

Environmental standard disclosures (GRI 300)

Environmental sustainability is a precondition for successful mining and smelting operations. Boliden's environmental strategy is based on three component parts: Environmental Impact, Resource Efficiency, and Credibility. These elements address the areas of greatest importance for Boliden's license to operate and our long-term competitiveness.

Environmental Targets, 2014–2018

Metal Discharges to Water	Discharges of metals to water shall decrease by 25%
Metal Emissions to Air	Emissions of metals to air shall decrease by 10%
Sulfur Dioxide Emissions	Emissions of sulfur dioxide to air shall be reduced by 10%
Carbon Dioxide Emissions	The carbon dioxide intensity shall not exceed 0.77 tonnes of carbon dioxide per tonne of metal produced
Environmental Incidents	Boliden's target is to have zero serious environmental incidents every month

(Base year 2012)

Group Direction beyond 2019

Air Pollution Emissions	CO ₂ intensity shall decrease by 3% per annum
Metal discharges to water	Discharges of metals to water shall decrease by 1% per annum
Metal emissions to air	Emissions of metals to air shall decrease by 1% per annum
Environmental Incidents	Boliden's vision is to have zero serious environmental incidents each month

*CO₂ intensity is measured as tonnes of CO₂ per tonne of metal produced

Environmental Performance 2018

The performance is presented in the Annual and Sustainability Reports.



301-103 Management Approach Environment

Environmental material topics

Environmental topics, such as energy, water, emissions, effluents & waste, compliance, and transport, are directly connected to how Boliden conducts its operations and whether it maintains stable processes that comply with permit requirements. Several topics are linked and impact Boliden's overall performance and compliance. Other environmental topics, such as materials, biodiversity, closure planning, grievance mechanisms and supplier assessments constitute material topics as they impact external stakeholders, and determine Boliden's license to operate and ability to develop the business. Reclamation work is also important and in 2018, Boliden completed reclamation work on 2 prioritized objects.

Materials

Materials are a fundamental topic and Boliden's core business is mining (production of concentrates) and smelting (transformation of concentrates to base metals). Recycling of materials, e-scrap and batteries to maximize metal recovery are also important constituents of the circular economy.

Sustainable resource usage

Boliden extracts minerals and produces high-quality metals, which are mainly sold to industrial customers in Europe. Material stewardship is important to us, and care and consideration for people, society and the environment is a constant theme of all of our value chain activities – from exploration to customer deliveries.

Energy

Metal production is very energy intensive, both in the mining phase and in the refining processes. Boliden's energy consumption is a major cost item, accounting for approximately 14% (13%) in the breakdown of the Group's total operating costs. Boliden's energy policy states that all business units shall implement and maintain energy management systems in accordance with ISO 50001. This also ensures the company's compliance with the rules and regulations imposed by the Energy Efficiency Directive 202/27/EU. Boliden shall reduce its dependence on fossil fuels by using renewable and/or recycled energy wherever possible.

Water

Boliden's operations are located in areas where there is no scarcity of water, and no water sources are significantly affected by the water withdrawal by Boliden's operations. Boliden aims, nonetheless, to reduce both its consumption of freshwater and the discharge of used water, and water is therefore considered a material topic.

Biodiversity

Access to large areas of land is essential to the majority of Boliden's activities, i.e. exploration, mining, and the construction of tailings ponds and dams. Boliden's land holdings include key habitats, habitat protection areas, nature reserves, and voluntary designated areas for nature conservation. Most of the mines are located in rural areas. The exception is Tara Mines, which is located near the community of Navan in Ireland. The smelters are all located in industrial areas adjacent to a community and close to the coast.

Air

Boliden is working with systematic reviews of its actual energy and CO₂ emission trends, to identify possible improvements and efficiency measures. Boliden's units continuously evaluate their material topics during their annual environmental aspects reviews in compliance with the requirements of the ISO 14001 standard.

Using the best available technical solutions, using resources efficiently, and replacing fossil fuels with renewable ones will all be important components of Boliden's efforts to reduce CO₂ emissions. All units are also obliged to work continuously on making improvements to process efficiency.

Boliden's smelters have all been working, for many years now, to make improvements and reductions in their emissions to air, focusing on metals and sulfur dioxide.

Local action plans are being drawn up both at mines and smelters with the aim of reducing diffuse emissions (dust).

Waste

Mines and smelters generate waste consisting of waste rock, tailings sand, slag and sludge. Boliden's waste is normally handled within the producing unit, but some waste requires specific treatment and is sent to another Boliden unit or external facility.

Compliance

Environmental compliance is a material topic, because environmental sustainability is a precondition for successful mining and smelting operations. Legal requirements shall always be met.

Supplier assessments

Environmental criteria are a vital part of Boliden's Business Partner Code of Conduct, and accordingly also a crucial part of the evaluation of business partners and supplier assessments. Boliden requires all business partners to identify and document their environmental aspects and to be aware of and comply with environmental legislation and common practices. Business partners are expected to strive to minimize their environmental impact.

Grievances about environmental impacts

It is the responsibility of every employee to ensure that operations are conducted properly and in compliance with given instructions. Employees must promptly report any suspected violation relating to accounting, internal controls, and auditing to their immediate superior.

Neighbors and other stakeholders are welcome to contact either the business unit or any of the company functions by a variety of channels, i.e. phone, e-mail, written correspondence.

The subjects of reports received by Boliden included noise, vibrations, dust, and other types of disturbances to the locality. Complaints are handled in accordance with local procedures.

