dei prodotti esaminati sono stati raccolti tramite l'analisi della produzione e dei dati ambientali, confrontando dati relativi al LCA all'interno della catena di approvvigionamento del 2013 e sulla base dei dati medi presentati dalle associazioni. I dati raccolti sono stati controllati per saggiarne plausibilità e coerenza.

La qualità dei dati di fondo della produzione di vetro è considerata di grande importanza, perché la produzione di vetro dà un contributo significativo ai livelli di produzione A1-A3.

3.7 Periodo sotto revisione

Tutti i dati primari sono stati raccolti nel 2013.

3.8 Distribuzione

I dati sull'estrusione dei profili e sulla produzione delle finestre si basano sul peso medio del volume di produzione.

3.9 Compatibilità

Sostanzialmente, è possibile eseguire un paragone o una valutazione dei dati EPD solo se tutti i dati da comparare sono stati creati secondo /EN 15804/ e se vengono presi in considerazione il contesto di costruzione e le caratteristiche di prestazione specifiche per il prodotto.

4. LCA: Scenari e ulteriori informazioni tecniche

Le seguenti informazioni tecniche costituiscono la base per i moduli dichiarati o possono essere utilizzate per sviluppare scenari specifici nel contesto di una valutazione di costruzione se i moduli non vengono dichiarati (MND).

Utilizzo (B1) vedere il Capitolo 3.2 Utilizzo

Le dispersioni nette di calore causate dalle finestre sono qui considerate. Queste consistono nella trasmissione di dispersioni di calore e nell'aumento del calore solare ottenuto grazie alla finestra. Gli effetti della fase di utilizzo dipendono, in larga misura, dalle effettive circostanze climatiche e tecniche di uno specifico edificio.

I calcoli delle dispersioni di calore, dell'aumento del calore e i risultati delle valutazioni sugli impatti si basano sui parametri delle condizioni medie dell'Europa centrale:

La richiesta di energia durante la fase di utilizzo nel sito di riferimento viene calcolata dalle dispersioni di calore e l'aumento del calore solare, ai sensi di /DIN V 18599-2/..

Nome	Valore	Unità
Fattore grado giornaliero Europa centrale	3641	K*d
Radiazione solare	209	kWh/m²

La misura dell'energia del calore è stata definita, secondo i dati dei requisiti per il riscaldamento tedesco: 49% di gas, 30% di olio combustibile e 13% di teleriscaldamento. Il rimanente 8% viene aggiunto in parti uguali alle già citate fonti di energia.

Sostituzione (B4), rinnovo (B5)

La sostituzione di componenti individuali che hanno raggiunto la fine della loro vita tecnica, secondo /BBSR/, viene considerata nel modulo B4.

Nome		Valore	Unità
Ciclo sostituzione	vetratura	1	Numero/RSL
	sigillature	3	Numero/RSL
	giunzioni	1	Numero/RSL

Vita utile di riferimento

La vita utile di riferimento della finestra, così come il ciclo di vita tecnico dei componenti individuali ai sensi di /BBSR/, è stabilito come segue:

Nome	Valore	Unità
Vita utile di riferimento per elemento finestra	40	a
Vita utile di riferimento per vetratura isolata	30	a
Vita utile di riferimento per giunzioni	25	a
Vita utile di riferimento sigillature	12	a

Fine del ciclo di vita (C1-C4)

Alla fine della loro vita utile, le finestre e i loro componenti possono essere facilmente raccolti, suddivisi e riciclati. Diversamente, vengono smaltiti in discariche o in siti per l'incenerimento dei rifiuti per il recupero del calore.

