Environmental Product Declaration

EAA - European Aluminium Association
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Producer

Sapa Building Systems Växjö AB
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Declaration number

EAA-K/120627-001-EN

Date of issue

2014-04-16

Declared product

Product type

The declared product is specified by the profile series, product name, product characteristics and section shown in the EPD document. It can consist of various building materials and related accessories.

Validity

This validated declaration applies to the above mentioned products for three years from date of issue. The producer is liable for the information and evidence on which the declaration is based. EAA and Hydro Building Systems are not liable for the user input relevant for the declaration.
A long version of the EPD can be obtained from the producer.

Comparability

This EPD is based on information modules that do not cover all aspects of the product's use. An environmental assessment of a product has to consider also the product's application in the building and the respective environmental aspects during the use ph

Product Category Rules

The EPD is based on the PCR for Aluminium Building Products of the EAA Environmental Product Declaration Program. The PCR document is available from the EAA webpage www.aluminium.org.

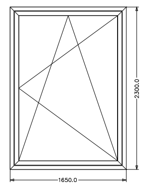
Verification

Table 1: Verification information

Review of the PCR document by the independent Advisory Board. Chair of the Advisory Board: Dr. Eva Schmincke
Independent verification of the calculation system and the data the declaration is based on according to ISO 14025:2006 [ ] - Internal Verification [x] - External Verification
Verifier of the declaration tool: Dr. Eva Schmincke

1 Description of the product

Product description



Product characteristics

Construction size

Amount:	1
Width:	1650.00 mm
Height:	2300.00 mm

Transparent area

Transparent area:	2.89 m²

Surface

Surface treatment:	powder coating / anodized

Total weight of the construction

Mass:	135.9 kg

Characteristics of the construction

Thermal transmittance (uw-value)[W/m²*K]:	0.82
Light transmittance value of glass (TL)[%]:	1
Solar factor (g-value)[%]:	npd
Burglar resistance:	npd
Acoustic performance [dB]:	npd
Resistance to fire:	npd
Air permeability:	npd

According to EN 14351-1: npd - no performance determined
Characteristics provided by producer

Profile system

Range of application

The product is usually applied incorporated in the wall of buildings or act as a wall itself in order to provide functions such as air exchange and light transmission.

Product standard / technical approval

Fönster och dörrar: EN 14351-1 Fasad: EN 13830

Life cycle stages

This EPD considers the following life cycle stages:

- Material production, component production and surface treatment

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- Transports to manufacturer
- Assembly of the product
- Transport to building site
- Cleaning and maintenance
- Demolition/disassembly of the product
- Transport to recycling site
- Recycling of the product and disposal of the residues

The part of the use stage which only can be determined in relation to a specific building, such as heat losses or solar gains, is not included in this EPD.

