



Environmental Protection in the Aurubis Group  
and Consolidated Aurubis AG Environmental Statement 2020  
Hamburg and Lünen Sites



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## Consolidated Aurubis AG Environmental Statement 2020

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Dear readers,

As I'm writing this, the world is fighting the coronavirus pandemic. It still isn't clear what changes this will bring for humans, for our society, and for Aurubis in the short, medium, and long term. In light of these events, it's more apparent than ever that companies directly depend on a functioning environment, which includes an intact natural environment. Consequently, it only makes sense that we in industry make our contribution to protecting and conserving the environment and that we always reflect on the direct and indirect impacts our activities have on people and nature.

This is why environmental protection takes especially high priority at Aurubis. It is an established aspect in the Group that is part of our Sustainability Strategy and is substantiated with concrete targets. For many years now, annual investments in environmental protection measures have been in the double-digit million euro range. As it stands, we're already global leaders in environmental protection in our sector. And we continue to make investments, for instance in a new ridge turret suctioning system in our copper smelter in Hamburg to reduce emissions even further.

And our next big challenge lies ahead. Aurubis is committed to the European Green Deal. We make a particularly strong contribution to the goal of more efficient resource utilization and a circular economy. Aurubis also holds a leading position in energy efficiency. The efficient use of energy is an ecological and economic obligation for Aurubis. One of the innovative projects is the use of waste heat for highly efficient and flexible electricity production at the Lünen site. Hamburg's HafenCity East is the first urban neighborhood to be almost fully supplied with CO<sub>2</sub>-free industrial heat. Using a chemical subprocess of copper production, Aurubis extracts CO<sub>2</sub>-free heat and,

together with the energy supplier energcity, delivers it through a roughly 3.7 km long pipeline to HafenCity East.

We have already done a great deal and work intensively on continuously improving ourselves. For example, Aurubis has implemented what are referred to as "best available techniques" (BAT) and produces at the highest energy efficiency level, reducing its specific CO<sub>2</sub> emissions by about one-third since 2000. Our metals are a key component of modern environmental technologies; without our products, an energy transition wouldn't be possible in the first place.

With the recent acquisition of Metallo, Aurubis is reinforcing its recycling capabilities. Recycling is crucial for a sustainable society. We will be able to recover even more metals for progress and be in a position to significantly boost the processing of raw materials with low metal contents. Metallo's processing know-how and technical processes perfectly complement Aurubis' core expertise. Together, we will continue to expand our capabilities and capacities for recycling important industrial and precious metals, making a meaningful contribution to strengthening the circular economy.

We warmly welcome you to take a personal glimpse into Aurubis' environmental protection achievements. Enjoy reading about them.

Sincerely,



**Dr. Thomas Bünger**  
Chief Operating Officer

# Company Profile and Business Model

## The Aurubis Group

The Aurubis Group is a leading global provider of non-ferrous metals and the largest copper recycler worldwide. We process complex metal concentrates, scrap metals, and metal-bearing recycling materials into metals of the highest quality. Aurubis produces more than 1 million tons of copper cathodes annually, and from them a variety of products such as wire rod, continuous cast shapes, profiles, and flat rolled products made of copper and copper alloys. Aurubis produces a number of other metals as well, including precious metals, selenium, lead, nickel, tin, and zinc. The portfolio also includes additional products such as sulfuric acid and iron silicate.

Sustainability is a fundamental part of the Aurubis strategy. “Aurubis responsibly transforms raw materials into value” – following this maxim, the company integrates sustainable conduct and business activities into the corporate culture. This involves a careful approach to natural resources, responsible social and ecological conduct in everyday business, and sensible, healthy growth.

Aurubis has about 7,400 employees, production sites in Europe and the US, and an extensive service and distribution system in Europe, Asia, and North America.

## Business model and Group structure

In accordance with our Vision 2025, we are consistently expanding our current business model, which is focused on copper, to encompass a broader multi-metal approach. We are increasingly extracting other metals in addition to copper from systematically purchased raw materials and intermediate products and then processing them into marketable value-added products.

On the one hand, we use copper concentrates that are obtained from ores and are offered by mining and trading companies on the global market. We purchase the necessary raw materials for our two primary smelters in Hamburg and Pirdop (Bulgaria) – we don't hold any stakes in mines.

On the other hand, we also process copper scrap and other metal-bearing recycling materials and bought-in intermediate products at our secondary smelters in Lünen (Germany) and Olen (Belgium), among other sites. We source most of the materials on the European market. The main suppliers are metal trading companies, though some recyclable materials also reach us directly from product manufacturers.

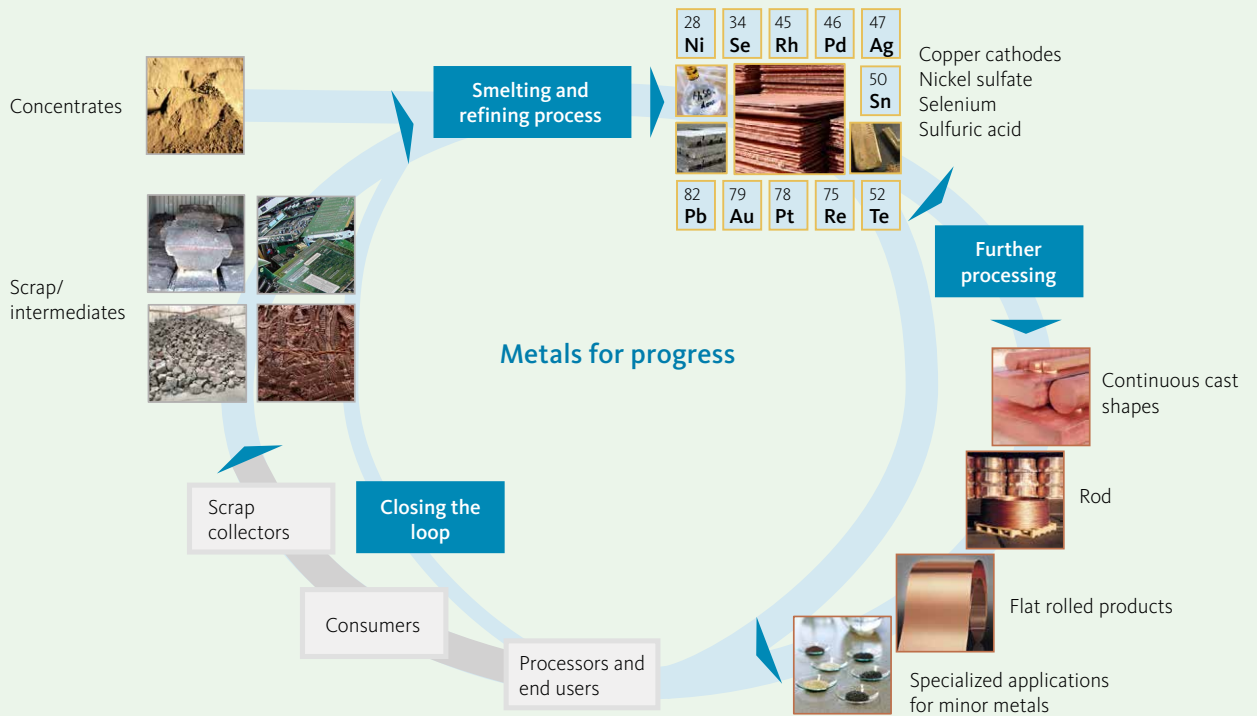
We produce copper cathodes, some of which we process further into standard and specialty products made of copper and its alloys. Products made of different metals and by-products such as iron silicate and sulfuric acid round off our portfolio. Aurubis' customers include companies in the semis industry; the electrical engineering, electronics, and chemical industries; and suppliers of the renewable energies, construction, and automotive sectors, among others.

