REYNAERS ALUMINIUM NV/SA

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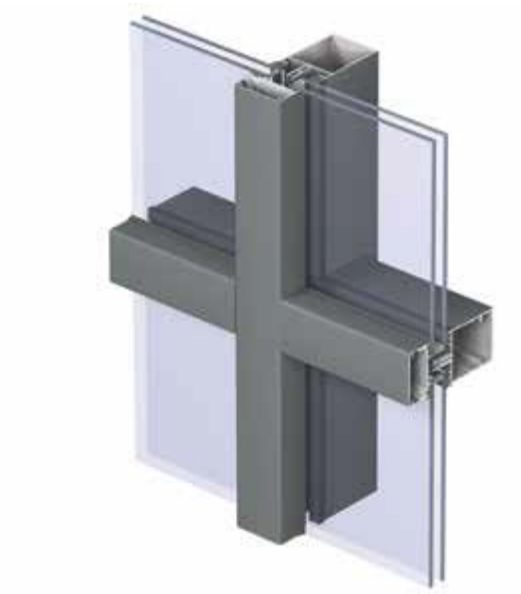
ENVIRONMENTAL PRODUCT DECLARATION
in accordance with ISO 14025 and EN 15804

Product	Curtain wall Concept Wall® CW 60 – CW 60 HI
	
Declaration holder	
Publisher and programme holder	European Aluminium EUROPEAN ALUMINIUM
Declaration number	EPD EUROPEAN ALUMINIUM 2020 – REYNAERS 14
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Weblink	www.reynaers.com

1. General information

Owner of the declaration	Reynaers Aluminium Oude Liersebaan 266 B- 2570 Duffel, Belgium
Programme holder	European Aluminium AISBL (previously European Aluminium Association AISBL) Avenue de Tervueren, 168 B - 1150 Brussels Belgium  Dr Gerd Götz, Director General
PCR used for the verification	EAA Product Category Rules (PCR) for Aluminium Building Products – version of 30 January 2013
Verification	EN15804 serves as core PCR completed by EAA PCR Verification of the EPD by an independent third party in accordance with ISO 14025 ☐ Internally ☒ Externally
Verifier	 **Carl-Otto Nevén** NEVÉN Miljökonsult/Environmental Cons.
Declaration number	EPD EUROPEAN ALUMINIUM 2020 – REYNAERS 14
Declared Unit	1 m^2 of curtain wall type Concept Wall® CW 60 – Concept Wall® CW 60 HI
Product group covered and applicability	This EPD covers 1 m^2 of curtain wall type Concept Wall® CW 60 - Concept Wall® CW 60 HI. These EPD results have been calculated from a modelling software originally developed by thinkstep and successively updated by Ecoinnovazione s.r.l. via an i-report in GaBi 8.7. Among the product family, three representative products have been selected and corresponding EPD results have been calculated based on specific bill of materials. These three products refer to double glazing curtain wall for CW 60 and CW 60-HI and triple glazing curtain wall for CW 60-HI. The results generated by this EPD-data software can be considered as a good proxy to model the curtain walls designed by Reynaers and fabricated by their European distributors.
Liability	The owner of the declaration is liable for the underlying manufacturing information and evidence; European Aluminium, i.e. the programme holder, is not be liable in this respect.

2. Product

2.1. Product description and application

This Environmental Product Declaration (EPD) is for business to business communication. This EPD refers to the Concept Wall® 60 (CW 60) and Concept Wall® 60 - HI (CW 60-HI) which are a façade and roof system that offers unlimited design freedom and allows maximum transparency. CW 60 and CW 60-HI are available in several design and glazing variants, but also includes different technical variants to comply with specified levels of fire-

resistance and thermal insulation. The design variants offer solutions for both the exterior and the interior of the building.

The representative product is a double-glazed curtain wall of 7.2 m high by 3.6 m wide as sketched in Figure 1.

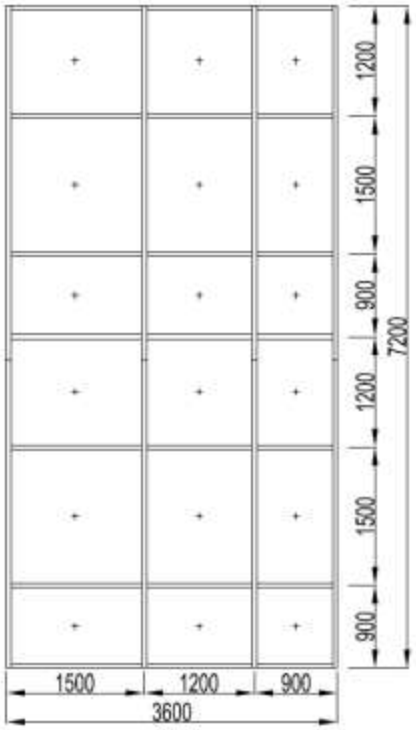

Figure 1. Sketch of the representative product for the curtain wall.

The representative products are composed of 2 vertical mullions (profiles) and 2 horizontal transoms forming the border of the section. Two additional vertical mullions and 5 transoms divide the curtain wall area in 18 sections, ranging in size from 0.9m x 0.9m to 1.5m x 1.5m. All these sections are filled with double or triple glazing units depending on the product.
As a conservative estimate, the calculated BoM considers 100% of the mass of the profiles located at the boarder of the representative product. In practice, these profiles can be shared with subsequent curtain wall sections.

EPD results have been calculated for 3 representative products, that are detailed in Table 1. There is no integration of operable windows in the representative product.

Table 1. List of representative products

ID	Model	Size (W x H)	Glazing	Surface area (m^2)
1	CW 60	7.2 m x 3.6 m	Double (10+8 mm)	25.92
2	CW 60 - HI	7.2 m x 3.6 m	Double (10+ 8 mm)	25.92
3	CW 60 - HI	7.2 m x 3.6 m	Triple (10+8+10 mm)	25.92

2.2. Technical data

The most relevant technical data are reported in Table 2.