I tassi di riciclaggio e i metodi di smaltimento sono diversi a seconda del paese e differiscono largamente tra i vari paesi europei. Per il modulo C, sono previsti quattro scenari in totale:
C-0 recupero medio presente
C-a allocazione principale: discarica
C-b allocazione principale: incenerimento
C-c allocazione principale: riciclaggio

Per i punti C-a e C-b i tassi di riciclo di materiali come vetro e metallo dovrebbero essere gli stessi attualizzati (C-0), mentre la parte rimanente, che non è destinata al riciclo, viene portata completamente in discarica (C-a) e all'incenerimento (C-b). I risultati di questi scenari da a -c e di LCA sono presentati nel capitolo 6.4.

Tassi per la raccolta e il recupero per C-0:

Nome	Valore	Unità
Tasso di raccolta per tutti i materiali	95	%
* di cui sono riciclati	-	
vetro	65	%
PVC	59	%
acciaio/alluminio	92	%
altri	0	%
* quota d'incenerimento per il materiale da smaltire	-	
vetro	25	%
PVC	35	%
acciaio/alluminio	0	%
altri	20	%

Potenziale di riutilizzo, recupero e riciclo (D), scenario pertinente

L'energia (energia termica ed elettricità) e il materiale riciclato risultante dall'utilizzo termico e materiale sono nominati qui
.

5. LCA: Risultati

I risultati si adattano a tutti i tipi di rinforzi per profili e superfici elencati nella lista dell'ambito per i sistemi di finestre con blocchi di vetro, così come sistemi di vetratura incollata. I presenti tassi medi per il riciclaggio (scenario C-0), si applicano agli stadi della fine del ciclo di vita, da C1 a C4.

DESCRIZIONE DEL CONFINE DI SISTEMA (X = INCLUSO IN LCA; MND = MODULO NON DICHIARATO)

STADIO DEL PRODOTTO			STADIO PROCESSO DI COSTRUZIONE		STADIO DI UTILIZZO							STADIO FINE DEL CICLO DI VITA				BENEFICI E CARICHI OLTRE IL CONFINE DEL SISTEMA
Fornitura materie prime	Trasporto	Produzione	Trasporto dal luogo di produzione a quello di	Assemblaggio	Utilizzo	Manutenzione	Riparazione	Sostituzione	Ripristino	Utilizzo energia operativo	Utilizzo acqua operativo	Smontaggio e demolizione	Trasporto	Trattamento rifiuti	Smaltimento	Riutilizzo Recupero Riciclo potenziali
A1	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
X	X	X	X	X	X	MND	MND	X	MND	MND	MND	X	X	X	X	X

RISULTATI DELL'IMPATTO AMBIENTALE - LCA: finestre (1,23 m x 1,48 m) con triplo vetro

Parametro	Unità	A1-A3	A4	A5	B1	B4	C1	C2	C3	C4	D
GWP	[kg CO_2-Eq.]	1,58E+2	1,07E+0	1,96E+0	4,01E+2	1,12E+2	0,00E+0	3,31E+0	8,47E-1	7,82E+0	-3,67E+1
ODP	[kg CFC11-Eq.]	1,05E-5	1,75E-7	2,49E-8	5,91E-5	1,01E-5	0,00E+0	5,46E-7	1,14E-7	1,80E-7	-1,10E-6
AP	[kg SO_2-Eq.]	8,25E-1	4,20E-3	7,84E-3	5,56E-1	7,12E-1	0,00E+0	1,31E-2	5,97E-3	1,00E-2	-1,25E-1
EP	[kg $(PO_4)^{3-}$-Eq.]	9,17E-2	8,57E-4	1,59E-3	6,39E-2	7,83E-2	0,00E+0	2,68E-3	1,28E-3	2,66E-3	-1,48E-2
POCP	[kg ethene-Eq.]	4,14E-2	1,39E-4	4,44E-4	4,38E-2	3,04E-2	0,00E+0	4,37E-4	1,67E-4	6,67E-4	-1,35E-2
ADPE	[kg Sb-Eq.]	1,31E-3	3,24E-6	1,28E-5	8,32E-5	1,24E-3	0,00E+0	1,02E-5	7,67E-7	2,30E-5	-1,31E-4
ADPF	[MJ]	2,40E+3	1,71E+1	3,27E+1	6,31E+3	1,49E+3	0,00E+0	5,35E+1	1,27E+1	2,54E+1	-6,51E+2

