B-EPD ENVIRONMENTAL PRODUCT DECLARATION

Menuiserie Riche
Wood Window

To close a permanent opening of 1 m^2 in an exterior wall with a window size 1.23 x1.48 m, while allowing lightning, manual opening/closing, thermal insulation, over a lifespan of 60 years, if applied according to STS 52-1.

Issued 17.09.2021
Valid until 17.09.2026

Third party verified
Conform to EN 15804+A2, NBN/DTD B08-001, EN 17213 and ISO 14025

Modules declared					
A123	A4	A5	B	C	D
•	•	•	•	•	•

[B-EPD n° 21-0117-002.00.00]

OWNER OF THIS ENVIRONMENTAL PRODUCT DECLARATION
Menuiserie Riche

EPD PROGRAM OPERATOR
Federal Public Service of Health, Food Chain Safety and Environment
www.b-epd.be

The intended use of this EPD is to communicate scientifically based environmental information for construction products, for the purpose of assessing the environmental performance of buildings. This EPD is only valid when registered on www.b-epd.be. The FPS Public Health cannot be held responsible for the information provided by the owner of the EPD.

PRODUCT DESCRIPTION

PRODUCT NAME

Menuiserie Riche wood windows with double or triple glazing of 1.23 x1.48m .

PRODUCT DESCRIPTION

Menuiserie Riche wood windows exist in different types of glued laminated timber (Meranti, Larch, Sipo, Oak, Pine, Spruce). These windows can be double or triple glazing, with 1.23x1.48m dimension and 80 mm thickness.
The frames are finger-joint assembled, increasing their stability as well as their resistance to humidity.
The glazing is maintained with a wooden glazing bead and silicone joints, for an easy replacement.
Different frame thicknesses are available: 60 mm, 80 mm, 90 mm.
Menuiserie Riche is certified PEFC [1] for its wood coming from sustainably managed forests, and also received the bio-based label “biosourcé” for its wood windows[2]. The Menuiserie Riche 80 mm wood window is made of 84 % bio-based materials (mass without glazing).
The products of Menuiserie Riche are subject to the CE-marking.

INTENDED USE

Menuiserie Riche offers a wide range of opening types (windows, doors, slidings). Menuiserie Riche can achieve high performance in acoustics, thermal and safety, depending on the combinations of the frames with specific glazing or hardware.

Menuiserie Riche wood windows can be provided with different technical specifications regarding sun and/or burglar-proofing protection, smart (intelligent) glasses. These added elements are pre-mounted in Menuiserie Riche workshops.
Prefabrication with massive wood walls is possible for 2D building prefabrication.
After deconstruction of the building, it is possible to re-use the window in another building, but a worst case scenario is considered in this B-EPD.

Menuiserie Riche is specialized in wood windows for modern buildings as well as for heritage buildings.

These are final products.

This is a single EPD, from a single company manufacturer.

REFERENCE FLOW / DECLARED UNIT

The functional unit is described as follows:

“To close a permanent opening of 1 m^2 in an exterior wall with a window size 1.23x1.48m, while allowing lightning, manual opening/closing, thermal insulation, over a lifespan of 60 years, if applied according to STS 52-1.”

The product is not sold with packaging.

INSTALLATION

The scope of the product is as installed.

The wood windows are installed in exterior wall. Hardware, joints and seals are needed to install them. A screwdriver is necessary and depending on the kind of construction/renovation site, a building machine might also be used. Materials for fixation and installation are included.

During installation, no losses are considered, as the windows are custom ones. There is no packaging.

IMAGES OF THE PRODUCT AND ITS INSTALLATION

COMPOSITION AND CONTENT

Components	Composition / content / ingredients	Quantity
Product	*- Glued laminated wooden profiles* *- Glazing* *- Window fittings* *- Others*	*34-42%* *49-59%* *4-5%* *2-3%*
Fixation materials	*Brackets and screws*	*0.99 kg/window*
Jointing materials	*Polyurethan foam* *silicone joint* *sealant joint*	*0.26016 kg/window* *0.13008 kg/window* *0.05691 kg/window*
Treatments	*Not applicable for this product*	

Menuiserie Riche wood windows do not contain any SVHC substance registered at ECHA – in a concentration under 0.1% of final product mass.

REFERENCE SERVICE LIFE

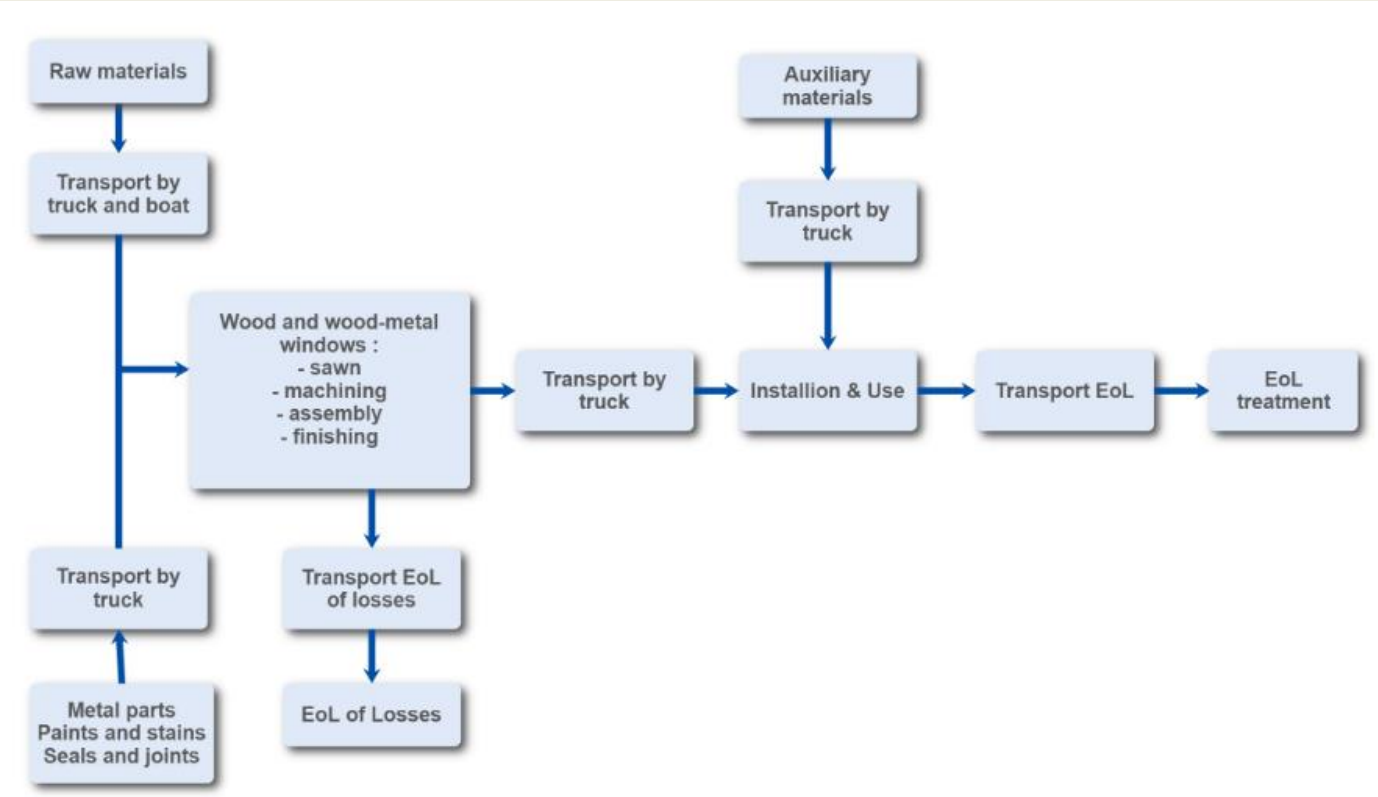
The reference service life is estimated at 60 years,if the elements are installed and maintained according to the STS 52, B.B.R.I.'s technical documents (Belgian Building Research Institute) and the manufacturer's instructions..
The conditions under which this RSL is valid are as following: if applied and maintained correctly according to the manufacturer's guidelines. Maintenance consists of painting external wood frame each 7.5 years, counting after the first 10 years. Glazing has to be replaced after 30 years use.