Table 2. Most relevant technical data

Category	Description & value	Standards
Thermal Insulation	Between 0.76 and 2.6 depending on the profile and insulation level	EN 12631 EN 13947
Acoustic performance	Rw (C;Ctr) = 34 (-1;-4) dB/47 (-2;-5) dB, depending on the glazing type	EN ISO 10140-3; EN ISO 717-1
Air tightness	A4 (600 Pa)	EN 12153, EN 12152
Water tightness	RE 1200	EN 12155, EN 12154
Wind load resistance	2400 Pa	EN 12179, EN 13116
Resistance against impact	I5/E5	EN 14019
Burglar resistance	RC2/RC3	

For the most up-to-date values of the technical data, please refer to the product specifications available on the Reynaers website (see the specifications for CW 60 – CW 60 HI products in the section www.reynaers.com/consumers/our-products).

2.3. Relevant Standards for market Applications

Most relevant standards for applications of aluminium curtain walls in buildings are EN 13830

2.4. Delivery status and packaging

The Curtain walls are supplied in customised dimensions with appropriate protection and transport equipment e.g. racks. Occasionally, the aluminium profiles can be protected with a thin adhesive plastic film. This packing is not considered in this EPD study.

2.5. Curtain wall fabrication (foreground processes)

The curtain wall considered in the EPD project is a stick-type curtain wall.
This curtain wall is based on installed long vertical aluminium profiles (called mullions) covering several floors, i.e. between 2 to 3 floors, and shorter aluminium profiles positioned horizontally (called transoms) to fix the various glazing units or opaque panels. Framing members may be fabricated in a shop, but all installation and glazing is typically performed at the jobsite.

The contribution of the fabrication process to the overall production impact of the curtain wall is below the cut-off rule of 5%. Hence, no specific LCA modelling has been done on that process step, except a scrap rate of 3% for the aluminium profile which has been considered.

2.6. Main background processes

The main production processes are reported in Figure 2.

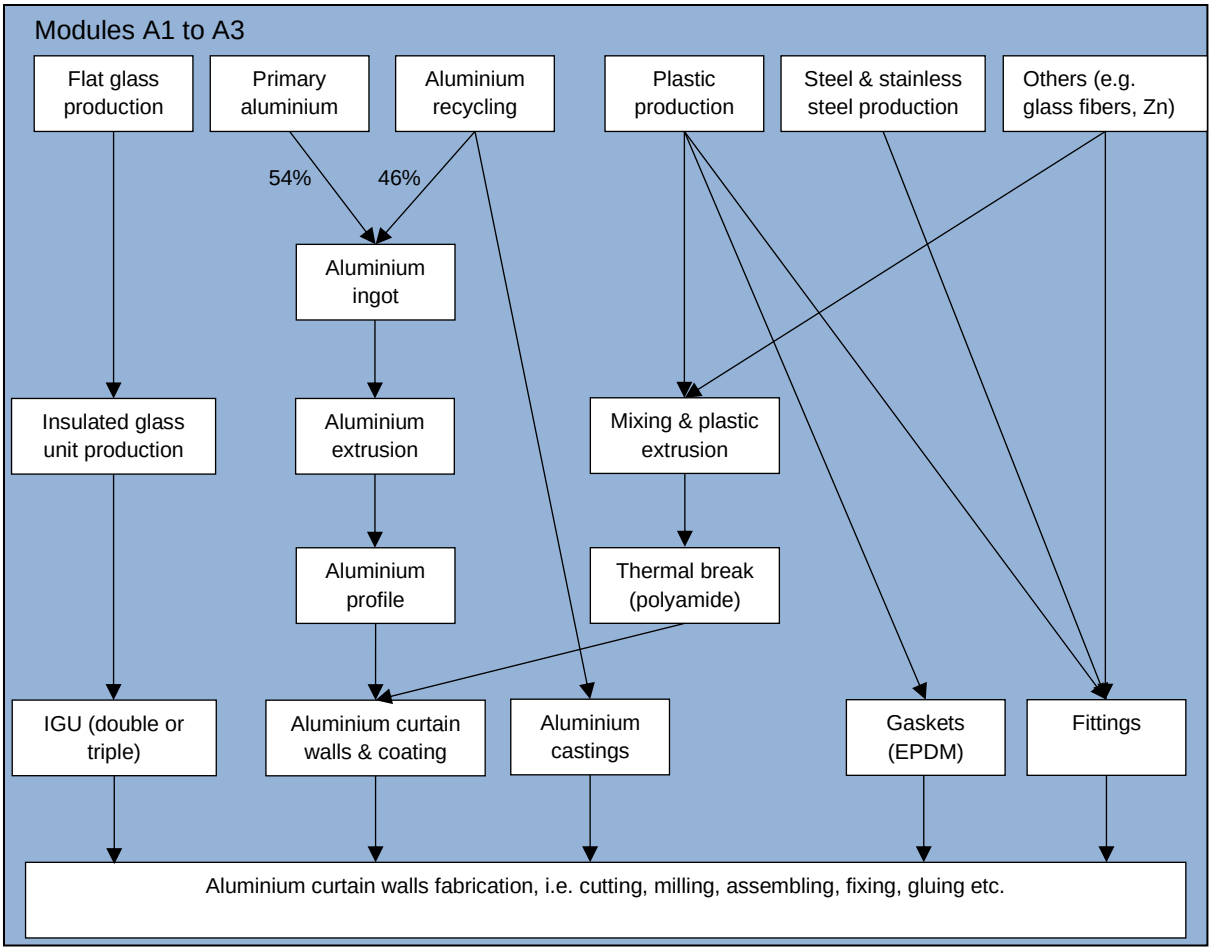

Figure 2. Main production processes and components of aluminium curtain wall

The aluminium profile production has been modelled using European Aluminium LCI datasets (year 2015) for the primary aluminium production, extrusion, recycling and remelting as described in the Environmental profile report developed by European Aluminium. The aluminium ingot (i.e. the billet) production has assumed that aluminium originated for 54% from primary aluminium and 46% from recycling which corresponds to the average recycling input rate of aluminium produced in Europe.

