

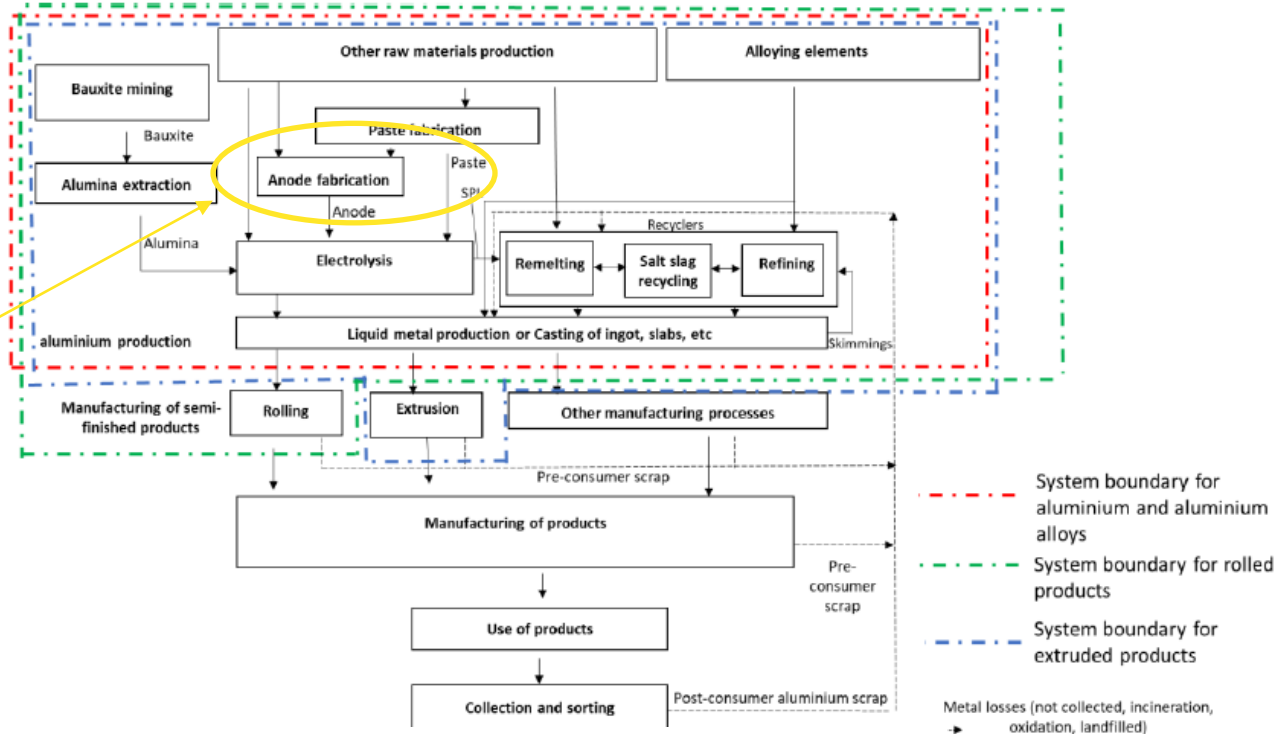
ALUMINIUM

Background material

28 September 2023

System boundaries for intermediate aluminium products

Main hotspot



Source: European Aluminium, methodological guidance for the environmental assessment of intermediate and semi-finished products - [link](#)

Variation of CF for primary aluminium

Link: [here](#)

4.3.1. Impact Category Indicator Results⁴

The impact category and additional indicator results (including GWP breakdown) have been calculated using GaBi version 2022.2. Water scarcity footprint results are calculated in accordance with ISO 14046. All results are reported per tonne aluminium ingot.

	Global	Scenario 1	Scenario 2	Scenario 3	Scenario 4
<i>Bauxite → Alumina → Aluminium</i>	<i>GLO</i>	<i>CNA→CNA→CNA</i>	<i>OCA→OCA→GCC</i>	<i>AFR→EUR→EUR</i>	<i>SAM→SAM→CAN</i>
Acidification Potential (AP) [kg SO ₂ -Equiv.]	89	108	44	29	54
Depletion of fossil energy resources (DFE) [MJ]	161,640	193,010	147,380	74,710	44,782
Eutrophication Potential (EP) [kg Phosphate-Equiv.]	6	7	4	2	2
Global Warming Potential (GWP 100 years) [tonne CO ₂ -Equiv.]	16.8	20.3	11.3	7.4	5.4
Ozone Layer Depletion Potential (ODP) [kg R11-Equiv.]	2.6E-9	3.4E-9	2.8E-9	2.6E-9	3.6E-9
Photochemical Ozone Creation Potential (POCP) [kg Ethene-Equiv.]	6	8	3	2	3
Water Scarcity Footprint (WSFP - AWARE) [m ³ World-Equiv.]	775	842	85	445	575

Table 11: Impact category and additional indicator results (per tonne of primary aluminium ingot)

⁴ The results of this study are not intended to be used in comparative assertions and are an example of how the inventory data can be used in life cycle assessments.



