Decarbonizing the aluminium sector: a common challenge for primary and recycling

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**RUSAL** is the largest producer of low carbon aluminium in the world

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- **> 90%** Aluminium produced with hydropower
- **1st** Aluminium producer outside China
- **6.2%** RUSAL share of global alu production

### Aluminium production capacity
- 4 million tons

### Alumina production capacity
- 7.5 million tons

### Bauxite mining capacity
- 12 million tons

### RUSAL Worldwide
- Armenia
- Ireland
- Italy
- Kazakhstan
- Russia
- Ukraine
- Sweden
- Nigeria
- Australia
- Guyana
- Guinea
- Jamaica

### Key sales markets
- Europa
- Russia
- CIS
- North America
- Asia
- Japan
- Korea

### Plants (2018)
- 10 aluminium smelters
- 8 alumina refineries
- 7 bauxite mines
- 4 aluminium powder plants
- 2 silicon factories
- 4 foil mills
- 1 nepheline mine
- 2 wheels factories
Automotive OEMs move toward carbon-neutral cars

Mercedes-Benz’s aggressive climate pledge: All cars will be carbon-neutral by 2039

Mercedes-Benz pledged on Monday to make its new passenger car fleet carbon-neutral within two decades, an ambitious goal built on electric vehicles and renewable energy.

Audi launched a new structure to manage the CO2 emissions from their supply-chain, with alu in focus

Toyota Environmental Challenge 2050

- **CHALLENGE 1**: New Vehicle Zero CO2 Emissions Challenge
- **CHALLENGE 2**: Life Cycle Zero CO2 Emissions Challenge
- **CHALLENGE 3**: Plant Zero CO2 Emissions Challenge
As OEMs move to EVs, raw material represents a larger share of the automotive carbon footprint.

Life Cycle Emissions

g / km driven for use-phase, C-segment
(normalized from T CO₂eq and 230,000 km lifetime)

Baseline Steel ICEV
- Material production: 16
- Manufacturing (inc. battery): 7
- Use: 240
- EOL: 7

Baseline Al ICEV
- Material production: 25
- Manufacturing (inc. battery): 10
- Use: 193
- EOL: 7

Al BEV with renewable energy grid
- Material production: 32
- Manufacturing (inc. battery): 52
- Use: 50
- EOL: 5

Share of Material + Manufacturing

Baseline Steel ICEV: 8%
Baseline Al ICEV: 15%
Al BEV with renewable energy grid: 60%

Source: The impact of low CO₂ footprint aluminium on lifecycle emissions, Evan Petkov, 2017
“Together toward zero”

The Carlsberg Group’s carbon footprint

<table>
<thead>
<tr>
<th>Component</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trade refrigeration</td>
<td>Small</td>
</tr>
<tr>
<td>Distribution</td>
<td>Medium</td>
</tr>
<tr>
<td>Packaging materials</td>
<td>Small</td>
</tr>
<tr>
<td>Breweries</td>
<td>Large</td>
</tr>
<tr>
<td>Melting &amp; processing</td>
<td>Medium</td>
</tr>
<tr>
<td>Agriculture</td>
<td>Small</td>
</tr>
<tr>
<td>Carbon emissions</td>
<td>52.3 kg CO₂/HL</td>
</tr>
</tbody>
</table>

Impacts along the value chain

- Agriculture
- Packaging
- Brewing
- Distribution
- Customers & consumers

Carlsberg
Primary aluminium and recycling go together
Not enough «old scrap» to meet the growing demand of aluminium

GLOBAL ALUMINIUM FLOW 2018

- Bauxite (1) 337
- Alumina (2) 128
- Primary Production 66
- Remelted Aluminium 71
- Recycled Aluminium 30
- Bauxite Residue and Water 209
- Primary Aluminium Stock 11
- Ingots 137
- Semis-fabricated Products 94
- Final Products 81
- Net Addition 2018: 52
- Total Products in Use since 1888 1039
- Dross and Fabricator Scrap (3) 43
- Traded New Scrap (4) 13
- Old Scrap 18
- Recovery and Disposal (6) 5
- Under Investigation (7) 3
- Other Application (5) 3

- While EoL recycling rates are high finished products contains
  On average 30% of post consumer scraps
- Therefore 70% of aluminium demand is met by primary aluminium

Source: IAI
Low CO$_2$ primary aluminium and recycling are both part of the solution for the low carbon economy.

28% of post consumer scrap is available (world average all aluminium industry).

Low carbon primary aluminium is the best complement to the recycled scraps.

Low CO$_2$ primary aluminium and end-of-life recycling are the 2 key drivers for climate impact.

Source: RUSAL intelligence
74% of global primary aluminium is produced with non-renewable energy.