Material Topic: Materials

301-1 Materials used by weight or volume

Levels of mined rock, milled ore, concentrate, and smelting materials production and usage were all similar in 2018 to those posted in previous years. Boliden has included tonnage of rock, ore and concentrates in the material used in its reporting. Other materials specified in the table include waste rock from a mine that is not part of the Boliden Group, which is used as backfill material in Boliden mines. Some of the concentrate produced in the mines is sold to external parties. The total smelting material feed comprises concentrates both from Boliden’s own mines and from external mines, purchased secondary materials, and secondary materials sent from one smelter to another.

Materials are mostly weighed in connection with loading and/or charging (ore, concentrates, and most smelting materials). The mined rock figure is based on calculations (waste rock and ore). A minor part of input materials is calculated from input and stock.

Materials used by weight, (ktonnes)	2016	2017	2018
Mined rock	100,765	110,256	112,392
Whereof milled ore	49,000	55,000	54,000
Whereof concentrate produced	1,249	1,388	1,361
Smelting materials ¹⁾	2,676	2,656	2,742
Other materials	786	1,174	1,077
Whereof non-renewables	150	154	162

1) Adjusted calculations.

301-2 Recycled input materials used

Boliden uses its own and other companies’ by-products and residues for the extraction and recycling of metals. The Boliden Rönnskär smelter began using a new electronic scrap recycling facility in 2012, making Boliden among the world leaders in e-scrap recycling. Boliden Bergsöe, which recycles about 70,000 tonnes of lead acid batteries and 4,000 tonnes other lead scrap per year, is, furthermore, the only secondary lead smelter in the Nordic region.

Metals can be recycled endlessly without any deterioration in their quality and it is important that electronic materials and scrap, such as telephone cables, copper roofs and copper pipes, from the demolition or construction of buildings and infrastructure is re-utilized to as high a degree as possible. The Rönnskär smelter produces 36% (38) of the gold, 26% (27) of the copper, 23% (28) of the silver, and 82% (84) of the zinc from secondary raw materials.

The recycling input rate (RIR) shows the fraction of secondary materials in the total input to Boliden Smelters. Recycled materials include secondary materials from external sources and secondary materials sent from one plant to another within the Group. By-products and non-product outputs recirculated internally at the sites and slag sent from smelters to mines are not included.

Percentage of recycled materials (tonnes)	2016	2017	2018
Total secondary feed ¹⁾	333,600	341,800	348,500
Total feed ¹⁾ (primary and secondary)	2,676,000	2,656,000	2,742,000
Recycling rate	12%	13%	13%

1) Adjusted calculations.

Material Topic: Sustainable resource usage

Boliden contributes towards a circular economy

As a sustainability leader in the metals and mining sector, Boliden clearly has a role to play in meeting the societal need for metals as sustainably as possible by ensuring that waste materials are reused.

Boliden promotes more circular resource use

Boliden has created value from waste for many years – long before the term circular economy was coined. Examples include being one of Europe’s largest recyclers of used lead-acid batteries, benefiting from decades-long resource-effective industrial synergies, and continuously finding innovative new ways of creating value from our own waste materials.

The benefits of circular resource use

Ensuring society’s waste materials are safely reused reduces the amount of virgin materials that need to be extracted and processed. This can also help to decrease lifecycle energy use and greenhouse gas emissions, and can ensure potentially hazardous substances are dealt with properly. Reusing waste also often makes financial sense for Boliden and its partners by converting or recovering valuable materials from waste.

The recyclability of metals

Metals can be recycled repeatedly without altering their properties. Metals are also valuable, which makes complex recovery and recycling processes profitable and worthwhile. Boliden uses a variety of consumer and industrial metal waste as raw materials. Waste materials are also exchanged between Boliden’s smelters with different capabilities when it comes to recovering and recycling certain metals from waste in order to optimize metal extraction.

Electronic waste recycling at Rönnskär

Boliden’s Rönnskär copper smelter in Sweden has recycled various waste materials since the 1960s and is today one of the largest recyclers of metal from electronic material in the world. The smelter’s annual capacity for recycling electrical material is 120,000 tonnes, including circuit boards from computers and mobile phones that are sourced primarily from Europe.

Processing hazardous waste from the steel industry at Odda Boliden’s Odda zinc smelter in Norway has recycled waelz oxide filter powder from the scrap steel recycling industry since 2008. The smelter produces 15,000 to 20,000 tonnes of zinc each year from waelz oxide filter powder, which is a hazardous waste.

Recycling lead scrap at Bergsöe

The Boliden Bergsöe smelter in Sweden recycles the lead from 4 million lead-acid batteries each year. The recycled lead is mainly sold to European battery manufacturers, where it is used to produce new batteries. A plastic separation plant will be commissioned in 2019 to recover the plastic from battery casings, which will then be re-used to manufacture new battery casings.

Successful trials to create value from jarosite residue at Kokkola

Boliden is constantly innovating to find new uses for waste materials. The Boliden Kokkola zinc smelter in Finland has conducted promising trials to recover valuable metals from potentially hazardous jarosite iron residue. Boliden's trials have successfully processed the residue to recover valuable zinc, silver and lead. A clean slag with a wide variety of potential construction applications, such as in road construction, has also been produced in cooperation with research partners.

Pioneering manganese recovery research

Anode sludge containing manganese oxide is a common by-product in zinc production that is typically landfilled as it cannot currently be processed to extract the valuable manganese. Boliden Kokkola has, however, succeeded in extracting the manganese from the waste, which has great potential for use in products such as fertilizers, as an additive in the steel industry or as a precursor material for lithium-ion batteries.

