Chain Analysis Spantech - Aluminum

1 Introduction

Spantech has conducted a chain analysis of its two main Scope 3 carbon emissions as part of its efforts to achieve Level 4 and 5 on the CO_2 Performance Ladder.

This report presents the supply chain analysis of the aluminum components used in Spantechs contstructions, covering their entire life from cradle to grave.

A supply chain analysis involves calculating the CO_2 emissions of a specific product or service across the entire supply chain. T his includes all life cycle stages, from raw material extraction to waste processing or recycling.

For over 20 years, Spantech has been designing, building, and installing modular structures worldwide. With its expertise in modular building solutions, Spantech built a strong reputation as a specialist in design and construction. The company leverages the latest technologies to provide comprehensive turnkey solutions, managing every step from design to installation to ensure a seamless, end-to-end service tailored to clients' needs.

Spantech is part of the modular construction sector and contributes to circular building practices for a more sustainable future. With over 125 employees, more than 100 projects annually, and a presence on three continents, Spantech continues to grow and innovate within the construction industry.

The Spantech Group, headquartered in Belgium, employs 125 staff across more than seven countries.

For more information about our CO_2 Performance Ladder initiatives and sustainability efforts, visit our website: https://span-tech.com/CO2-ladder/.

2 Change log

Date	Revision	Remarks
26/01/2024	00	First version

3 Organizational and operational boundaries

The CO2 Performance Ladder management system applies to the following companies:

- Spantech International, Belgium
- Spantech Manufacturing Deutschland GmbH, Germany
- Spantech Poland
- Spantech France SAS
- Polytent SA (emissions included in Spantech International's total)
- ST Services (emissions included in Spantech Poland's total)

These entities' activities are providing temporary building solutions for the following industries:

- Entertainments
    - Film & TV production
    - Live entertainment
    - Event & expo
- Sports & Esports
    - Sport arena
    - Training facility
    - E-sports stadium
- Aviation
    - MRO Hangar
    - Airport
- Industry
    - Warehousing
    - Offices
    - Custom building

This chain analysis was conducted based on CO2 data of the calendar year 2023 and 2024.

4 Content

1 Introduction 1
2 Change log 1
3 Organizational and operational boundaries 2
4 Content 3
5 The supply chain of Aluminum 4
5.1 General description of the Aluminum supply chain 4
5.2 The aluminum supply chain at Spantech 7
5.3 Analysis of chain partners 8
6 Aluminum related Scope 3 emissions 10
6.1 Data sources and emission factors 10
6.2 Carbon footprint 10
6.2.1 Carbon emissions stage A1-A3; C1-C4 and D 10
6.2.2 Carbon emissions stage A4 – Carbon in upstream transport 11
6.2.3 Uncertainty 14
6.2.4 Overview of total CO2 emissions in the Aluminum supply chain 15
7 Reduction potential and chances for initiatives 17
7.1 General considerations 17
7.2 Raw Material Extraction (A1) 18
7.3 Upstream Transport of Raw Materials (A2) 18
7.4 Manufacturing (A3) 18
7.5 Product Transport (A4) 19
7.6 Construction/Installation (A5) 19
7.7 Use Phase (B1-B7) 19
7.8 End-of-Life Management (C1-C4) 20
8 References 21

5 The supply chain of Aluminum

5.1 General description of the Aluminum supply chain

In this chain analysis, we investigate the supply chain of aluminum construction elements in modular constructions. The analysis follows the life cycle stages according to the NBN EN 15804 'Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products' (NBN EN, 2012) as illustrated in Figure 1.