Aurubis has acquired the recycling company Metallo. The formal closing of the transaction was effective May 29, 2020. Metallo has been fully consolidated into the Aurubis Group since June 1.

With Metallo, the Aurubis Group, a leading global provider and recycler of copper and other non-ferrous metals, has acquired another company in Belgium (Beerse) in addition to Olen, as well as a company in Spain for the first time (Berango). The name Metallo, an established name on the recycling market, will be retained.



Fig. 1.1: The Aurubis AG business model



### Our Group structure

The Executive Board of the Aurubis Group oversees the three areas of Operations, Executive, and Financial, the Group's organizational structure.

Operations processes complex metal concentrates, copper scrap, and metal-bearing recycling materials into metals of the highest quality. It covers the production of all basic products and metals, as well as their subsequent processing into products. From an organizational perspective, Operations comprises the Hamburg, Pirdop, Lünen, and Olen sites, as well as the Metallo sites in Beerse and Berango, the Rod and Shapes division, and the corporate departments Health & Safety, Environmental Protection, Research & Development, and Continuous Improvement & AOS.

The Executive area makes company decisions to manage the company's business and resources. It therefore guides raw material purchasing and product sales and is the central point of communication between the Executive Board (and Supervisory Board) and the public. From an organizational aspect, this area oversees the Commercial division and the corporate departments Supply Chain Management, Human Resources, Legal Affairs & Corporate Governance, Communications & Investor Relations, External Affairs, and Energy & Climate Affairs.

This organizational core is framed by the functions of the Financial area, which includes the corporate departments Accounting & Consolidation, Corporate Controlling & Risk Management, Treasury, Tax, IT, Group Process Management, Corporate Procurement, Internal Audit, and the Flat Rolled Products (FRP) segment. Flat Rolled Products (FRP) processes copper and copper alloys – primarily brass, bronze, and high-performance alloys – into flat rolled products and specialty wire and then markets them.

# Our Environmental Policy – Company Guidelines on Environmental Protection

In order to ensure that our environmental protection standards are safeguarded throughout the Group and continuously optimized, we have established the following principles as our company guidelines:

- » The continuous improvement of the environmental performance, in particular of water pollution control, soil protection, and immission control, is a key target of the Environmental Protection division.
- » For reasons of accountability, environmental and climate protection should be developed in such a way as to conserve natural resources and avoid or minimize strain on the environment and our employees.
- » Issues of environmental protection should be taken into account equally in the planning and development of new products and production processes.
- » Processed raw materials and intermediate products should be brought into the economic cycle as completely as possible, and unavoidable waste should be properly recycled or harmlessly disposed of. Raw material suppliers are advised on issues related to environmental protection if needed.
- » Essential precautions to avoid accidents and operational disruptions are in place to prevent or minimize environmental hazards for our employees and neighbors, as well as effects on the environment.
- » Our employees' sense of responsibility in environmental protection should be strengthened and objective, open, and respectful dialogue should take place with them, the relevant authorities, and the public.
- » Our customers are appropriately informed about the features of our products and necessary safety measures and are advised on questions related to product disposal.
- » Contractors working for us must be selected, informed, and advised in such a way as to ensure that laws and our environmental protection standards are observed.

Compliance with legal regulations is the basis and minimum standard of our activities.

# Environmental Protection in the Aurubis Group

## Environmental protection is part of the company strategy

With our new Aurubis strategy, we have developed a clear compass that directs the path to our Vision 2025. For Aurubis, responsible corporate governance is an integral contribution to securing the company's future. The Sustainability Strategy for 2018 to 2023 creates the framework for this. It is a component of the Group strategy and follows the mission of responsibly transforming raw materials into value to provide metals for an innovative world.

As a multi-metal group, Aurubis assumes responsibility for protecting the environment and the climate. The efficient use of energy and the reduction of CO<sub>2</sub> emissions are an important part of the company's ecological and economic responsibility. Environmental protection, resource efficiency, and climate protection have been components of our company culture for many years. They are some of the key topics of the Aurubis strategy and are established in our company guidelines.

For all production sites and across all business processes, Aurubis places an emphasis on modern and energy-efficient plant technology that complies with high environmental standards. We also develop innovative and energy-efficient technologies in environmental protection that often set new benchmarks worldwide and form the basis for establishing best available techniques (BAT) at European level. Aurubis views the value chain as a whole and strives to strike a balance between the economy, the environment, and people.

Metals are necessary for technical progress and a high standard of living. Rising demand worldwide is met with limited resources, however. Metal recycling is therefore an important source of raw materials – especially for a country like Germany that lacks natural resources. It makes an important contribution to supply security and to environmental and resource protection. It is becoming more and more important to recycle products after their

life cycle is over. Valuable raw materials are used efficiently, resources are conserved, and environmental pollution is avoided. Our core product, copper, has the best conditions for achieving this because it is a metal that can be recycled as often as desired without a loss of quality. This means that copper of the highest purity can be produced from recycling materials again and again. We at Aurubis have created an internal function for this, as well: Customer Scrap Solutions unites copper product sales and the sourcing of recycling raw materials. In this way, customers become suppliers at the same time. In the spirit of resource protection, nearly all raw materials are converted into marketable products, and waste is effectively avoided and – wherever possible – recycled.

## Achievements and successes in environmental protection

After we safely achieved and, in some cases, significantly exceeded the targets we had set in 2013 for the year 2018, we set new Group-wide targets in environmental protection and defined concrete targets for the individual sites within the scope of the Sustainability Strategy 2018-2023. The effectiveness of these targets and measures is reviewed continuously.

In 2019, dust emissions per ton of copper output in copper production were reduced by 18% compared to 2012 (target: 15%). This target still would have been achieved in 2019 if the Metallo acquisition had been included. If Metallo is included, dust emissions in 2019 have been reduced by 19% compared to the Aurubis reference year 2012 (excluding Metallo). If Metallo is included in reference year 2012, a 17% reduction has been achieved.

Our goal is to continue maintaining this very low level. Similarly, SO<sub>2</sub> emissions in primary copper production were reduced by 19% in the same period under review. When compared internationally, Aurubis is a forerunner in reducing specific sulfur dioxide emissions.