For the other components and materials production, e.g. thermal break, gaskets, glass unit or fittings, datasets from the GaBi database have been used (version GaBi 8.7, SP39, 2019). The powder coating of aluminium profile has been modelled using GaBi datasets as well.

2.7. Health and safety aspects during production and installation

There are no critical health and safety aspects during the production of aluminium curtain walls. The pre-treatments used for the pre-treatment of aluminium profile do not contain chromium nor other substances of very high concern (SVHC substances), and this process is followed by a coating process realised using a powder without VOC.

There are no relevant aspects of occupational health and safety during the further processing and installation of Reynaers curtain walls. Under normal installation, no measurable environmental impacts can be associated with the use of Reynaers aluminium curtain walls. The appropriate safety measures need to be taken at the building site, especially if installation takes place on a high-rise building.

2.8. Further processing, use and reference service life

CW 60 – CW 60 HI curtain walls are customised building products which are assembled on the building site. This EPD does not cover the downstream process to install the product at the building site.

During use, the indoor air quality, i.e. VOC emission, is not affected by aluminium curtain walls / VOC from aluminium windows/.

Since the use phase is not modelled, no specific information can be given about the Reference Service Life. In normal use, aluminium building products are not altered or corroded over time. A regular cleaning (e.g. once a year) of the product suffices to secure a long service life. However, the use of highly alkaline (pH >10) or highly acidic (pH < 4) cleaning solutions should be avoided.

In practice, a service life of 50 years can be assumed in normal use for such application /DURABILITY/.

In case of fire, aluminium is a non-combustible construction material (European Fire Class A1) in accordance to EN 13501 as well as Directive 96/603/EC, and does not therefore make any contribution to fire.

2.9. End of life stage

At the end-of-life stage, aluminium curtain walls should be specifically dismantled and collected in order to be treated since they include several materials which can be efficiently recycled or can be used for energy recovery.

In particular the aluminium profiles are systematically dismantled and sent for recycling. This high collection rate has been confirmed by a study done by Delft University showing that large aluminium pieces like aluminium profiles are systematically collected thanks to their intrinsic economic value /EAA DELFT/. Hence, a collection rate of 99% was used for the profiles.

Gaskets, thermal breaks and hardware are collected together with the aluminium profiles and are then treated through shredding and sorting with the aluminium profile. The glazing unit, however, is not systematically collected at the building renovation or demolition site. Indeed, the glazing unit is still often broken on site and is then sent to landfilling. In some European countries, the glazing unit is specifically collected and sent to recycling, e.g. in the Netherlands. Hence, two extreme end of life scenarios have been used for flat glass: 100% recycling or 100% landfilling.

From collected aluminium scrap (99%), up to the recycled aluminium ingot (92%), it is assumed as a conservative estimate that 7% of the aluminium metal is lost.

The waste code for aluminium in accordance with the European Waste Catalogue (EWC) is 17 04 02. Figure 3 reports the main processes and parameters used for the end of life stage modelling.

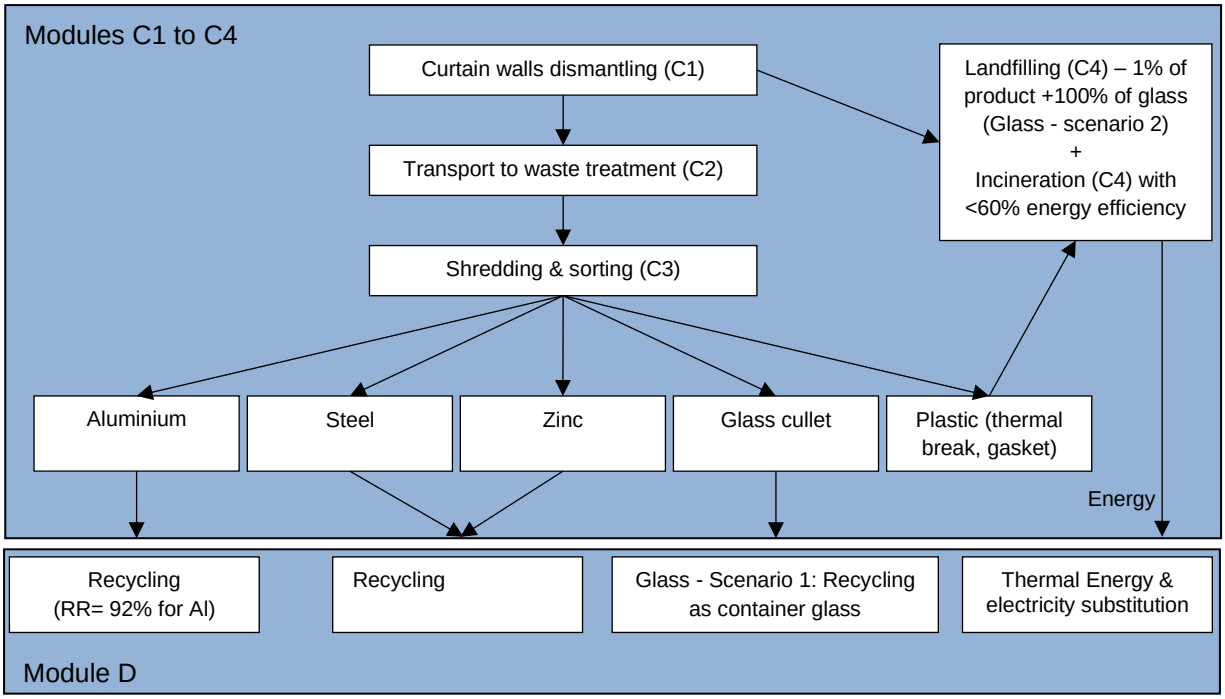

Figure 3. Main processes and parameters for the end of life stage modelling

3. LCA: Calculation rules

3.1. Product size, Bill of Materials and declared unit

EPD calculations have been done for the three representative products described under point 2.1. The Bill of Materials of the three representative products are reported in Table 4. The declared unit corresponds to 1 m^2 of curtain wall.