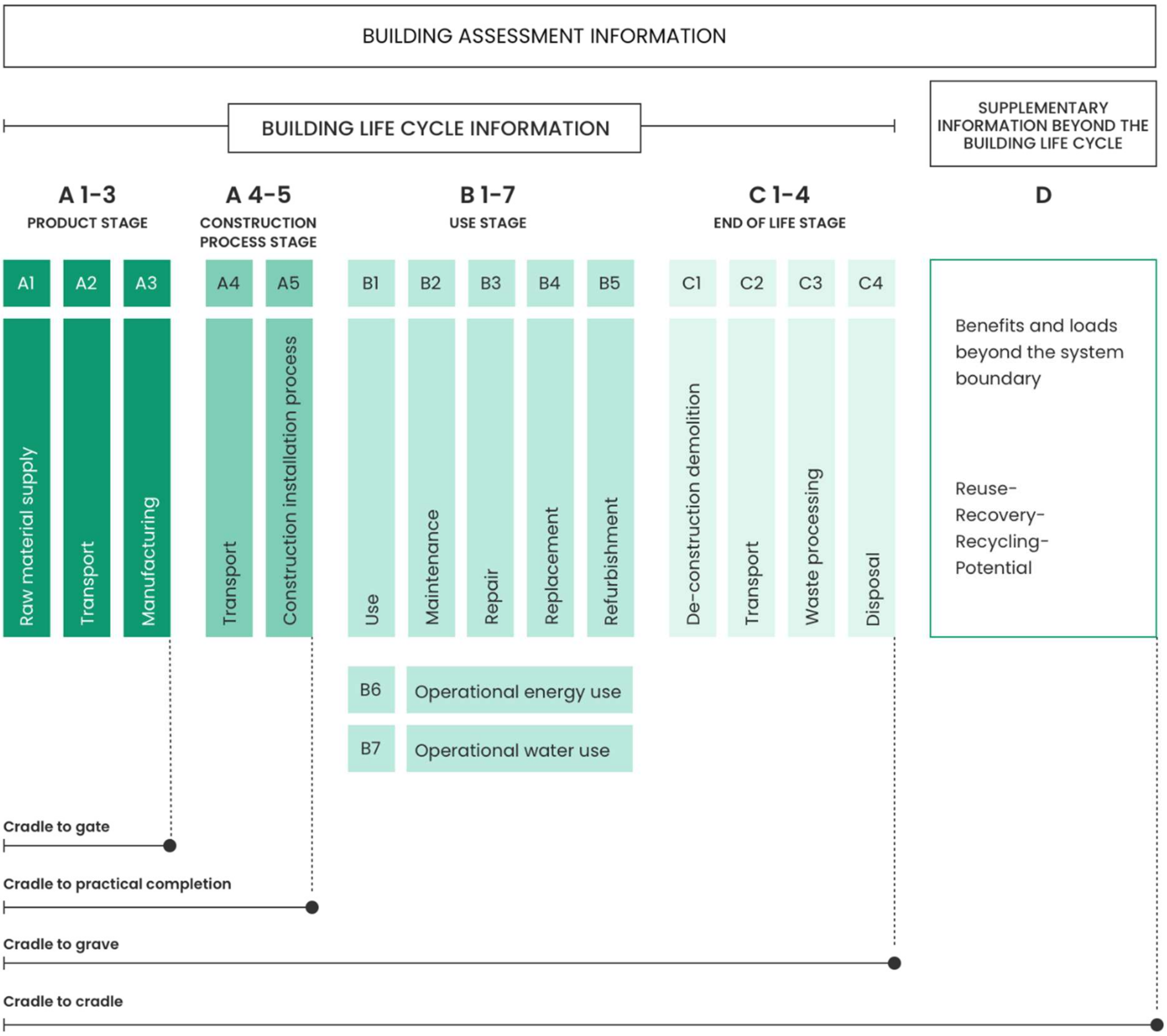

Figure 1 Life stages of material according to EN Standards (One Click LCA, 2025)

EU aluminium sector

Europe represents about 7% of global primary aluminium production, around half of which comes from within the EU (the other half from EFTA countries). The number of aluminium smelting plants in the EU has decreased from 26 plants in 2002 to 15 plants in 2019, two of which were idled that year. The 13 active plants are located in nine countries: France, Germany, Greece, The Netherlands, Spain, Romania, Slovakia, Slovenia and Sweden. An additional 10 smelting plants are located in Norway, Iceland and the UK.

At the same time, the value chain of aluminum in the EU consists of around 600 plants involved in processing raw materials, producing semi-fabricates such as rolled and extruded products, and recycling. Smelters and rolling mills mills are often owned by multinational companies, while the majority of the plants involved in extrusion and recycling are small and medium-sized enterprises (ERCST, 2021).

The aluminum supply chain for construction elements in modular constructions can be broken down into several key stages (Hydro, 2024); (Harbor Aluminum, 2025); (Reginald B.H. Tan, 2005).

1. Bauxite mining process
   Bauxite is basically aluminum ore, which consists of approximately 50% aluminum oxide, 10 - 20% water, and various other impurities. Bauxite is typically mined in open-pits and is usually processed into alumina by a refinery.

2. Alumina refining
   At the refinery, bauxite is processed into alumina using the Bayer process. This includes digesting bauxite with caustic soda (NaOH), clarifying the liquor stream, precipitating alumina hydrate, and finally calcining alumina. At the end of the refining process, alumina is present as a white powder.

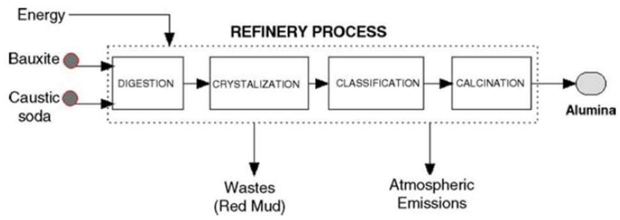

Figure 2 The alumina refinery process (Reginald B.H. Tan, 2005)

3. From alumina to aluminum
   The conversion of alumina to aluminum occurs via a smelting method known as the Hall-Héroult process. This process involves dissolving alumina in cryolite, a molten solvent. An electric current is passed through the mixture, causing the carbon from the carbon anode to attach to the oxygen in the alumina, producing aluminum and carbon dioxide (CO_2). This process takes place at temperatures between [940 and 980°C] and yields high-purity aluminum.

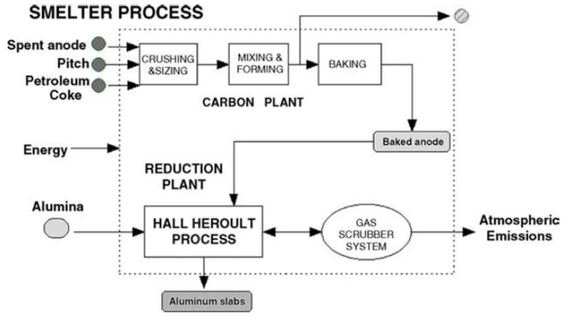

Figure 3. The smelter processes

4. Finished products
   After aluminum is molded, it is distributed to manufacturers, who then transform it into consumer products. A manufacturer will create new aluminum products by remelting them and adding alloys or other materials as needed. Pure aluminum has low tensile strength. For this reason, it is often alloyed with small amounts of elements such as copper, iron, or titanium to enhance strength or provide other desired properties.

5. End-of-life management
   Aluminum is nearly 100% recyclable without loss of quality, making it ideal for a circular economy approach (Taylor B., 2024); (Recycling Today, 2025); (European Aluminum Association, 2022); (European Aluminum, 2023).

   Many recyclable aluminum products undergo a secondary production process. The scrap metal is loaded into a furnace and melted down, which removes any coatings and inks.