**Dr. Karin Hinrichs-Petersen, Head of Corporate Environmental Protection:**

»We ensure our leading position in environmental protection by learning and improving continuously. Together with the sites, we therefore create the basis for environmentally sound production in the Aurubis Group and for future growth processes.«

**(From l. to r.): Dr. Jörn Mühlenfeld, Jan Drzymalla, Daniela Cholakova, Laura Robert, Dr. Karin Hinrichs-Petersen, Orhan Cekel, Nicole Hennings**

We have also made significant improvements in water pollution control. We have reduced metal emissions to water in copper production processes from 2.2 to 1.0 g per ton of copper output since 2012. This is a decline of 54 % (target: 50 %).

These targets still would have been achieved in 2019 if Metallo's metal emissions to water had been included. If Metallo is included, metal emissions to water in 2019 have been reduced by 57 % compared to the Aurubis reference year 2012 (excluding Metallo). If Metallo is included in reference year 2012, a 54 % reduction has been achieved.

We were only able to achieve these successes with continuous investments: we have invested more than € 630 million since 2000 and more than € 230 million since 2012 in measures to improve environmental protection throughout the Group.

As an energy-intensive company, Aurubis feels especially committed to climate protection. We therefore invest in energy-efficient plant technologies at all sites, carry out measures to save additional energy, and implement projects such as the use of industrial heat for heating purposes. This long-term commitment has been successful: we have considerably reduced our CO<sub>2</sub> emissions per ton of copper at the sites. In the next three years, we want to raise the bar even higher when it comes to environmentally sound production:

» We want to reach a new milestone at the Hamburg plant, where we will be investing about € 100 million in measures to continue reducing emissions in the primary smelter. These measures include optimized source extraction, a newly installed procedure for processing intermediates, and the use of state-of-the-art suctioning and filter technology to trap residual dust emissions. After our plans are fully implemented, we will reduce fugitive emissions from the primary smelter by more than 70 %, further developing the primary smelter to be able to process increasingly complex

Fig. 1.2: Our environmental targets

**Climate protection**

- » **Target: Reducing CO<sub>2</sub> emissions by 100,000 t of CO<sub>2</sub> compared to 2012 through energy efficiency projects and heat recovery projects**
- » Example: Use of industrial waste heat for district heating in Hamburg

**Nature conservation & biodiversity**

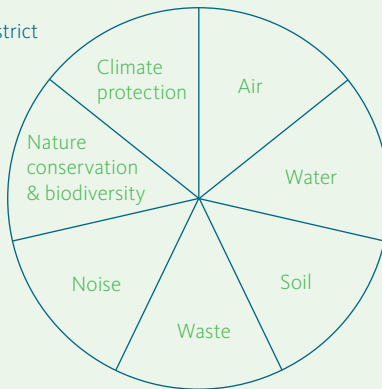
- » **Target: Improvement of nature conservation at the production sites**
- » Example: Participation in the NABU project UnternehmensNatur in Hamburg

**Noise**

- » **Target: Reducing noise emissions, especially in new technical projects**

**Environmental management**

- » **Target: Introduction of ISO 14001 standard across the Group**



**Waste**

- » **Target: Increasing recycling rates**
- » Example: Stronger marketing of fayalite in Pirdop

**Air**

- » **Target: Reducing dust emissions in copper production by 15% compared to 2012 (18% reduction achieved in 2019)**
- » Example: Reduction of fugitive emissions

**Water**

- » **Target: Reducing metal emissions to water in copper production by 50% until 2022 compared to 2012 (54% reduction achieved in 2019)**
- » Example: Optimizing the new rainwater treatment systems in Lünen and Pirdop

**Soil**

- » **Target: Reducing input of harmful substances into soil**
- » Example: Further paving of plant premises in Lünen

The target for reducing metal emissions to water was increased from 40% to 50% in spring 2020.

raw materials as well. All of this contributes to our Sustainability Strategy – and makes the site ready for the future in the long term.

- » Our project to utilize industrial heat from the Hamburg plant facilitates an energy-efficient heat supply for the Hafencity East district. At the same time, 12 million m<sup>3</sup> less cooling water and Elbe River water is used each year, as the excess warmth is now used for heating purposes (see page 20 “Energy and Climate Protection”).
- » To reduce fugitive emissions, a new facility for cooling converter slag in pots was built at the site in Pirdop, Bulgaria, and was commissioned in 2019.
- » Likewise in Pirdop, Bulgaria, a new sand filter was installed in the facility for cleaning process wastewater in 2019. This reduces the discharge of undissolved substances into bodies of water.
- » To reduce noise and CO<sub>2</sub> emissions, a new facility for loading ships, the Cu-Port, was constructed at the site in Olen, Belgium. Transports that were previously carried by truck are now carried out by waterway. This prevents a total of about 20,000 truck deliveries per year and thus 237 t of CO<sub>2</sub>.
- » At the Lünen site, equipment was set up to clean up historic oil damage. It successfully completed test operation at the end of 2019. The equipment captures the oil damage with the help of the pump-and-treat procedure, depleting the harmful substances and removing the pollution.



Initial test runs in the ship loading facility (Cu-Port) at the Olen site

- » The Avellino site was certified in accordance with EMAS for the first time at the end of 2018. In addition to the Hamburg, Lünen, and Stolberg Schwermetall sites, Avellino is now the fourth site in the Group that has an EMAS certificate in addition to the ISO 14001 certificate.
- » To promote biodiversity, a pilot project to add greenery to facades on the plant premises was concluded at the Hamburg site in 2019.
- » Soil material that was removed from the Retorte site during environmental remediation in summer 2019 was recycled at the Hamburg site. The soil material was mainly composed of sand and was used as an additive to form slag for recovering selenium at the end of the copper refining process.

### Dialogue with interested parties & commitment

We have determined and evaluated the interested parties that are relevant for Aurubis: governmental authorities, non-governmental organizations, customers, and employees play an important role in particular. Aurubis continued to hold open dialogue with authorities, citizens, and other interested parties across the Group in the past year. This helps us understand the expectations and requirements that those around us place on us and to take them into account in our activities. In addition, we participated in various environmental projects.

Since 2013 we have participated in the EU projects Organizational Environmental Footprint and Product Environmental Footprint, which seek to achieve an environmental balance in organizations and products. The goal of this collaboration is to develop and test the methods for determining the environmental footprint. On this basis, the European Commission is striving to create a single market for “environmentally friendly products” and “environmen-

tally friendly organizations.” In 2018, the two pilot projects we participated in were successfully concluded when the results were accepted by the official supervisory bodies. We will take part in the next phase of the environmental footprint and contribute our experience in this area.

In Hamburg, we have been a member of the Environmental Partnership since 2003, and a member of the Partnership for Air Quality and Low-Emission Mobility, which is coordinated by the city of Hamburg. The goal of the latter partnership is to reduce nitrogen dioxide emissions, which are caused by transport in particular. For this purpose, we also participated in the German model project Mobil.Pro.Fit® in collaboration with the environmental organization B.A.U.M. e. V., which has led to different measures for low-emission mobility. For instance, bike boxes with locks were provided for employees at nearby train stations and a bike rental station was set up in front of a plant entrance.