DESCRIPTION OF GEOGRAPHICAL REPRESENTATIVITY

This EPD is cradle-to-grave, and it is representative for the Belgian market.

DESCRIPTION OF THE PRODUCTION PROCESS AND TECHNOLOGY

The raw materials are transported by truck, by ship or by train to the production plant. The window manufacturing consists of wood cutting up, assembling the frame with the glazing, glue and other metal attachment hardware, and finishing with paints and wood stains. The used electricity comes from the Belgian electricity mix. Wood losses during manufacturing declared in the collected data from Menuiserie Riche are used in the building heating. Some other paint losses or metal losses during manufacturing are incinerated and landfilled, respectively. The product is not packed. Distribution is made by truck.



[1] certificate PEFC/07-32-181/1
[2] certificate n° BE/13/03/20/82-BE

TECHNICAL DATA / PHYSICAL CHARACTERISTICS

Technical property	Double glazing	Triple glazing	Unit	Standard/comment
Window acoustic performance Rw * - **	From 34.0 to 47.1		dB	EN ISO 10140-2 Depending on glazing composition
Air performance	4			EN 12207
Water performance	E 1200 A			EN 12208
Wind performance	C4			EN 12210
Manoeuvring efforts	1			-
Glass thermal performance (Ug)**	From 1.0 to 0.5		W/m^2K	Depending on glazing composition
Double glazing	0.1 W/m^2K			
Triple glazing	0.5 – 0.7 W/m^2K			
Window thermal performance (Uw)**	From 1.25 to 0.77		W/m^2K	Depending on glazing composition and wood essence
Wood frame thermal performance (Uf)	From 1.49 to 1.11		W/m^2K	Depending on wood essence
Larch - Pine	1.21 W/m^2K			
Meranti	1.38 W/m^2K			
Oak - Sipo	1.49 W/m^2K			

All tests have been reported by the CSTC in Belgium. Acoustic performances have been tested with different types of wood and glazings (results on demand).

* Test realised for Meranti wood.
** These results are specific to the glazing used for the tests at a given time and reflect the market. Menuiserie Riche can offer innovative glazing and spacers solutions to achieve specific performances.

LCA STUDY

DATE OF LCA STUDY
Data used in this cradle-to-grave LCA study represent the year 2019.

SOFTWARE
For the calculation of the LCA results, the software program Simapro version 9.1.1 has been used.

INFORMATION ON ALLOCATION
No co-product allocation occurs in the product foreground system.
No multi-input allocation occurs in the product system.
The allocations from the background database are kept intact.

INFORMATION ON CUT OFF
Menuiserie Riche provided the data used in this study. Some plausibility and completeness assessments and checks were conducted for some inputs. For a few remaining data, no extended assessment was conducted, therefore accepting data gaps.

In all cases, it is assumed that the cut-off criteria of EN 15804 are met.

INFORMATION ON EXCLUDED PROCESSES
Following processes were excluded for the inventory:

- The effects of capital goods and infrastructural processes have been excluded.
- Flows related to human activities such as employee transport and administration activities are excluded.

INFORMATION ON BIOGENIC CARBON MODELLING

Wood window products are mainly made of wood, with high biogenic carbon content. As long as these windows are in use, the carbon is stored in the product. For the windows, biogenic global warming potential is assessed based on the following formula and is provided in the overall LCA results. Global warming potential impacts excluding biogenic CO2 emissions are also provided in a separate indicator.

$$CO_2\ content\ (kg\ in\ air) = wood\ content * (1-u) * carbon\ content * 3.67\ (mol\ ratio\ CO_2 - C)$$

When u = 13% humidity and carbon content = 0.5

For EN 15804+A2 include following table:

	Biogenic carbon content (kg C / FU) Wood window
Biogenic carbon content in product (at the gate)	11.04
Biogenic carbon content in accompanying packaging (at the gate)	0

INFORMATION ON CARBON OFFSETTING

Carbon offsetting is not allowed in the EN 15804 and hence not taken into account in the calculations.

ADDITIONAL OR DEVIATING CHARACTERISATION FACTORS

The characterization factors from EC-JRC were applied. No additional or deviating characterisation factors were used. }

DESCRIPTION OF THE VARIABILITY

This EPD covers different wood-based windows. The method used to define the different wood types to be included was by performing a variability analysis in accordance with EN 15804+A2. The homogeneous impacts for this type of product allowed us to model an average product. This average product is constructed by taking a market share of each wood type.

DATA

SPECIFICITY

The data used for the LCA are specific for these products which are manufactured by a single manufacturer in a single production site (Menuiserie Riche).

PERIOD OF DATA COLLECTION

Manufacturer specific data have been collected for the year 2019.

INFORMATION ON DATA COLLECTION

The generic data used in this B-EPD is from Ecoinvent 3.6.

DATABASE USED FOR BACKGROUND DATA

Ecoinvent version 3.6 was used, released in September 2019.

ENERGY MIX

The Belgium energy mix is considered for the manufacturing of the product and to declare the benefits beyond the system boundaries (for module D).

PRODUCTION SITES

Menuiserie Riche
Zoning Industriel
Rue du Karting 5
5660 Mariembourg
Belgium

SYSTEM BOUNDARIES

Product stage			Construction installation stage		Use stage							End of life stage					Beyond the system boundaries
Raw materials	Transport	Manufacturing	Transport	Construction installation stage	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 = included in the EPD
MND = module not declared

POTENTIAL ENVIRONMENTAL IMPACTS FOR WOOD FRAME

The LCIA results are provided to close a permanent opening of 1 m^2 in an exterior wall with a wood frame size 1.23x1.48m, while allowing lightning, manual opening/closing, thermal insulation, over a lifespan of 60 years, if applied according to STS 52-1.