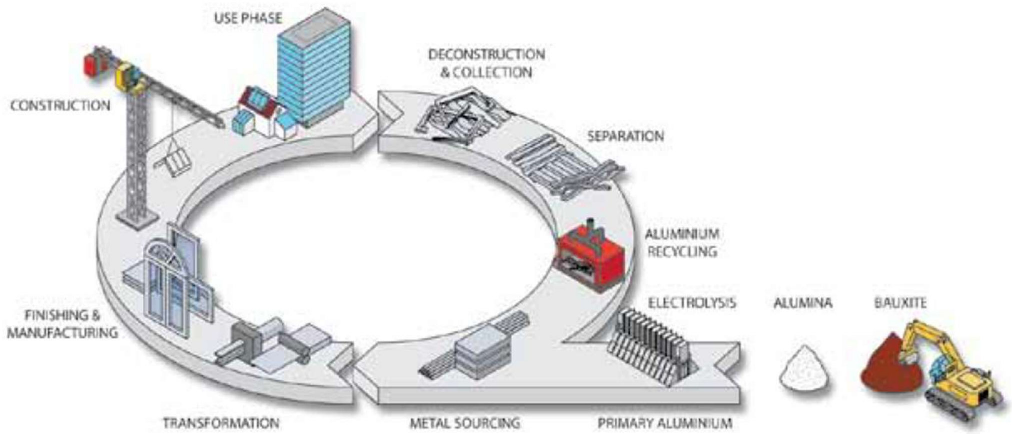

Figure 4 From cradle to cradle (European Aluminum Association, 2022)

5.2 The aluminum supply chain at Spantech

Figure 5 illustrates the aluminum supply chain at Spantech. Aluminum is primarily delivered to the German subsidiary. From there it is either directly supplied to construction sites or first transported to Belgium for assembly, before being sent to the construction sites.

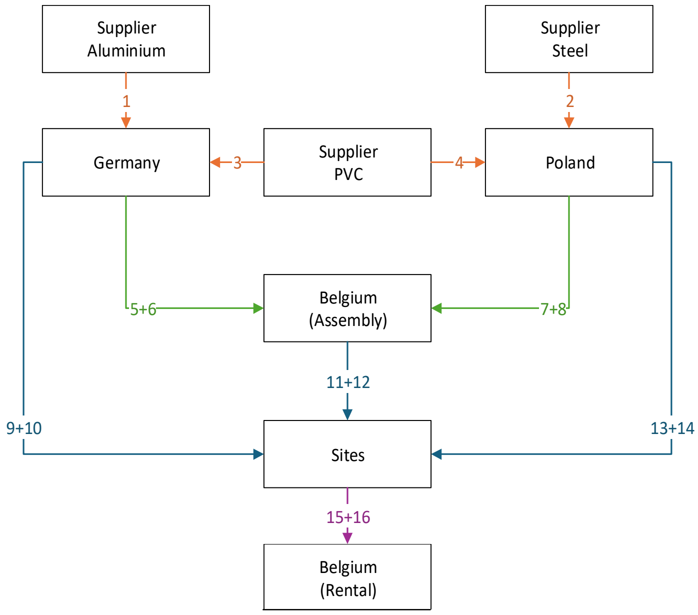

Figure 5 The aluminum supply Chain at Spantech

Table 1 lists the direct chain partners, both internal and external, that Spantech interacts with for its main supplies. The steps correspond to the numbers in the diagram shown in Figure 5, with steps 1 and 5 to 16 referring refer to the aluminum supply chain.

Table 1. Chain partners directly involved in Spantechs aluminum supply chain.

Steps	Chain partner
1	Supplier Alu
2	Supplier Steel
3	Supplier PVC to Germany
4	Supplier PVC to Poland
5	Own transport Germany - Belgium
6	Subcontracted transport Germany - Belgium
7	Own transport Poland - Belgium
8	Subcontracted transport Poland - Belgium
9	Own transport Germany - Projects
10	Subcontracted transport Germany - Projects
11	Own transport Belgium - Projects
12	Subcontracted transport Belgium - Projects
13	Own transport Poland - Projects
14	Subcontracted transport Poland - Projects
15	Own transport Projects - Belgium (rentals coming back)
16	Subcontracted transport Projects - Belgium (rentals coming back)

Figure 6 provides an overview of Spantech products.

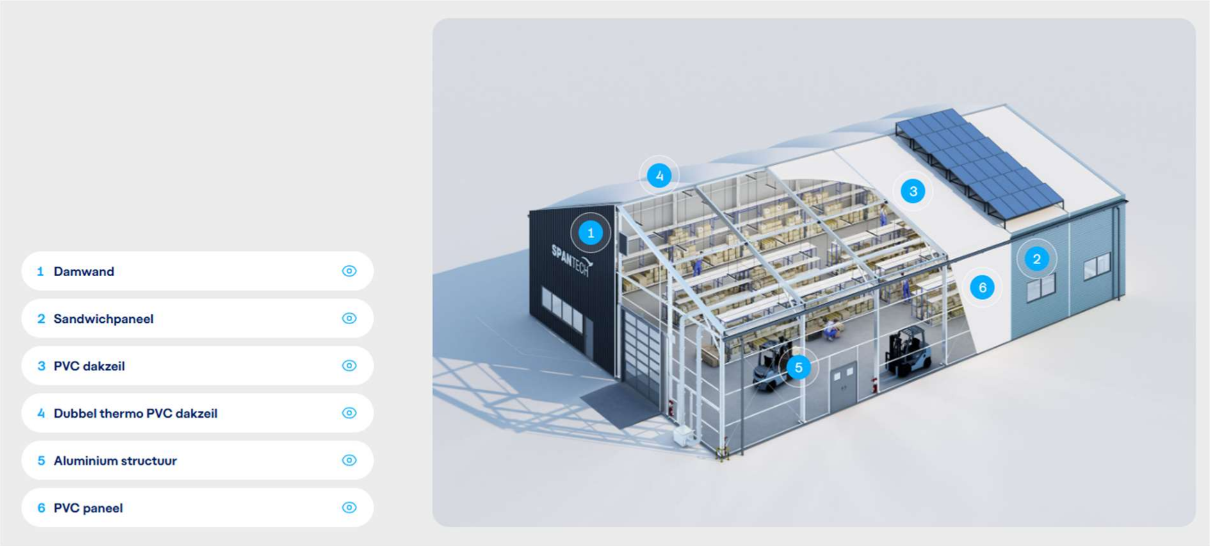

Figure 6. Products of Spantech NV

5.3 Analysis of chain partners

Table 2 provides an overview of the (potential) chain partners for each LCA phase.