The EPD results are reported for the three representative products in the 3 annexes of this EPD.

Table 4. Bill of Materials (kg) of the declared unit for the 3 representative products

Reference	1	2	3
Type	CW 60 double GU	CW 60 -HI Double GU	CW 60-HI triple GU
Glass	42.12	42.12	65.52
Aluminium	8.37	8.37	8.59
Thermal break	0.01	0.01	0.01
Gasket	0.73	0.60	0.73
Fitting	0.10	0.10	0.18
Others - in plastics	0.34	0.03	0.05
Others - other materials	0.00	0.00	0.00
Total	51.67	51.23	75.07

3.2. System boundaries

Type of EPD: Cradle to gate – with options

The production stage (modules A1-A3) includes processes that provide materials and energy input for the system, manufacturing and transport processes up to the factory gate, as well as waste processing.

For the end of life, a collection rate of 99% is assumed and directed to recycling (module D). The 1% lost product is modelled through landfilling (module C4). Considering the few losses along the recycling chain, it is assumed that 92% of the Al material is effectively recycled as new ingot. Hence, an end of life recycling rate of 92% is used within module D to reflect the benefits of recycling through the substitution principle.

3.3. Estimates and assumptions

It has been assumed that the aluminium profiles were composed of a mix of 54% primary aluminium and 46% recycled aluminium. Such mix represents the typical sourcing of aluminium in Europe, all markets included. Alloying elements were not considered and a pure aluminium profile has been assumed as a proxy. Alloy used by Reynaers is composed of at least 98% of Aluminium. Hence, such assumption appears adequate.

3.4. Cut-off criteria

No specific data were collected and used to model the fabrication stage, which has a limited impact on the full life cycle profile of windows, doors or curtain walls. The impact of fabrication operations is below the cut-off rules of 5%. Nevertheless, a scrap rate of 3% at the fabrication stage has been considered into the LCA model.

3.5. Background data

GaBi 8.7 2019 – the software system for comprehensive analysis developed initially by thinkstep (previously PE International) – was used for modelling the life cycle for the production of the aluminium sliding doors. Generic GaBi 8.7 data sets have been used for energy, transport and consumables. For the aluminium primary production, recycling and sheet production, the datasets described in the environmental profile report 2018 of European Aluminium have been used.

3.6. Foreground data and EPD-data tool

The modelling efforts were focussed on the identification of representative products and the proper calculation and consideration of the BoM of the representative products within the LCA model.

No specific process data have been collected considering that their impact on the whole product life cycle is limited. In most cases, the curtain wall fabrication is not performed by Reynaers but by their distributors disseminated in Europe which sell and install Reynaers systems on the European market. Hence, collecting data on this process step is also very challenging. In any case, energy and consumables used at the fabrication stage are below the cut-off rule of 5% and were not considered. A scrap rate of 3% at fabrication stage was anyway considered in the model.

3.7. Data quality

The data quality can be considered as good. The LCA models have been checked and most relevant flows are considered. Technological, geographical and temporal representativeness is appropriate. The use of collective data can be considered as a reasonable proxy for the Reynaers aluminium systems.

3.8. Allocation

Any aluminium scrap produced along the fabrication chain is sent back to recycling. This recycling loop has been modelled in the GaBi model so that the aluminium curtain wall is the only product exiting the gate. Hence, the production process does not deliver any co-products.

At the end-of-life stage, the aluminium curtain wall is sent to an EoL treatment which is modelled according to the scenario reported in section 2.9. The environmental burdens and benefits of recycling and energy recovery are calculated in module D accordingly.

3.9. Comparability

As a general rule, a comparison or evaluation of EPD data is only possible when all of the data to be compared has been drawn up in accordance with EN 15804 and the building context or product-specific characteristics are taken into consideration.

4. LCA scenarios and additional technical information

Modules A4, A5 and B1-B7 are not taken into consideration in this Declaration. In module A1, a recycled metal content of 46% is assumed. Hence, end of life credits are calculated in Module D based on a net aluminium recycling of 92% at end of life minus 46% at production stage, i.e. a quantity representing 46% of the aluminium content of the door. It is assumed that the inherent properties are conserved through recycling, i.e. quality factor is kept to one.

Table 5. Modules addressed in the EPD study (X: module declared, MND: module not declared)

Production			Installation		Use stage							End-of-Life				Next product system
Raw material supply (extraction, processing, recycled material)	Transport to manufacturer	Manufacturing	Transport to building site	Installation into building	Use / application	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction / demolition	Transport to EoL	Waste processing for reuse, recovery or recycling	Disposal	Reuse, recovery or recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	X	X	X	X	X

5. LCA results

The LCA results are reported in the 3 annexes.

List of abbreviations: GWP: Global warming potential; ODP: Ozone layer depletion potential; AP: Acidification potential of land and water; EP: Eutrophication potential; POCP: Photochemical oxidation potential; ADPE: Abiotic depletion potential (elements); ADPF: Abiotic depletion potential (fossil fuels); 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 materials; RSF: Use of renewable secondary fuels; NRSF: Use of non- renewable secondary fuels; FW: Use of net fresh water; HWD: Hazardous waste disposed; NHWD: Non-hazardous waste disposed; RWD: Radioactive waste disposed; CRU: Components for re-use; MFR: Materials for recycling; MER: Materials for energy recovery; EEE: Exported electrical energy; EET: Exported thermal energy.

6. LCA interpretation

- Aluminium curtain wall production – Module A.

The majority of the environmental impacts come from the aluminium profile and to a lesser extent from the glazing unit. Hence, most indicators are influenced by the mass of aluminium in the declared unit: The higher the aluminium mass, the higher the indicator. Within the aluminium production processes, the primary aluminium production is dominant, especially the alumina production and the electrolysis. The recycled ingot production, which presents a much lower impact than the primary ingot production, is used in Module A1-A3 for the fraction of aluminium coming from recycling (46%). The extrusion process which transforms ingot, i.e. billets, into profile is much less significant. The LCA modelling and the impact of the primary aluminium production is detailed in the environmental profile report 2018.