	Production			Construction process stage		Use stage							End-of-life stage				
	A1 Raw material	A2 Transport	A3 manufacturing	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	C1 Deconstruction / demolition	C2 Transport	C3 Waste processing	C4 Disposal	D Reuse, recovery, recycling
GWP total (kg CO2 equiv/FU)	-2.84E+01	4.44E+00	3.31E+01	2.14E-01	2.85E+00	0.00E+00	1.03E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.04E-01	2.81E-01	3.33E+01	3.26E+00	-9.45E+00
GWP fossil (kg CO2 equiv/FU)	1.84E+01	4.44E+00	8.36E+00	2.14E-01	2.83E+00	0.00E+00	1.02E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.04E-01	2.81E-01	1.19E-01	2.08E+00	-8.40E+00
GWP biogenic (kg CO2 equiv/FU)	-4.67E+01	3.05E-03	2.49E+01	8.74E-05	9.05E-03	0.00E+00	3.96E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.80E-05	1.15E-04	2.12E+01	1.16E+00	-1.07E+00
GWP luluc (kg CO2 equiv/FU)	4.87E-02	2.96E-03	1.87E-02	7.49E-05	1.04E-03	0.00E+00	8.42E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.60E-05	9.82E-05	4.67E-05	1.67E-05	-6.55E-03
ODP (kg CFC 11 equiv/FU)	1.23E-04	9.00E-07	1.65E-06	4.87E-08	2.74E-07	0.00E+00	1.34E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.37E-08	6.38E-08	1.69E-08	8.22E-09	-7.50E-07
AP (mol H+ equiv/FU)	1.20E-01	6.15E-02	5.32E-02	8.76E-04	1.23E-02	0.00E+00	1.25E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.36E-03	1.15E-03	3.63E-03	4.12E-04	-2.02E-02
EP - freshwater (kg P equiv/FU)	8.31E-04	5.34E-05	2.11E-04	1.68E-06	7.21E-05	0.00E+00	5.08E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.37E-07	2.21E-06	2.28E-06	7.77E-07	-1.05E-04
EP - marine (kg N equiv/FU)	2.90E-02	1.52E-02	2.23E-02	2.60E-04	3.14E-03	0.00E+00	1.02E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.73E-04	3.41E-04	1.68E-03	1.93E-04	-4.59E-03
EP - terrestrial (mol N equiv/FU)	3.24E-01	1.69E-01	2.55E-01	2.87E-03	2.88E-02	0.00E+00	1.08E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.29E-03	3.77E-03	1.93E-02	1.94E-03	-5.14E-02
POCP (kg NMVOC equiv/FU)	1.42E-01	4.59E-02	6.42E-02	8.80E-04	9.13E-03	0.00E+00	3.99E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.78E-03	1.15E-03	5.05E-03	5.31E-04	-1.42E-02

ADP Elements (kg Sb equiv/FU)	3.08E-04	6.75E-06	6.26E-06	4.17E-07	7.11E-06	0.00E+00	5.53E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.18E-08	5.47E-07	1.91E-07	6.07E-08	-2.65E-04
ADP fossil fuels (MJ/FU)	2.73E+02	6.28E+01	3.15E+02	3.23E+00	4.04E+01	0.00E+00	1.80E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.79E+00	4.24E+00	1.51E+00	3.78E-01	-1.50E+02
WDP (m^3 water eq deprived /FU)	6.66E+00	2.16E-01	2.86E+00	8.99E-03	1.78E+00	0.00E+00	9.74E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.73E-03	1.18E-02	3.91E-02	1.19E-02	-2.55E+00

GWP total = total Global Warming Potential (Climate Change); GWP-luluc = Global Warming Potential (Climate Change) land use and land use change; ODP = Ozone Depletion Potential; AP = Acidification Potential for Soil and Water; EP = Eutrophication Potential; POCP = Photochemical Ozone Creation; ADPE = Abiotic Depletion Potential – Elements; ADPF = Abiotic Depletion Potential – Fossil Fuels; WDP = water use (Water (user) deprivation potential, deprivation-weighted water consumption)

RESOURCE USE

	Production			Construction process		Use stage							End-of-life stage				
	A1 Raw material	A2 Transport	A3 manufacturing	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	C1 Deconstruction / demolition	C2 Transport	C3 Waste processing	C4 Disposal	D Reuse, recovery, recycling
PERE (MJ/FU, net calorific value)	1.01E+03	1.48E+00	-1.70E+02	4.56E-02	2.10E+00	0.00E+00	1.48E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.51E-02	5.98E-02	-4.22E+02	2.41E-02	-1.77E+01
PERM (MJ/FU, net calorific value)	6.65E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-2.34E+01	-2.22E+01
PERT (MJ/FU, net calorific value)	1.68E+03	1.48E+00	-1.70E+02	4.56E-02	2.10E+00	0.00E+00	1.48E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.51E-02	5.98E-02	-4.22E+02	-2.34E+01	-3.99E+01
PENRE (MJ/FU, net calorific value)	3.12E+02	6.45E+01	3.33E+02	3.26E+00	4.34E+01	0.00E+00	2.06E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.77E+00	4.27E+00	1.69E+00	4.27E-01	-1.62E+02
PENRM (MJ/FU, net calorific value)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT (MJ/FU, net calorific value)	3.12E+02	6.45E+01	3.33E+02	3.26E+00	4.34E+01	0.00E+00	2.06E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.77E+00	4.27E+00	1.69E+00	4.27E-01	-1.62E+02

SM (kg/FU)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF (MJ/FU, net calorific value)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF (MJ/FU, net calorific value)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW (m^3 water eq/FU)	1.71E-01	7.34E-03	8.67E-02	2.47E-04	4.16E-02	0.00E+00	2.12E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.98E-05	3.24E-04	5.46E-03	8.24E-04	-6.00E-02

PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Net use of fresh water

WASTE CATEGORIES & OUTPUT FLOWS

	Production			Construction process stage		Use stage							End-of-life stage				
	A1 Raw material	A2 Transport	A3 manufacturing	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	C1 Deconstruction / demolition	C2 Transport	C3 Waste processing	C4 Disposal	D Reuse, recovery, recycling
Hazardous waste disposed (kg/FU)	1.39E+00	6.65E-02	2.05E-01	2.08E-03	3.88E-02	0.00E+00	1.29E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.76E-03	2.73E-03	1.01E-01	4.21E-02	-1.34E-01
Non-hazardous waste disposed (kg/FU)	1.12E+01	2.09E+00	2.27E+00	1.70E-01	4.42E-01	0.00E+00	6.60E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.08E-02	2.23E-01	4.75E-02	6.75E-01	-3.47E+00
Radioactive waste disposed (kg/FU)	8.97E-04	4.23E-04	3.06E-03	2.20E-05	6.22E-05	0.00E+00	5.98E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.93E-05	2.89E-05	7.34E-06	6.21E-06	-6.35E-04
Components for re-use (kg/FU)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Materials for recycling (kg/FU)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.88E-01	0.00E+00	0.00E+00
Materials for energy recovery (kg/FU)	0.00E+00	0.00E+00	2.40E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.12E+01	0.00E+00	0.00E+00
Exported energy heat (MJ/FU)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.25E+01	0.00E+00	0.00E+00
Exported energy electricity (MJ/FU)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.12E+01	0.00E+00	0.00E+00