Nota	GWP = Global warming potential (Potenziale di riscaldamento globale); ODP = Depletion potential of the stratospheric ozone layer (Potenziale di eliminazione dell'ozono); AP = Acidification potential of land and water (Potenziale di acidificazione di terra e acqua); EP = Eutrophication potential (Potenziale di eutrofizzazione); POCP = Formation potential of tropospheric ozone photochemical oxidants (Potenziale di formazione degli ossidanti fotochimici dell'ozono troposferico); ADPE = Abiotic depletion potential for non-fossil resources (Potenziale di svuotamento abiotico per risorse non fossili); ADPF = Abiotic depletion potential for fossil resources (Potenziale di svuotamento abiotico per risorse fossili)

RISULTATI DELL'IMPATTO AMBIENTALE - LCA: finestre (1,23 m x 1,48 m) con triplo vetro

Parametro	Unità	A1-A3	A4	A5	B1	B4	C1	C2	C3	C4	D
PERE	[MJ]	1,51E+2	2,32E-1	1,70E+0	2,80E+1	1,03E+2	0,00E+0	7,09E-1	2,74E-1	2,03E+0	-1,96E+1
PERM	[MJ]	1,35E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0
PERT	[MJ]	1,52E+2	2,32E-1	1,70E+0	2,80E+1	1,03E+2	0,00E+0	7,09E-1	2,74E-1	2,03E+0	-1,96E+1
PENRE	[MJ]	2,60E+3	1,82E+1	3,81E+1	6,43E+3	1,77E+3	0,00E+0	5,66E+1	1,41E+1	3,61E+1	-5,43E+2
PENRM	[MJ]	3,20E+2	0,00E+0	0,00E+0	0,00E+0	3,69E+1	0,00E+0	0,00E+0	0,00E+0	0,00E+0	-2,48E+2
PENRT	[MJ]	2,92E+3	1,82E+1	3,81E+1	6,43E+3	1,81E+3	0,00E+0	5,66E+1	1,41E+1	3,61E+1	-7,91E+2
SM	[kg]	4,05E-2	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0
RSF	[MJ]	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0
NRSF	[MJ]	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0
FW	[m^3]	5,53E-1	6,69E-4	8,71E-3	5,47E-2	2,00E-1	0,00E+0	2,12E-3	3,86E-4	9,22E-3	-2,74E-1

Nota	PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials (Utilizzo di energia primaria rinnovabile, ad esclusione delle fonti di energia primaria usata come materia prima); PERM = Use of renewable primary energy resources used as raw materials (Utilizzo di fonti di energia primaria rinnovabile, usata come materia prima); PERT = Total use of renewable primary energy resources (Utilizzo totale di fonti di energia primaria rinnovabile); PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials (Utilizzo di fonti di energia primaria non rinnovabile, ad esclusione di fonti di energia primaria non rinnovabile usate come materie prime); PENRM = Use of non-renewable primary energy resources used as raw materials (Utilizzo di fonti di energia non rinnovabile usate come materie prime); PENRT = Total use of non-renewable primary energy resources (Utilizzo totale di fonti di energia primaria non rinnovabile); SM = Use of secondary material (Utilizzo di materie secondarie); RSF = Use of renewable secondary fuels (Utilizzo di carburanti secondari rinnovabili); NRSF = Use of non-renewable secondary fuels (Utilizzo di carburanti secondari non rinnovabili); FW = Use of net fresh water (Utilizzo di acqua fresca netta)

RISULTATI DEL FLUSSO DI USCITA - LCA E DELLE CATEGORIE DI RIFIUTI: finestra (1,23 m x 1,48 m) con triplo vetro