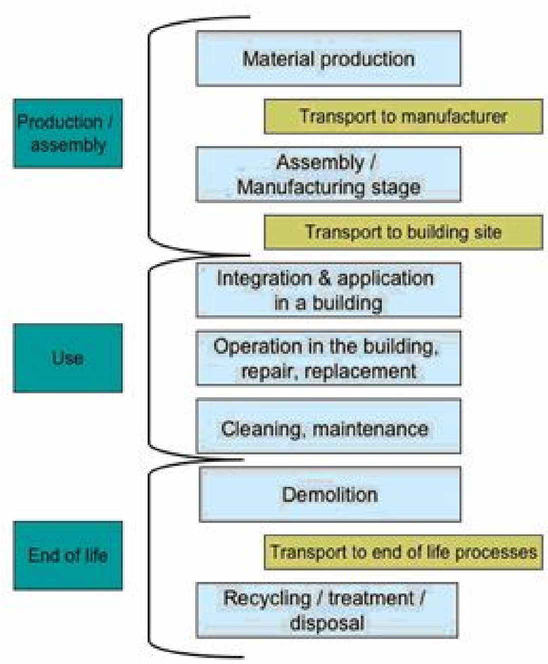

Figure 1: Life cycle stages

2 Components / Materials

Components of the product

Table 2: Components of the product

WICLINE 65 evo, fönster			
Type of element	**Element definition**	**Material**	**Description**
Frame and sash	System [PROFILE SYSTEM]	EN AW-6060	EN AW-6060
		PA 6.6 , 25%GF	PA 6.6 , 25%GF
		Ethylene Propylene Diene Monomer	Ethylene Propylene Diene Monomer
		Anodiserad	Anodiserad
		PE polyethylene	PE polyethylene
Glass and panel	Infill	EN AW-6060	EN AW-6060
		Float glass	Float glass
Gasket	Gaskets	Ethylene Propylene Diene Monomer	Ethylene Propylene Diene Monomer
Fittings and accessories	Hardware unit components	1.4301	1.4301
		PA polyamide	PA polyamide
		EN AW-6060	EN AW-6060
		Low alloyed C-steel, hot galvanized	Low alloyed C-steel, hot galvanized
		PA 6.6 , 25%GF	PA 6.6 , 25%GF
		Ethylene Propylene Diene Monomer	Ethylene Propylene Diene Monomer
		Aluminium alloy corner cleats	Aluminium alloy corner cleats
		Standard fitting material	Standard fitting material

This table contains all materials relevant for the calculation according to the cut-off rules. Handles and fittings are not considered in the life cycle stages.

Hazardous substances

Please refer to Material Safety Data Sheet.

According to the state of the art permits, the manufacturer shall establish those materials in the product which are liable to emission or migration during normal intended use and for which emission or migration into the environment is potentially dangerous to hygiene, health or the environment. The manufacturer shall establish and make the appropriate declaration of content according to the legal requirements in the intended country of destination.

An informative database of European and national provisions on dangerous substances is available at the Construction web site on EUROPA (accessed through http://ec.europa.eu/enterprise/construction/internal/dangsub/dangmain_en.htm)

3 Additional information on production and assembly

Availability, extraction and origin of materials

Aluminium:

Aluminium Primary Production

The common raw material for aluminium production, bauxite is composed primarily of one or more aluminium hydroxide compounds, plus silica, iron and titanium oxides as the main impurities. It is used to produce aluminium oxide through the Bayer chemical process and subsequently aluminium through the Hall-Heroult electrolytic process. On a world-wide average 4 to 5 tonnes of bauxite are needed to produce two tonnes of alumina, from which one tonne of aluminium can be produced. In Europe, the average bauxite consumption is 4.1 tonnes per tonne of aluminium. Then 140 million tonnes of bauxite are mined each year. The major locations of bauxite deposits are found in a wide belt around the equator.

Bauxite has to be processed into pure aluminium oxide (alumina) before it can be converted to aluminium by electrolysis. This is achieved through the use of the Bayer chemical process in alumina refineries.

Primary aluminium is produced in reduction plants (or "smelters"), where pure aluminium is extracted from alumina by the Hall-Héroult process. The reduction of alumina into liquid aluminium is operated at around 950 degrees Celsius in a fluorinated bath under high intensity electrical current. There are currently two types of smelter technology in use depending on the type of anode. All potlines built since the early 1970s use the prebake anode technology, where the anodes, manufactured from a mixture of petroleum coke and coal tar pitch (acting as a binder), are ‘pre-baked’in separate anode plants. In the Soederberg technology, the carbonaceous mixture is fed directly into the top part of the pot, where ‘self-baking’anodes are produced using the heat released by the electrolytic process.

Liquid aluminium, possibly after addition of alloying elements, is cast into ingot through DC (Direct chill) casting.