Table 2 Chain analysis partners per LCA stage.

LCA stage	LCA Sub stage	LCA Sub stage description	Potential Chain Partners
Production stage	A1	Raw material supply	Alumina/aluminum raw material producers; Legislators/government
	A2	Upstream Transport Raw materials	Transport companies; Legislators/government
	A3	Manufacturing	Alumina/Aluminum manufacturers; Legislators/government
Construction stage	A4	Upstream transport products	Transport companies (on behalf of manufacturers); Customers; Waterway managers; Legislators/government
	A5	Construction/installation process	Customers; Contractors; Legislators/government
Use stage	B1	Use	Users of aluminum products; Owners of construction projects; Private individuals; Authorities (managers); Legislators
	B2	Maintenance	Owners of construction projects; Private individuals; Authorities (managers); Legislators
	B3	Repair	Repair companies; Authorities (managers); Legislators
	B4	Replacement	Contractors; Authorities (managers); Legislators

LCA stage	LCA Sub stage	LCA Sub stage description	Potential Chain Partners
	B5	Refurbishment	Contractors; Authorities (managers); Legislators
	B6	Operational energy use	Energy producers; Owners of construction projects; Authorities for energy; Private individuals; Legislators
	B7	Operational water use	Water producers; Owners of construction projects; Authorities for water management; Private individuals; Legislators
End off life stage	C1	De-construction and demolition	Owners of construction projects; Authorities for waste and materials; Contractors; Legislators
	C2	Downstream transport of waste	Contractors; Transport companies; Waste handlers; Legislators
	C3	Waste treatment	Contractors; Waste processors; Legislators
	C4	Waste disposal	Disposal facility operators; Legislators

Beyond the system boundaries	D	Benefits and load beyond the system boundaries: reuse, recovery and/or recycling potential.	Contractors; Aluminum recyclers; Waste processors; Legislators; Manufacturers using recycled or recovered aluminum

6 Aluminum related Scope 3 emissions

6.1 Data sources and emission factors

Table 3 provides an overview of the primary and secondary data sources used in the calculation of the carbon footprint. The data sources include sectoral Environmental Product Declarations (EPDs), internal company records, and emission factor databases.

Table 3. Data sources of emission factors and data typology.

Nr	Bron	Primaire data	Secundaire data
[1]	Sector EPD European Aluminium (European Aluminum, 2023)		x
[2]	Value of invoiced Aluminum (financial data Spantech)	x	
[3]	Density aluminum = 2700 kg/m³ (MCB, 2025)		x
[3]	Average aluminum tonnage / value (data Spantech)		x
[4]	Distance suppliers to the receiving companies (data Spantech)	x	
[5]	Distance inter-company transport (google maps)	x	
[6]	Distance delivery to projects (data Spantech)		x
[7]	Emission factors for transport of goods on www.emissiefactoren.nl (referred to from www.emissionfactoren.be) (CO2 Logic & Energie Idee, 2023)		x
[8]	Handboek CO2 prestatieladder 3.1 (SKAO, 2020)		x

6.2 Carbon footprint

6.2.1 Carbon emissions stage A1-A3; C1-C4 and D

Emission factors from the sector EPD for anodized aluminum sheets of European Aluminum were utilized [1] (European Aluminum, 2023). Calculations were performed using the Global Warming Potential (GWP-Total) emission factors provided in the EPD.

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP - total	kg CO_2 eq.	1.95E+01	1.67E-04	3.61E-01	3.32E-02	8.58E-02	7.91E-04	-1.28E+01

Table 4. Emission factors used for stage A1-A3; C1-C4 and D.

The declared unit of the EPD is defined as “1 m2 of 1mm anodised sheet for industrial cladding”.

To calculate CO_2 emissions, the annual aluminum tonnage (data source [2]/[3]) in 2023 was divided by the density of 2,7 T/m³ , and the thickness of the sheets in the EPD (1 mm; 0,001 m), to derive a theoretical total surface area of the product. This value was then multiplied by the respective emission factors.

In 2023, 270 tonnes of aluminum were supplied via the German subsidiary (datasource [2]/[3]). Table 5 presents the emissions derived solely from these data.

Table 5. Emissions solely based on EPD data.

Ton aluminum	M² alu	Unit	A1-A3 emissions	A4 emissions	C1 emissions	C2 emissions	C3 emissions	C4 emissions	D - emissions	Cradle To Practical completion A1-A5 - emissions	Cradle to Grave A1-C4 - emissions	Cradle to Cradle A1-D - emissions
270 Ton via Germany	100 048	T CO2e	1,95E+03	1,67E-02	3,61E+01	3,32E+00	8,58E+00	7,91E-02	-1,28E+03	1,95E+03	**2,00E+03**	7,18E+02

The emissions for Stage A4 are recalculated below using primary data in section § 6.2.2. Table 6 provides the emissions from stages A1-A3; C1-C3, and D, excluding the data for Stage A4.

Table 6. Emission based on EPD data with stage A4 'transport' omitted.

Ton aluminum	M² alu	Unit	A1-A3 emissions	A4 emissions	C1 emissions	C2 emissions	C3 emissions	C4 emissions	D - emissions	Cradle To Practical completion A1-A5 - emissions	Cradle to Grave A1-C4 - emissions	Cradle to Cradle A1-D - emissions
270 Ton via Germany	100 048	T CO2e	1,95E+03		3,61E+01	3,32E+00	8,58E+00	7,91E-02	-1,28E+03	1,95E+03	**2,00E+03**	7,18E+02

Apparently the A4 emissions considered in this EPD were neglible: the distance factored in was 1 km.

6.2.2 Carbon emissions stage A4 – Carbon in upstream transport

6.2.2.1 Supplied to the subsidiaries from external suppliers

The Aluminum products are transported from external suppliers to the German subsidiary. Distances and tonnages of shipments are documented (data source [4]/[2]).