Parametro	Unità	A1-A3	A4	A5	B1	B4	C1	C2	C3	C4	D
HWD	[kg]	1,47E+1	1,35E-2	1,07E-1	9,55E-1	1,54E+1	0,00E+0	4,35E-2	6,29E-3	4,16E+0	-2,08E+0
NHWD	[kg]	6,53E+1	1,71E-1	2,11E-1	6,60E+0	7,09E+1	0,00E+0	5,58E-1	5,22E-2	2,05E+1	-7,89E+0
RWD	[kg]	5,27E-3	1,39E-5	2,10E-5	1,65E-3	4,36E-3	0,00E+0	4,21E-5	1,86E-5	1,51E-4	-2,55E-4
CRU	[kg]	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0
MFR	[kg]	3,64E+0	0,00E+0	0,00E+0	0,00E+0	2,78E+1	0,00E+0	0,00E+0	4,57E+1	0,00E+0	0,00E+0
MER	[kg]	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0
EEE	[MJ]	1,28E-1	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	5,06E+0	-5,19E+0
EET	[MJ]	3,98E-1	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	0,00E+0	1,57E+1	-1,61E+1

Nota	HWD = Hazardous waste disposed (Rifiuti pericolosi disponibili); NHWD = Non-hazardous waste disposed (Rifiuti non pericolosi disponibili); CRU = Components for re-use (Componenti per il riutilizzo); MFR = Materials for recycling (Materie per il riciclaggio); MER = Materials for energy recovery (Materie per il recupero energetico); EEE = Exported electrical energy (Energia elettrica esportata); EET = Exported thermal energy (energia termica esportata)

6. LCA: Interpretazione

6.1 Sommario

I parametri del potenziale di riscaldamento globale (GWP) e l'utilizzo di fonti di energia primaria non rinnovabile (PENRT) rappresentano gli indicatori degli impatti ambientali e degli utilizzi delle risorse. Essi sono determinati dalle previsioni basate sulla fase di utilizzo dell'energia per compensare le dispersioni di calore causate dall'installazione della finestra (modulo B1). Se la fase di utilizzo viene rimossa dall'equazione, praticamente tutti gli impatti ambientali sono causati dai moduli A1-A3 (produzione) e B4 (sostituzioni, in particolare della vetratura). Al contrario, l'impatto sullo stadio della fine del ciclo di vita (moduli C1-C4), coprendo la demolizione e il trattamento dei rifiuti, è trascurabile. Il potenziale di riciclo e il processo di combustione, nello scenario della fine del ciclo di vita e il credito risultante dell'elettricità e dell'energia termica conducono, su carta, a valori negativi nella categoria di effetti del modulo D.

È necessario sottolineare il fatto che il dettaglio del modulo B1 per le finestre è facoltativo. Tuttavia, a causa della sua influenza significativa sul consumo complessivo di energia dell'edificio, è ragionevole una compensazione della sua fase di utilizzo. Per l'ottimizzazione delle prestazioni ambientali della finestra è chiaro, a partire da una considerazione generale, che la priorità sia quella di ridurre la dispersione termica che, a sua volta, si basa sul coefficiente UW della trasmissione del calore. Inoltre, l'aumento del calore solare (per esempio, in caso di orientamento o oscuramento) deve essere ottimizzata. Al contrario, la scelta della materia per il controtelaio è di importanza minore.

