Alcoa has a leading product portfolio because of its continuous improvement to productivity and efficiency, innovation, and commitment to sustainability across all business segments. Throughout the world, sustainability drives us to minimize our impacts and maximize our value. In 2016, we reduced our absolute greenhouse gas emissions by 6 million metric tons, energy intensity by 1 percent, landfilled waste by 86,500 metric tons and water consumption by 19 million cubic meters compared to prior year. We created sustainable value for the communities where we operate through Alcoa Foundation investments and the Alcoa Community Framework. We continued to enhance the sustainability of our products with the introduction of our Sustana™ line of aluminum products, which is produced with low carbon emissions and recycled content. Alcoa’s new primary aluminum products named Ecolum™, represent a full suite of low carbon cast products produced at Alcoa smelters predominantly operated with hydro-electric power. As a member of the Aluminum Stewardship Initiative, we also help to foster greater sustainability and transparency throughout the aluminum industry.
This declaration is an environmental product declaration (EPD) in accordance with ISO 14025. EPDs rely on Life Cycle Assessment (LCA) to provide information on a number of environmental impacts of products over their life cycle. **Exclusions:** EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc. **Accuracy of Results:** EPDs regularly rely on estimations of impacts, and the level of accuracy in estimation of effect differs for any particular product line and reported impact. **Comparability:** EPDs are not comparative assertions and are either not comparable or have limited comparability when they cover different life cycle stages, are based on different product category rules or are missing relevant environmental impacts. EPDs from different programs may not be comparable.

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<tr>
<td>DECLARATION NUMBER</td>
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<tr>
<td>DECLARED PRODUCT</td>
<td>Ecolum™ Cast Aluminum Products</td>
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<tr>
<td>DATE OF ISSUE</td>
<td>June 9, 2017</td>
</tr>
<tr>
<td>PERIOD OF VALIDITY</td>
<td>5 Years</td>
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</table>
| CONTENTS OF THE DECLARATION | Product definition and information about building physics  
Information about basic material and the material’s origin  
Description of the product’s manufacture  
Indication of product processing  
Information about the in-use conditions  
Life cycle assessment results  
Testing results and verifications |

The PCR review was conducted by:  
**IBU**  
The Independent Expert Committee

This declaration was independently verified in accordance with ISO 14025 by Underwriters Laboratories  
☐ INTERNAL  
☒ EXTERNAL

Wade Stout, UL Environment

This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:  
**Thomas Gloria, Industrial Ecology Consultants**
Alcoa

Alcoa is a leader in the production of bauxite, alumina, and aluminum products. In operation since inventing the aluminum industry in 1888, Alcoa continues to innovate with new technologies and processes. Its comprehensive portfolio of bauxite mining, alumina refining, and aluminum smelting represents an estimated 12% of global aluminum production (excl. China). Alcoa has a leading product portfolio because of its commitment to productivity and efficiency improvement, innovation, and commitment to sustainability across all business segments. Throughout the world, sustainability drives us to minimize our impacts and maximize our value. In 2016, we reduced our absolute greenhouse gas emissions by 6 million metric tons, energy intensity by 1 percent, landfilled waste by 86,500 metric tons and water consumption by 19 million cubic meters compared to prior year. We created sustainable value for the communities where we operate through Alcoa Foundation investments and the Alcoa Community Framework. We continued to enhance the sustainability of our products with the introduction of our Sustana™ line of aluminum products, which is produced with low carbon emissions and recycled content. Alcoa’s new primary aluminum products named Ecolum™, represents a full suite of low carbon cast products produced at Alcoa smelters predominantly operated with hydro-electric power and represents an estimate 6% of global aluminum production (excl. China). As a member of the Aluminum Stewardship Initiative, we also help to foster greater sustainability and transparency throughout the aluminum industry. Alcoa is working to continuously reduce and measure environmental impacts and improve our footprint while creating long-term, sustainable value.

Product

Product Description

This declaration covers the suite of Ecolum™ cast aluminum products manufactured at Alcoa smelters predominantly operated with hydro-electric power. The products considered in this declaration are as follows:

- Billet
- Primary foundry alloy ingot (PFA)
- Rolling ingot (Slab)
- Rod
- High purity unalloyed ingot (HP)

This EPD for the cast aluminum products is based on information supplied by seven Alcoa facilities in Norway, Iceland, the United States and Canada. In aggregate, the facilities in the analysis produced 1.7 million MT of cast products in 2015, about 6% of total global production (excl. China) for the year. The participating locations produced the below product mixes:
Applications

Cast aluminum products are utilized in a wide variety of market sectors, including:

- **Building and Construction**: windows, doors, curtain walls, façade systems, skylights, canopies, louvers, light shelves, interior partitions, bridges, etc.
- **Transportation**: automotive structural and chassis components, crash management systems, auto body and trim components, truck and trailer components, rail passenger and freight car components, etc.
- **Electrical and Energy**: electronics housings and heat sinks, LED lighting components, solar energy mounting and racking systems, cable raceways, conduit, etc.
- **Medical and Consumer durables**: components of recreation products, home & garden tools, appliances, packaging, ambulatory care products, medical diagnostic equipment, etc.