The impact of the other components, e.g. thermal break, gaskets and fittings, is less significant due to their low contribution to the BoM.

- End of life stage (Module C) and benefits and loads resulting from reusable products, recyclable materials and/or useful energy carriers entering & leaving the product system (module D)

Parameters reported in Table 3 were used to model the end of life stage.

Module C: In all cases, the contribution of module C is very limited compared to modules A1-A3 and module D. (see Annex 3 for graphical representation). However, in case of the glass landfilling scenario, the mass of non-hazardous waste disposed becomes significant, i.e. corresponding at least to the mass of the glazing unit.

Module D: The environmental benefits come not only from the recycling of aluminium and metal fittings but also from glass recycling in case of the scenario with 100% recycling of the glass. About 40% to 50% depending on the representative product of GWP savings are obtained in Module D compared to the value calculated for module A1-A3 (see Annex 4 for graphical representation). The energy indicators follow the same trends. Additional benefits are also resulting from the energy recovery from EPDM and thermal break.

Since aluminium is one of the major materials used in the product and one of the major contributors to the total environmental impact of the product, the environmental impact of the aluminium used plays a fundamental role in determining the total environmental impact of the product. To show the relevance of this, Tables 6 – 11 report the results of a sensitivity analysis where the effect of having a different global warming potential for the aluminium used in the products on the global warming potential of the products object of this EPD is reported. For the calculation of the sensitivity analysis, 100% primary aluminium is considered and the values of 4 kg CO2/kg of primary aluminium and 5.1 kg CO2/kg primary aluminium have been used. The results are expressed per declared unit (1 m2 of curtain wall).

The results reported in Annexes 1-4 are calculated considering that the aluminium has a recycled content of 46% and the remaining primary aluminium has been modelled as “Primary Aluminium, European Consumption”, to which corresponds a global warming potential of 8.6 kg CO_2/kg of primary aluminium.

Table 6 – Results of the sensitivity analysis on global warming potential calculated considering 4 kg CO_2/ kg primary aluminium for CW 60 – double glazing.

	Glass landfill	**Glass recycling**
Impact Indicator	Global warming potential	

	Glass landfill	Glass recycling
Unit	kg CO_2-eq/m^2	
A1-A3	104.15	104.15
C1	$1.98 \cdot 10^{-1}$	$1.98 \cdot 10^{-1}$
C2	$1.74 \cdot 10^{-1}$	$3.75 \cdot 10^{-1}$
C3	$2.82 \cdot 10^{-1}$	1.86
C4	3.28	2.65
D	-32.14	-54.39

Table 7 – Results of the sensitivity analysis on global warming potential calculated considering 4 kg CO_2/ kg primary aluminium for CW 60 HI – double glazing

	Glass landfill	Glass recycling
Impact Indicator	Global warming potential	
Unit	kg CO_2-eq/m^2	
A1-A3	102.75	102.75
C1	$1.97 \cdot 10^{-1}$	$1.97 \cdot 10^{-1}$
C2	$1.67 \cdot 10^{-1}$	$3.69 \cdot 10^{-1}$
C3	$2.69 \cdot 10^{-1}$	1.85
C4	2.24	1.61
D	-31.87	-54.19

Table 8 – Results of the sensitivity analysis on global warming potential calculated considering 4 kg CO_2/ kg primary aluminium for CW 60 HI – triple glazing

	Glass landfill	Glass recycling
Impact Indicator	Global warming potential	
Unit	kg CO_2-eq/m^2	
A1-A3	140.21	140.21
C1	$2.12 \cdot 10^{-1}$	$2.12 \cdot 10^{-1}$

	Glass landfill	Glass recycling
C2	$2.27 \cdot 10^{-1}$	$5.41 \cdot 10^{-1}$
C3	$2.82 \cdot 10^{-1}$	2.74
C4	2.93	1.96
D	-32.89	-68.83

Table 9 – Results of the sensitivity analysis on global warming potential calculated considering 5.1 kg CO_2/ kg primary aluminium for CW 60 – double glazing.

	Glass landfill	Glass recycling
Impact Indicator	Global warming potential	
Unit	kg CO_2-eq/m^2	
A1-A3	113.27	113.27
C1	$1.98 \cdot 10^{-1}$	$1.98 \cdot 10^{-1}$
C2	$1.74 \cdot 10^{-1}$	$3.75 \cdot 10^{-1}$
C3	$2.82 \cdot 10^{-1}$	1.86
C4	3.28	2.65
D	-40.72	-62.97

Table 10 – Results of the sensitivity analysis on global warming potential calculated considering 5.1 kg CO_2/ kg primary aluminium for CW 60 HI – double glazing

	Glass landfill	Glass recycling
Impact Indicator	Global warming potential	
Unit	kg CO_2-eq/m^2	
A1-A3	111.87	111.87
C1	$1.97 \cdot 10^{-1}$	$1.97 \cdot 10^{-1}$
C2	$1.67 \cdot 10^{-1}$	$3.69 \cdot 10^{-1}$
C3	$2.69 \cdot 10^{-1}$	1.85
C4	2.24	1.61

	Glass landfill	Glass recycling
D	-40.45	-62.77

Table 11 – Results of the sensitivity analysis on global warming potential calculated considering 5.1 kg CO_2/ kg primary aluminium for CW 60 HI – triple glazing

	Glass landfill	Glass recycling
Impact Indicator	Global warming potential	
Unit	kg CO_2-eq/m^2	
A1-A3	149.58	149.58
C1	$2.12 \cdot 10^{-1}$	$2.12 \cdot 10^{-1}$
C2	$2.27 \cdot 10^{-1}$	$5.41 \cdot 10^{-1}$
C3	$2.82 \cdot 10^{-1}$	2.74
C4	2.93	1.96
D	-41.71	-77.64