IMPACT CATEGORIES ADDITIONAL TO EN 15804

		Production			Construction process		Use stage							End-of-life stage				
		A1 Raw material	A2 Transport	A3 manufacturing	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	C1 Deconstruction / demolition	C2 Transport	C3 Waste processing	C4 Disposal	D Reuse, recovery, recycling
	*PM (disease incidence)*	3.96E-06	2.46E-07	4.68E-06	1.49E-08	1.78E-07	0.00E+00	5.70E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.59E-08	1.96E-08	3.16E-08	3.78E-09	-2.30E-07
	*IRHH (kg U235 eq/FU)*	9.43E-01	2.85E-01	3.59E+00	1.41E-02	8.42E-02	0.00E+00	5.92E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.19E-02	1.85E-02	6.92E-03	1.51E-03	-8.06E-01
	*ETF (CTUe/FU)*	8.68E+02	5.06E+01	4.98E+02	2.59E+00	8.02E+01	0.00E+00	3.15E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.68E+00	3.39E+00	2.78E+00	2.43E+00	-1.40E+02
	*HTCE (CTUh/FU)*	2.32E-08	2.46E-09	5.70E-09	7.27E-11	1.05E-08	0.00E+00	1.83E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.11E-10	9.54E-11	3.30E-09	2.53E-09	-5.20E-09
	*HTnCE (CTUh/FU)*	4.98E-07	5.18E-08	2.88E-07	2.82E-09	1.13E-07	0.00E+00	3.19E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.90E-09	3.70E-09	1.06E-08	4.17E-09	-1.15E-07

	Land Use Related impacts (dimension less)	6.81E+03	3.15E+01	8.11E+01	2.23E+00	-1.87E-03	0.00E+00	6.31E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.56E-01	2.92E+00	6.55E-01	4.71E-01	-6.02E+01

HTCE = Human Toxicity – cancer effects; HTnCE = Human Toxicity – non cancer effects; ETF = Ecotoxicity – freshwater; (potential comparative toxic unit)
PM = Particulate Matter (Potential incidence of disease due to PM emissions);
IRHH = Ionizing Radiation – human health effects (Potential Human exposure efficiency relative to U235);

POTENTIAL ENVIRONMENTAL IMPACTS FOR DOUBLE GLAZING

The LCIA results are provided to close a permanent opening of 1 m^2 in an exterior wall with a double glazing in a wood window size 1.23x1.48m, while allowing lightning, manual opening/closing, thermal insulation, over a lifespan of 60 years, if applied according to STS 52-1.

	Production			Construction process stage		Use stage							End-of-life stage				D Reuse, recovery, recycling
	A1 Raw material	A2 Transport	A3 manufacturing	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	C1 Deconstruction / demolition	C2 Transport	C3 Waste processing	C4 Disposal	
GWP total (kg CO2 equiv/FU)	1.81E+01	2.95E-01	0.00E+00	2.10E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.16E+01	0.00E+00	0.00E+00	0.00E+00	2.05E-01	1.57E-01	2.04E-02	9.59E-01	-1.63E+01
GWP fossil (kg CO2 equiv/FU)	1.80E+01	2.95E-01	0.00E+00	2.10E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E+01	0.00E+00	0.00E+00	0.00E+00	2.05E-01	1.57E-01	2.03E-02	9.15E-01	-1.63E+01
GWP biogenic (kg CO2 equiv/FU)	1.54E-01	1.20E-04	0.00E+00	8.54E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.72E-01	0.00E+00	0.00E+00	0.00E+00	3.80E-05	6.41E-05	3.40E-05	1.91E-03	-9.41E-02
GWP luluc (kg CO2 equiv/FU)	7.64E-03	1.03E-04	0.00E+00	7.32E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.14E-03	0.00E+00	0.00E+00	0.00E+00	1.60E-05	5.49E-05	1.98E-05	6.62E-05	-3.99E-03
ODP (kg CFC 11 equiv/FU)	1.97E-06	6.70E-08	0.00E+00	4.76E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.24E-04	0.00E+00	0.00E+00	0.00E+00	4.38E-08	3.57E-08	4.27E-09	5.23E-08	-1.84E-06
AP (mol H+ equiv/FU)	1.75E-01	1.21E-03	0.00E+00	8.56E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.89E-01	0.00E+00	0.00E+00	0.00E+00	1.36E-03	6.42E-04	1.48E-04	1.42E-03	-1.79E-01
EP - freshwater (kg P equiv/FU)	4.64E-04	2.32E-06	0.00E+00	1.65E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.19E-04	0.00E+00	0.00E+00	0.00E+00	7.38E-07	1.23E-06	2.72E-07	2.87E-06	-3.07E-04

EP - marine (kg N equiv/FU)	2.78E-02	3.58E-04	0.00E+00	2.54E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.07E-02	0.00E+00	0.00E+00	0.00E+00	5.73E-04	1.91E-04	6.01E-05	5.02E-04	-2.76E-02
EP - terrestrial (mol N equiv/FU)	3.38E-01	3.95E-03	0.00E+00	2.81E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.71E-01	0.00E+00	0.00E+00	0.00E+00	6.30E-03	2.11E-03	6.64E-04	5.54E-03	-3.42E-01
POCP (kg NMVOC equiv/FU)	8.38E-02	1.21E-03	0.00E+00	8.60E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.37E-02	0.00E+00	0.00E+00	0.00E+00	1.78E-03	6.45E-04	1.83E-04	1.65E-03	-8.19E-02
ADP Elements (kg Sb equiv/FU)	8.72E-05	5.75E-07	0.00E+00	4.08E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.20E-05	0.00E+00	0.00E+00	0.00E+00	5.19E-08	3.06E-07	2.65E-08	3.49E-07	-5.80E-05
ADP fossil fuels (MJ/FU)	2.18E+02	4.45E+00	0.00E+00	3.16E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.50E+02	0.00E+00	0.00E+00	0.00E+00	2.79E+00	2.37E+00	4.83E-01	3.91E+00	-1.82E+02
WDP (m^3 water eq deprived /FU)	4.48E+00	1.24E-02	0.00E+00	8.79E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.80E+00	0.00E+00	0.00E+00	0.00E+00	3.74E-03	6.59E-03	3.27E-03	2.85E-02	-3.69E+00

GWP total = total Global Warming Potential (Climate Change); GWP-luluc = Global Warming Potential (Climate Change) land use and land use change; ODP = Ozone Depletion Potential; AP = Acidification Potential for Soil and Water; EP = Eutrophication Potential; POCP = Photochemical Ozone Creation; ADPE = Abiotic Depletion Potential – Elements; ADPF = Abiotic Depletion Potential – Fossil Fuels; WDP = water use (Water (user) deprivation potential, deprivation-weighted water consumption)