In 2023, 270 tonnes of aluminum were supplied to the German subsidiary. For each supply, the ton-kilometers (ton.km) were calculated. These data were summarized, resulting in 501 522 ton.km.

The national emission factors of the Netherlands, obtained from CO2emissiefactoren.nl (referenced by the Belgian emission factors at CO2emissiefactoren.be), were applied. In the EPD there was proposed to take into account a diesel driven Truck-trailer, Euro 4, 34 - 40t gross weight / 27t payload capacity. This corresponds with the emission factor for a truck and trailer <20 tonnes : 0,122 kg CO_2e/ton.km.

Based on this, the emissions associated with the transported aluminum are calculated as follows:

$$501\ 522 \text{ ton.km} \times 0{,}122 \text{ kg } CO_2\text{e/ton.km} = 61{,}19 \text{ tonnes } CO_2\text{e.}$$

6.2.2.2 Internal transport

A portion of the aluminum is transported internally to other Spantech plants. This transport is carried out by both internal and external transporters. In this chain analysis, both transport types are analyzed together.

From the German plant 156 tonnes (52%) of products were transported to the Belgian plant and 143 tonnes (48%) of products were transported directly to client project sites. If we assume this division is proportional to the distribution of aluminum weight in the Spantech products, the 270 Tonnes supplied aluminium is divided as followed:

- 52 % or 140 tonnes transported to Belgium
- 48 % or 130 tonnes transported directly to project sites

By calculating the percentage of each transport relative to the total transported weight and applying this percentage to the total aluminum weight transported, an estimated aluminum weight per transport was obtained. Based on this estimate, combined with transport distances, the ton-kilometers (ton.km) for aluminum were calculated.

Applied Emission Factors:

- Truck <10 tonnes: 0,363 kg CO_2e/ton.km
- Heavy truck + trailer (>10 tonnes): 0,088 kg CO_2e/ton.km

Table 7 presents the CO2 emissions corresponding with the internal transports.

Table 7. Emission from internal transport.

From	To	Ton.km	Means of transport	EF Unit	WTW	WTT	TTW	Emissions (T CO2e)
Spantech GmbH, Germany	Spantech International, Belgium	22 370	Heavy truck+trailer	Kg CO2e/Ton.km	0,088	0,067	0,021	1,97
Spantech GmbH, Germany	Spantech International, Belgium	94 474	vrachtwagen < 10T	Kg CO2e/Ton.km	0,363	0,275	0,088	34,3

Total CO2 emissions from internal transport: 37,1 Ton CO2e.

6.2.2.3 Supplies of Spantech products to the project sites of clients

Both the German and Belgian subsidiaries transport products containing aluminum components to project sites.

From the German plant:

- 48 % or 130 tonnes of aluminum is transported directly to project sites (see §6.2.2.2 ‘Internal transport’).
- 52 % or 141 tonnes of aluminum is transported to Belgium.

From the Belgian plant:

- 141 tonnes of aluminum is transported to project sites
  - 33% or 46,0 tonnes is distributed using Spantech's own transport.
  - 67% or 94,5 tonnes is distributed via external transport providers.

The national emission factors of the Netherlands, sourced from CO2emissiefactoren.nl (referenced by the Belgian emission factors at CO2emissiefactoren.be), were applied. Since individual shipments ranged from 0,5 tonnes to 50 tonnes , the emission factor for a truck < 10 tonnes (0,363 kg CO_2e/ton.km) was used for all transports up to 10 ton, and the emission factor for a heavy truck with trailer (0,088 kg CO_2e/ton.km) was used for all transports over 10 tonnes .

Table 8 presents the CO2 emissions corresponding with the deliveries at project sites.

Table 8. Emission from deliveries at project sites.

From	To	Ton.km	Means of transport	EF Unit	WTW	WTT	TTW	Emissions (T CO2e)
Spantech GmbH, Germany	Projects	53 829	Heavy truck+trailer	Kg CO2e/Ton.km	0,088	0,067	0,021	4,74
Spantech GmbH, Germany	Projects	32 242	Truck < 10T	Kg CO2e/Ton.km	0,363	0,275	0,088	11,7
Spantech International, Belgium with external transport	Projects	36 671	Heavy truck+trailer	Kg CO2e/Ton.km	0,088	0,067	0,021	3,23
Spantech International, Belgium with external transport	Projects	3 406	Truck < 10T	Kg CO2e/Ton.km	0,363	0,275	0,088	1,24
Spantech International, Belgium with internal transport	Projects	8 565	Heavy truck+trailer	Kg CO2e/Ton.km	0,088	0,067	0,021	0,754

Total CO2 emissions from delivery of Aluminum in products to project sites: 21,664 Ton CO2e.

6.2.2.4 Supplies of rented material

Based on the total shipped freight weight and the total aluminum supplied by external suppliers in 2023, an estimate of the mass percentage of aluminum in the final product was obtained.

Using this mass percentage and the shipped-out weight for rental (both internal and external transport), the aluminum weight in rented goods transport was determined. Table 9 provides an overview of the data used to calculate the estimated weight of aluminum in rental.

Table 9. Estimated weights of aluminum in rental.

Item	Value	Unit
Total weight shipped out to clients	2 438,96	Ton
Total weight ALU received at Spantech	270	Ton
Mass % ALU in end product	11,08%	%
Shipped out in rental	1134,2	Ton
Shipped ALU out, in rental (based in %ALU)	125,62	Ton
Shipped by own transport (%)	20%	%
Shipped by external transport (%)	80%	%
Shipped ALU by own transport (T)	24,70	Ton
Shipped ALU by external transport (T)	100,92	Ton

By combining these values with the registered transport distances, the applicable ton-kilometers (ton.km) for aluminum transport were calculated.