7. References

CEN/TR 15941	Sustainability of construction works - Environmental product declarations - Methodology for selection and use of generic data; CEN/TR 15941:2010
DIRECTIVE 96/603/EC	COMMISSION DECISION of 4 October 1996 establishing the list of products belonging to Classes A ' No contribution to fire '
DURABILITY	Aluminium and Durability - Towards Sustainable Cities, edited by Michael Stacey, Published by Cwningen Press, November 2014 ISBN 978-0-9930162-0-2 (available at http://www.world-aluminium.org/publications/)
EAA DELFT	COLLECTION OF ALUMINIUM FROM BUILDINGS IN EUROPE - A Study by Delft University of Technology – 2004, available at http://european-aluminium.eu/media/1628/collection-of-aluminium-from-buildings-in-europe.pdf
EAA EPR	Environmental Profile Report for the European Aluminium Industry - 2018- Data for the year 2015, available at https://www.european-aluminium.eu/resource-hub/environmental-profile-report-2018/
EAA PCR	Product Category Rules (PCR) for Aluminium Building Products – version of 30 Jan 2013, available at http://european-aluminium.eu/resource-hub/epd-programme-according-to-en15804/
EN 1026	Windows and doors. Air permeability. Test method
EN 1027	Windows and doors. Watertightness. Test method
EN 12207	Windows and doors. Air permeability. Classification
EN 12208	Windows and doors. Watertightness. Classification
EN 12210	Windows and doors. Resistance to wind load. Classification
EN 12211	Windows and doors. Resistance to wind load. Test method
EN 12519	Windows and pedestrian doors — Terminology
EN 12519	Windows and pedestrian doors — Terminology
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 15804	Sustainability of construction works –Environmental Product Declarations – Core rules for the product category of construction products
EN 1627	Pedestrian doorsets, windows, curtain walling, grilles and shutters. Burglar resistance. Requirements and classification
EN 1630	Pedestrian doorsets, windows, curtain walling, grilles and shutters - Burglar resistance - Test method for the determination of resistance to manual burglary attempts
EN 573-3	Aluminium and aluminium alloys – Chemical composition and form of wrought products – Part 3: Chemical composition and form of products
EN ISO 10077-1	Thermal performance of windows, doors and shutters -- Calculation of thermal transmittance -- Part 1: General
EN ISO 10077-2	Thermal performance of windows, doors and shutters -- Calculation of thermal transmittance -- Part 2: Numerical method for frames
EN ISO 14025	Environmental labels and declarations - Type III environmental declarations - Principles and procedures
EN ISO 140-3	Acoustics -- Measurement of sound insulation in buildings and of building elements -- Part 3: Laboratory measurements of airborne sound insulation of building elements
EN ISO 14040	Environmental management - Life cycle assessment - Principles and framework
EN ISO 14044	Environmental management - Life cycle assessment - Requirements and guidelines
EN ISO 717-1	Acoustics -- Rating of sound insulation in buildings and of building elements -- Part 1: Airborne sound insulation
GABI 6	GaBi 6.3 dataset documentation for the software-system and databases, LBP, University of Stuttgart and PE INTERNATIONAL AG, Leinfelden-Echterdingen, 2013 (http://documentation.gabi-software.com/)
NEN 6069	Beproeving en klassering van de brandwerendheid van bouwdelen en bouwproducten (fire resistance testing and classification of building elements and products)
RECYCLING IN EN15804	TACKLING RECYCLING ASPECTS IN EN15804 – paper presented at the « LCA & Construction » conference in Nantes 10-12 July 2012
VOC from Al windows	Evaluation of Volatile Organic Compounds and aldehydes emitted by a “thermolacquered aluminium window posed (White QUALICOAT)" according to ISO 16000, Bureau Veritas Laboratoires, Report N°1200410-1 (E12-002890)

Annex 1: EPD results for the 2 end of life scenarios of CW 60 double glazed

Reference	1
Width of the door [m]	3.6
Height of the door [m]	7.2
Glazing Unit	Double glazing (8 mm glass – 15 mm gap – 10 mm glass)

Bill of Materials of the declared unit in kg	
Glass	42.12
Aluminium	8.37
Thermal break	0.01
Gasket	0.73
Fitting	0.10
Others - in plastics	0.34
Others - other materials	0.00
Total	51.67

The results are expressed per declared unit (1 m2 of curtain wall)

ENVIRONMENTAL IMPACTS

			Glass landfill					Glass recycling				
Parameter	**Unit**	**A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**	**C1**	**C2**	**C3**	**C4**	**D**
GWP	kg CO2-eq	1.15E+02	1.98E-01	1.74E-01	2.82E-01	3.28E+00	-2.91E+01	1.98E-01	3.75E-01	1.86E+00	2.65E+00	-5.10E+01
ODP	kg CFC11-eq	7.57E-10	4.67E-15	5.98E-17	1.18E-14	5.67E-15	-3.93E-10	4.67E-15	1.29E-16	4.58E-15	2.03E-15	-3.93E-10
AP	kg SO2-eq	5.46E-01	5.40E-04	6.91E-04	3.83E-04	4.09E-03	-1.42E-01	5.40E-04	1.49E-03	6.39E-04	3.70E-04	-2.49E-01
EP	kg PO43- eq	6.34E-02	6.89E-05	1.73E-04	6.75E-05	5.00E-04	-8.43E-03	6.89E-05	3.74E-04	5.79E-04	7.86E-05	-2.14E-02
POCP	kg ethene eq	-4.41E-03	4.10E-05	-2.64E-04	2.88E-05	3.24E-04	-7.87E-03	4.10E-05	-5.70E-04	-1.20E-03	3.55E-05	-1.56E-02
ADPE	kg Sb-eq	5.70E-05	5.21E-08	1.57E-08	1.10E-07	8.52E-08	-8.45E-06	5.21E-08	3.39E-08	5.64E-08	2.28E-08	-9.26E-06
ADPF	MJ	1.41E+03	2.21E+00	2.34E+00	2.75E+00	1.06E+01	-3.09E+02	2.21E+00	5.05E+00	1.59E+00	1.85E+00	-5.41E+02