It is of vital importance to Boliden that we develop the by-product business along with the metals business. The largest by-product by volume is sulfuric acid, which is sold for industrial use. Slag-based products, such as 'iron sand' from the Rönnskär processes, are another example of Boliden by-products, and one where the raw material comprises slag from copper production. The slag is purified and granulated into a black coarse-grained glassy material, which is very suitable for use as a filler in road and building construction. The use of iron sand reduces the extraction of gravel and sand from nature. The iron sand from Rönnskär is CE marked, which means that Boliden has drawn up procedures for assuring the quality of both the production process and product handling, e.g. for storage and shipping. During 2018, the

chemical composition of the iron sand has been adjusted to fulfil the new Specific Concentration Limits in REACH to be a sellable product, without the need for transport and user instructions for hazardous goods. This is another step in Boliden's efforts to have iron sand classified as a product that conforms to the ideas of the circular economy.

What is a circular economy?

A circular economy goes beyond the current extract-use-dispose industrial model to create circular systems that gain the maximum value from resources by recovering and reusing materials at the end of each service life.

SDG 12: Responsible consumption and production



SDG 12 is one of Boliden's prioritized Sustainable Development Goals that involves ensuring sustainable consumption and production patterns. The goal is closely related to the circular use of materials and the circular economy.

The circularity gap

According to the 2018 Circularity Gap Report by Circle Economy, only 9% of the resources used globally are recycled back into the economy after use. The report argues this leaves a massive 'circularity gap' that must be closed to prevent further and accelerated environmental degradation and social inequality.

Material Topic: Energy

302-1 Energy consumption within the organization

Energy consumption in 2018 totaled 19.7 (19.8) million gigajoules (GJ). Electricity accounts for 16.2 (16.5) million GJ of this consumption, which equates to 4.5 (4.6) TWh.

The reported energy usage is based on invoiced incoming and outgoing deliveries, supplemented by internal measurements and stock inventories at the end of the year. Conversions between weight and energy have been performed using energy values specified by the supplier or by using tabled values provided by national bodies.

Coke, coal, oil, and fuel gases are used for the reduction and smelting of copper, lead, and zinc concentrates. Diesel is used for transportation purposes, in mining operations, and for internal transportation. Limited amounts of heating oil and gas are used for heating purposes during the cold season. The use of biofuels in metallurgical processes has been tested and evaluated, but has, until now, been negligible in the larger context. A boiler based on biomass has been added during the reporting period. Bio-based fuels have also, to a limited extent, been used in road transports. Electricity is the dominant source of indirect energy in the Group. Out of the total indirect energy used, 94% comprises electricity and only 6% is purchased heat.

Direct Energy consumption within the organization (GJ)	2016	2017	2018
Coal & coke	1,743,000	1,844,000	2,053,000
Gas	446,000	289,000	306,000
Oil	1,794,000	2,128,000	2,285,000
Diesel & petrol	1,689,000	1,611,000	1,666,000 ¹⁾
Other	13,000	36,000	49,000
Total renewable energy	29,000	51,000	69,000
Total energy	5,686,000	5,908,000	6,359,000
Electricity, purchased	16,080,000	16,524,000	16,156,000
Heat, purchased	453,000	501,000	1,100,000
Gross energy input	22,218,000	22,934,000	23,614,000
Produced energy, for internal use	2,205,000	2,291,000	2,335,000
Produced energy, sold	3,157,000	3,146,000	3,964,000
Net energy used	19,061,000	19,788,000	19,650,000

1) Whereof 20,571 GJ diesel from renewable sources

302-3 Energy intensity

Boliden's energy intensity was 13.03 (13.39) GJ/t metal, an increase from the previous year. The energy intensity ratio is reported as the product intensity (energy consumed per unit produced). It is calculated as Boliden's net total energy consumption (the same as in GRI 302-1) for all Boliden sites, divided by the production output in metal tonnes from Boliden's production sites. This indicator is affected both by process efficiency and by the product mix and raw material properties.

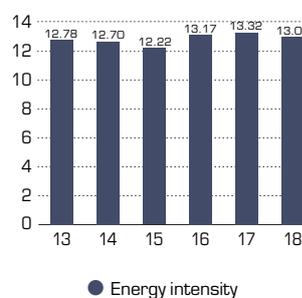
302-4 Reduction of energy consumption

Boliden has implemented routines for purchasing high-consumption electrical equipment and procedures for the evaluation of life-cycle costs in construction and renovation as important parts of its ISO 5001-certified energy management systems. Boliden has chosen, due to the different character of mining and smelting operations, to work with local energy targets, rather than Group targets. Boliden's operations reduced their energy usage by 138,000 GJ during the year.

Boliden's smelting operations strive to take advantage of excess heat from the processes, either transforming it to electric power or supplying it for use in external district heating or steam deliveries. In 2018, 2,335,000 (2,291,000) GJ of heat was used internally, and 3,964,000 (3,146,000) GJ was delivered externally for use in district heating systems.

ENERGY INTENSITY

GJ/t metal



Material Topic: Water

303-1 Interaction with water as a shared resource

Water conservation is an important part of Boliden's policy. Reduction of water use has a high priority without, however, compromising on safety and environmental responsibility. Each Boliden site must assess their water system at least biannually and perform a water risk evaluation.