Technical Data

Technical data is available upon request.

Manufacture

Alcoa manufactures a suite of five cast aluminum products at predominately hydro-based facilities. The products produced at each facility are considered to be generic ‘cast aluminum ingot’ for the purposes of this study. Figure 1 below provides an overview of the manufacturing process for the cast aluminum product. Alumina, refined from bauxite, is smelted to aluminum via electrolysis. Carbon anodes are either produced on site or purchased and are consumed during the smelting process. Molten aluminum produced in the smelting process is transferred to a cast house, where it is combined with alloying elements and cast into the desired profile.
Environmental and Health during Manufacturing

**Air:** Hazardous air emission releases from the casting and finishing processes comply with regulatory thresholds.

**Water/Soil:** Pollutants in wastewater discharge comply with regulatory thresholds.

**Noise:** Due to adequate acoustical absorption and mitigation devices, measurements of sound levels have shown all values inside and outside the production plant comply with regulatory thresholds.

Product Processing and Installation

Any fabrication, further processing, assembly and/or installation of Ecolum™ cast aluminum products is dependent on application and customer specification, and is outside the scope of this EPD.

Condition of Use

No special conditions of use are relevant under the scope of this EPD.

Environment and Health During Use

The environmental and health effects during use of the cast aluminum product are outside the scope of this EPD.

Reference Service Life
Service lives for cast aluminum products will vary depending on the application, but is typically long due to aluminum’s high corrosion resistance. This EPD does not cover the product use stage and therefore makes no specific claims regarding typical service lives.

**Extraordinary Effects**

**Fire**: Cast aluminum products comply with all national and local regulations with respect to fire hazards and control.

**Water**: There is no evidence to suggest water runoff or exposure under normal and intended operation will violate general water quality standards.

**Mechanical destruction**: Not relevant for cast aluminum products

**Recycling and Disposal**

Modules for end of life and next product system are not declared for Eolum™ cast aluminum products, thus recycling and disposal are outside the scope of this EPD.

**Life Cycle Assessment**

**Declared Unit**

The declared unit is *one metric ton (1,000 kg) of cast aluminum product.*

**System boundary**

This cradle-to-gate analysis provides information on the Product Stage of the aluminum product life cycle, including modules A1-A3.

<table>
<thead>
<tr>
<th>Production</th>
<th>Installation</th>
<th>Use stage</th>
<th>End-of-Life</th>
<th>Next product system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw material supply (extraction, processing, Transport to manufacturer)</td>
<td>Transport to building site</td>
<td>Use / application</td>
<td>Operational water use</td>
<td>Reuse, recovery or recycling potential</td>
</tr>
<tr>
<td>A1</td>
<td>A2</td>
<td>A3</td>
<td>A4</td>
<td>A5</td>
</tr>
</tbody>
</table>

X = declared module; MND = module not declared
Estimates and assumptions

In the case of some facilities, there is a small amount of external scrap, or cold metal input. This input was modeled using the net scrap approach. Any scrap that was not accounted for by scrap generated in the casting process was considered to come into the system burden free based on the cut-off approach.

All materials sent for recycling (aluminum scrap, dross, refractory material, SPL, etc.) were modeled using the cut-off approach.

All carbon emissions data (including CO2, CH4, ¬CF4, and C2F6) were provided for the smelting and casting processes separated by fuel and non-fuel sources. All non-fuel carbon emissions from smelting were attributed to the electrolysis process and all fuel carbon emissions were attributed to anode production, as fuels are combusted as in the baking process. While this assumption changes which stage the carbon emissions are attributed to, it does not change the overall carbon emissions from the cradle-to-gate system.

Carbon emissions were calculated by Alcoa via its environmental metrics system, which is based on the IAI Aluminum Sector GHG Protocol. All calculations were confirmed internally by Alcoa and spot checked by thinkstep. Carbon emissions for the organization also undergo a third party limited assurance to further verify conformance with GHG protocols.

In the year 2015, Baie Comeau purchased about 70% of its anodes from Alcoa’s Lake Charles anode production facility in Lake Charles, LA and another 30% from the market to have a full complement of baked anodes. Emissions from the Lake Charles facility are assumed to be typical of a traditional anode manufacturing facility, therefore it is assumed that the emissions profile for the remaining 30% purchased anodes is the same as the Lake Charles facility.

Fjärdaål anodes are purchased from Alcoa’s Mosjøen facility where they are produced in dedicated anode production furnaces. Impacts from Mosjøen anode production were allocated between Fjärdaål and Mosjøen based on total aluminum production volume.

Where the water inputs and outputs did not balance across a facility, it was assumed the difference evaporated as water vapor.

Transport for ancillary materials was assumed to be 60 km. Transport of waste to landfill was assumed to be 7 km.

Cut-off criteria

As required by EN 15804, in case of insufficient input data or data gaps for a unit process, the cut-off criteria were 1% of renewable and non-renewable primary energy usage, and 1% of the total mass input of that unit process. The total of neglected input flows per module was a maximum of 5% of energy usage and mass.

