STEEL LIFE

Life Cycle Assessment by voestalpine
steel life
steel life

Life Cycle Assessment by voestalpine
STEEL-LIFECYCLE

» Holistic Approach

» Life cycle stages
  - Extraction of raw materials and energy
  - Steel production
  - Further processing
  - Use
  - Recycling
STEEL IS USED, BUT IS NEVER CONSUMED.

Primary production is steelmaking based on primary raw materials in the blast-furnace (BF) and the basic oxygen furnace (BOF).
ENERGY CONSUMPTION A CRUDE STEEL PRODUCTION voestalpine’s LEADING ROLE

- Since 2005 energy consumption (global average) constant / stagnant
- Voestalpine: 15% reduction since 1999
- World average includes less energy-intensive production of steel in the electric arc furnace
Leading role voestalpine: energy savings of 3 Gigajoules per ton of crude steel compared to the average worldwide energy consumption.
ANNUAL ENERGY SAVINGS
voestalpine STEEL DIVISION

Δ3

energy consumption in voestalpine steel production

Average worldwide energy consumption in steel production

18 Mio. GJ/year at a production level of 6 mio. tons/year

17.3 GJ per ton

GJ = Gigajoule
ANNUAL ENERGY SAVINGS
voestalpine STEEL DIVISION

energy consumption in voestalpine steel production

17.3 GJ per ton

Average worldwide energy consumption in steel production

20.3 GJ per ton

18 Mio. GJ/year at a production level of 6 mio. tons/year

GJ = Gigajoule
ANNUAL ENERGY SAVINGS
voestalpine STEEL DIVISION

17.3 GJ per ton

18 Mio. GJ/year
at a production level of 6 mio. tons/year

20.3 GJ per ton
ANNUAL ENERGY SAVINGS
voestalpine STEEL DIVISION

17.3 GJ per ton

20.3 GJ per ton

Δ3

4 years
of electricity for a city (such as Linz)
with 200,000 inhabitants

voestalpine Stahl GmbH
16/05/2019  |  LCA Life Cycle Assessment
SCARP UTILIZATION IN STEELMAKING BLAST FURNACE ROUTE

- voestalpine uses more than 25% scrap in the steelmaking process.
- The share of recycled content is more than twice as high as that in China.

Primary production is steelmaking based on primary raw materials in the blast-furnace (BF) and the basic oxygen furnace (BOF).
GLOBAL WARMING POTENTIAL (LCA) CO$_2$ EQUIVALENTS

<table>
<thead>
<tr>
<th>Material</th>
<th>CO$_2$ Equivalents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td>2,000 – 2,500 kg/t</td>
</tr>
<tr>
<td>Aluminium</td>
<td>approx. 16,500 kg/t</td>
</tr>
<tr>
<td>CFRP*</td>
<td>21,000 – 23,000 kg/t</td>
</tr>
<tr>
<td>Magnesium</td>
<td>36,000 – 56,000 kg/t</td>
</tr>
</tbody>
</table>

*Carbon Fibre reinforced plastics / kohlefaserverstärkte Kunststoffe

voestalpine Stahl GmbH
13 | 16/05/2019 | LCA Life Cycle Assessment
ENERGY CONSUMPTION ALUMINIUM / STEEL
A COMPARISON

Energy consumption voestalpine
17.3 GJ/t
- 15.0%

Energy consumption steel production
20.3 GJ/t

Energy consumption aluminum production
85.5 GJ/t
+ > 400.0%
FUEL SAVINGS
TYPICAL AUTOMOTIVE APPLICATION

Conventional steel
100 kg

High strength steel
75 kg

Aluminium
67 kg

-25 kg

-8 kg
FUEL SAVINGS
TYPICAL AUTOMOTIVE APPLICATION

High strength steel
75 kg

Aluminium
67 kg

-8 kg

Travel distance
200,000 km

1 tank of fuel
(not reproducible and quantifiable)
GLOBAL WARMING POTENTIAL
TYPICAL AUTOMOTIVE APPLICATION