RESOURCE USE

	Production			Construction process		Use stage							End-of-life stage				
	A1 Raw material	A2 Transport	A3 manufacturing	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	C1 Deconstruction / demolition	C2 Transport	C3 Waste processing	C4 Disposal	D Reuse, recovery, recycling
PERE (MJ/FU, net calorific value)	1.42E+01	6.28E-02	0.00E+00	4.46E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.69E+01	0.00E+00	0.00E+00	0.00E+00	1.51E-02	3.34E-02	3.60E-02	8.79E-02	-9.04E+00
PERM (MJ/FU, net calorific value)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT (MJ/FU, net calorific value)	1.42E+01	6.28E-02	0.00E+00	4.46E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.69E+01	0.00E+00	0.00E+00	0.00E+00	1.51E-02	3.34E-02	3.60E-02	8.79E-02	-9.04E+00
PENRE (MJ/FU, net calorific value)	2.45E+02	4.48E+00	0.00E+00	3.19E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.81E+02	0.00E+00	0.00E+00	0.00E+00	2.78E+00	2.39E+00	5.01E-01	4.04E+00	-2.02E+02

PENRM (MJ/FU, net calorific value)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT (MJ/FU, net calorific value)	2.45E+02	4.48E+00	0.00E+00	3.19E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.81E+02	0.00E+00	0.00E+00	0.00E+00	2.78E+00	2.39E+00	5.01E-01	4.04E+00	-2.02E+02
SM (kg/FU)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF (MJ/FU, net calorific value)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF (MJ/FU, net calorific value)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW (m^3 water eq/FU)	7.41E-02	3.40E-04	0.00E+00	2.42E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.83E-02	0.00E+00	0.00E+00	0.00E+00	9.99E-05	1.81E-04	9.69E-05	3.65E-03	-3.67E-02

PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Net use of fresh water

WASTE CATEGORIES & OUTPUT FLOWS

	Production			Construction process stage		Use stage							End-of-life stage				
	A1 Raw material	A2 Transport	A3 manufacturing	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	C1 Deconstruction / demolition	C2 Transport	C3 Waste processing	C4 Disposal	D Reuse, recovery, recycling
Hazardous waste disposed (kg/FU)	1.03E+00	2.86E-03	0.00E+00	2.03E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.30E+01	0.00E+00	0.00E+00	0.00E+00	1.76E-03	1.52E-03	3.01E-04	1.12E+01	4.33E-01
Non-hazardous waste disposed (kg/FU)	4.45E+00	2.34E-01	0.00E+00	1.66E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.61E+00	0.00E+00	0.00E+00	0.00E+00	1.08E-02	1.25E-01	3.13E-03	1.46E-01	-2.24E+00

Radioactive waste disposed (kg/FU)	8.43E-04	3.03E-05	0.00E+00	2.15E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.57E-04	0.00E+00	0.00E+00	0.00E+00	1.94E-05	1.62E-05	4.18E-06	2.33E-05	-6.39E-04
Components for re-use (kg/FU)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling (kg/FU)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for energy recovery (kg/FU)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy heat (MJ/FU)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy electricity (MJ/FU)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

IMPACT CATEGORIES ADDITIONAL TO EN 15804

		Production			Construction process		Use stage							End-of-life stage				
		A1 Raw material	A2 Transport	A3 manufacturing	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	C1 Deconstruction / demolition	C2 Transport	C3 Waste processing	C4 Disposal	D Reuse, recovery, recycling
	PM (disease incidence)	1.66E-06	2.05E-08	0.00E+00	1.46E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.84E-06	0.00E+00	0.00E+00	0.00E+00	2.59E-08	1.09E-08	3.46E-09	3.69E-08	-1.74E-06
	IRHH (kg U235 eq/FU)	7.32E-01	1.94E-02	0.00E+00	1.38E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.28E-01	0.00E+00	0.00E+00	0.00E+00	1.20E-02	1.04E-02	4.26E-03	1.54E-02	-4.90E-01
	ETF (CTUe/FU)	4.39E+02	3.56E+00	0.00E+00	2.53E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.85E+02	0.00E+00	0.00E+00	0.00E+00	1.68E+00	1.90E+00	2.53E-01	9.58E+00	-2.82E+02

	HTCE (CTUh/FU)	7.59E-09	1.00E-10	0.00E+00	7.11E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.53E-09	0.00E+00	0.00E+00	0.00E+00	3.12E-10	5.33E-11	1.01E-11	3.92E-10	-2.65E-09
	HTnCE (CTUh/FU)	1.74E-07	3.88E-09	0.00E+00	2.76E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.21E-07	0.00E+00	0.00E+00	0.00E+00	1.90E-09	2.07E-09	1.93E-10	5.24E-09	-1.07E-07
	Land Use Related impacts (dimension less)	8.58E+01	3.07E+00	0.00E+00	2.18E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.04E+02	0.00E+00	0.00E+00	0.00E+00	3.56E-01	1.63E+00	3.21E-01	5.42E+00	-7.05E+01

HTCE = Human Toxicity – cancer effects; HTnCE = Human Toxicity – non cancer effects; ETF = Ecotoxicity – freshwater; (potential comparative toxic unit)
PM = Particulate Matter (Potential incidence of disease due to PM emissions);
IRHH = Ionizing Radiation – human health effects (Potential Human exposure efficiency relative to U235);

POTENTIAL ENVIRONMENTAL IMPACTS FOR TRIPLE GLAZING

The LCIA results are provided to close a permanent opening of 1 m^2 in an exterior wall with a triple glazing in a wood window size 1.23x1.48m, while allowing lightning, manual opening/closing, thermal insulation, over a lifespan of 60 years, if applied according to STS 52-1.

	Production			Construction process stage		Use stage							End-of-life stage				
	A1 Raw material	A2 Transport	A3 manufacturing	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	C1 Deconstruction / demolition	C2 Transport	C3 Waste processing	C4 Disposal	D Reuse, recovery, recycling
GWP total (kg CO2 equiv/FU)	2.84E+01	4.43E-01	0.00E+00	3.15E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.26E+01	0.00E+00	0.00E+00	0.00E+00	2.36E-01	3.06E-02	1.45E+00	-2.44E+01	-2.44E+01
GWP fossil (kg CO2 equiv/FU)	2.82E+01	4.42E-01	0.00E+00	3.14E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.22E+01	0.00E+00	0.00E+00	0.00E+00	2.36E-01	3.04E-02	1.38E+00	-2.45E+01	-2.45E+01
GWP biogenic (kg CO2 equiv/FU)	2.35E-01	1.80E-04	0.00E+00	1.28E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.54E-01	0.00E+00	0.00E+00	0.00E+00	9.61E-05	5.10E-05	2.87E-03	-1.41E-01	-1.41E-01
GWP luluc (kg CO2 equiv/FU)	1.18E-02	1.55E-04	0.00E+00	1.10E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.35E-02	0.00E+00	0.00E+00	0.00E+00	8.24E-05	2.97E-05	9.95E-05	-5.99E-03	-5.99E-03
ODP (kg CFC 11 equiv/FU)	3.07E-06	1.00E-07	0.00E+00	7.14E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.25E-04	0.00E+00	0.00E+00	0.00E+00	5.35E-08	6.40E-09	7.85E-08	-2.75E-06	-2.75E-06