## Metallo – Facts and figures

- » Metallo Belgium is located in Beerse, in the north of Belgium (close to Antwerp)
- » Metallo Spain is located in Berango, in the north of Spain (close to Bilbao)
- » Employees: 450 employees at Metallo Belgium and 90 at Metallo Spain
- » Revenue: close to € 1 billion annually
- » Throughput: 350,000 t of secondary raw materials annually
- » Supplier base: 660 different types of materials coming from close to 500 suppliers
- » Global activity: Metallo Group is active in 56 countries across all continents

### Metallo acquisition – We are strengthening our profile in the business of recycling non-ferrous metals

On May 4, 2020, the EU antitrust authorities issued Aurubis AG unconditional approval for the acquisition of the Belgian-Spanish Metallo Group. “Today is a remarkable day for Aurubis and Metallo. We enthusiastically welcome the approval of the Metallo Group acquisition. The merger is a key milestone in the implementation of our multi-metal strategy,” said Aurubis AG Executive Board Chairman Roland Harings after the EU approval was issued. The formal closing of the transaction took place on May 29, 2020.

Metallo specializes in the recovery of non-ferrous metals from a variety of material streams. Building on over 100 years of experience, the company serves an established base of international business partners and contributes to strengthening the circular economy. Today, Metallo processes more than 315,000 t of secondary raw materials annually, recovering metals and metal products. These are returned to the value chain as refined copper, tin, and lead, as well as metal products such as nickel sulfate solution, zinc oxides, and metal sludges.

### Products of the Metallo Group

#### » Refined metals

“B Grade” copper cathodes, copper anodes/blister, high-purity low-lead tin ingots (LME-registered “M brand”), lead (soft and alloyed)

#### » Unrefined metal products

Zinc oxides, nickel sulfate solution, precious metal sludge

#### » Minerals

Koranel®, Metamix®, Elmix®

### Sustainable development

For Metallo, sustainability and economy go hand in hand. Convinced that corporate social responsibility is essential to its relationship with partners worldwide, Metallo builds and continuously reinforces trust.

Daily emission monitoring, including stack emissions, ambient air monitoring, workplace monitoring, and continuous testing and analysis provide a trustworthy and safe working environment both in Spain and Belgium. Metallo has a zero waste business model, meaning it strives to convert all scrap materials into valuable output, making the company one of the frontrunners in metal recycling.

### Expertise is key

In order to provide an answer to the increasing complexity of input materials, Metallo has dedicated teams of experts in different fields. Its in-depth knowledge of markets, materials, quality analysis, pricing mechanisms, and technologies solidifies Metallo’s reputation as a reliable partner. With the acquisition of Metallo, Aurubis is reinforcing its recycling capabilities. Recycling is crucial for a sustainable society. We will be able to recover even more metals for progress and be in a position to significantly boost the processing of raw materials with low metal contents.







Production site Metallo Belgium N.V., Beerse

### Brief profile of Metallo Belgium

Metallo Belgium, based in Beerse, was founded in 1919 and is located in the province of Antwerp in northern Belgium. In the 1960s, the company developed processes to recycle copper, tin, and lead from raw materials with low metal contents and promoted innovations to invest in sustainable technologies in order to strengthen its “zero waste” strategy.

The Beerse site is the main production site and the company's headquarters. The input material includes black copper from Berango, metal-bearing residues, copper scrap and alloys, metallic shredder material, and waste.

#### Certifications:

- » ISO 14001
- » ISO 9001
- » Authorized Economic Operator (AEO) certificate

#### Business segment:

Recycling and refining company focusing on multi-metals and zero waste

**Site size:** 448,794 m<sup>2</sup>

**Employee headcount:** 450



Production site Metallo Spain S.L.U., Berango

### Brief profile of Metallo Spain

Metallo Spain, formerly called Elmet, was founded in Berango (in the province of Biscay) in 1991 and focuses exclusively on complex and low-grade recycling materials to produce black copper, solder, and Elmix®. The company was founded as Elmet S.L.U. and is currently a sustainability role model and forerunner in the broader Basque region.

#### Certifications:

- » ISO 14001
- » ISO 9001
- » OHSAS 18001 (Occupational Health and Safety Assessment Series)
- » Authorized Economic Operator (AEO) certificate

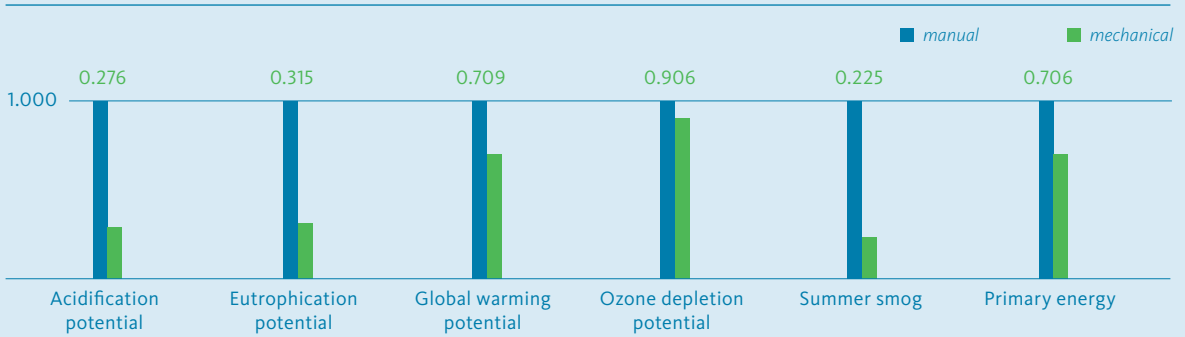
#### Business segment:

Recycling complex and low-grade recycling materials

**Site size:** 91,470 m<sup>2</sup>

**Employee headcount:** 90

Fig. 1.3: Results of the ecological assessment: Comparison of impact categories in manual dismantling and mechanical shredding



**Our participation in the Horizon 2020 project FORCE**

Recycling valuable metals and optimally recovering them with an environmentally sound approach is particularly important to us. As a result, we are one of 22 national and international partners participating in the European research project “FORCE – Cities Cooperating for Circular Economy.” The project is taking place within the scope of Horizon 2020, the overarching European Union research and innovation program.

The goal of the project is to develop new concepts for waste avoidance and treatment for the material streams for plastics, biomass, used electrical equipment, and wood. We support the project with our expertise as a multi-metal recycler for the purpose of improving the recycling of strategic metals (e.g. copper, gold, silver, and lead) through the best possible collection and dismantling system for waste electrical and electronic equipment.

In the course of the project, Aurubis actively collaborates with different project partners in Hamburg, for instance the Senate Chancellery and the municipal waste management service of the city of Hamburg, Hafencity University, and the Hamburg College of Applied Sciences (HAW), and creates momentum for sustainability initiatives in science and business.