303-2 Management of water discharge-related impacts

In mining, water is typically used in mineral processing and slurry transport, while in smelting, it is used for cooling and gas cleaning purposes. Boliden's operations do not re-use water from other organizations, but in Harjavalta and Kokkola, waste water from adjacent operations is ducted into Boliden's waste water treatment plants for treatment before being discharged to recipients. These volumes are not reported to Boliden. All other water volumes are based on data from flow meters.

Water recycled and reused (million m ³)	2016	2017	2018
Recycled volume	110	106	107
Percentage of water recycled	78%	73%	74%

303-3 Water withdrawal

The water volumes are measured and/or calculated for each site by the use of flow meters and/or the monitoring of pump operating data.

Total water withdrawal by source (million m ³)	2016	2017	2018
Surface water (sea)	80	81	80
Surface water (inland)	40	44	46
Ground water	17	17	16
Collected rain water	1	1	1
Municipal water	2	2	2
Total water withdrawal	140	145	145

303-4 Water discharge

Discharges to water derive from dams and tailings ponds at the mines, and from water treatment plants and collection of surface water at smelters and mines. Boliden's smelters account for approximately 70% of metal discharges to water while the mines account for the remaining 30%. Boliden's mines account for approximately 80% of the Group's nitrogen discharges with the nitrogen generated mainly from the use of explosives and their handling. The remaining 20% comes mainly from wastewater recycling at the Kokkola smelter.

Ensuring efficient and stable operations at water treatment plants and recirculating the process water as much as possible are important parts of reducing discharges to water. Boliden's

operations include purifying process water as well as a significant amount of the rainwater that falls within the industrial areas. In recent years, there has been heavy rainfall, underlining the need for increasing the water treatment capacity, and several of Boliden's operations have consequently implemented measures to meet this need.

In total the discharge of metals and nitrogen to water from Boliden's units decreased in 2018 due to improved water management and control, and the nitrogen treatment plants taken into operation. There was a slight increase during the middle of the year that was mainly due to increased operations.

The management and monitoring of water consumption has also been improved due to the decision that all Boliden's units shall have a Water Management Plan.

Once the water-cleaning processes are completed, the smelters discharge their water to the sea while the mines discharge the water into rivers and lakes. The water discharged to recipients is monitored to ensure that levels of pollutants are within the quality standards stipulated in the environmental permit. Accredited laboratories, both internal and external, are used for analyses of samples taken on site. Metal discharges to water from Smelters have been stable during 2018, and well below both target and budget.

Water discharge	2016	2017	2018
Metal discharges to water, tonnes (me-eq)	13	9	8
Metal discharges to water, tonnes (mass)	22	15	14
Nitrogen /N-tot/ to water tonnes (mass)	300	236	240

Discharged water volume (million m ³)	2016	2017	2018
To wetland	0	0	0
To inland surface water	64	57	55
To sea surface water	62	71	78
To municipal treatment plants	0.03	0.03	0.03
Total	126	128	133

303-5 Water consumption

The water consumption of Boliden is calculated from the difference between the total water withdrawal and the discharged water volume of Boliden's sites.

Water consumption (million m ³)	2016	2017	2018
Total water withdrawal	140	145	145
Discharged water volume	126	128	133
Water consumption	14	17	12

Material Topic: Biodiversity

304-1 Operational sites in areas of high biodiversity values

Boliden's impacts on biodiversity are above all related to land use in current or abandoned operations. As of December 31, 2018, Boliden owned or controlled 23,100 (23,000) ha of land in connection with existing operations, in areas adjacent to existing or former operations, or in other areas of interest for exploration. Most operations are located in areas where mining or smelting activities have been carried out for anything between several decades and several hundred years. Some of the older mining and industrial areas are from a time when environmental legislation did not exist and knowledge levels were much less developed than is currently the case, and it is consequently not only impossible to determine an original baseline, but difficult to quantify the precise long-term impact of the activities. For every operation there is a permit process, and for time-limited operations, such as mines, Boliden always ensures that the areas can be reclaimed after the mine closing. Strategies are constantly being developed for the definition of proper compensation measures for application when utilizing land and thus causing a loss of biodiversity. Closure and remediation plans, including biodiversity aspects, are a mandatory part of the environmental permit issued to operate a mine.

Details of the sites that are located in or adjacent to national or regional protected areas, including Natura 2000 habitats defined by EU Member States, can be found in the table.

Sites	Operation	Country	Size, ha	Protected areas
Aitik	Mine	Sweden	7,158	Yes ¹⁾²⁾³⁾
Bergsöe	Smelter	Sweden	13	No
Boliden Area	Mine	Sweden	5,425	Yes ²⁾
Garpenberg	Mine	Sweden	1,312	No
Harjavalta	Smelter	Finland	452	No
Kevitsa	Mine	Finland	1,420	Yes ¹⁾²⁾
Kokkola	Smelter	Finland	340	No
Kylylahti	Mine	Finland	654	Yes ¹⁾²⁾
Odda	Smelter	Norway	40	No
Rönnskär	Smelter	Sweden	153	No
Tara	Mine	Ireland	894	Yes ²⁾
Old mining areas and forests	-	Sweden	5,266	Yes ¹⁾²⁾³⁾

1) In the area

2) Adjacent to

3) Containing portions of area

All land and forests owned or leased is managed in a forest management plan for each site. The forest management plan has a register divided into separate areas and is connected to a map of them. Protected areas and findings of protected and listed species are registered and described as well as areas with high value forest for future development to raise the values. None of the operational sites, including the protected areas, are considered to be in high biodiversity areas.

For new mining projects a specific inventory of natural values is always carried out early on in the project to be able to develop the project according to the mitigation hierarchy.