AP (mol H+ equiv/FU)	2.71E-01	1.81E-03	0.00E+00	1.28E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.86E-01	0.00E+00	0.00E+00	0.00E+00	9.63E-04	2.22E-04	2.13E-03	-2.68E-01	-2.68E-01
EP - freshwater (kg P equiv/FU)	7.30E-04	3.47E-06	0.00E+00	2.47E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.89E-04	0.00E+00	0.00E+00	0.00E+00	1.85E-06	4.08E-07	4.32E-06	-4.60E-04	-4.60E-04
EP - marine (kg N equiv/FU)	4.31E-02	5.36E-04	0.00E+00	3.81E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.67E-02	0.00E+00	0.00E+00	0.00E+00	2.86E-04	9.01E-05	7.55E-04	-4.14E-02	-4.14E-02
EP - terrestrial (mol N equiv/FU)	5.23E-01	5.93E-03	0.00E+00	4.21E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.62E-01	0.00E+00	0.00E+00	0.00E+00	3.16E-03	9.96E-04	8.32E-03	-5.12E-01	-5.12E-01
POCP (kg NMVOC equiv/FU)	1.30E-01	1.82E-03	0.00E+00	1.29E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.42E-01	0.00E+00	0.00E+00	0.00E+00	9.67E-04	2.74E-04	2.47E-03	-1.23E-01	-1.23E-01
ADP Elements (kg Sb equiv/FU)	1.49E-04	8.62E-07	0.00E+00	6.12E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.54E-04	0.00E+00	0.00E+00	0.00E+00	4.59E-07	3.98E-08	5.24E-07	-8.70E-05	-8.70E-05
ADP fossil fuels (MJ/FU)	3.43E+02	6.67E+00	0.00E+00	4.74E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.80E+02	0.00E+00	0.00E+00	0.00E+00	3.55E+00	7.24E-01	5.87E+00	-2.72E+02	-2.72E+02
WDP (m^3 water eq deprived /FU)	7.18E+00	1.86E-02	0.00E+00	1.32E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.52E+00	0.00E+00	0.00E+00	0.00E+00	9.89E-03	4.91E-03	4.28E-02	-5.53E+00	-5.53E+00

GWP total = total Global Warming Potential (Climate Change); GWP-luluc = Global Warming Potential (Climate Change) land use and land use change; ODP = Ozone Depletion Potential; AP = Acidification Potential for Soil and Water; EP = Eutrophication Potential; POCP = Photochemical Ozone Creation; ADPE = Abiotic Depletion Potential – Elements; ADPF = Abiotic Depletion Potential – Fossil Fuels; WDP = water use (Water (user) deprivation potential, deprivation-weighted water consumption)

RESOURCE USE

	Production			Construction process		Use stage							End-of-life stage				
	A1 Raw material	A2 Transport	A3 manufacturing	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	C1 Deconstruction / demolition	C2 Transport	C3 Waste processing	C4 Disposal	D Reuse, recovery, recycling
PERE (MJ/FU, net calorific value)	2.20E+01	9.41E-02	0.00E+00	6.69E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.48E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.02E-02	5.39E-02	1.32E-01	-1.36E+01
PERM (MJ/FU, net calorific value)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

PERT (MJ/FU, net calorific value)	2.20E+01	9.41E-02	0.00E+00	6.69E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.48E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.02E-02	5.39E-02	1.32E-01	-1.36E+01
PENRE (MJ/FU, net calorific value)	3.85E+02	6.73E+00	0.00E+00	4.78E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.27E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.58E+00	7.51E-01	6.06E+00	-3.04E+02
PENRM (MJ/FU, net calorific value)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT (MJ/FU, net calorific value)	3.85E+02	6.73E+00	0.00E+00	4.78E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.27E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.58E+00	7.51E-01	6.06E+00	-3.04E+02
SM (kg/FU)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF (MJ/FU, net calorific value)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF (MJ/FU, net calorific value)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW (m^3 water eq/FU)	1.22E-01	5.10E-04	0.00E+00	3.62E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.38E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.72E-04	1.45E-04	5.48E-03	-5.50E-02

PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Net use of fresh water

WASTE CATEGORIES & OUTPUT FLOWS

	Production			Construction process stage		Use stage							End-of-life stage				
	A1 Raw material	A2 Transport	A3 manufacturing	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	C1 Deconstruction / demolition	C2 Transport	C3 Waste processing	C4 Disposal	D Reuse, recovery, recycling

Hazardous waste disposed (kg/FU)	1.65E+00	4.29E-03	0.00E+00	3.05E-03	0.00E+00	0.00E+00	0.00E+00	1.92E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.29E-03	4.51E-04	1.68E+01	6.49E-01
Non-hazardous waste disposed (kg/FU)	7.20E+00	3.51E-01	0.00E+00	2.49E-01	0.00E+00	0.00E+00	0.00E+00	8.61E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.87E-01	4.70E-03	2.20E-01	-3.36E+00
Radioactive waste disposed (kg/FU)	1.30E-03	4.55E-05	0.00E+00	3.23E-05	0.00E+00	0.00E+00	0.00E+00	1.46E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.42E-05	6.27E-06	3.50E-05	-9.58E-04
Components for re-use (kg/FU)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling (kg/FU)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for energy recovery (kg/FU)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy heat (MJ/FU)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy electricity (MJ/FU)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

IMPACT CATEGORIES ADDITIONAL TO EN 15804

		Production			Construction process		Use stage							End-of-life stage				
		A1 Raw material	A2 Transport	A3 manufacturing	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	C1 Deconstruction / demolition	C2 Transport	C3 Waste processing	C4 Disposal	D Reuse, recovery, recycling
	*PM (disease incidence)*	2.57E-06	3.08E-08	0.00E+00	2.19E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.78E-06	0.00E+00	0.00E+00	0.00E+00	1.64E-08	5.19E-09	5.53E-08	-2.61E-06	-2.61E-06
	*IRHH (kg U235 eq/FU)*	1.13E+00	2.92E-02	0.00E+00	2.07E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.25E+00	0.00E+00	0.00E+00	0.00E+00	1.55E-02	6.40E-03	2.31E-02	-7.35E-01	-7.35E-01
	*ETF (CTUe/FU)*	7.21E+02	5.34E+00	0.00E+00	3.79E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.07E+03	0.00E+00	0.00E+00	0.00E+00	2.85E+00	3.80E-01	1.44E+01	-4.24E+02	-4.24E+02
	*HTCE (CTUh/FU)*	1.33E-08	1.50E-10	0.00E+00	1.07E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.55E-08	0.00E+00	0.00E+00	0.00E+00	8.00E-11	1.51E-11	5.89E-10	-3.98E-09	-3.98E-09
	*HTnCE (CTUh/FU)*	2.89E-07	5.82E-09	0.00E+00	4.14E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.42E-07	0.00E+00	0.00E+00	0.00E+00	3.10E-09	2.89E-10	7.87E-09	-1.61E-07	-1.61E-07
	*Land Use Related impacts (dimension less)*	1.36E+02	4.60E+00	0.00E+00	3.27E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.59E+02	0.00E+00	0.00E+00	0.00E+00	2.45E+00	4.82E-01	8.14E+00	-1.06E+02	-1.06E+02