Aurubis and Stadtreinigung Hamburg (the city of Hamburg’s municipal waste management service) carried out a trial to investigate the recycling advantages of manually pre-dismantling small electrical and electronic devices compared to non-dismantled devices. For this purpose, 10 t of waste electrical and electronic devices from collection group 5 were dismantled and separated into the material groups plastic, iron, non-ferrous metal (NF metal), and aluminum to the greatest possible extent. These results were compared with the results of the groups of unprocessed devices (10 t dismantled mechanically).



The unprocessed electrical and electronic devices prior to handling ...



... during the dismantling process ...



... and dismantled into individual parts in wire mesh crates.





Start of the manual dismantling of the electrical and electronic devices in the workshop of the subsidiary (Stilbruch Hamburg-Altona) of Hamburg's municipal waste management service with their own cooperation partners: Aurubis representatives, Hamburg's municipal waste management service, and software developer Consist ITU

The benefits for environmental protection and resource conservation were investigated for both recycling processes through an ecological assessment. The difference between the assessments of the two scenarios fluctuates, depending on the impact category, between 10 % (ozone depletion) and 80 % (summer smog) in favor of manual dismantling (see Fig. 1.3).

Taking the time requirement into account, purely manual pre-dismantling proved to be inefficient under the current conditions. At about four months, manual dismantling

took significantly longer than the 22-minute mechanical shredding. Therefore, initial suggestions for future device design were developed to improve the economic efficiency of manual dismantling and also possibly enable additional metals to be recovered in a cost-efficient manner in the future.

The results and experience gathered from the project were submitted to the European Commission together with other project insights from the Hamburg project cluster and will be presented at the closing event of the FORCE project.



Aerial photo of the material preparation, crushing, and separation plant (MV-ZS facility) in Lünen



Releasing the electrical and electronic devices onto the feed conveyor of the MV-ZS facility

### Environmental management organization

Chief Operating Officer Dr. Thomas Bunger and Head of Corporate Environmental Protection Dr. Karin Hinrichs-Petersen are responsible for the strategic positioning of environmental protection in the Group. Environmental officers oversee the environmental protection duties at the individual sites under the technical supervision of Corporate Environmental Protection management.

With the involvement of employees, plant managers/ managing directors, and the Executive Board, uniform environmental protection standards were developed, established in a corporate policy, and implemented across the Group as part of the environmental management system (ISO 14001 or EMAS). This Environmental Statement is part of the EMAS registration and comprises Aurubis AG, which includes the Hamburg and Lunen sites. Moreover, energy management systems in accordance with ISO 50001 have been implemented and certified at

several sites. The annual external audit in the scope of the certifications offers us the opportunity to have the successful environmental protection measures confirmed by an independent third party and to recognize additional potential for improvement.

The Corporate Environmental Protection Policy defines areas of activity and responsibility, specifies information and reporting requirements, and establishes the duties of Corporate Environmental Protection, as well as cooperation with the local environmental protection officers and the managing directors/plant managers. This ensures a uniform approach to environmental protection within the Group and in terms of public image. The Group headquarters supports the sites with expertise and technology transfer. All of this makes an important contribution to implementing our new Group strategy in environmental protection.

Fig. 1.4: Corporate Environmental Protection organizational chart

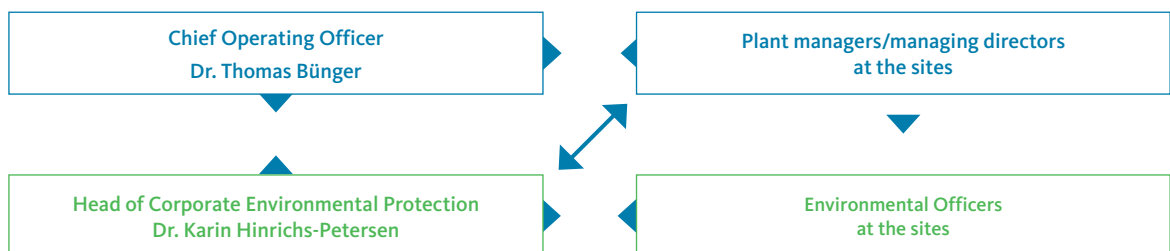
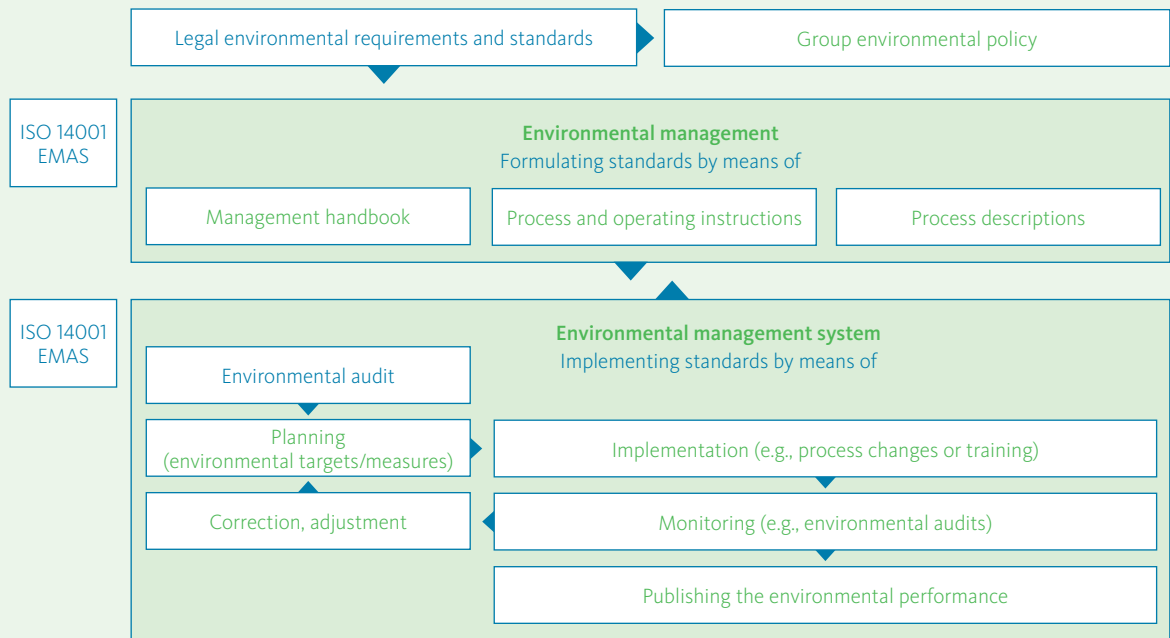


Fig. 1.5: Environmental management in the Aurubis Group



Compliance with legal regulations is the basis and minimum standard of our activities. The regulations that are significant for our production include in particular the German Federal Immission Control Act, the Closed Cycle and Waste Management Act, the Water Management Act, and the European chemical regulation, REACH. The results of internal and external assessments confirm that the legal regulations and guidelines from the permits were adhered to. An integrated management system (IMS) was developed for Aurubis AG for the areas of environment, quality, and energy. It was certified in its entirety for the first time in 2017. The IMS utilizes synergies, harmonizes processes, and improves environmental, quality, and energy management.