6.2 Stadio di produzione

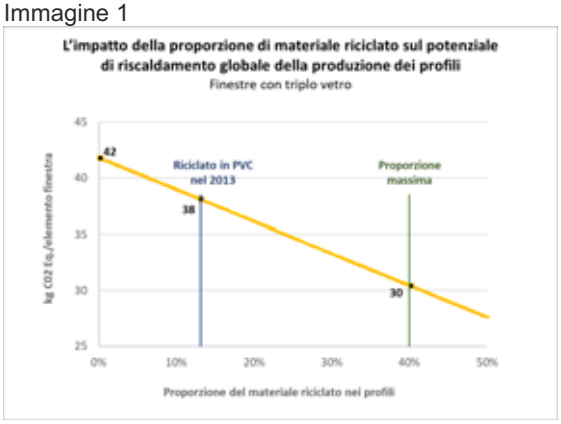
Oltre alla produzione di materie prime in PVC, la produzione del vetro e delle giunzioni giustifica le quote più grandi di tutte le categorie di impatti ambientali. Circa il 50 % degli impatti ambientali dello stadio di produzione sono causati producendo vetro isolante e i componenti delle giunzioni.

6.3 Informazione riguardo all'uso del PVC riciclato

Nella produzione di profili per finestre in PVC non plastificato, la materia prima vergine in PVC è parzialmente sostituita da materiale riciclato ottenuto da vecchie finestre. Tuttavia, l'apporto di materiale da vecchie finestre è limitato: prima di tutto, la quantità di materia riciclata disponibile è limitata e, inoltre, l'impiego di materiale vergine è necessario per via dei requisiti di prestazione del prodotto. Di conseguenza viene utilizzato un limite massimo pari al 40% di materiale riciclato - relativo alla quantità annuale di produzione di profili per finestre in PVC non plastificato.

L'analisi di sensibilità effettuata per la produzione dei profili mostra chiaramente che, a causa della riduzione di materie prime, le emissioni di CO2 e, di conseguenza, il potenziale di riscaldamento globale GWP si riducono in maniera significativa (vedere immagine 1). Il tasso di riciclaggio nell'anno in cui sono stati raccolti i dati era circa del 13 %, causando, così, un calo del 10% del GWP. Per la produzione di profili, una proporzione di riciclaggio del 40 % è equiparabile a un risparmio potenziale totale di GWP di circa il 28%.

Immagine 1



6.4 6.4 Scenari per la fine del ciclo di vita (EoL)/tasso di smaltimento

In aggiunta alla variante di base, sono stati valutati altri tre scenari per specificare l'influenza del riciclaggio materiale e termico (fare riferimento alle spiegazioni nel capitolo 4).

C-a Discarica prioritaria

Tassi per:	Riciclaggio	Incenerimento	Discarica
Vetro	62 %	-	38 %
PVC non plasitficato	-	-	100 %
Acciaio/alluminio	87 %	-	13 %
Altro	-	-	100 %

C-b Incenerimento prioritario

Tassi per:	Riciclaggio	Incenerimento	Discarica
Vetro	62 %	9 %	29 %
PVC non plastificato	-	100 %	-
Acciaio/alluminio	87 %	-	13 %
Altro	-	100 %	-

C-c Riciclaggio prioritario

Tassi per:	Riciclaggio	Incenerimento	Discarica
Vetro	100 %	-	-
PVC non plastificato	100 %	-	-
Acciaio/alluminio	100 %	-	-
Altro	100 %	-	-

Alcuni risultati degli indicatori selezionati sono mostrati nella tabella in basso:

parametri scelti	C-a discarica prioritaria		C-b incenerimento prioritario		C-c riciclaggio prioritario	
	C1-C4	D	C1-C4	D	C1-C4	D
GWP	6,26E+00	-1,97E+01	4,35E+01	-3,17E+01	6,96E+00	-4,87E+01
ODP	6,74E-07	-5,34E-07	1,36E-06	-1,92E-06	8,95E-07	-1,22E-06
AP	1,92E-02	-6,80E-02	6,95E-02	-8,53E-02	2,55E-02	-1,72E-01
EP	5,30E-03	-8,53E-03	1,18E-02	-1,07E-02	6,42E-03	-2,00E-02
POCP	1,04E-03	-1,01E-02	2,81E-03	-1,13E-02	1,07E-03	-1,70E-02
ADPe	9,90E-06	-3,92E-05	1,57E-04	-4,13E-05	1,50E-05	-2,03E-04
ADPf	6,71E+01	-3,06E+02	1,87E+02	-4,85E+02	8,94E+01	-8,99E+02
PENRT	7,16E+01	-3,47E+02	2,57E+02	-5,48E+02	9,59E+01	-1,11E+03