RESOURCE USE

			Glass landfill					Glass recycling				
Parameter	**Unit**	**A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**	**C1**	**C2**	**C3**	**C4**	**D**
PERE	MJ	0	1.24	0.143	1.95	1.53	-3.08	1.24	0.309	-0.549	0.383	-10.3
PERM	MJ	320	0	0	0	0	-160	0	0	0	0	-166
PERT	MJ	320	1.24	0.143	1.95	1.53	-162	1.24	0.309	-0.549	0.383	-175
PENRE	MJ	0.723	3.43	2.35	3.61	11.1	-14.5	3.43	5.07	-0.449	2.05	-117
PENRM	MJ	1550	0	0	0	0	-368	0	0	0	0	-510
PENRT	MJ	1550	3.43	2.35	3.61	11.1	-365	3.43	5.07	-0.449	2.05	-609
SM	kg	4.02	0	0	0	0	0	0	0	0	0	0
RSF	MJ	0	0	0	0	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0	0	0	0	0
FW	m3	7.09E-01	1.46E-03	1.64E-04	1.05E-03	7.69E-03	-4.05E-01	1.46E-03	3.54E-04	1.63E-03	5.41E-03	-4.65E-01

WASTE

			Glass landfill					Glass recycling				
Parameter	**Unit**	**A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**	**C1**	**C2**	**C3**	**C4**	**D**
HWD	kg	4.07E-06	2.54E-08	1.34E-07	2.80E-09	1.68E-07	-2.02E-07	2.54E-08	2.89E-07	8.42E-07	1.30E-08	-7.57E-07
NHWD	kg	1.69E+01	2.22E-03	1.58E-04	3.73E-03	4.33E+01	-8.53E+00	2.22E-03	3.40E-04	4.24E-02	1.11E+00	-9.37E+00
RWD	kg	5.62E-02	4.85E-04	2.79E-06	3.40E-04	1.99E-04	-2.21E-02	4.85E-04	6.02E-06	-8.09E-04	7.73E-05	-2.65E-02

OUTPUT FLOWS

CRU	kg	0	0	0	0	0	-	0	0	0	0	-
MFR	kg	0	0	0	0	0	7.5	0	0	0	0	48.3
MER	kg	0	0	0	0	0	-	0	0	0	0	-
EEE	MJ	0	0	0	0	3.71	-	0	0	0	3.71	-
EET	MJ	0	0	0	0	6.68	-	0	0	0	6.68	-

Annex 2: EPD results for the 2 end of life scenarios of CW 60-HI double glazed

Reference	2
Width of the door [m]	3.6
Height of the door [m]	7.2
Glazing Unit	Double glazing (8 mm glass – 15 mm gap – 10 mm glass)

Bill of Materials of the declared unit in kg	
Glass	42.12
Aluminium	8.37
Thermal break	0.01
Gasket	0.60
Fitting	0.10
Others - in plastics	0.03
Others - other materials	0.00
Total	51.23

The results are expressed per declared unit (1 m2 of curtain wall)

ENVIRONMENTAL IMPACTS

			Glass landfill					Glass recycling				
Parameter	**Unit**	**A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**	**C1**	**C2**	**C3**	**C4**	**D**
GWP	kg CO2-eq	114	0.197	0.167	0.269	2.24	-28.9	1.97E-01	3.69E-01	1.85E+00	1.61E+00	-5.07E+01
ODP	kg CFC11-eq	6.92E-10	4.67E-15	5.77E-17	1.12E-14	3.91E-15	-3.93E-10	4.67E-15	1.27E-16	4.01E-15	2.71E-16	-3.93E-10
AP	kg SO2-eq	5.44E-01	5.39E-04	6.67E-04	3.64E-04	3.89E-03	-1.42E-01	5.39E-04	1.47E-03	6.20E-04	1.64E-04	-2.48E-01
EP	kg PO43- eq	6.31E-02	6.86E-05	1.67E-04	6.42E-05	4.58E-04	-8.38E-03	6.86E-05	3.68E-04	5.75E-04	3.65E-05	-2.13E-02
POCP	kg ethene eq	-4.73E-03	4.09E-05	-2.55E-04	2.75E-05	3.03E-04	-7.83E-03	4.09E-05	-5.61E-04	-1.20E-03	1.49E-05	-1.56E-02
ADPE	kg Sb-eq	5.66E-05	5.20E-08	1.51E-08	1.05E-07	6.60E-08	-8.40E-06	5.20E-08	3.34E-08	5.10E-08	3.58E-09	-9.21E-06
ADPF	MJ	1380	2.2	2.26	2.62	9.15	-305	2.20E+00	4.97E+00	1.46E+00	3.80E-01	-5.38E+02

RESOURCE USE

			Glass landfill					Glass recycling				
Parameter	**Unit**	**A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**	**C1**	**C2**	**C3**	**C4**	**D**
PERE	MJ	0	1.24	0.138	1.85	1.22	-2.13	1.24	0.304	-0.642	0.0665	-9.32
PERM	MJ	316	0	0	0	0	-160	0	0	0	0	-166
PERT	MJ	316	1.24	0.138	1.85	1.22	-161	1.24	0.304	-0.642	0.0665	-174
PENRE	MJ	0.723	3.43	2.26	3.43	9.51	-9.82	3.43	4.99	-0.623	0.427	-112
PENRM	MJ	1520	0	0	0	0	-368	0	0	0	0	-510
PENRT	MJ	1520	3.43	2.26	3.43	9.51	-360	3.43	4.99	-0.623	0.427	-604
SM	kg	4.02	0	0	0	0	0	0	0	0	0	0
RSF	MJ	0	0	0	0	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0	0	0	0	0
FW	m3	7.03E-01	1.46E-03	1.58E-04	9.99E-04	5.58E-03	-4.04E-01	1.46E-03	3.48E-04	1.58E-03	3.29E-03	-4.64E-01