Aluminium classification

VDA classification

1.2.3	high-alloy cast iron
2.1	Aluminium / aluminium alloys
2.1.1	Cast aluminium alloys
2.1.2	Forged aluminium alloy
2.2	Magnesium magnesium alloys

Comments on VDA classification:

- Forged aluminium is a small % in vehicles
 - We usually differentiate between cast aluminium alloys & wrought aluminium alloys
 - Cast aluminium alloys are used for casting application (engines, wheels...)
 - Wrought aluminium alloys are used for rolled and extruded applications (doors, beams, CMS...)
-
- **EN 1676:2020 for cast alloys**
 - **EN 573-3:2019 for wrought alloys**

Cast and wrought alloys

Cast alloys

- Alloys that have very high “castability*”
 - High content of silicon (ca. 8-10%)
 - Highly alloyed
 - Used in casting
 - Are divided (informally) in primary and secondary cast alloys.
-
- High percentage of alloying elements may have an important impact in term of Carbon footprint calculations

Wrought alloys

- Alloys for which the most important properties are the ductility and the formability
- Lower alloying element content (ca. 2-5%)
- Used in rolling and extrusion

Families of alloys for modelling

Aluminium Alloy Designation System (CEN)

	Major alloying element	Atoms in solution	Work hardening	Precipitation hardening	
WROUGHT ALLOYS*) EN AW-	1XXX	None (min. 99.00% Al)	X		
	3XXX	Mn	X	X	Non-heat treatable alloys
	4XXX	Si	X	X	
	5XXX	Mg	X	X	
	2XXX	Cu	X	(X)	
	6XXX	Mg + Si	X	(X)	
	7XXX	Zn	X	(X)	
	8XXX	Other	X	(X)	

Cast Aluminum Alloy Designation System

Alloy Series	Principal Alloying Element
1xx.x	Aluminum (99.000% minimum)
2xx.x	Copper
3xx.x	Silicon plus copper and/or magnesium
4xx.x	Silicon
5xx.x	Magnesium
6xx.x	Unused series
7xx.x	Zinc
8xx.x	Tin
9xx.x	Other elements

→ For carbon footprint calculations, it may be useful to differentiate in different alloy families, especially for casting alloys that have higher alloy content.

Aluminium use in cars (European cars)

Components
&
Families

Aluminum content is distributed between 12 component families, each of which encompasses a various number of components – adding up to a total of 96 components

DUCKER

1. BIW (13 components)

- ▶ Crash Management System (CMS)
- ▶ Cross members
- ▶ Door beams
- ▶ Door sills/rockers
- ▶ Front longitudinals
- ▶ Rear longitudinals
- ▶ Front-end structure (incl. radiator support)
- Instrument panel structure
- Pillars
- Roof bows (incl. windshield header, actual roof bow, and rear header)
- ▶ Shock towers
- Truck bed rail
- Floor group (incl. firewall and rear panel)
- Other BIW components

2. BRAKES (6 components)

- ABS/ESP housings
- ▶ Brake calipers
- Rotor hats/Bells
- Brake booster vacuum parts
- Electric brake boosters
- ▶ Master cylinders
- Other brake components

3. CHASSIS (4 components)

- Control arms/links
- Knuckles
- ▶ Subframes/cradles
- Bushings
- Other chassis components

4. CLOSURES (7 components)

- ▶ Body side panels
- ▶ Fenders
- ▶ Front doors
- ▶ Hood
- ▶ Rear doors
- ▶ Roof
- ▶ Tailgate/Trunk
- Other closure components

5. DRIVELINE (4 components)

- Differential carriers (incl. case)
- Drive shaft
- Transmission mounts
- Yokes
- Other driveline components

6. EV SPECIFIC (5 components)

- ▶ Ballistic protection
- ▶ Battery cooling plates
- ▶ Battery pack housing (may incl. sills)
- ▶ Electric motor housing(s)
- EV gearbox housing
- Other EV specific components (cables, connectors, HV devices housings)
- Battery foil, battery cell/module housings are not part of the scope*

7. POWERTRAIN (19 components)

- Accessory brackets
- Alternator case
- Bed plates
- ▶ Engine block
- Head/Cam covers
- ▶ Cylinder heads
- Front covers
- Fuel rails
- Intake manifolds
- Mounts
- Oil filter adapters
- Oil pans
- Pistons
- Starter motor housings
- Thermostat housings
- Timing chain covers
- Turbochargers
- Water outlet tubes
- Water pump housings
- Other powertrain components

8. STEERING (4 components)

- Universal joint / Yoke
- Column housings
- Rack & pinion housings
- Tie Rod Ends
- Other steering components

9. THERMAL MANAGEMENT (10 components)

- Compressor housings (incl. scrolls, pistons)
- Condensers
- Connection hardware (incl. heat transfer lines)
- Evaporators
- Heat shields
- Heat sinks
- Heater cores
- Intercooler (charge-air cooler)*
- ▶ Oil coolers
- ▶ Radiator
- Other thermal management components

**Intercooler has been included in the component list after project kick-off*

10. TRANSMISSION (9 components)

- Automatic & CVT cases
- Brackets
- Extension covers
- Manual clutch housings
- Manual transmission cases
- Transfer cases/PTUs
- Transfer plates
- ▶ Transmission valves
- ▶ Valve bodies
- Other transmission components

11. TRIM (14 components)

- Adjustment motor housings
- Airbag canisters
- Computer/sensor housings
- Overhead/luggage rails
- Running boards
- Seat belt spools/retractors
- Seat frames
- Seat motor housings
- Seat pans
- Seat tracks
- Sunroof motor housings
- Sunroof rails
- ▶ Decorative trim
- Wiper arms
- Other trim components

12. WHEELS (1 component)

- ▶ Road wheels

OTHER MISCELLANEOUS PARTS

▶ Components (total of 30) selected to be focus components for a detailed analysis

An average European car has 205kg of aluminium today



Main messages

- Primary aluminium may be used as a proxy for aluminium alloys, especially wrought alloys
- If secondary datasets are used, it is fundamental that these datasets are representative for the primary aluminium used in term of geography (electricity mix adaptation)
- The use of primary data for the modelling of primary aluminium is recommended.

→ Question: how to model aluminium alloys? How to model alloying elements in aluminium alloy?

THANK YOU!

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European Aluminium

ANYTHING BUT BASIC



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