» Including use phase

- Conventional steel: 10 kg
- High strength steel: 8.5 kg
- Aluminium: 6 kg

Source: Landesagentur für Elektromobilität und Brennstoffzellentechnologie Baden-Württemberg GmbH, an agency who also references the assessments of Volkswagen AG and Daimler AG.
ENERGY EFFICIENCY
voestalpine ELECTRICAL STEEL

Comparison of CO₂ emissions in the steel production and net CO₂ reduction potential for different applications

voestalpine electrical steel can support realizing and exploiting parts of these potentials

Netto CO₂-Einsparungspotenzial [Mio. t]
Emissionen bei der Stahlproduktion [Mio. t]
Verhältnis CO₂-Einsparung zu Einsatz
STEEL IN A CIRCULAR ECONOMY
THE FOUR „R´S“
LIFE CYCLE AND END OF LIFE (EOL)

Steel
- 94% recycling
- 5% reuse
- 1% landfill

Wood
- 58% landfill
- 13% recycling
- 13% reuse
- 6% incineration

Concrete
- 75% downcycling
- 5% landfill
- 20% recycling

Source: The whole story from cradle to grave, BSCA, 2011
ENVIRONMENTAL AND LIFE CYCLE ASPECTS

Steel strengths:

» CO₂-footprint (global warming potential) across the entire life cycle
» Approximately 75 % lower energy consumption in the production of steel as compared to aluminium
» Approximately 80 % lower emissions in the production of steel compared to aluminium
» Multiple recycling possible
» Recycling in blast furnace route and electric arc route
» The emission reduction achieved by using aluminium through weight reduction is not quantifiable
ENVIRONMENTAL AND LIFE CYCLE ASPECTS

Steel strengths:

- Multiple recycling possible
- Recycling in blast furnace route and electric arc furnace route
- Reinforcing steel must be used in concrete components that are subject to tensile loads in building construction and civil engineering
ENVIROMENTAL AND LIFE CYCLE ASPECTS

Steel strengths:

» Multiple recycling possible
» Recycling in blast furnace route and electric arc furnace route
» Closed-loop recycling: only small amounts of steel are landfilled (material loss as tramp element in waste)
## OUR ENVIRONMENTAL ASPECTS

**voestalpine STEEL DIVISION**

<table>
<thead>
<tr>
<th><strong>CO₂ Emissions</strong></th>
<th><strong>Energy consumption</strong></th>
<th><strong>Recycling</strong></th>
</tr>
</thead>
</table>
| Improved air pollution control  
voestalpine has reduced the specific emissions of the following air pollutants over the past since 1999:  
» CO₂ minus 22%  
» NO₂ minus 75%  
» SO₂ minus 76%  
» Dust minus 95% | Energy consumption in steelmaking  
With an energy consumption of 17.3 GJ/ton of crude steel, voestalpine is among the best performers and lies below the world’s average of 20.3 GJ/ton (worldsteel). This average also takes electric steel making into account.  
In the past 30 years, voestalpine has reduced its energy consumption by 15%. | Recycling – scrap utilization  
voestalpine uses more than 25% scrap in the steel making process, a higher rate than the average in Europe.  
Recycling – other on-site/off-site material streams  
voestalpine recycles roughly 600,000 tons of on-site materials (circulating materials, by products, recovered materials, etc.) in crude steel production.  
An additional 70,000 tons of off-site materials (e.g. waste, etc.) are recycled in the crude steel production. |

**CO₂-Emissions**  
voestalpine has reduced CO₂ emissions in the past three decades by 22%
CORPORATE RESPONSIBILITY
WE PURSUE A HOLISTIC APPROACH
» Steel is indispensible in our modern society

» A holistic assessment underscores the advantages of steel

» Environmental and life cycle aspects emphasize the leading role of voestalpine
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