Source: CRU, RUSAL
Aluminium smelter powered by hydropower generate 4-5 times less CO₂ than coal powered smelters.

Carbon footprint T CO₂ / MT of aluminium (smelter Scope 1 & 2)

World primary aluminium production in MT split by energy source

*IAI data 2016
ALLOW and ASI certification: at the heart of RUSAL’s sustainability value proposition

Together toward a low carbon industry

**ALLOW**
- Low carbon aluminium
- Made from Hydropower with CO₂ certificates

**Climate leadership**
- SBT (science based targets)
- GHG reductions
- Energy efficiency
- Inert anodes

**Value chain partnerships**
- ASI
- WEF
- LME
- IAI, regional ass.
- Local governments
- Brand
- End consumers

Comprehensive Holistic sustainability standard for aluminium
RUSAL has a leading climate strategy

- 90% of RUSAL aluminium is produced from renewable hydropower – with goal to be 95% carbon free by 2025
  - Reduce smelter power consumption by 7% by 2025

- Reduce specific GHG emissions by 2025 (from 2014 levels)
  - -15% at our smelters
  - -10% at our alumina refineries

- Promote low CO₂ aluminium with a distinctive brand – ALLOW by RUSAL

- $525 million – RUSAL’s total environmental investments of during the last 5 years

- CO₂ free technologies for anode production (inert anode)
We commit to transparency by providing an independently verified carbon footprint certificates

**Carbon footprint, T of CO₂ / T of Al**

<table>
<thead>
<tr>
<th>Location</th>
<th>Scope 1&amp;2</th>
<th>Full scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOAZ</td>
<td>1,5</td>
<td>4,5</td>
</tr>
<tr>
<td>SAZ</td>
<td>2,2</td>
<td>7,5</td>
</tr>
<tr>
<td>IrkAZ</td>
<td>2,4</td>
<td>6,3</td>
</tr>
</tbody>
</table>

**CO₂ content (full scope) per ton of aluminium**

- **BOAZ**: 4 T of CO₂ / T of Al
- **World average**: 8 T of CO₂ / T of Al

Source: IAI data

**Statement of carbon footprint of aluminium produced by RUSAL**

Carbon footprint assessment - level 3
Aluminium, produced with the trademark ALLOW at BOAZ (OJSC “RUSAL Boguchansky aluminium smelter”, Tazheisky village, Boguchansky region, 660687, Krasnoyarsky region, Russian Federation)

We hereby confirm that an assessment of carbon footprint of aluminium produced in the above mentioned plant has been conducted using the following standards and guidelines:
- ISO/TS 14067:2013 (GHG - Carbon footprint of products – requirements and guidelines for quantification and communication),
- the «Aluminium Carbon Footprint Technical Support Documents», V1.0 Feb 2018, prepared by the International Aluminium Institute.

The assessment has resulted in the carbon footprint of:

4,5 ton CO₂ eq./ton Al

This assessment is part of the “Report on carbon footprint of aluminium produced by RUSAL in 2017”. The latter has been verified by KPMG with the assurance report dated 21/12/2018. KPMG’s report is available upon request via your trader.

*The level 3 is a complete cycle to get carbon footprint of aluminium ingot, which includes all direct emissions from bauxite mining, smelter production, carbon anode production, smelting reduction and rolling processes, non-renewable transports, electricity & heat generation, aluminium deep processing, as well as ancillary materials and fuels required for primary aluminium production. For more information about the methodologies see the «Guidelines».
Towards zero carbon: the challenge of the aluminium industry

**2040 Scenarios**

(2040 Scenarios (world capacity: 90 Mln t Al))

**World Primary Al Production CO2 emissions, Mln t**

- **New capacities with**
  - Renewable energy
  - Inert anode

**2040 Scenarios**

**CO2 emissions, Mln t**

- **Carbon footprint**
  - Transparency across supply chain
  - Market incentives for lower carbon footprint products
  - Right policies/Carbon pricing

**Energy- Technology**

- Low carbon electricity
- Energy efficiency – retrofits
- More circularity- recycling
- Inert anode - BAT Process emissions
- Retrofits smelting/refining
- Carbon capture and storage

**Mission possible, IF**

Maximizing of recycling rates

**Source:** RUSAL intelligence based on IAI
ALLOW™ is part of the solution for a decarbonized aluminium supply-chain

**Commercial value**
Reduce CO₂ footprint of your products

**Positive impact for society**
Promote a low CO₂ aluminium and drive the industry in the low carbon economy

**Supply chain transparency**
Better control of the origin of products, from mine to end-products

**Regulations**
Anticipate!

**Corporate reputation**
Sustainable procurement of materials
aluminium crafted by hydro power

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