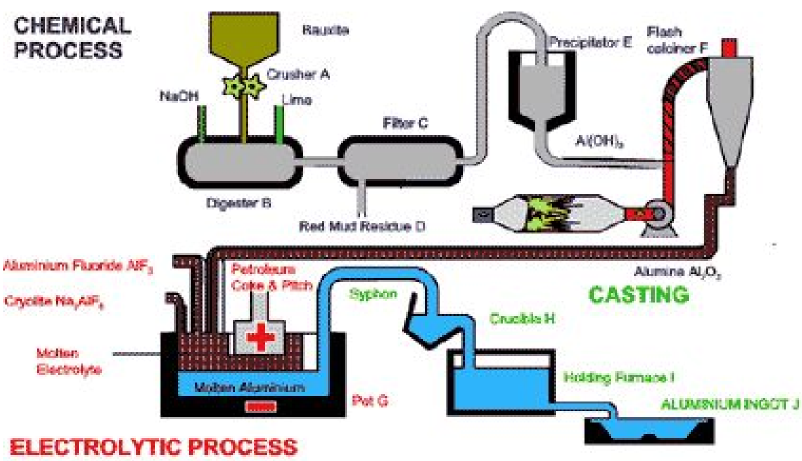

Figure 2: Aluminium primary production, source /EAA 2006/

Extruded Aluminium products

Aluminium profiles are produced through the extrusion process. These profiles are produced from aluminium ingots called billets (usually cylinders) which are pressed at hot temperature (400-500°C) through shaped dies. Aluminium billets are produced by DC (Direct Chill) casting in cast houses. Primary and recycled aluminium as well as alloying elements (Mg, Si, etc.) are used for producing aluminium billets (for more details about aluminium production processes, please visit www.aluminium.org). resulting profile is stretched and cut into pieces of fixed length which are heat treated in order to obtain the required mechanical properties by age hardening. Afterwards they undergo a chemical pre-treatment process followed by powder coating.

The information module by which this process chain is modelled for the LCA includes the recycling of production scrap.

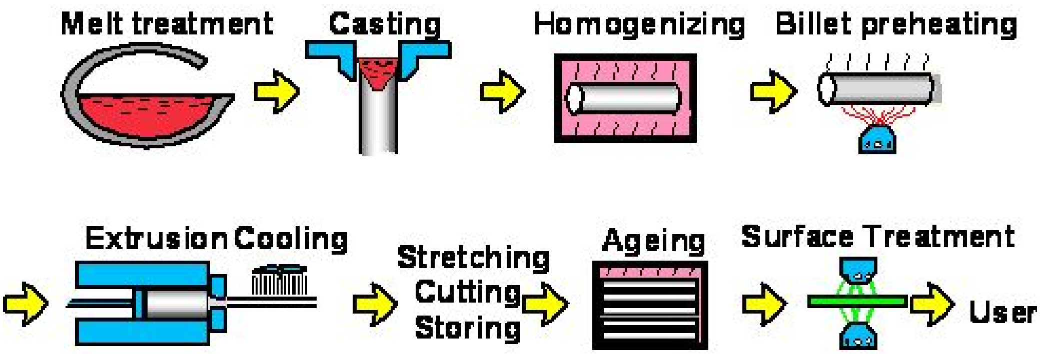

Figure 3: Typical production chain of aluminium extrusions, source /EAA 2006/

Surface treatment:

Anodising

Pre-treatment and Powder

Float glass:

Raw materials

The mix of raw materials used in the production of flat glass is known as the batch, which is mainly composed of three components: silica sand, soda ash and dolomite/limestone. In addition recycled glass (cullet) is used in the fabrication of flat glass and represents on average 15 per cent of the materials used. Its addition helps reduce the energy required in the process. Silica sand, soda ash, dolomite and dolomite/limestone represent together 99 per cent of all raw materials used in the production of glass, excluding the recycled glass. The remaining ingredients aid the melting and refining (bubble removal) reactions and impart colour and there is water addition during batch mixing to prevent subsequent segregation. Silica sand is the main component of the batch as it constitutes about 62 per cent of the batch weight (excluding recycled glass). Soda ash is one of the most expensive raw materials used in glass manufacturing and represents about 16 per cent of the batch weight.

Production process

When charged to the oven, the raw materials are weighed electronically, blended and moistened. They then constitute a vitrifiable load which, after the addition of cullet (melted scraps of glass) is transferred to the oven. The oven (tank) is made of refractory (material resistant to very high temperatures), which can hold up to 2000 tonnes of molten glass (largest ovens), taken up to a temperature of 1550 °C.

At a temperature of 1100 °C, the glass melted in the oven is cast onto a bath of molten tin, the floating step. The glass, which is then floating on an even liquid surface, is drawn out in a ribbon. On the edges of the ribbon, toothed cogs (toprolls) are placed, which stretch or push back the glass from the side, depending on the required thickness. This thickness currently varies between 1.1 mm and 19 mm. Thin glass is needed for lamination for the car industry, in order to reduce the weight of vehicles, and also for applications in the area of electrical goods; while thick glass is particularly used for safety and decoration.

The glass then needs to cool down. To this end, it passes along the rollers of a cooling tunnel (known

as the "lehr") 100 meters long. Placed at 600 °C at the outset, it ends its "travel" at ambient temperature. And it is at around 500 °C that it acquires its definitive properties.

Placed on a square-cutter, the glass ribbon, which ends the cooling process in the open air, is then checked and cut into sheets (6 m x 3 m is a common dimension in Europe). The edges are trimmed automatically. The sheets of glass are then placed vertically on trestles, with the help of uprighters with suction cups.