La presente comparazione mostra l'influenza di un metodo di smaltimento sugli effetti ambientali:

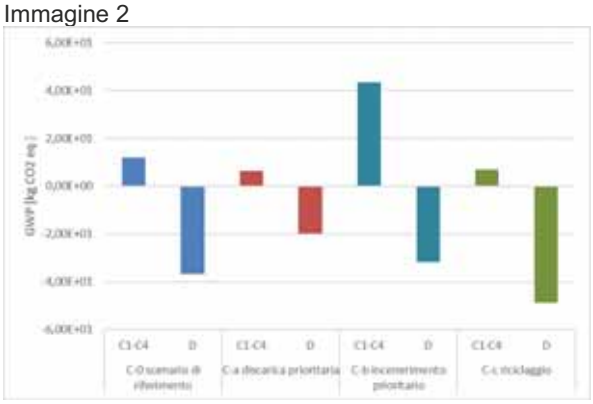
C-a (scenario discarica)
Paragonati allo scenario di base, sia il debito che il credito sono più bassi per via del mancato incenerimento.

C-b (scenario incenerimento)
I valori di tutti gli impatti aumentano a causa dell'incenerimento. Il presente paragrafo è originale o rielaborato. D'altra parte, la generazione dell'energia causata dall'incenerimento comporta un ampio credito.

C-c (scenario riciclaggio)
I crediti più ampi, in tutti gli scenari, sono raggiunti da un recupero completo del materiale.

Nell'immagine 2, i valori del potenziale di riscaldamento globale GWP vengono comparati con tutti gli scenari.

Immagine 2



6.5 Considerazioni individuali per gli indicatori d'impatto e i loro fattori d'influenza

6.5.1 Impatti ambientali

Potenziale di riscaldamento globale (GWP)
Il 92% del potenziale di riscaldamento globale è determinato dalle emissioni di CO2. La maggior parte ha origine dal consumo di energia verificatosi durante la fase di riutilizzo (B1), così come la produzione delle materie prime (vetratura, PVC non plastificato, acciaio). Il contributo rimanente fa riferimento alle emissioni di metano, analogamente associate con il consumo di energia durante la fase di utilizzo (B1).

Potenziale di eliminazione dell'ozono (ODP)
L'alon 1391 è realizzato durante la produzione di gas, mentre gli oli combustibili usati come carburanti compongono buona parte di questo indicatore (fase di utilizzo B1).

Potenziale di acidificazione (AP)
Questa categoria è per il 71% determinata dalle emissioni di ossido di zolfo e per il 27% da emissioni di monossido di azoto. Le loro fonti principali sono la produzione di energia durante la fase di utilizzo e la produzione di materie prime (per lo più vetro, PVC e acciaio).

Potenziale di eutrofizzazione (EP)
Il potenziale di eutrofizzazione riflette prevalentemente le emissioni di monossido di azoto (62%), di fosfato (22%) e la richiesta chimica di ossigeno (7%). I contributi più importanti sono dovuti alla produzione di calore (B1) e la produzione della vetratura (A1).

Potenziale di formazione degli ossidanti fotochimici dell'ozono troposferico (POCP)
Il potenziale di creazione fotochimica dell'ozono deriva dalle emissioni di ossido di zolfo (55%), sviluppato dai carburanti a combustibile fossile (B1) e della produzione della vetratura (A1). Altri contributi riflettono le emissioni dei composti volatici organici dal consumo di combustibili fossili e dalla produzione di materie prime (vetro, acciaio, PVC)

Potenziale di svuotamento abiotico per risorse non fossili (ADPE)
Il consumo principale di elementi rari (in particolare, zinco 31%, cromo 18%) è associato alla produzione di zinco e acciaio ricoperto di stagno per le giunzioni (A1-A3).