The national emission factors of the Netherlands, sourced from CO2emissiefactoren.nl (referenced by the Belgian emission factors at CO2emissiefactoren.be), were applied. Since more than 99% of all ton.km where performed with transports from over 10 ton, the emission factor for a heavy truck with trailer (0,088 kg CO_2e/ton.km) was used for all transports.

As the rented goods need to return to Spantech, a factor of 2 was applied to calculate the total emissions, including the return transport.

Table 10 presents the calculated CO2 emissions from aluminum in rental of Spantech products.

Table 10. Emissions from transport of aluminum in rental of Spantech products.

From	To	Ton.km	Means of transport	EF Unit	WTW	WTT	TTW	Emissions (T CO2e)
Spantech location (with own transport)	Rental Project	3 167	Heavy truck+trailer	Kg CO2e/Ton.km	0,088	0,067	0,021	0,28
Spantech location (with external transport)	Rental Project	59 269	Heavy truck+trailer	Kg CO2e/Ton.km	0,088	0,067	0,021	5,22
Rental Project (with own transport)	Spantech location	3 167	Heavy truck+trailer	Kg CO2e/Ton.km	0,088	0,067	0,021	0,28
Rental Project (with external transport)	Spantech location	59 269	Heavy truck+trailer	Kg CO2e/Ton.km	0,088	0,067	0,021	5,22

Total CO2 emissions from delivery of aluminum products to rental project and the return: 11,0 Ton CO2e.

6.2.2.5 Overview of CO2 emissions from transport (LCA Stage A4)

Table 11 presents the total emissions from transport.

Table 11. Overview of CO2 emissions from transport (LCA stage A4)

Item	Value	Unit
§ 6.2.2.1. Supplied to the subsidiaries	61,2	Ton CO2e
§ 6.2.2.2. Internal transport	37,1	Ton CO2e
§ 6.2.2.3. Supplies of Spantech products to the project sites	21,7	Ton CO2e
§ 6.2.2.4. Supplies of rented material	11,0	Ton CO2e
§ 6.2.2.5. Overview of CO2 emissions from transport (LCA Stage A4)	**131,0**	**Ton CO2e**

6.2.3 Uncertainty

The data in this report are subject to the uncertainties oulined below:

- Various sectoral EPDs were evaluated, and the decision was made to use data from the European Aluminium sector EPD (European Aluminum, 2023). The values from this EPD (functional unit: 1 m² of 1 mm thickness) were compared to other sectoral EPDs (functional unit: 1 kg of aluminum). A conversion factor of 2.7 (density) was applied before making the comparison.

  For cradle-to-grave emission factors across different EPDs, a standard deviation of 13% was found. The emission factor used is set 20% lower than the highest value identified. Considering that the calculated emissions serve as a reference for future reductions, it is logical to use a lower emission factor to avoid overestimating future reductions.

- Data on the weight of transported goods for deliveries from the Belgian plant to project sites using Spantech's own transport were incomplete. At the time of drafting this chain analysis, data were missing for approximately 70% of transports. The calculation was based on a sample representing 30% of transports, which was then extrapolated.

- Uncertainty exists regarding the emission factors sourced from emissiefactoren.nl.
- The proportion of aluminum in the total transported goods is assumed to remain constant for all distributed products (i.e., each delivered product is estimated to contain the same percentage of aluminum by weight).
- Border data inconsistencies: Some of the aluminum supplied by external suppliers in 2023 was not processed or transported further to other plants or projects in that same year. Conversely, some of the aluminum processed and distributed in 2023 originated from supplies received before 2023.
- In this report, all aluminum supplied by external suppliers is attributed to aluminum products that are transported, sold, and used at client project sites. However, an undetermined portion is actually used in products that are transported and rented for projects. At the same time, emissions have also been assigned to the transport of rented products based on ton-kilometers transported. As a result, these emissions are effectively counted twice: once for the transport of aluminum in sold products and once for the transport of aluminum in rented products.

  A more precise approach would involve reducing the transport emissions allocated to sold products by half of the transport emissions associated with rented products. However, for simplicity, this correction has not been applied in the final table, leading to an estimated error of 5,5 Ton CO2e or 4,2% of the emissions in stage A4, or 0,27% of the total emission in the aluminum chain (see Table 10. Emissions from transport of aluminum in rental of Spantech products.) .

6.2.4 Overview of total CO2 emissions in the Aluminum supply chain

Table 12 and Figure 7 represent the total CO2 emissions in the supply chain of aluminum products of Spantech.

Table 12. Emission based on EPD data with stage A4 'Transport' substituted.

Item	Unit	A1-A3 emissions	A4 emissions	C1 emissions	C2 emissions	C3 emissions	C4 emissions	D - emissions	Cradle To Practical completion A1-A5 - emissions	Cradle to Grave A1-C4 - emissions	Cradle to Cradle A1-D - emissions
270 Ton ALU via Germany based on EPD, A4 excluded	T CO2e	1,95E+03	Omitted	3,61E+01	3,32E+00	8,58E+00	7,91E-02	-1,28E+03	1,95E+03	**2,00E+03**	7,18E+02
SUM based on EPD for A,-A3; A5; C1-C4; D; A4 substituted with Spantech transport in the ALU Chain	T CO2e	1,95E+03	1,31E+02	3,61E+01	3,32E+00	8,58E+00	7,91E-02	-1,28E+03	2,08E+03	**2,13E+03**	8,49E+02
SUM based on EPD for A,-A3; A5; C1-C4; D; A4 substituted with Spantech transport in the ALU Chain	T CO2e	1950	131	36,1	3,32	8,58	0,0712	-1280	2 080	**2 013**	849
SUM based on EPD for A,-A3; A5; C1-C4; D; A4 substituted with Spantech transport in the ALU Chain	% distribution over LCA	92%	6,5%	1,7%	0,16%	0,40%	0,0037%	-60%	98%	**100%**	40%