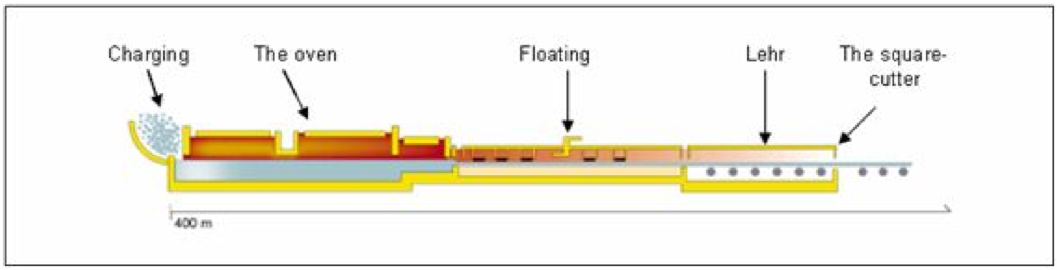

Figure 4: Production of float glass, source /saint-gobain-vitrage/

Polyamide 6.6 GF:

Polyamide 6.6 is produced from hexamethylene diamine and adipic acid via AH-salt.

Hexamethylene diamine is made when butadiene and hydrogen cyanide (HCN) react at 80°C with a catalyst. After a separation step butadiene- and HCN components, which have not reacted, were recycled. The resulting blend of isomeric pentene nitrile and methylbutene nitrile is isomerised predominantly to 3- and 4-pentene nitriles. In a second stage adiponitrile is produced by HCN-addition. Adiponitrile is hydrogenated with hydrogen under high pressure conditions to hexamethylene diamine.

The technical privileged route to adipic acid is the oxidation breakdown of the cyclohexane. Therefore the production is caused by two steps via cyclohexanole and cyclohexanone. Oxidation of cyclohexane runs by 125-165°C and 8-15bar in the liquid phase with air (and Mn- or Co-salts) as catalyst to anole-anone mixture. Primary product of the free radical reaction is cyclohexylhydroperoxide, which react further to anole-anone. Simultaneous some adipic acid has been builded already. The cyclohexane conversion is set to 10-12% (high selectivity of 80-85% to anole-anone). Afterwards distillation of the remaining cyclohexane and recirculation to oxidation process. The acids are washed out with alkali and the ester is hydrolised.

For the production of glass fibres the glass raw materials are melted (alternative: gas or electrical tank) and extended to fibres by nozzle blowing-, centrifugal casting or nozzle drawing process and coated.

EPDM:

Basic materials for the EPDM production are propylene and ethylene fractions. There are existing different processes for polymerisation, which the vapour phase process, the solution process and emulsion process were the most important.

For the production of the products ethene and propylene, naphtha and LNG are split by a steam cracker. Beside ethylene and propylene, C4-cut, pyrolysis gas, pyrolysis tar, fuel gas and hydrogen are further products from this split.

Steel:

The mining and beneficiation is done in countries, with an import specific share in the European import

mix. The transportation processes are taken into account for each share, as well as the import mix for the pellets is considered in the balance. Iron ore, pellets, sinter feed and additives are fed into the blast furnace (charge mixture). The raw iron is further on fed into the oxygen blow converter. The following processes are the secondary metallurgy and the continuous casting. The balances for the processes, from the sintering process until the steel ingot, are based on the German standard.

Manufacturing

Assemblage of product:

The components, specifically the aluminium profiles which are already surface treated and connected with the thermal bars, are cut and tailored to the respective frame size. The residual aluminium profiles are preserved for recycling. Together with the fl

The assemblage is placed in Sweden.

Packaging

Product packaging

Usually the product is not packaged. In rare cases a PE plastic wrap for protection is applied. The plastic foil is fed to the regional municipal waste collection system.

Transport packaging

The packaged products are placed in transport carriers and are placed on Euro-pallets. For transport to the building site a reusable carrier is applied.

Occupational health and safety during production

There are no relevant aspects of occupational health and safety during the production of this building product.

4 Additional information concerning integration and application in a building

Referrals and auxiliary materials for installation

Refer to information brochures for installation instructions.

Occupational health and safety during installation

There are no relevant aspects of occupational health and safety during the installation of the product.

Environmental aspects

Only proper installation can guarantee the technical properties, which is relevant during the operation stage of the building.

Residual material at the building site

No residual materials occur at the building site.