All inventories and how the project development has proceeded according to the mitigation hierarchy is described in an application for environmental permit.

Boliden has also initiated one of Sweden's most comprehensive research projects investigating ecological compensation in collaboration with the Swedish University of Agricultural Sciences (SLU).

The abandoned mining site of Näsliden, where after-treatment has been carried out in consultation with local residents to create ecological and social added value is another example of Boliden's approach.

304-3 Habitats protected and restored

Boliden continues to monitor and manage the areas that have been reclaimed for an indeterminate period of time, and this may, if necessary, entail implementing additional measures in already reclaimed areas. Where appropriate, reclamation is done in partnership with affected land owners or Sami villages.

There are various different types of protected areas in the vicinity of the majority of Boliden's mining operations, such as wildlife and plant sanctuaries, key biotopes, protected watercourses of national interest, nature reserves, and Natura 2000 areas.

A list of 10 prioritized reclamation objects has been drawn up and is updated on the basis of the results of studies showing changes in the status of the respective objects. An object may be anything from measures designed to improve dam safety, or large-scale ground installation projects, to out-and-out nature conservation in the form of water treatment, planting, or the installation of nesting boxes for birds. Boliden's interventions in older abandoned mining areas are often aimed at complementing the old techniques with new and improved methods.

Habitats restored	Type of activity	Size, ha	Start	End
Rävlidmyran	Reclamation work	-	2017	2018
Gillervattnet	Reclamation work	300	2014	2019-21
Näsliden	Reclamation work	5	2015	2018
Holmtjärn	Reclamation work	1	2018	2019
Old Forests Aitik	Ecological compensation	837	2017	2022

Ecological compensation work has been ongoing at Boliden Aitik since 2017. Two areas totaling 837 hectares were selected for the compensation work. The goal is to maintain the value and, in parallel therewith, increase natural values in the near vicinity of the Aitik mine. The compensation plan includes both protection of selected areas and more active measures such as relocation of dead wood and biologically important species such as insects in hibernation and wood mushrooms. Boliden has also identified a possibility for improving the opportunities for recreational and adventure tourism.

MM1 Amount of land disturbed or rehabilitated

Mining companies can often own or hold licenses over very large areas of land. The extraction sites, infrastructure, or other production activities will often disturb a small proportion of that land holding.

Soil conservation and the reclamation of mining areas which have reached the end of their productive lifespans are part of Boliden’s operations and responsibility. The reclamation programs are designed to reduce the impact on surrounding areas of land and local biological diversity. In 2018, approximately 48 (2) hectares were restored/ reclaimed, while 217 (78) hectares were utilized for operations. Boliden has made ongoing provisions of funds for future rehabilitation. At the end of 2018, a total of SEK 4,016 (3,123) million had been allocated for future reclamation of mining areas and smelters.

Land management (hectares)	2016	2017	2018
Total land holding	22,600	23,000	23,100
Disturbed and not yet rehabilitated (opening balance)	5,937	6,805	6,881
Disturbed in the reporting period	963	78	217
Rehabilitated in the reporting period	95	2	48
Disturbed and not yet rehabilitated (closing balance)	6,805	6,881	7,050

New mines and the expansion of existing businesses

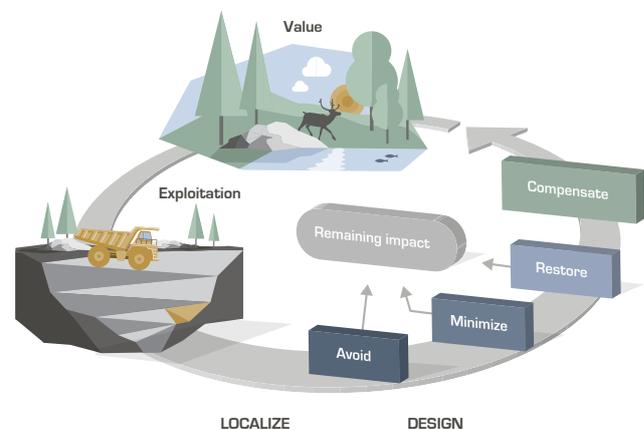
The establishment of new mines and the expansion of existing businesses requires land utilization. The physical impact on surrounding areas of land of the opening of a mining operation, for example, is considerable. A substantial amount of forested land must often be cleared to create space for industrial activities. The aim is to have the minimum possible impact on biodiversity. Once the mine is operational, the impact continues in the form of waste products – such as waste rock and tailings sand – traffic, noise, dust, and other emissions and discharges to air and water.

When new mines are opened in previously undisturbed areas, all of the relevant areas’ natural and cultural values are inventoried. This is part of the EIA, (Environmental Impact Assessment) which is a mandatory part of the permit application process for new activities. The EIA makes it possible to measure the effects on the flora and fauna before, during, and after any operation is carried out. This inventory, or baseline, can be used as a reference when planning and utilizing the remediation actions. EIAs are also carried out and a current baseline established in conjunction with changes to existing operations and the establishment of new operations in already disturbed areas. The majority of Boliden’s acreage in northern Scandinavia is adjacent to reindeer grazing land and Boliden prioritizes in-depth dialogues with representatives of the reindeer industry to ensure the optimum protection of their interests. This may, for example, entail ensuring that the reindeer herds can roam freely between grazing areas, or that grazing land is, as far as possible, maintained in an undisturbed condition and that the lichen and plants on which the reindeer feed are included in the flora planted when areas are reclaimed.