Furthermore, we determine key environmental protection factors, which are uniform within the Group and are reviewed and certified by external auditors annually. In the future, there are plans to introduce a software program Group-wide to monitor and update environmental KPIs and to simplify compliance with all laws and standards. At the site in Hamburg, the software is already in use for certain sub-areas. The plan is to gradually expand the roll-out to the individual sites.

Environmental discussions take place continually across the Group and employees are trained on environmentally relevant topics regularly.

Emergency plans and alarm and danger prevention plans have been established for emergencies and accidents. These measures ensure that environmental impacts are effectively avoided and that employees and the community are protected. We carry out training sessions and emergency drills regularly, documenting and evaluating the procedures. Emergency plans are developed in coordination with the responsible authorities. The corporate environmental protection guidelines also include the tasks to implement the European chemical regulation, REACH.

Supported by the Aurubis Operating System (AOS) introduced in 2017, production processes are systematically analyzed and continuously optimized with environmental aspects in mind. The environmental management system therefore ensures that, in addition to production targets, environmental protection targets can also be achieved and development opportunities can be utilized.

To prepare ourselves for future developments, we regularly evaluate opportunities and risks that the company faces. When we see opportunities, we use them by implementing projects. Risk management exists to prevent environmental damages, non-compliance, and unexpected costs. Thus, environmental risks are investigated regularly and minimized by establishing precautionary measures.

Fig. 1.6: Site certifications

Site	EMAS	ISO 14001	ISO 50001	ISO 45001	ISO 9001	IATF 16949	EfbV
Hamburg, headquarters (DE)	x	x	x		x		
Lünen (DE) <sup>1</sup>	x	x	x		x		x
Pirdop (BG)		x		x	x		
Olen (BE)		x			x		
Beerse, Metallo (BE)		x			x		
Berango, Metallo (ES)		x		x	x		
Emmerich, Deutsche Giessdraht (DE)		x	x		x		
Avellino (IT)	x	x		x	x		
Fehrbellin, CABLO (DE)		x	x		x		x
Nersingen, Strass, CABLO (DE)		x	x		x		x
Hamburg, E.R.N. (DE)		x	x		x		x
Röthenbach, RETORTE (DE)					x		
Hamburg, Peute Baustoff (DE) <sup>2</sup>					x <sup>1</sup>		
Buffalo (USA)					x	x	
Zutphen (NL)		x			x	x	
Pori (FI)		x		x	x		
Stolberg (DE)			x		x	x	
Stolberg, Schwermetall (DE) <sup>3</sup>	x	x	x	x	x		

<sup>1</sup> Lünen certification: CENELEC 50625

<sup>2</sup> For the sale of iron silicate granules used to produce blasting abrasives

<sup>3</sup> Not majority-owned by Aurubis (50% stake)

**EMAS:** system with guidelines for environmental management systems and environmental audits

**ISO 14001:** standard for environmental management systems

**ISO 50001:** standard for energy management systems

**ISO 45001:** standard for occupational health and safety management systems

**ISO 9001:** standard for quality management systems

**IATF 16949:** standard for quality management systems for the automotive industry, based on ISO 9001

**EfbV:** Ordinance on Specialized Waste Management Companies (German certificate)

# Energy and Climate Protection

The individual production steps in the Aurubis value chain are complex and very energy-intensive overall. For us, the effective and efficient use of energy is an issue of ecological and economic responsibility. The development and implementation of the Group-wide energy strategy and the corresponding coordination of the targets and measures are the central responsibility of the head of Corporate Energy & Climate Affairs, who reports directly to the Executive Board.

Aurubis holds a leading position in energy efficiency. However, as we increase productivity and efficiency, we are also reaching our technical limits. Efficiency enhancements that have already been achieved don't serve as a blueprint for future development because the more steps that have already been taken in energy efficiency, the more difficult it is to optimize energy demand further. Because there are technological limits to reducing energy consumption and emissions, a continued high level of capital expenditure leads to only marginal improvements compared to past years.

In order to control energy consumption optimally and identify additional energy savings potential, the main German sites are certified in accordance with DIN EN ISO 50001:2018: the main uses of energy are determined and evaluated to derive suitable targets and measures, taking opportunities and risks into account, in order to continuously improve energy performance. This is managed via comprehensive measurement and monitoring systems as well as corresponding energy KPIs and is reviewed annually through internal and external audits. The plan is to introduce an energy management system in accordance with DIN EN ISO 50001 at all Aurubis sites by fiscal year 2021/22.

Energy & Climate Affairs coordinates the Group-wide development of the energy management and monitoring systems. In this way, they provide for a uniform approach where this makes sense and facilitate the exchange of expertise regarding best practice examples, for instance in the form of an internal energy efficiency network. Furthermore, since 2015 Aurubis has actively taken part in energy efficiency networks as part of an initiative of German government and business, entering into a moderated dialogue on energy efficiency projects and potential with other companies beyond Aurubis' plant and company boundaries.



Environmental protection already accounts for a large proportion of energy consumption at Aurubis, as the rising use of complex recycling raw materials with comparatively low copper content requires a higher amount of energy. However, since materials other than copper are also recovered, primary energy demand is decreasing steadily when the total input is considered. We therefore work to harmonize environmental protection, resource conservation, and energy efficiency optimally across the raw material spectrum.

With the installation of a power-to-steam facility – an electric steam boiler – we participated in the project NEW 4.0 to identify potential for electricity flexibility and sector interconnectedness for our plants. This large-scale project – funded by the German Federal Ministry for Economic Affairs and Energy – brings together more than 50 partners in the German federal states of Hamburg and Schleswig-Holstein. “NEW” stands for “Norddeutsche





The winners of the four competition categories of the 2018 dena Energy Efficiency Awards

EnergieWende" (Northern German Energy Revolution) and the "4.0" indicates the threshold to the fourth industrial revolution, i.e., the digitalization of industry, in which the intelligent networking of systems is playing an increasingly decisive role, including with regard to the energy transition.

Energy consumption is the main source of CO<sub>2</sub> emissions in the Aurubis Group. The biggest CO<sub>2</sub> emitters in the Group are the German sites in Hamburg and Lünen. Currently, Aurubis systematically records the direct CO<sub>2</sub> emissions at the sites, as well as the energy-related indirect emissions, for example from purchased electricity. In this context, the possibilities and limits regarding the decarbonization of our processes are being investigated, for instance through the use of hydrogen.

