Applying Sustainability Principles to Mining and Smelting

Christer Ryman, Director Sustainability, Boliden Group
ABOUT BOLIDEN

THIS IS BOLIDEN

• A world-class metals company
• Metals that make modern life work
• Operations within exploration, mining, smelting and recycling
• Leading position in sustainable mining and metal production
• Technology development provides world-class productivity
Products

Base metals
- Zinc
- Copper
- Lead
- Nickel

Precious metals
- Gold
- Silver

Concentrates and other products
- Metal concentrate
- Sulphuric acid
- By-products
Our business model
– part of a circular economy

We take responsibility for the entire value chain – from exploration and mining to production and recycling of metals.
Enhancing performance through corporate responsibility

- Focus on safety improves production stability
- High emission standards lowers environmental risk
- Experts in developing reclamation methods for decommissioned mines
- Responsible business through monitored supply-chain
Integrated company with mines and smelters

- MINES
- SMELTERS
- HEADQUARTER
Our mines

Aitik
• One of the most productive open-pit copper mines in the world
• Copper, gold and silver

Boliden Area
• Three underground mines and one open-pit mine
• Zinc, copper, lead, gold, silver and tellurium

Garpenberg
• One of the most productive underground zinc mines in the world
• Zinc, silver, lead, copper and gold

Kevitsa
• Open-pit mine acquired in 2016
• Nickel, copper, gold, platinum and palladium

Kylylahti
• Underground mine in an interesting geological area
• Copper, gold and zinc

Tara
• Europe’s largest zinc mine
• Zinc and lead
Boliden Area

- Three underground mines and one open-pit mine
- Mineral-rich mines on historic ground
- Zinc, copper, lead, gold, silver and tellurium
- Milled tonnage: 2,138 ktonnes
- Pb concentrate: 12 ktonnes
- The concentrates are delivered to Boliden’s own smelters, other lead smelters in Europe and tellurium customers in Asia
Garpenberg

- One of the world’s most productive underground zinc mines
- Complex ore containing zinc, silver, lead, copper and gold
- Milled tonnage: 2,622 ktonnes
- Pb concentrate: 54 ktonnes
- New industrial area commissioned in 2014
- Industry-leading and largely automated technology that makes the operations more reliable, eco-friendly and cost-effective
Our smelters

Bergsöe
- One of Europe’s biggest recycling facilities for lead batteries
- Lead and lead alloys

Harjavalta
- Further development of the nickel operations
- Copper, nickel matte, gold, silver and sulphuric acid

Kokkola
- One of the world’s biggest zinc smelters
- Zinc and zinc alloys, sulphuric acid and silver in concentrate

Odda
- A significant exporter to Europe’s steel industry
- Pure zinc, zinc alloys and sulphuric acid

Rönnskär
- One of the world’s biggest e-scrap recycling units
- Copper, gold, silver, lead, sulphuric acid, zinc clinker, etc
Bergsöe

- Only recycling facility for lead batteries in Scandinavia
- Production of secondary lead and lead alloys: 46 ktonnes
- Supply of district heating to the Landskrona municipality
- Plastic separation installation in 2017
- Customers: European battery industry
Rönnskär

- One of the world’s largest electronic recycling units
- Copper, gold, silver, lead, sulphuric acid and zinc clinker
- The plant receives deliveries of copper and lead concentrates and secondary materials from our own mines and from external suppliers
- Production - copper: 207 ktonnes
- Production - primary lead: 42 ktonnes
- Large underground waste deposits (under construction)
Boliden’s environmental impact

- **Waste**
  - rock, sand, slag, sludge and dust

- **Greenhouse gas emissions**
  - due to energy use

- **Emissions to air**
  - of dust, sulphur dioxide and metals

- **Discharges to water**
  - of metals and nitrogen

- **Land use, biological diversity**
  - mines and smelters
Reducing the environmental footprint

Prioritised areas related to metal (lead) production

- Reclamation and restoring of mining areas
- Reducing emissions to air and water
- Energy housekeeping
- Reduction of waste products
- Recycling of metals
Reclamation and restoring of mining areas

- Boliden is responsible for reclamation of 30 active and decommissioned mines
- Systematic monitoring and risk assessments are conducted
- Provisions for reclamation are paid during the whole lifespan of the mine
- Goal: Use of best possible technology and promoting biodiversity
Reducing emissions of Pb to air and water

• Improved (heat resistant) process gas filters
• Fire-fly system to extinguish sparks before the reach filters
• Removal of filter dust and some drosses in feed
• Optimisation of water treatment plants
• Measures to avoid water overflow during extreme precipitation

Examples, Bergsöe smelter Pb to air (kg/year)
Energy housekeeping

Examples, excess energy use at Bergsöe smelter

- District heating
  - 20 GWh/yr

- Land based fish farming
Reduction of waste products

- Boliden processes intermediate and waste products in order to maximise metal recovery
- Materials are directed to the facilities with the best technology for handling each metal
- Advanced underground disposal of hazardous wastes

Examples

<table>
<thead>
<tr>
<th>OPERATIONS</th>
<th>INTERMEDIATE PRODUCTS</th>
<th>RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEAD SMELTER BERGSÖE</td>
<td>Lead-bearing filter dust</td>
<td>RONNSKAR Lead production</td>
</tr>
<tr>
<td></td>
<td>Matte, slag</td>
<td>ODDA Final storage in mountain caverns</td>
</tr>
<tr>
<td></td>
<td>Metal-bearing slag</td>
<td>THE BOLIDEN AREA Increased metal recovery levels through slag concentration</td>
</tr>
<tr>
<td>COPPER AND LEAD SMELTER RONNSKAR</td>
<td>Zinc clinker</td>
<td>ODDA Zinc production</td>
</tr>
<tr>
<td></td>
<td>Antimony slag</td>
<td>BERGSÖE Antimony-lead alloy production</td>
</tr>
</tbody>
</table>
Recycling of metals

SOCIETY’S LEAD BATTERY USERS
- Lead scrap and plastic from car batteries, etc.

SOCIETY’S ELECTRONICS USERS
- Electronic scrap from mobile phones, computers, electronic goods, etc.

WASTE PRODUCTS FROM OTHER INDUSTRIES
- Metal scrap, ashes, filters, dust

BERGSÖE
- The metal content is recycled and new lead products produced. As of 2017, plastic will also be recycled.

RÖNNSKÅR
- The metal content is recycled and new metal products produced.
Sustainable development goals provide guidance

See https://sustainabledevelopment.un.org/sdgs for more detailed information.
We evaluate and prioritize our sustainability work with stakeholder dialogues.
Sustainability principles

• We focus on sustainable metal production and our vision is to be one of the leading companies in the industry in terms of development, productivity and responsibility.

• By providing, refining and recycling the base and precious metals that society needs, Boliden acts as an important component of the circular economy.

• We work to ensure optimum resource and materials processing at every stage of the value chain and strive to ensure sustainable development in the fields of safety, environmental performance and business ethics.
More information

in Boliden’s Annual Report at www.boliden.com and the GRI Report at www.reports.boliden.com or Sustainability contact sustainability@boliden.com