In practice, all inputs and outputs, for which data are available, have been included in the calculation. Data gaps have been filled by conservative assumptions with average or generic data.

Background Data

In order to model the life cycle for the production and recycling of the cast aluminum product, the GaBi Professional software system developed by thinkstep AG was used. All relevant background data necessary for the production of cast aluminum product were taken from the GaBi ts database 2016.

Data Quality

Inventory data quality is judged by its precision (measured, calculated or estimated), completeness (e.g., unreported emissions), consistency (degree of uniformity of the methodology applied on a study serving as a data source) and
representativeness (geographical, temporal, and technological).

To cover these requirements and to ensure reliable results, primary data collected from Alcoa were used in combination with consistent background LCA information from the GaBi ts database 2016. Other life cycle inventory (LCI) datasets were sourced from the GaBi 2016 databases and are representative of years 2007-2015. LCI datasets from the GaBi 2016 databases are widely distributed and used with the GaBi Professional Software. The datasets have been used in LCA models worldwide, in industrial and scientific applications, and in internal as well as in many critically reviewed and published studies. In the process of providing these datasets they are cross-checked with other databases and values from industry and science.

**Period under review**

Primary data were collected on production within calendar year 2015. Background data for upstream and downstream processes (i.e., raw materials, energy resources, transportation and ancillary materials) were obtained from the GaBi ts database 2016.

**Allocation**

Since there is no significant difference in the manufacturing process for the 5 cast products, all cast aluminum products are considered as a generic cast aluminum product for the scope of this study. There is some additional energy required for the casting of billet, but since this energy cannot be separated from the total casting energy, it is shared between the 5 products equally. No co-product of multi-input allocation occurs in the product foreground system.

**Comparability**

A comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to EN 15804 and the building context, and if the product-specific characteristics of performance are taken into account.
# Life Cycle Assessment: Results

Cast aluminum product

Results given per one metric ton of product.

## ENVIRONMENTAL IMPACTS

### CML 2001 (v4.1)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
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<tbody>
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<tr>
<td>ODP</td>
<td>kg CFC-11 eq</td>
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<tr>
<td>AP</td>
<td>kg SO₂ eq</td>
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<tr>
<td>EP</td>
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<td>POCnP</td>
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## RESOURCE USE

### Manufacturing

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## OUTPUT FLOWS AND WASTE CATEGORIES

### Manufacturing

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<tr>
<td>EET</td>
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## Glossary

### Environmental Impacts

- **GWP**: Global warming potential
- **ODP**: Depletion potential of the stratospheric ozone layer
- **AP**: Acidification potential of land and water
- **EP**: Eutrophication potential
- **SP**: Smog formation potential
- **POCP**: Formation potential of tropospheric ozone photochemical oxidants
- **ADPE**: Abiotic depletion potential for non fossil resources
- **ADPF**: Abiotic depletion potential for fossil resources
- **FF**: Fossil fuel consumption

### Resource Use

- **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 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

### Output Flows and Waste Categories

- **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
Life cycle assessment: Interpretation

Figure 2 presents the results for the aluminum cast product by EPD production stage. The primary drivers for most of the environmental burden is A1, raw materials supply. For GWP and AP, there is also a significant contribution in module A3 from process emissions. For EP, there is a significant contribution from ship transport of the alumina.

The majority of the A1 burden comes from the upstream production of the alumina. For water use, the burden is driven by evaporation from reservoirs used for hydro power generation.

Auxiliary materials are significant for ODP due to the use of worldsteel datasets for the steel used in the electrolysis cell. The worldsteel datasets are based on a GaBi 4 model with older background data. Our data has since been updated to reflect the phasing-out of ozone-depleting refrigerants.

Process emissions are a significant contributor to GWP, AP, and POCP. The major contributor to GWP is carbon dioxide (CO₂), which accounts for about 94% of the burden. The other emissions contributing to GWP are methane (CH₄) and the tetrafluoromethane (CF₄) and hexafluoroethane (C₂F₆). AP is driven primarily by sulfur dioxide (SO₂) emissions, with some contribution from nitrogen oxides (NOx). POCP is driven by SO₂ as well as a significant contribution from NOx and non-methane volatile organic compounds (NMVOC).

Process emissions and alloying components are the main drivers of the casting process.

There is no significant difference between the seven sites, and when the sites were all normalized to the production of 1 tonne of aluminum, impacts were within 3% for each site.
Additional Environmental Information

Environmental Indexes and Certifications

Environmental controls and transparency are very important to Alcoa Corporation. As such, we participate in several external index initiatives and certifications. A few that demonstrate our environmental commitment and disclosure transparency are noted below.

Primary Aluminum Alloys Are Cradle to Cradle Bronze certified thru November 2017.

Our Corporate Environmental Management System is ISO14001 certified.

We have been on the Dow Jones Sustainability Index for 14 years, and counting, and have received high scores by CDP for our focus on mitigating carbon emissions and emission performance disclosure transparency.

References


Contact Information

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Cast aluminum product

According to ISO 14025

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