Boliden owns land and forests and practices responsible forestry, as defined by the Forest Stewardship Council (FSC® FSC-C007235), by promoting and protecting biodiversity and creating environmental and social values. Boliden has assigned approximately 10% of its productive forested land for nature conservation. This area is partly protected through the establishment of nature conservation land, key habitats and habitat-protected areas, and partly managed to promote nature-conservation interests. The areas protected by Boliden mainly comprise older forests, wetland, and areas dominated by deciduous forest. Over time, some of the older forests are becoming more and more primeval. In areas dominated by deciduous forest, forestry is conducted in a way that prioritizes deciduous tree species. On the productive forested land, Boliden manages the forestry from a landscape ecological perspective.

In previous years, the Group’s forestry management in these areas has included prescribed felling, which is intended to benefit deciduous wooded pastures, and controlled burning in order to promote certain species and biological diversity. By adapting the forest management in areas used for outdoor recreation, social values are created and maintained. Boliden’s ambition is for the wildlife on Boliden’s land to be in harmony with the forestry, hunting, and other public interests. Current long-term plans extend for at least ten years and include remediation, planned measures, and allocated funding for a number of abandoned pit mines. Boliden is constantly working to develop new options for restoring impacted ecosystems and to identify opportunities to compensate for impact through offsets.

Boliden’s operations take advantage of exploration, mining, enrichment and transport. Boliden consequently conducts ongoing work designed to minimize the social and environmental impact. Boliden’s operations shall be sustainable throughout the chain from prospecting and production to post-processing, and in the long-term. Boliden takes responsibility for the impact of its business operations and works proactively on loss of biodiversity and ecosystem services. In practice, this means that Boliden not only avoids or minimizes the impact, but also adds or creates new values. The work is based on the four steps of the so-called harmless hierarchy; avoid, minimize, restoration and offsets.



Material Topic: Air Pollution Emissions

305-1 Direct (Scope 1) GHG emissions

Boliden reports this indicator for the units over which it has operational control. The direct carbon dioxide emissions arise from GHG emissions from carbonaceous raw materials, from fuels in metal extraction processes and fuels for heating, and from the use of fuels for mining operations and road transportation within the company.

The direct emissions are calculated in accordance with the procedures laid down in the WBCSD¹⁾ GHG²⁾ Protocol, together with additional guidelines from the EU and/or national authorities.

The CO₂ reporting within the framework of ETS is carried out in accordance with separately audited procedures in each country, and although we seek to report the same data, we cannot guarantee that the Group's GRI disclosure will correlate exactly to the CO₂ data reported within ETS.

305-2 Energy indirect (Scope 2) GHG emissions

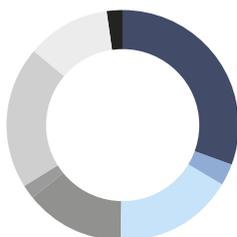
Boliden reports this indicator for the units over which it has operational control and includes only production-related indirect emissions. In 2015, Boliden began using location-based emission factors. This was an adaptation to the updated GHG Protocol Guidelines for Scope 2 reporting. The calculation is made by multiplying the energy used with the production mix for the specific region. The production mix should be as current as possible, and Boliden uses emission factors published by International Energy Agency. For the 2018 reporting, the following emission factors were applied: for the operations in Sweden 10.8 (11.0), Finland, 106.8 (147.2), Norway 9.0 (8.0), and Ireland 417.6 (425.2) g/kWh.

Carbon dioxide emissions, Scope 1+2, tonnes	2016	2017	2018
Direct emissions, (305-1)	594,000	605,000	644,000
Indirect emissions, (305-2)	459,000 ¹⁾	419,000	327,000
Total (305-1 + 305-2)	1,052,000¹⁾	1,024,000	971,000

1) The indirect emissions for 2016 have been corrected to 459,000 from 404,000 t due to an incorrect CO₂ emission factor in the previous GRI report disclosure.

CARBON DIOXIDE EMISSIONS (SCOPE 1 + SCOPE 2), 2018 PER SOURCE

The total reported CO₂ emissions are 0.971 (1.024) Mtonnes for the year.



- Electricity, 31%
- Heat, 3%
- Oil, 17%
- Raw material, 14%
- Gas, 2%
- Coal and coke, 20%
- Diesel and petrol, 12%
- Other, 2%

1) World Business Council for Sustainable Development
2) Greenhouse gas

305-4 GHG emission intensity

Boliden's GHG intensity was 0.64 (0.69) t/t metal. The GHG intensity is reported as the product emission intensity (metric tonnes of direct [Scope 1] and indirect [Scope 2] emissions per unit of metal product). Boliden only includes CO₂ gas in the GHG intensity.

The new CO₂ intensity target is to reduce emissions by 3% per year measured from 2017. Boliden has measured CO₂ intensity for all units since 2012.

305-5 Reduction of GHG emissions

The GRI definitions state that this indicator should reflect reductions of CO₂ emissions identified under 305-1 and 2. The reductions result is estimated from reported energy savings and energy efficiency initiatives reported in 305-2.

Boliden strives to deliver the excess heat from its processes for use in district heating, wherever possible. The heat supplied by Boliden Bergsöe, Boliden Rönnskär, Boliden Kokkola and Boliden Harjavalta in 2018 corresponds to 340,000 (270,000) tonnes/annum of CO₂ (Scope 1) if the same amount of heat had been produced from a fossil-fuel source.