5 Additional information for modelling the use stage

Aspects on environment and health

There are no aspects concerning environment and health related to the use of the building product.

Service life

A service life of 50 years is used for calculations.

Maintenance

Periodical cleaning and maintenance are basis for a long service life of a building envelope. Cleaning agents must be neutral (ph-value 5-8).

Maintenance (checking and greasing) of the hardware components every 2 years is recommended.

External influences on durability

No external influences on the durability are relevant.

Special influences

No special influences are relevant.

6 Additional information for end of life processes

End-of-life treatment

The end-of-life operations consist of three steps, namely

- demolition;
- shredding and / or sorting;
- remelting / incineration / land fill

The demolition takes place either at building site or after transport of de-installed products at a recycling plant. The demolition usually destroys the float glass, 95 % of it goes for material recycling, the balance is land-filled. It is assumed that the recycled glass displaces the identical mass of raw material for the glass production. The aluminium frame together with the polymers and hardware components are going for the next recycling step without losses.

After the shredding operation the steel fraction is removed by magnetic sorting with an efficiency of 95%. Plastics are separated from aluminium by eddy current sorting machines with an efficiency of 90%. Plastics are sent to incineration with energy recovery.

As the third step of the end-of-life operations, the recovered aluminium scrap will be re-melted to extrusion ingots of the same inherent properties as the ingots from which the profiles have been produced. A net metal yield of 98 % is assumed.

All together, a recycling rate of 93% is obtained. This figure includes the collection rate (assumed to be 96%), the metal losses during shredding and/or sorting, and the re-melting.

Recycled aluminium is credited in this EPD as substituting primary aluminium. As illustrated in fig.6, only aluminium losses in each stage need to be balanced by primary aluminium.

Recycling

The following figure 5 illustrates the substitution methodology at the example of the life cycle of an aluminium building product.

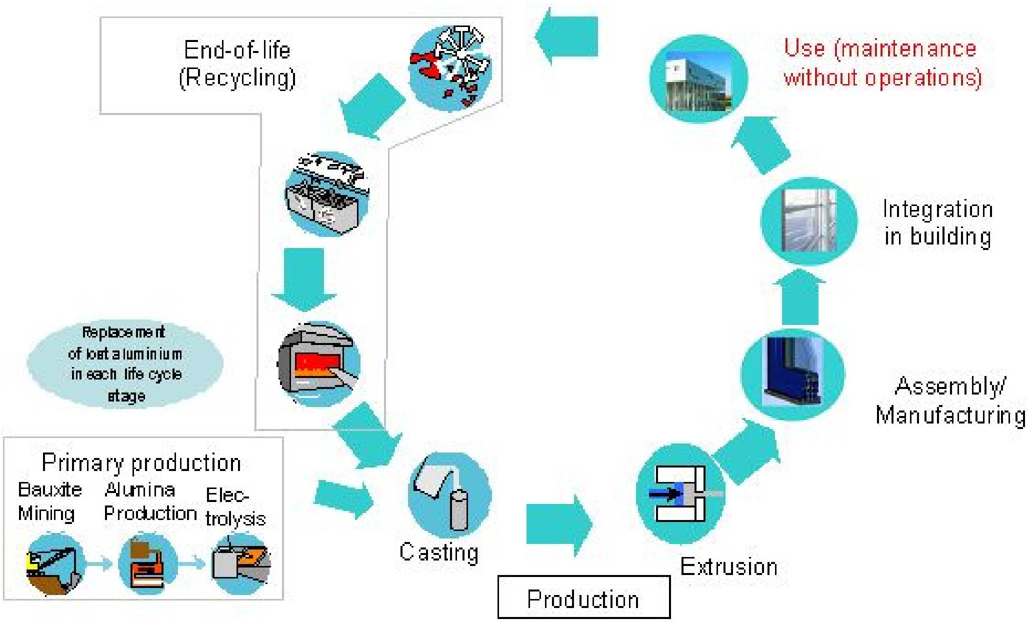

Figure 5: Subsitution methodology illustrated for the Life cycle of an aluminium window frame, source /EAA 2006/

Disposal

Since most materials of the building product are recycled, only a small amount and the losses from the recycling processes have to be landfilled.

7 Life cycle assessment

7.1 LCA documentation

Declared unit

Declared unit:

The declared product is specified by the profile series, product name, product characteristics and section shown in the EPD document. It can consist of various building materials and related accessories.