## NEW 4.0

Norddeutsche EnergieWende

### Our successes

#### Best Newcomer Germany and Index Leader MDAX: Aurubis

Aurubis has participated in the investor initiative CDP (formerly Carbon Disclosure Project) since 2015. The CDP surveys companies about risks and opportunities related to the climate, as well as CO<sub>2</sub> reduction potential. CDP awarded Aurubis the distinction of Best Newcomer Germany (2015) and Index Leader MDAX (2016). The Sustainability Strategy and the transparent presentation of Aurubis' approach to the opportunities and risks of climate change contributed to the good performance. This distinction includes the copper products that contribute to increasing efficiency in applications, as well as the effective production processes, energy management, and

investment in energy and CO<sub>2</sub> efficiency optimizations. For Aurubis, this award is proof of its innovation capacity and at the same time an incentive to keep up its efforts in CO<sub>2</sub> reduction and energy and resource efficiency.

#### Best Practice in Energy Efficiency: Award for the Lünen plant

The efficient use of energy is an ecological and economic obligation for Aurubis. At the Lünen site, one of the innovative projects to increase energy efficiency ensures highly efficient and flexible electricity production.

By using waste heat, for instance converting it into electricity and using the residual heat, the recycling center achieves the optimum energy recovery possible. The installation can produce about 23 million kWh of electricity (about 14 % of the site's energy needs, or the average energy demand of around 6,500 three-person households). It therefore simultaneously manages to prevent 14,000 t of CO<sub>2</sub> annually. The energy efficiency initiative of the German Energy Agency (dena) rated the project as exemplary and awarded it the label Best Practice in Energy Efficiency in 2015.



### Our flagship project – The Climate Alliance between Aurubis und enercity

Hamburg's Hafencity East is the first urban neighborhood to be almost fully supplied with CO<sub>2</sub>-free industrial heat. Using a chemical subprocess of copper production, Aurubis extracts CO<sub>2</sub>-free heat and, together with the energy supplier enercity, delivers it through a roughly 3.7 km long pipeline to Hafencity East. In its size and complexity, the project is unique in Germany. It cuts about 20,000 t of CO<sub>2</sub> annually. This is equivalent to the emissions of about 10,000 mid-range cars, each driving 12,000 km per year. Industrial Heat is a flagship project for a climate-friendly heat supply.

The two participating companies invested over € 20 million in the project each, 30 to 40 % of which was publicly funded. Aurubis received funding from the German Reconstruction Loan Corporation (KfW), while enercity received support from the European Regional Development Fund (ERDF) and the KfW. The funding was initiated by the German Federal Ministry for Economic Affairs and Energy (BMWi) and the Hamburg Authority for Environment and Energy (BUE).

If the full industrial heat potential of the Hamburg plant is utilized, CO<sub>2</sub> emissions could even be reduced by about 140,000 t CO<sub>2</sub> per year. However, the necessary framework and incentives have to be created, for example the full recognition of the CO<sub>2</sub> reduction within the scope of the emission trading system. Calculations by the German Energy Agency (dena) show: throughout Germany, companies could save up to 37 million t of CO<sub>2</sub> and roughly € 5 billion in energy costs if industrial heat were used consistently.

The following distinctions the project has received from 2018 to 2020 impressively demonstrate the flagship character of the climate alliance.



Responsible Care – ein Beitrag zur Nachhaltigkeitsinitiative Chemie<sup>3</sup>



# Our Raw Materials – Responsibility in the Supply Chain

We take responsibility for our actions. As a processor of copper concentrates, copper scrap, and other metal-bearing recycling materials, as well as bought-in intermediates, we have a high purchasing volume. It is important to us to carefully select our business partners. This is all the more important because we source raw materials from around the world for our business. In our current Sustainability Strategy, we have set the target of continuing to manage our supply chains responsibly. In the process, we take impacts on the social environment, economic aspects, and the natural environment into account. It's important to us to minimize environmental strains and risks and to improve environmental performance along the supply chain as well.

Aurubis has a global, diversified supplier portfolio, and we source a significant portion of our copper concentrates from South American countries such as Peru, Chile, and Brazil. For primary raw materials, we value long-term relationships and strategic cooperation with our suppliers. Our primary concentrate suppliers are the mining companies Vale, Teck, Antofagasta, and Newmont Mining. Most of the copper scrap and metal-bearing recycling raw materials for our two secondary smelters in Lünen (Germany) and Olen (Belgium) are sourced in Europe. Compared to primary raw materials, secondary raw materials are largely purchased on the basis of short-term supply contracts.

In order to conserve resources and promote solutions to prevent waste along the downstream value chain as well, we close the material cycle for copper and other metals and place high priority on this “closing-the-loop” approach. The focus of this approach is on materials such as production waste and residues that accumulate along the copper value chain in production, for example with our customers.

Aurubis AG has taken part in the United Nations Global Compact (UNGC) since late 2014 and supports its principles and goals related to human rights, labor, the environment and climate, and anti-corruption. In the Aurubis Business Partner Code of Conduct, we express our expectation that our business partners also follow these standards as well as those of the fundamental conventions of the International Labour Organization (ILO), the United Nations Declaration of Human Rights, and applicable national and local laws and regulations. The Code of Conduct was introduced Group-wide in 2019.

Our due diligence in selecting suppliers has been supported by our Business Partner Screening since 2015 and applies to suppliers of both primary materials and secondary materials. Using this tool, we analyze our business partners in a structured manner with regard to their integrity relating to social and ecological criteria. The screening is carried out pursuant to the OECD Due Diligence Guidance for Responsible Mineral Supply Chains. Risks under financial, tax, and criminal law aspects, as well as risks relevant to sustainability, such as environmental impacts, are assessed in the screening. The result includes a profile that, in the case of increased risk, leads to additional research by the Commercial, Compliance, and Sustainability departments. Based on this assessment, management decides on possible contracts or restrictions.

### Certificate for conflict-free gold

Since 2013, we have been annually certified as conflict-free according to the standards of the London Bullion Market Association (LBMA). The certificate verifies the effectiveness of our due diligence process related to gold production. Conflict-free means that the purchase of gold-bearing materials doesn't finance or facilitate conflicts. In 2019, we obtained this certificate for our silver production as well. The suppliers of the other raw materials go through the same process as those who supply gold- and silver-bearing raw materials.

### Identifying a sector solution

Aurubis is a member of the International Copper Association (ICA). The ICA released the concept of the Copper Mark, which entails a review of the sustainability standards of copper production sites including mines, smelters, and refineries. The Copper Mark has worked as an independent entity since 2019. We identified the Copper Mark as a fitting initiative in 2019 and are actively supporting the further development process.