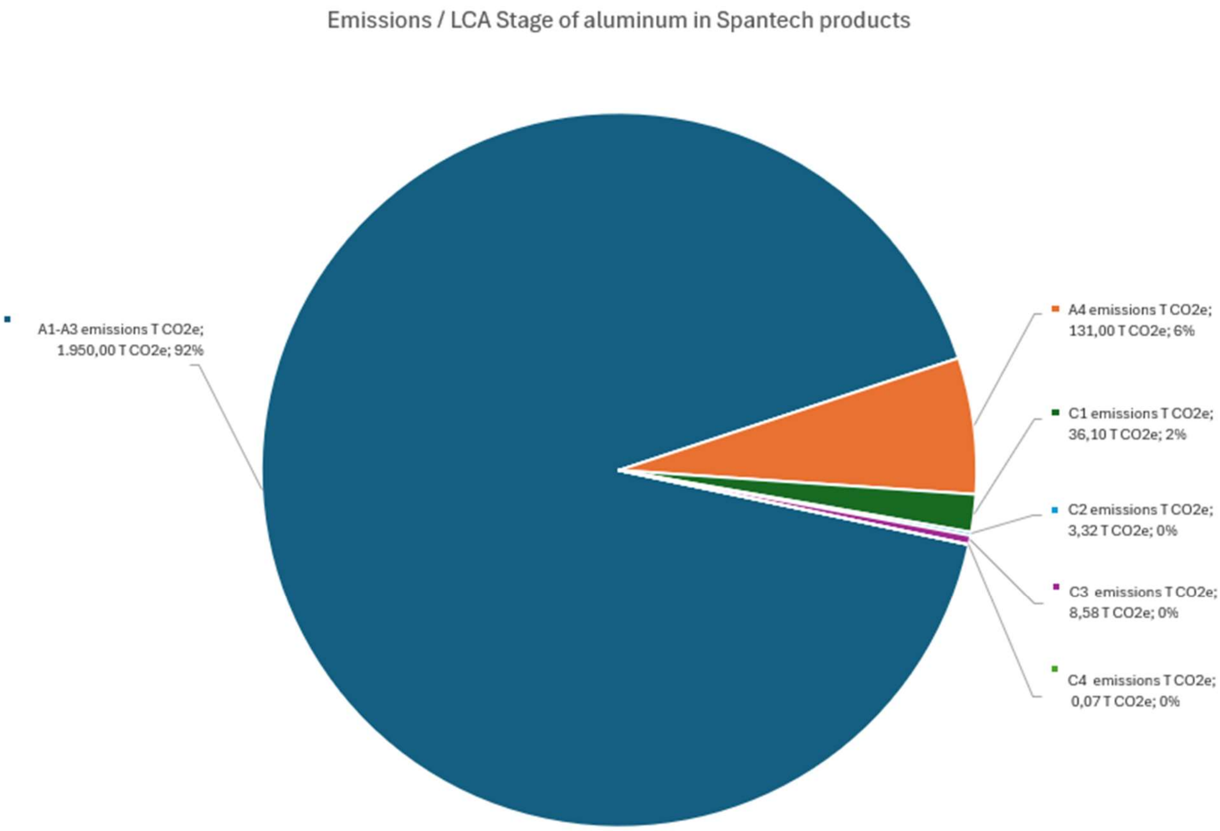

Figure 7. CO2 Emission in Spantechs supply chain of aluminum in products.

7 Reduction potential and chances for initiatives

7.1 General considerations

Calculating CO_2 emissions in the value chain is a complex task, and significant errors may arise. For this reason, general CO_2 accounting is often insufficient for accurately monitoring the progress of reduction efforts.

It is therefore crucial to track specific actions taken within the supply chain and quantify the corresponding CO_2 reductions compared to a business-as-usual scenario. For recurrent calculations of generic CO_2 emissions in the aluminum supply chain, you may choose an EPD that aligns with your purchased aluminum product(s). The emissions calculated using this approach represent the 'business-as-usual' emissions.

Next, for each action taken within the review period, you calculate:

- The generic emissions under the business-as-usual scenario (using the same EPD emission factors).
- The specific emissions resulting from your action.

The difference between these two values represents the CO_2 savings achieved and can be deducted from your total calculated emissions for the aluminum supply chain.

Business as usual scanrio: example of calculation:

- Total purchased aluminum for the period under review: **100 tonnes**
- Generic aluminum EPD chosen as reference: **7,5 kg CO_2e/kg aluminum**
- Total yearly footprint under business-as-usual scenario: **750 tonnes CO_2e**

The issue with this approach is that it does not account for any reduction measures taken.

Scenario with Sustainable Aluminum:
A specific project used 10 tonnes of aluminum, where the client ordered products based on sustainable aluminum. This aluminum was produced using >80% recycled scrap and smelted in an electric furnace powered by renewable energy. The emission factor for this sustainable aluminum is 2 kg CO_2e/kg.

Emission calculations:

- Business-as-usual emissions for 10 tonnes (using generic EPD): 75 tonnes CO_2e
- Actual emissions with sustainable aluminum: 20 tonnes CO_2e
- CO_2 savings achieved: 55 tonnes CO_2e

Thanks to your choice for sustainable aluminum, you effectively avoided 55 tonnes of CO_2e in the aluminum supply chain, and you can deduct this amount from your generic scope 3 calculation of the aluminum supply chain.

7.2 Raw Material Extraction (A1)

- Reduction Potential: 10-15% reduction in CO2 emissions.
- Key actions:
  - Increasing the use of secondary (recycled) aluminum, which requires only 5% of the energy needed for primary aluminum production.
  - Partnering with suppliers that use renewable energy sources for alumina refining and smelting.
  - Encouraging the sourcing of aluminum from low-carbon smelters, such as those powered by hydroelectricity.
- Key Chain Partners:
  - Aluminum smelters and refiners
  - Mining and raw material suppliers
  - Renewable energy providers
- Engagement Strategies:
  - Long-term contracts with incentives for lower carbon materials.
  - (Joint) investments in renewable energy projects.