Table 3: Material composition of the entire building product (basis for LCA calculation)

Material	Weight of the material in all components of the product
1.4301	0,05 kg
Aluminium alloy corner cleats	0,37 kg
Anodiserad	0,68 kg
EN AW-6060	23,40 kg
Ethylene Propylene Diene Monomer	1,42 kg
Float glass	104,84 kg
Low alloyed C-steel, hot galvanized	0,00 kg
PA 6.6 , 25%GF	3,49 kg
PA polyamide	0,02 kg
PE polyethylene	0,00 kg
Standard fitting material	2,20 kg

System boundaries

Description of the life cycle:

- production and transport to the building site
- installation and maintenance (cleaning)
- demolition, transport to recycler, shredder, material recycling of aluminium, glass, and ferrous metals, incineration with energy recovery of thermal bars and gaskets, all other components and residues go to landfill

The following recovery rates for demolition and shredder are determined and basis for the calculation of the LCA:

- Aluminium 96%
- Steel, stainless steel and zinc: 95%
- Glass: 95%
- Thermal bars and gaskets: 90%
- All other materials: 0%

Allocation

All materials with recovery rates above 0% are recycled, the demand of energy and auxiliary materials is accounted in the end of life stage. The gained secondary material is used (and calculated) in production. Recycled aluminium is credited by the substitution methodology. For more details about this methodology, please refer to the EAA document Aluminium recycling in LCA which can be downloaded at www.aluminium.org (see sections EHS > LCA > Recycling).

Cut-off criteria

All material flows that enter the system on the input side and whose contribution is more than 1% of the total mass or more than 1% to the primary energy use were considered. All material flows, which exit the system on the output side and whose environme

Data quality

The representativity and data sources of the used data are shown in the table below. Geographical coverage of the data is Europe.

Table 4: Representativity of the LCA data

Data quality			
Material / process	**Geographical representativity**	**Time coverage**	**Data source**
Aluminium	high	2002	EAA
Surface treatment	medium	1995	GaBi 4
Glass	medium	2000	Ecoinvent
Thermal bars	high	1995	GaBi 4 / industry
Gaskets	medium	1995	GaBi 4 / industry
Steel / stainless steel	high	2000	Eurofer
Window assembly	medium	1995	GaBi 4 / industry
Use phase	medium	2005	GaBi 4
EOL / demolition & shredder	high	1995	GaBi 4 / industry
EOL / recycling of metals	high	2002	EAA / GaBi 4 / industry
EOL / incineration	high	2005	GaBi 4

Geographical coverage is Europe.

7.2 Life Cycle indicators

Life Cycle Inventory

The tables and graphs below are showing aggregated results of the life cycle inventory and results from the impact assessment.

Table 5: Primary energy consumption of the life cycle of the declared aluminium product

WICLINE 65 evo, fönster					
Primary energy consumption	**Unit per product**	**Total Life Cycle**	**Production**	**Use**	**End of Life**
Primary energy, non-renewable	[MJ]	**2579**	1841	92,37	645,9
Primary energy, renewable	[MJ]	**284,5**	247,1	0,6972	36,66

Primary energy is a measure for the consumption of non renewable (fossil and nuclear) and renewable (water and wind power, solar and biomass) energy resources. The availability of non renewable resources is limited.

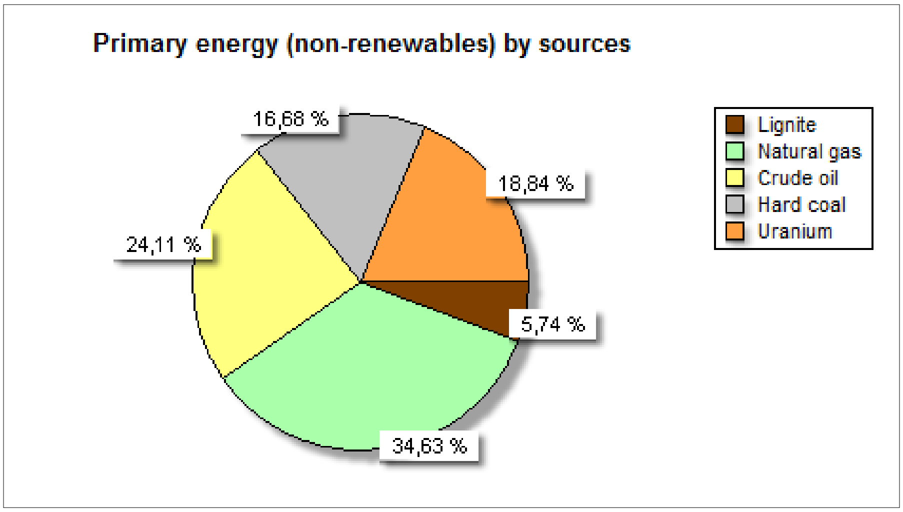

Figure 6: Breakdown of the use of non-renewable primary energy by energy sources for production, use and end of life of the declared building product