HTCE = Human Toxicity – cancer effects; HTnCE = Human Toxicity – non cancer effects; ETF = Ecotoxicity – freshwater; (potential comparative toxic unit)
PM = Particulate Matter (Potential incidence of disease due to PM emissions);
IRHH = Ionizing Radiation – human health effects (Potential Human exposure efficiency relative to U235);

Environmental impact categories explained

	*Global Warming Potential*	*The global warming potential of a gas refers to the total contribution to global warming resulting from the emission of one unit of that gas relative to one unit of the reference gas, carbon dioxide, which is assigned a value of 1.* *It is split up in 4:* - *Global Warming Potential total (GWP-total) which is the sum of GWP-fossil, GWP-biogenic and GWP-luluc* - *Global Warming Potential fossil fuels (GWP-fossil) : The global warming potential related to greenhouse gas (GHG) emissions to any media originating from the oxidation and/or reduction of fossil fuels by means of their transformation or degradation (e.g. combustion, digestion, landfilling, etc).* - *Global Warming Potential biogenic (GWP-biogenic) : The global warming potential related to carbon emissions to air (CO2, CO and CH4) originating from the oxidation and/or reduction of aboveground biomass by means of its transformation or degradation (e.g. combustion, digestion, composting, landfilling) and CO2 uptake from the atmosphere through photosynthesis during biomass growth – i.e. corresponding to the carbon content of products, biofuels or above ground plant residues such as litter and dead wood.*[3] - *Global Warming Potential land use and land use change (GWP-luluc): The global warming potential related to carbon uptakes and emissions (CO2, CO and CH4) originating from carbon stock changes caused by land use change and land use. This sub-category includes biogenic carbon exchanges from deforestation, road construction or other soil activities (including soil carbon emissions).*
	*Ozone Depletion*	*Destruction of the stratospheric ozone layer which shields the earth from ultraviolet radiation harmful to life. This destruction of ozone is caused by the breakdown of certain chlorine and/or bromine containing compounds (chlorofluorocarbonsor halons), Which break down when they reach the stratosphere and then catalytically destroy ozone molecules.*
	*Acidification potential*	*Acid depositions have negative impacts on natural ecosystems and the man-made environment incl. buildings. The main sources for emissions of acidifying substances are agriculture and fossil fuel combustion used for electricity production, heating and transport.*
	*Eutrophication potential*	*The potential to cause over-fertilization of water and soil, which can result in increased growth of biomass and following adverse effects.* *It is split up in 3:* - *Eutrophication potential – freshwater: The potential to cause over-fertilization of freshwater, which can result in increased growth of biomass and following adverse effects.* - *Eutrophication potential – marine: The potential to cause over-fertilization of marine water, which can result in increased growth of biomass and following adverse effects.* - *Eutrophication potential – terrestrial: The potential to cause over-fertilization of soil, which can result in increased growth of biomass and following adverse effects.*
	*Photochemical ozone creation*	*Chemical reactions brought about by the light energy of the sun creating photochemical smog. The reaction of nitrogen oxides with hydrocarbons in the presence of sunlight to form ozone is an example of a photochemical reaction.*
	*Abiotic depletion potential for non-fossil ressources*	*Consumption of non-renewable resources, thereby lowering their availability for future generations. Expressed in comparison to Antimonium (Sb).* *The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.*
	*Abiotic depletion potential for fossil ressources*	*Measure for the depletion of fossil fuels such as oil, natural gas, and coal. The stock of the fossil fuels is formed by the total amount of fossil fuels, expressed in Megajoules (MJ).* *The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.*
	*Ecotoxicity for aquatic fresh water*	*The impacts of chemical substances on ecosystems (freshwater).* *The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.*

[3] Carbon exchanges from native forests shall be modelled under GWP - luluc (including connected soil emissions, derived products or residues), while their CO2 uptake is excluded.

	*Human toxicity (carcinogenic effects)*	*The impacts of chemical substances on human health via three parts of the environment: air, soil and water.* *The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.*
	*Human toxicity (non-carcinogenic effects)*	*The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.*
	*Particulate matter*	*Accounts for the adverse health effects on human health caused by emissions of Particulate Matter (PM) and its precursors (NOx, SOx, NH3)*
	*Resource depletion (water)*	*Accounts for water use related to local scarcity of water as freshwater is a scarce resource in some regions, while in others it is not.* *The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.*
	*Ionizing radiation - human health effects*	*This impact category deals mainly with the eventual impact on human health of low dose ionizing radiation of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.*
	*Land use related impacts*	*The indicator is the "soil quality index" which is the result of an aggregation of following four aspects:* - *Biotic production* - *Erosion resistance* - *Mechanical filtration* - *Groundwater* *The aggregation is done based on a JRC model. The four aspects are quantified through the LANCA model for land use.* *The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.*

DETAILS OF THE UNDERLYING SCENARIOS USED TO CALCULATE THE IMPACTS

A1 – RAW MATERIAL SUPPLY

This module takes into account the extraction and processing of all raw materials and energy which occur upstream to the studied manufacturing process. The product is mainly composed by glued laminated wooden layers, glazing, window fittings and other components.

A2 – TRANSPORT TO THE MANUFACTURER

The raw materials are transported to the manufacturing site at Belgium by truck 16-32 and 3.5-7.5 metric tons, and by train and by ship.

A3 – MANUFACTURING

The glued laminated wood profile is cut, treated, painted, joints and hardware are added, finishing with the addition of glazing. Menuiserie Riche declared electricity and water used for manufacturing. Production losses vary depending on the raw material. It represents around 52.5% for the wood raw materials, 10% for paints and wood stains, and 1% for joints, seals and metal hardware. These losses are treated at the end of life: building heating (wood), paints and joints incineration and metal parts landfilling.

A4 – TRANSPORT TO THE BUILDING SITE

Transport to the construction site	*Transport type*	*Distance (km)*	*Average load factor and empty return*
From site to professional	Lorry 16-32 metric ton, EURO 5	66.67	Ecoinvent 3.6
From professional to final client	Lorry 16-32 metric ton, EURO 5	20	Ecoinvent 3.6

A5 – INSTALLATION IN THE BUILDING

Hardware, joints and seals are needed to install the windows. A screwdriver is used and a building machine might be used depending on the kind of construction/renovation site.

Auxiliary materials	
Screws	*0.99 kg/window*
Joints	*0.5691 kg/window*
Seals	*0.13008 kg/window*
Tightening foam	*0.26016 kg/window*
Screwdriver	*0.0146 kWh/window*
Building machine	*5 min/window*

During installation, no losses are considered, as the windows are custom ones. There is no packaging, thus no packaging end of life.