WASTE

			Glass landfill					Glass recycling				
Parameter	**Unit**	**A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**	**C1**	**C2**	**C3**	**C4**	**D**
HWD	kg	3.60E-06	2.51E-08	1.29E-07	2.67E-09	1.58E-07	-2.00E-07	2.51E-08	2.84E-07	8.42E-07	2.85E-09	-7.6E-07
NHWD	kg	1.69E+01	2.22E-03	1.52E-04	3.55E-03	4.27E+01	-8.53E+00	0.00222	0.000335	0.0422	0.564	-9.37
RWD	kg	5.51E-02	4.85E-04	2.69E-06	3.23E-04	1.40E-04	-2.17E-02	0.000485	5.93E-06	-0.00083	1.85E-05	-0.0262

OUTPUT FLOWS

CRU	kg	0	0	0	0	0	-	0	0	0	0	-
MFR	kg	0	0	0	0	0	7.5	0	0	0	0	48.3
MER	kg	0	0	0	0	0	-	0	0	0	0	-
EEE	MJ	0	0	0	0	2.59	-	0	0	0	2.59	-
EET	MJ	0	0	0	0	4.63	-	0	0	0	4.63	-

Annex 3: EPD results for the 2 end of life scenarios of CW 60-HI triple glazed

Reference	3
Width of the door [m]	3.6
Height of the door [m]	7.2
Glazing Unit	Triple glazing (10 mm glass – 15 mm gap – 8 mm glass – 15 mm gap – 10 mm glass)

Bill of Materials of the declared unit in kg	
Glass	65.52
Aluminium	8.59
Thermal break	0.01
Gasket	0.73
Fitting	0.18
Others - in plastics	0.05
Others - other materials	0.00
Total	75.07

The results are expressed per declared unit (1 m2 of curtain wall)

ENVIRONMENTAL IMPACTS

			Glass landfill					Glass recycling				
Parameter	**Unit**	**A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**	**C1**	**C2**	**C3**	**C4**	**D**
GWP	kg CO2-eq	151	0.212	0.227	0.282	2.93	-29.8	2.12E-01	5.41E-01	2.74E+00	1.96E+00	-6.51E+01
ODP	kg CFC11-eq	7.10E-10	4.68E-15	7.83E-17	1.18E-14	5.98E-15	-4.03E-10	4.68E-15	1.86E-16	5.58E-16	3.17E-16	-4.03E-10
AP	kg SO2-eq	7.12E-01	5.90E-04	9.06E-04	3.82E-04	5.98E-03	-1.46E-01	5.90E-04	2.15E-03	7.81E-04	1.90E-04	-3.18E-01
EP	kg PO43- eq	9.12E-02	8.07E-05	2.27E-04	6.74E-05	6.98E-04	-8.64E-03	8.07E-05	5.39E-04	8.63E-04	4.30E-05	-2.95E-02
POCP	kg ethene eq	-2.43E-03	4.60E-05	-3.46E-04	2.88E-05	4.66E-04	-8.07E-03	4.60E-05	-8.23E-04	-1.89E-03	1.74E-05	-2.06E-02
ADPE	kg Sb-eq	9.24E-05	5.33E-08	2.06E-08	1.10E-07	1.01E-07	-1.01E-05	5.33E-08	4.89E-08	2.63E-08	4.17E-09	-1.14E-05
ADPF	MJ	1820	2.4	3.07	2.75	14.1	-315	2.4	7.29	0.951	0.44	-691

RESOURCE USE

			Glass landfill					Glass recycling				
Parameter	**Unit**	**A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**	**C1**	**C2**	**C3**	**C4**	**D**
PERE	MJ	0	1.25	0.187	1.95	1.87	-2.59	1.25	0.445	-1.94	0.0777	-14.2
PERM	MJ	355	0	0	0	0	-164	0	0	0	0	-174
PERT	MJ	355	1.25	0.187	1.95	1.87	-165	1.25	0.445	-1.94	0.0777	-187
PENRE	MJ	0.723	3.62	3.08	3.61	14.6	-12.1	3.62	7.31	-2.71	0.496	-177
PENRM	MJ	1980	0	0	0	0	-378	0	0	0	0	-607
PENRT	MJ	1980	3.62	3.08	3.61	14.6	-372	3.62	7.31	-2.71	0.496	-766
SM	kg	4.19	0	0	0	0	0	0	0	0	0	0
RSF	MJ	0	0	0	0	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0	0	0	0	0
FW	m3	7.96E-01	1.47E-03	2.15E-04	1.05E-03	7.55E-03	-4.16E-01	1.47E-03	5.10E-04	1.95E-03	3.99E-03	-5.13E-01

WASTE

			Glass landfill					Glass recycling				
Parameter	**Unit**	**A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**	**C1**	**C2**	**C3**	**C4**	**D**
HWD	kg	5.54E-06	3.62E-08	1.75E-07	2.80E-09	2.44E-07	-2.10E-07	3.62E-08	4.17E-07	1.31E-06	3.13E-09	-1.1E-06
NHWD	kg	1.95E+01	2.23E-03	2.06E-04	3.73E-03	6.62E+01	-8.76E+00	0.00223	0.000491	0.0639	0.599	-10.1
RWD	kg	6.23E-02	4.85E-04	3.65E-06	3.39E-04	2.12E-04	-2.24E-02	0.000485	8.69E-06	-0.00145	2.21E-05	-0.0296

OUTPUT FLOWS

CRU	kg	0	0	0	0	0	-	0	0	0	0	-
MFR	kg	0	0	0	0	0	7.77	0	0	0	0	71.2
MER	kg	0	0	0	0	0	-	0	0	0	0	-
EEE	MJ	0	0	0	0	3.14	-	0	0	0	3.14	-
EET	MJ	0	0	0	0	5.62	-	0	0	0	5.62	-

Annex 4. Detailed results for the three representative products and for the two scenarios for glass end of life.