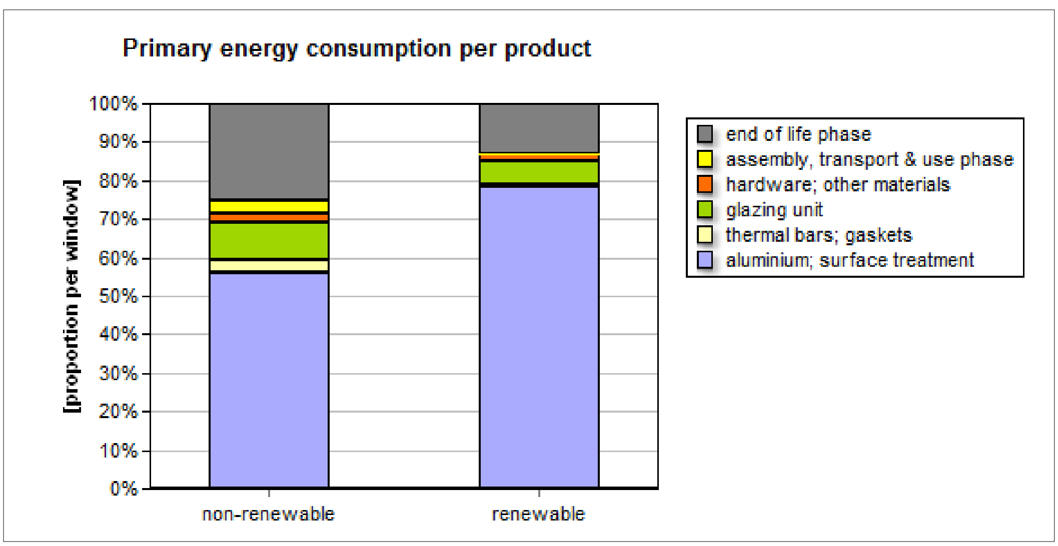

Figure 7: Breakdown of the use of non-renewable primary energy by energy sources for production, use and end of life of the declared building product

Table 6: Water consumption for the life cycle of the declared aluminium product

WICLINE 65 evo, fönster					
Water consumption	**Unit per product**	**Total Life Cycle**	**Production**	**Use**	**End of Life**
Water consumption	[kg]	**2785**	2497	152,2	206,2

The amount of waste and residues are technical figures, they do not describe an environmental impact which could be caused by waste treatment.

Table 7: Waste produced during the life cycle of the declared aluminium product

WICLINE 65 evo, fönster					
Waste	**Unit per product**	**Total Life Cycle**	**Production**	**Use**	**End of Life**
Non hazardous waste	[kg]	**17,37**	4,101	0,04734	13,22
Hazardous waste	[kg]	**1,923**	0,6288	0,02037	1,274
Residues					
Waste for recovery	[kg]	**5,343**	2,706	0,0121	124,8
Tailings	[kg]	**3,972**	3,833	0,072	0,06739
Overburden	[kg]	**277,6**	211,1	3,537	62,92

Impact assessment

The following table shows the contributions to the Depletion of Abiotic Ressources, Global Warming Potential, Ozone Depletion Potential, Acidification Potential, Eutrophication Potential and Photochemical Ozone Creation Potential impact categories.

Table 8: Results of the impact assessment for the life cycle of the declared aluminium product

WICLINE 65 evo, fönster					
Impact categories	**Unit per product**	**Total Life Cycle**	**Production**	**Use**	**End of Life**
Depletion of Abiotic Resources (ADP)	[kg Sb eqv.]	**1,635**	0,7231	0,04122	0,8704
Global Warming Potential (GWP)	[kg CO2 eqv.]	**323,4**	132,9	36,15	154,3
Ozone Depletion Potential (ODP)	[kg R11 eqv.]	**9,219E-005**	8,623E-006	5,505E-006	7,806E-005
Acidification Potential (AP)	[kg SO2 eqv.]	**1,403**	0,749	0,01227	0,6416
Eutrophication Potential (EP)	[kg PO4 eqv.]	**0,129**	0,06978	0,0008943	0,05834
Photochemical Ozone Creation Potential (POCP)	[kg ethene eqv.]	**0,1927**	0,06897	0,005314	0,1184

The table below describes the considered impact categories considered.