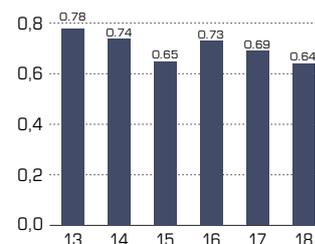
Boliden is also, over and above these measures, actively initiating attempted reductions in fossil-fuel emission by means of fuel substitution tests, participation in demonstrations of electrified road transports, and improved heat recovery/exchange with the aim of phasing out the use of fossil fuels for heating purposes.

Boliden is a co-owner of a production company for wind-based power, VindIn AB, which builds and operates wind farms in Scandinavia. The purpose of VindIn is to take a longer-term approach and to deliver low-cost, renewable electricity. VindIn currently produces about 300 GWh in its three wind farms in Sweden and Finland.

In 2018, Boliden Bergsöe inaugurated the microalgae cultivation for treatment of process emissions. The method used entails using waste heat from the process to grow algae. The project is expected to capture CO₂ emissions, create energy and clean metal emissions from the flue gas.

GREENHOUSE GAS EMISSION INTENSITY

t CO₂/t metal



- Greenhouse gas emission intensity

305-7 Other significant air emissions

Other significant air emissions deriving from Boliden's operations are nitrogen oxides (NO_x), sulfur oxides (SO_x), metals, and dust. The most common of the sulfur oxides (SO_x/SO₂) is sulfur dioxide, and Boliden generally uses the expression 'sulfur dioxide' to describe this emission. The figures for sulfur dioxide and NO_x disclosed in the table are the direct measured emissions from sources at Boliden's smelters. The figures for metals and dust include the direct-measured emissions from smelter stacks, but exclude diffuse emissions.

Diffuse emissions are generated at both mines and smelters and the environmental impact is due to dust particles containing metals being dispersed by the wind. All operations are working systematically to reduce particle emissions to air, e.g. by enclosure of dust-generating equipment and by salting and watering roads. The diffuse emissions are monitored, but are difficult to quantify in an aggregated manner.

Emission Reduction Efforts

Boliden's efforts to reduce emissions are based on an overall analysis of the environmental impact. The impact and risk assessments are revised on a regular basis, as are the measures to be taken. The work is controlled and conducted by each individual business unit, as local circumstances may differ. Follow-up at the Group level is conducted on a monthly basis.

Sulfur dioxide emissions to air are mainly attributable to gases generated during the smelting processes at the Harjavalta and Rönnskär copper smelters. The amount of sulfur dioxide emitted during the process depends on factors such as process stability, the efficiency of the gas cleaning systems, and the amount of sulfur in

the raw materials. One way of reducing emissions is, accordingly, to maintain a stable smelting process and to have continuous and effective maintenance work and control of the process. The monitoring and control of abatement systems for effective gas cleaning is important work and is carried out continuously.

The SO₂ emissions to air increased slightly in 2018 due to increased emissions at all Boliden Smelters in Q2. All leakages were effects of changes in the processes, which caused unexpected leakages. In Harjavalta there were problems in a converter, which were solved during maintenance work in June. In Kokkola there were leakages in the heat exchanger which were resolved in May. A new reduction agent grade was used at Rönnskär, resulting in higher SO₂ emissions. Several leakages in Rönnskär's converter hall were also identified and are currently still ongoing. They are, however, scheduled for correction during 2019.

The ongoing work focuses on process stability and the improvement and/or replacement of technology. Emissions to air are mainly based on periodic monitoring in accordance with applicable national standards. Emissions from fuel are calculated using the fuel properties data provided by the supplier. Accredited laboratories, both internal and external, are used for the analyses of samples taken on site.

Emissions to air (tonnes)	2016	2017	2018
NO _x	380	450	450
SO ₂	7,060	7,360	7,720
Particulate matter	110	193	181
Metal emissions to air (me-eq)	100	109	92
Metal emissions to air (mass)	22	21	19

Material Topic: Discharges to water and Waste

306-2 Waste by type and disposal method

Boliden handles considerable amounts of waste materials. These waste materials mainly comprise various types of dust and slag, tailings, rock, and other mineral formations. Boliden has developed processes to extract as much value as possible from the material streams at mines and smelters. Hazardous waste is sent for disposal or stabilization, in some cases to landfill and deep repository. The increasing amounts of waste rock in 2018 are attributable to the expansion of the Kevitsa mine in Finland.

Waste by type and disposal method (tonnes)	2016	2017	2018
Hazardous waste, total	826,000	873,000	876,000
Whereof to external use, treatment, or recovery	5,800	7,400	7,300
Whereof to external disposal	220	400	1,850
Non-hazardous waste, total	252,000	355,000	309,000
Whereof to external use, treatment, or recovery	69,800	75,200	85,800
Whereof to external disposal	1,500	1,600	2,200
Waste rock, total	52,036,000	55,482,000	58,785,000
Waste rock for internal construction	5,417,000	6,187,000	8,892,000
Storage of waste rock for future use	11,134,000	125,000	274,000
Sold waste rock	404,000	342,000	5,000
Tailings total	46,919,000	52,957,000	52,026,000
Tailings for internal construction	2,729,000	2,865,000	3,182,000

MM3 Waste types and disposal methods including overburden, rock, tailings and sludge, and their associated risks

Boliden processes a number of different metals and substances that are both toxic and environmentally harmful. The mining and smelting operations generate residual waste consisting of waste rock, tailings, slag, sludge, and dust. EU waste legislation currently has a strategic approach that views waste as a resource and deposition as the last option (Waste Framework Directive, 2008/98/EC). There is considerable awareness of the importance of waste issues within the Boliden Group: e.g. waste sorting, significant recycling of process residues and scrap, good reporting procedures and ongoing waste projects. The majority of Boliden's process and mining wastes are sent to landfills in accordance with the EU Landfill of Waste Directive (1999/31/EC) and the Mining Waste Directive (2006/21/EC). The remainder is used as construction material or as filler material. Waste rock dumps are covered continuously, wherever possible, in order to prevent weathering or leaching. Boliden's mine waste is handled in accordance with applicable environmental permits that specify how and where it may be stored and how it shall be covered and reclaimed.