B – USE STAGE (EXCLUDING POTENTIAL SAVINGS)

The lifespan of the wood windows is 60 years. The defined lifespan is in agreement with TOTEM lifespan.
Wood windows need maintenance every 7.5 years, counting after the first 10 years. Maintenance consists at painting the external part of the frame. Glazings must be replaced at the 30-year of the window lifespan. The procedure can be done manually, and the silicon must also be replaced in the process. The replaced materials follow the same EoL declared in EoL stage (C).

C: END OF LIFE

C1: A building machine (similarly used to the installation) is considered to dismantle it.
C2: EoL transport follows the Belgian default scenario from NBN/DTD B 08-001:2017
C3: Sorting process is added in this step, as well as the impacts according to the PCR EN 17213:2020.
C4: declared according to the Belgian default scenario from NBN/DTD B 08-001:2017 and the PCR EN 17213:2020.

Default End of life scenario for wood windows – PCR EN 17213:2020			
Material	Landfill	Incineration	Recycling
Wood	5%	90.25%	4.75%
Metals	5%		95%
Paints and other finishings	5%	95%	
Glazing	70%		30%

Module C2 – Transport to waste processing			
Type of vehicle (truck/boat/etc.)	Fuel consumption (litres/km)	Distance (km)	Capacity utilisation (%)
Transport, freight, lorry 16-32 metric ton, euro5 {RER}|market for transport, freight, lorry 16-32 metric ton, EURO5|Cut-off, U	Construction site to sorting plant	30	Ecoinvent 3.6
Transport, freight, lorry 16-32 metric ton, euro5 {RER}|market for transport, freight, lorry 16-32 metric ton, EURO5|Cut-off, U	Sorting plant to landfill	50	Ecoinvent 3.6
Transport, freight, lorry 16-32 metric ton, euro5 {RER}|market for transport, freight, lorry 16-32 metric ton, EURO5|Cut-off, U	Sorting plant to incineration	100	Ecoinvent 3.6

End-of-life modules – wood windows			
Parameter	Unit	Double glazing	Triple glazing
Wastes collected separately	kg	53.37	66.55
Wastes collected as mixed construction waste	kg		
Waste for re-use	kg		
Waste for recycling	kg	11.64	15.59
Waste for energy recovery	kg	21.92	21.92
Waste for final disposal	kg	19.81	29.04

D – BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES

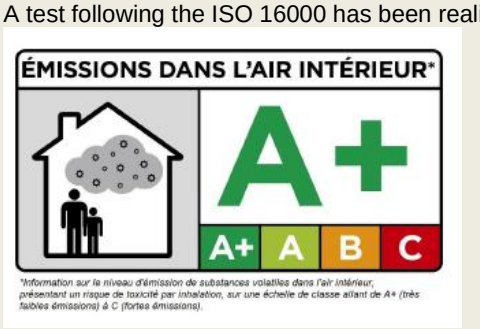
Module D is calculated, excluding any benefits or loads of allocated co-products. Recycling of metals, glazing and wood is considered as benefits and loads beyond the system boundaries, calculated in module D. The energy recovery from the incineration of wood is considered as benefits and loads beyond the system boundaries, calculated in module D. Incineration benefits regard electricity and heat generated and are calculated according to Belgian default scenario. Heating and electricity efficiencies are equal to 20% and 10%, respectively.

Quantitative description of the loads beyond the system boundaries	Loads represent the recycling transport done by truck 16-32 metric ton, euro5, within a 150 km, as well as the recycling processes for packaging.
Quantitative description of the benefits beyond the system boundaries	Benefits represent the recycled materials as well as electricity and heat generated due to product incineration.

ADDITIONAL INFORMATION ON RELEASE OF DANGEROUS SUBSTANCES TO INDOOR AIR, SOIL AND WATER DURING THE USE STAGE

INDOOR AIR

A test following the ISO 16000 has been realized. The emission class the most beneficial is retained for this B-EPD.



SOIL AND WATER

Not applicable as this product is not in contact with water and soil.

DEMONSTRATION OF VERIFICATION

EN 15804+A2 serves as the core PCR
Independent verification of the environmental declaration and data according to standard EN ISO 14025:2010 Internal ☐ External ☒
Third party verifier: Evert Vermaut Jan Olieslagerslaan 35 1800 Vilvoorde evermaut@vincotte.be

ADDITIONAL INFORMATION ON REVERSIBILITY

Reversibility	reversible with non repairable damage	mastic (window, sanitary elements…) for joints (Rjoint < Rmat)

Simplicity of disassembly	-	*simple - no specific dismantling tools required*
Speed of disassembly	-	*speedy disassembly*
Ease of handling (size and weight)	-	*can be handled manually, but size and/or weight may require more than one worker*
Robustness of material (material resistance to disassembly)	-	*disassembly is possible but should be done carefully in order not to generate any damage*

BIBLIOGRAPHY

- Menuiserie Riche Environmental Product Declaration Background Report – Wood and wood metal windows version 2.4
- ISO 14040:2006: Environmental Management-Life Cycle Assessment-Principles and framework.
- ISO 14044:2006: Environmental Management-Life Cycle Assessment-Requirements and guidelines.
- ISO 14025:2006: Environmental labels and Declarations-Type III Environmental Declarations-Principles and procedures.
- NBN EN 15804+A2:2019
- NBN/DTD B 08-001 (BE-PCR)
- PCR EN 17213:2020
- Product Environmental Footprint Category Rules – Thermal insulation
- TOTEM Lifespans (updated 15 October 2020)

General information

Owner of the EPD, Responsible for the data, LCA and information	**Menuiserie Riche** **Zoning Industriel, Rue du Karting 5, 5660** **Mariembourg, Belgium** *For more information you can contact* *Nathalie Lebrun – nlebrun@stabilame.be - 060310050*
EPD program Program operator Publisher of this EPD	**B-EPD** **FPS HEALTH / FOD Volksgezondheid** Galileelaan 5/2 1210 Brussels Belgium www.environmentalproductdeclarations.eu
Contact programma operator	epd@environment.belgium.be
Based on following PCR documents	EN 15804+A2:2019 NBN/DTD B 08-001 and EN 17213
PCR review conducted by	Federal Public Service of Health and Environment & PCR Review committee
Author(s) of the LCA and EPD	WeLOOP 254 Rue du Bourg 59130 Lambersart France
Identification of the project report	Menuiserie Riche Environmental Product Declaration Background Report – Wood and wood metal windows version 2.4
Verification	External independent verification of the declaration and data according to EN ISO 14025 and relevant PCR documents
Name of the third party verifier Date of verification	Evert Vermaut Vinçotte 09/06/2021
www.b-epd.be	**www.environmentalproductdeclarations.eu**

Comparing EPDs is not possible unless they are conform to the same PCR and taking into account the building context.
The program operator cannot be held responsible for the information supplied by the owner of the EPD nor LCA practitioner.

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LCA practitioner

Building calculator of the regiona authorities

www.totem-building.be

Federal Public Service of Health, Food Chain Safety and Environment

www.b-epd.be

Dieter De Lathauwer
((Signature