7.3 Upstream Transport of Raw Materials (A2)

- Reduction Potential: 5-10% reduction in CO2 emissions.
- Actions Required:
  - Shifting from road transport to lower-emission alternatives such as rail or maritime shipping.
  - Increasing transport efficiency by optimizing loading capacity and reducing empty return trips.
  - Exploring the use of biofuels or electrified transport options.
- Key Chain Partners:
  - Logistics providers.
  - Rail and shipping companies.
  - Fuel providers.
- Engagement Strategies:
  - Collaborate on supply chain mapping and route optimization.
  - Encourage adoption of electric or hybrid vehicles.

7.4 Manufacturing (A3)

- Reduction Potential: 10-20% reduction in CO2 emissions.
- Actions Required:
  - Switching to low-carbon energy sources in manufacturing plants, such as solar, wind, or hydroelectric power.
  - Implementing energy efficiency measures in rolling and extrusion processes.
  - Using inert anode technology in smelting, which eliminates CO_2 emissions from the process.
- Key Chain Partners:
  - Alumina/Aluminum manufacturers.
- Engagement Strategies:
  - Co-develop cleaner production methods with manufacturers.

  - Provide financial support for renewable energy transitions.
  - Renewable energy suppliers

7.5 Product Transport (A4)

- Reduction Potential: 5-15% reduction in CO2 emissions.
- Actions Required:
  - Consolidate shipments to reduce the frequency of transport.
  - It's less carbon intensive (and economically interesting) to use one full loaded heavy transport truck, in stead of more full loaded trucks of lower capacity.
  - Use low-carbon transport modes (e.g., EV trucks, green hydrogen trucks, HVO).
  - Implementing digital tracking for real-time route optimization.
- Key Chain Partners:
  - Transport companies.
  - Fuel providers.
- Engagement Strategies:
  - Negotiate contracts prioritizing green logistics.
  - Explore shared logistics partnerships to reduce empty return trips.

7.6 Construction/Installation (A5)

- Reduction Potential: 5-10% reduction in CO2 emissions.
- Actions Required:
  - Electrifying construction equipment to replace fossil fuel-powered machinery.
  - Transition to green renewable sources.
  - Improving waste management and material reuse on construction sites.
  - Optimize on-site energy usage.
- Key Chain Partners:
  - Production department / engineering department
  - Energy provider
  - Waste handlers
- Engagement Strategies:
  - Promote green construction practices.
  - Provide training and guidelines for low-carbon installations.

7.7 Use Phase (B1-B7)

- Reduction Potential: Variable depending on application and energy use.
- Actions Required:
  - Designing modular aluminum structures for disassembly and reuse, extending product lifespans.
  - Improving insulation properties of aluminum panels to enhance energy efficiency.
  - Encouraging clients to implement circular economy strategies.
  - Design products for energy-efficient use: e.g. daylight optimization.
- Key Chain Partners:
  - R&D, architects, engineers
  - Clients and end-users.

- Engagement Strategies:
  - Develop and share user guides emphasizing energy efficiency.
  - Offer maintenance and refurbishment services to extend product life.

7.8 End-of-Life Management (C1-C4)

- Reduction Potential: 15-25% reduction in CO2 emissions.
- Actions Required:
  - Increasing aluminum collection and recycling rates, as aluminum retains its properties indefinitely when recycled.
  - Collaborating with recyclers to ensure closed-loop recycling of construction aluminum.
  - Encouraging material passports for tracking aluminum content and facilitating efficient reuse.
- Key Chain Partners:
  - Waste handlers and waste management companies.
  - Recycling facilities.
- Engagement Strategies:
  - Establish partnerships with (local) recyclers.
  - Collaborate on take-back schemes with end-users and customers.

8 References

European Aluminum. (2023). *Recycling of aluminum composite panels*. Opgehaald van www.european-aluminium.eu.

CO2 Logic & Energie Idee. (2023, 04 18). *Emissiefactoren*. Opgehaald van www.co2emissiefactoren.be: https://www.co2emissiefactoren.be/factoren#goederenvervoer

ERCST. (2021). *The aluminium value chain and.* ERCST.

European Aluminum. (2023). *EPD Anodised sheet for industrial cladding.* Brussels: European Aluminum. Opgehaald van https://european-aluminium.eu/wp-content/uploads/2023/12/EPD_report_Slim_Anodised-sheet-for-industrial-cladding.pdf

European Aluminum Association. (2022). *Sustainability of aluminum in buildings.* European Aluminum Association.

Harbor Aluminum. (2025, 01 26). *Aluminum Production & Manufacturing Process Explained*. Opgehaald van https://www.harboraluminum.com/: https://www.harboraluminum.com/en/aluminum-process#steps

Hydro. (2024, 05 15). *Aluminum life cycle*. Opgehaald van https://www.hydro.com/: https://www.hydro.com/us/global/aluminum/about-aluminum/aluminum-life-cycle/?utm_source=chatgpt.com

MCB. (2025). *MCB Boek.* Valkenswaard: MCB.

NBN EN. (2012). *Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products.* NBN EN.

One Click LCA. (2025). *Life Cycle Stages.* Helsinki: One Click LCA Ltd.

Recycling Today. (2025). *Europe's aluminum producersrecycling at higher rate*. Opgehaald van https://www.recyclingtoday.com: https://www.recyclingtoday.com/news/european-aluminium-recycling-sustainability-progress-2025-goals/

Reginald B.H. Tan, H. H. (2005). An LCA study of a primary aluminum supply chain. *Journal of Cleaner Production 13* , pp. 607-618.

SKAO. (2020). *Handboek CO2 Prestatieladder vs 3.1.* Utrecht: SKAO.

Taylor B. (2024). *RecAL launches as European effortto boost aluminum recycling*. Opgehaald van https://www.recyclingtoday.com: https://www.recyclingtoday.com/news/aluminum-recycling-austria-europe-ati-recal-technology-research/