Potenziale di svuotamento abiotico per risorse fossili (ADPF)
Questo potenziale fa riferimento al consumo di gas naturale, olio crudo e antracite (65%), associati con il calore generato durante la fase di utilizzo (B1). Gli altri contributi derivano dal consumo di gas naturale e di olio grezzo, associati alla produzione di vetro (per la fornitura di energia) e la produzione di PVC (sia come fonte d'energia, che come materia prima)

6.5.2 Utilizzo delle fonti

L'utilizzo di energia primaria rinnovabile come energia (PERE) e come materia prima (PERM)
L'utilizzo di energia primaria rinnovabile come energia (PERE) e come materia prima (PERM) Nel complesso, l'utilizzo di energia rinnovabile è basso. Include l'impiego del legno come materia prima utilizzata per costruire palette, il consumo di elettricità generata da energia rinnovabile (energia idrica, energia eolica) e il calore generato da alcune compagnie dalla combustione del legno o residui della produzione propria per produrre calore.

L'utilizzo di energia primaria non rinnovabile come energia (PENRE) e come materia prima (PENRM)
Oltre alla fase di utilizzo, il consumo di energia non rinnovabile principale avviene durante la produzione di materie prime per le vetrature, il PVC e l'acciaio. Al contrario, la produzione di profili e la realizzazione di finestre presentano, entrambe, un consumo limitato. Il consumo di energia non rinnovabile per la produzione include le materie prime usate per generare i materiali plastici (PVC, rivestimenti, pellicole in LDPE, sigillature).

Utilizzo di materiale secondario (SM)
I materiali secondari sono prevalentemente utilizzati nella produzione di profili sotto forma di PVC non plastificato riciclato da vecchie finestre. Anche una piccola quantità di carta/cartone di scarto viene impiegata per produrre i materiali di imballaggio.

Utilizzo di carburante secondario (RSF, NRSF)
Non si fa utilizzo di carburanti secondari.

Utilizzo di acqua fresca netta (FW)
Il consumo principale di acqua deriva dalla produzione di vetro e PVC.

6.5.3 Flusso di uscita e categorie di scarto

Componenti per il riutilizzo (CRU)
Nessuna uscita.

Materiali per il riciclaggio (MFR)
La quantità significante di materiali per il riciclaggio nella lavorazione dei rifiuti, deriva da PVC non plastificato riciclato, vetro, alluminio e acciaio (rinforzi e giunzioni). Un piccolo contributo deriva dal riciclo di imballaggi nello stadio di produzione.

Mteriali per il recupero energetico (MER)
Come per il flusso dei rifiuti per il riciclaggio, la combustione di materiali provenienti da vecchie finestre tiene conto di buona parte della quota. Il piccolo contributo dei moduli A1 - A3 fa riferimento all'incenerimento dei materiali d'imballaggio (palette in legno e cartone) alla fine del suo ciclo di vita.

Energia esportata (EE)
Il recupero di energia in caso di incenerimento si verifica per lo più - come descritto sopra - nella lavorazione dei rifiuti (C3) e, in parte minore, alla fine del ciclo di vita del materiale d'imballaggio (A1 - A3).