Table 9: Description of the impact categories

Description of Impact Categories	
Impact categories	**Description**
Primary energy, non-renewable	Primary energy is a measure for the consumption of non renewable (fossil and nuclear) energy resources. The availability of non renewable resources is limited.
Depletion of Abiotic Resources (ADP)	Reduction of non renewable resources, such as metal ores, minerals or energy resources.
Global Warming Potential (GWP)	Changes in the surface-air temperature, referred to as the global temperature, brought about by the greenhouse effect which is induced by emission of greenhouse gases into the air.
Ozone Depletion Potential (ODP)	The integrated change in total ozone per unit mass emission of a specific compound, relative to the integrated change in the total ozone per unit mass of CFC-11.
Acidification Potential (AP)	Acidification is caused by direct outlets of acids or by outlets of gasses that forms acid in contact with rain and is deposited to soil and water. Three main pollutants exist: sulphur dioxide (SO2), nitrogen oxides (NOx), and ammonia (NH3). Acid depositi
Eutrophication Potential (EP)	Index used to measure nutrient enrichment (eutrophication), which may result in algal blooms, caused by the release of sulphur, nitrogen, phosphorous and egradeable organic substances into the atmosphere and water courses.
Photochemical Ozone Creation Potential (POCP)	Chemical reactions brought about by the light energy of the sun. The reaction of nitrogen oxides with hydrocarbons in the presence of sunlight to form ozone is an example of a photochemical reaction

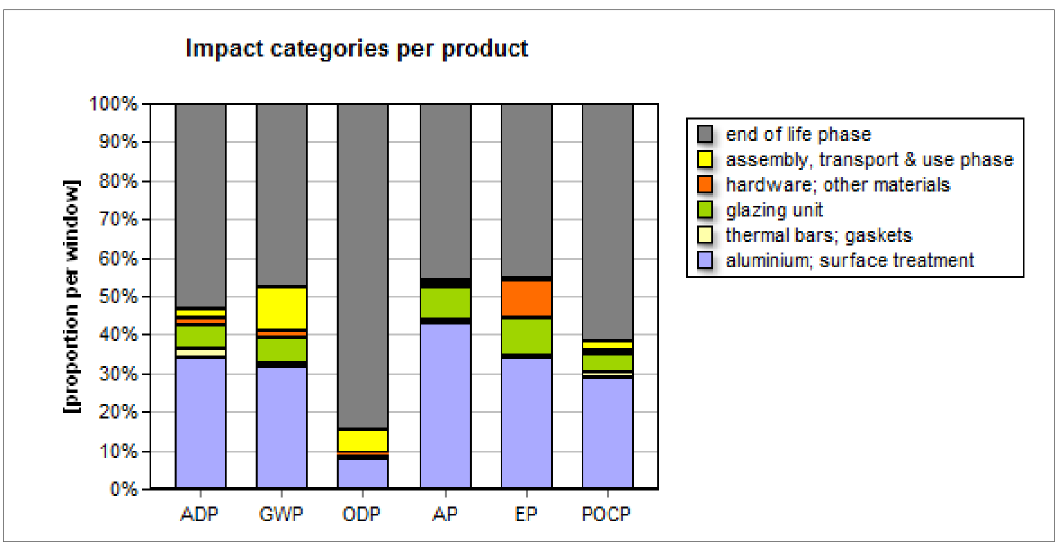

Figure 8: Breakdown of the impact categories by components for the production, use and end of life of the declared aluminium building product

8 Product Category Rules (PCR) and verification

PCR

This EPD is based on the PCR document Aluminium Building Products of the EAA Environmental Product Declaration Program. The PCR document is available from the EAA webpage.

PCR Review

Review of the PCR document by the independent Advisory Board.

EPD verification

Independent verification of the calculation system and the data the declaration is based on according to ISO 14025: External Verification

Verifier of the declaration: Dr. Eva Schmincke

9 References

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/Werner 2000 II/ Werner, Frank; EMPA Dübendorf, 2000, CH; Treatment of recycling of aluminium in LCA.