Extensive monitoring programs are in place to ensure a high level of dam safety and several measures to increase dam safety

have been finalized or are in progress. Boliden is responsible for around 40 dam facilities in Sweden, Norway, Finland, Ireland, and Canada. They are used or have been used to deposit tailings sand or other waste and for water management. This figure includes both operational and decommissioned facilities. Dam facilities in Sweden are managed according to GruvRIDAS (mining industry guidelines for dam safety).

Correctly processed waste can be turned into valuable products. Approximately 45% of the process residues generated are sent to another Boliden site for metals recovery or final deposition. What is considered waste for one operation can often constitute a raw material for another. Appropriately handled, the trade in waste and by-products can be of benefit to society by increasing overall resource efficiency. Boliden works continuously to identify internal and external recycling or landfill solutions for any process wastes generated. Boliden receives significant amounts of waste from external parties for recycling, construction purposes or safe deposition in landfills.

The export of waste to landfill or for recycling is extensively regulated. Boliden has also developed procedures for monitoring and following up on the receiving party's processing operations to ensure that their waste processing is acceptable from a health and environmental viewpoint.

The secondary raw materials for Boliden smelters, i.e. electronic scrap and waste batteries, contain plastics that are incinerated in the process. The incineration of the plastics serves as a reducing agent in order to produce the metal. The excess heat from the process is used for district heating.

Waste rock tonnage is based on calculations of volume and density. Tailings are based on calculations of tonnage of ore minus tonnage of concentrate output.

There are no statistics available for overburden as it is seldom that any overburden exists. Sludge that is not reused in the process accounts for an insignificant percentage of either hazardous waste or non-hazardous waste, depending on its properties.

Tailings are from underground mining operations, i. e. from the concentrator and, are, to a certain extent, used as back-fill, both as reinforcement and to reduce the amount of tailings above ground. Some waste is sent for final storage in underground facilities. Odda stores jarosite and slag in mountain caverns. In 2018, the Board approved an SEK 750 m investment in a new leaching plant at the Rönnskär site, with construction starting in 2019. This will enable waste material that has been stored at the site since 1975 to be reprocessed. The 460 ktonnes of waste material currently held will decrease to 220 ktonnes. The remaining 220 ktonnes will be stored in a deep underground repository, located under the Rönnskär smelter plant. The first phase of construction work on the underground repository was finished in 2018, and deposition of waste material in the repository will commence in 2020. This is a globally unique solution. This is the only place in the world where a deep underground repository shares a site with a smelter. Boliden has no organic waste material that is suitable for composting, other than small amounts from canteens, which are sent for municipal treatment.

Boliden does not practice deep well injection or waste incineration.

306-3 Significant spills

A total of 36 (23) larger (more than 150 liters) oil and/or diesel spills, were reported from Aitik, Boliden Area, Kevitsa, Odda and Rönnskär. All spills occurred within the site area. All spills were immediately sanitized and any contaminated soil was excavated. These events have not entailed any significant environmental impact or caused lasting harm to the surroundings. Investigations have been conducted in conjunction with all of the incidents in order to ascertain the causes of the spills and, wherever possible, to institute measures that will prevent any repeats.

306-4 Transport of hazardous waste

Processing of intermediate and waste products is a natural part of Boliden's value chain in order to maximize metal recovery levels. In some cases, however, hazardous waste is sent for disposal or stabilization, and/or to external landfill and deep repository. During 2018 7,300 (7,400) tonnes were sent for external use, treatment, or recovery and 1,850 (400) tonnes were sent for external disposal.

Material Topic: Environmental Legislation Compliance

307-1 Non compliance with environmental laws and regulations

Boliden has not been hit by any corporate environmental fines in 2018.

Material Topic: Business Partner Environmental Assessment

308-1 Percentage of new suppliers that were screened using environmental criteria

Boliden has identified both environmental and social topics as material. The integrated handling of these in Boliden's Evaluation of Business Partners processes is further explained in the GRI 414 section of this report.

Environment – part of UN Global Compact

Principle 7: Boliden should support a precautionary approach to environmental challenges.

Boliden's environmental commitments are based on the company's values and driven by the need to reduce environmental impact. Boliden strives to maximize the environmental benefit in relation to the resources invested. Legal requirements and Boliden's commitments shall always be met.

Principle 8: Boliden should undertake initiatives to promote greater environmental responsibility.

Boliden provides metals and related products to achieve the environmental goals of the modern society, including climate actions and efficient energy use. Boliden strives to minimize the use of resources such as land, water and energy. Boliden operates in a manner that reduces the impact on the surrounding communities from active and closed operations. Performance and examples are presented in the Annual and Sustainability Reports as well as in this Sustainability index.

Principle 9: Boliden should encourage the development and diffusion of environmentally friendly technologies.

Boliden systematically works with continuous improvements and innovations and our operations shall implement and maintain environmental management systems according to ISO 14001. Boliden strives to effectively reuse and recycle materials and develop solutions for valuable materials to find their way back into the economy.