7. Prove necessarie

Fuoco

Le prove di comportamento al fuoco differenti elementi sottoposti a prova da parte di vari produttori utilizzano il metodo di prova SBI, ai sensi di /EN 13823/, di Efectis Nederland BV, numero progetto 2012-Efectis-R0205

Risultato: Secondo i parametri identificati, le finestre di plastica soddisfano i seguenti criteri di classificazione, ai sensi di /EN 13501-1:2007+A1:2009/:
Classe materiali da costruzione: B – E
Emissioni di fumo: s3
Gocce ardenti: d0

VOC (composti volatili organici)

Progetto di ricerca sulle emissioni di composti volatili nei prodotti da costruzione; Bundesamt für Bauwesen und Raumordnung (Ufficio della Repubblica Federale Tedesca per la Costruzione e la Progettazione Regionale), come parte dell'iniziativa di ricerca "Building the Future", riferimento documento Z6-10.08.18.7-08.20/II2-F20-08-005, Dicembre 2010

Risultato: In termini di esposizione all'interno dei locali, le emissioni di COV ricadono ampiamente al di sotto dei requisiti della valutazione da parte della Commissione Tedesca per la Valutazione relativa alla salute dei prodotti da costruzione /AgBB/.

8. Riferimenti

AgBB: Schema di valutazione delle emissioni di composti volatili organici da prodotti da costruzione; Commissione per la valutazione relativa alla salute dei prodotti da costruzione; Germania, febbraio 2015

BBSR: Vite utili degli elementi costruttivi per l'analisi del ciclo di vita, secondo il BNB; Istituto Federale per la Costruzione, l'Urbanisitica e la Ricerca regionale; Germania, 2011

CER: Catalogo Europeo dei Rifiuti; 19 dicembre 2001

DIN 4102-1: Reazione al fuoco di materiali da costruzione e elementi costruttivi - Parte 1: Materiali di costruzione; progetti, requisiti e verifiche; DIN 4102-1:1998

DIN V 18599-2: Valutazione energetica degli edifici - Calcolo del fabbisogno energetico utile, finale e primario per riscaldamento, raffrescamento, ventilazione, acqua calda sanitaria e illuminazione - Parte 1: Procedure di bilanciamento generali, termini, zonizzazione e valutazione delle fonti energetiche.

ecoinvent 2.2: Database Ecoinvent, v. 2.2;
Centro Svizzero per gli Inventari sui Cicli Vitali (pub.); Duebendorf, Svizzera, 2010

EN 674: Vetro nell'edificio. Determinazione della trasmissione termica (valore U). Metodo della piastra calda; EN 674:2011

EN 675: Vetro nell'edificio. Determinazione della trasmissione termica (valore U). Metodo del flusso termico; EN 675:2011

EN 1026: Finestre e porte - Permeabilità all'aria - Metodo di prova; EN 1026:2000

EN 1027: Finestre e porte - Tenuta all'acqua - Metodo di prova; EN 1027:2000

EN 1191: Finestre e porte - Resistenza ai cicli ripetuti di apertura e chiusura Metodo di prova; EN 1191:2012

EN 12207: Finestre e porte - Permeabilità all'aria - Classificazione; EN 12207:1999

EN 12208 Finestre e porte - Tenuta all'acqua - Classificazione; EN 12208:1999

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Le seguenti società sono state coinvolte nella raccolta dei dati:

Pontedera, 11 ottobre 2019

Deceuninck, grazie al suo centro di riciclo del PVC con una capacità di recupero di 45.000 ton/anno, è leader nel campo del riciclo.

Per questo motivo i prodotti Deceuninck si fregiano della prestigiosa etichetta Vinyl Plus, quale riconoscimento dell'ecosostenibilità dei propri profili per serramenti in PVC e per rivestimenti esterni, dove la presenza di materiale proveniente dal processo di riciclo supera la soglia del 30%.

General Manager
Mirko Anesi

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VinylPlus® Product Label
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Deceuninck NV. is a proud partner of VinylPlus®, the Voluntary Commitment to sustainable development by the European PVC industry.

Deceuninck NV. is authorised to use the VinylPlus® Product Label in the sales territory of Europe (EU-28, plus Norway and Switzerland) for the following product(s) and location(s).

Product(s) families:
Zendow

Location(s):
Hooglede-Gits, Belgium

Signed for and on behalf of VinylPlus®

Brigitte Dero
General Manager

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