# Environmental Protection – Facts and Figures

As in previous years, this year's Environmental Statement is based on internationally recognized guidelines and reporting standards, in particular those pursuant to the Global Reporting Initiative (GRI) and EMAS.<sup>1</sup>

» We have invested more than € 630 million since 2000 and more than € 230 million since 2012 in measures to improve environmental protection throughout the Group

Fig. 1.7: Capital expenditure for environmental protection in Aurubis Group copper production

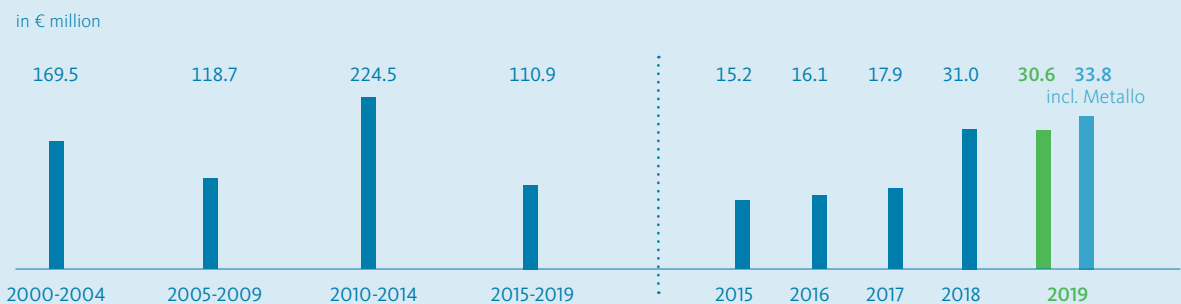
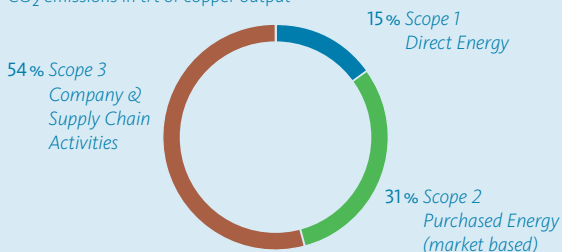


Fig. 1.8: CO<sub>2</sub> emissions from fuels in Aurubis Group copper production



Fig. 1.9: Aurubis Group CO<sub>2</sub> emissions – estimated

CO<sub>2</sub> emissions in t/t of copper output



Aurubis reports the emissions produced as a direct result of burning fuels in its own facilities (Scope 1) and emissions related to purchased energy, for example electricity (Scope 2). Furthermore, an estimate of the emissions caused by the services provided by third parties, such as transport, and purchased preliminary services is created with partially aggregated data (Scope 3).

<sup>1</sup> This report may include slight deviations in the totals due to rounding.

Fig. 1.10: Successful reduction of dust emissions in Aurubis Group copper production

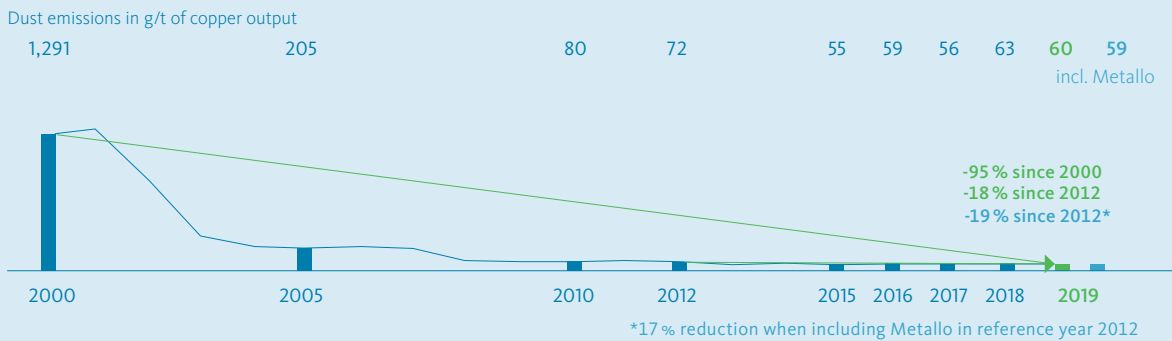


Fig. 1.11: Sulfur dioxide emissions in Aurubis Group primary copper production



At 0.22 t of CO<sub>2</sub> per ton of copper output, emissions from fuels were at a low level in 2019. Product-related emissions have been reduced by 32 % since 2000. If Metallo is included in 2019, Aurubis' product-related emissions since 2000 (excluding Metallo) have been reduced by 29 % (see Fig. 1.8).

The dust emissions arising during copper production can contain metals and metal compounds. The consistent use of the best available plant techniques has led to a 95 % decline in specific dust emissions in primary and secondary copper production since 2000.

If Metallo is included, specific dust emissions in 2019 have been reduced by 19 % compared to the Aurubis reference year 2012 (excluding Metallo). If Metallo is included in reference year 2012, a 17 % reduction has been achieved (see Fig. 1.10).

One of the main focuses in the 1990s was the use of state-of-the-art filter technologies for all directed emission sources, such as chimneys. Today, projects to reduce fugitive emissions have high priority. For example,

fugitive emissions can arise around hall openings – such as gates, doors, or ridge turrets – and during material storage and handling. We have already achieved a great deal in reducing directed dust emissions with technical measures and have nearly exhausted the technical possibilities. Further developments related to non-directed emissions pose additional challenges for the future. It will be necessary to develop innovative technologies and break new technical ground.

Apart from copper, sulfur is one of the main components of the copper concentrates in use. The gaseous sulfur dioxide produced when concentrates are smelted is converted into sulfuric acid in the sulfuric acid plant using the modern double catalysis process. When compared internationally, Aurubis is a forerunner in reducing sulfur dioxide emissions: emissions per ton of copper output have been reduced by 87 % since 2000 (see Fig. 1.11).

We use water for production processes and cooling purposes. Conserving water resources is one of our environmental protection targets in the Group. Wherever possible, Aurubis uses river water and rainwater to save potable



Fig. 1.12: Water withdrawal in Aurubis Group copper production

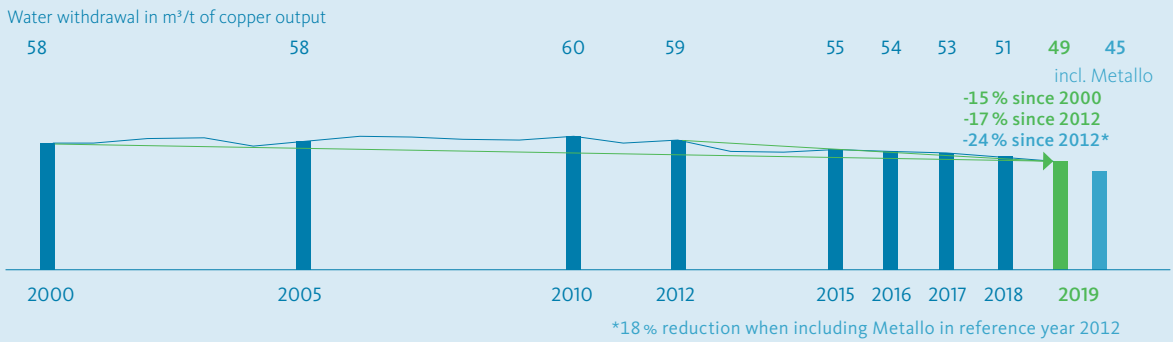
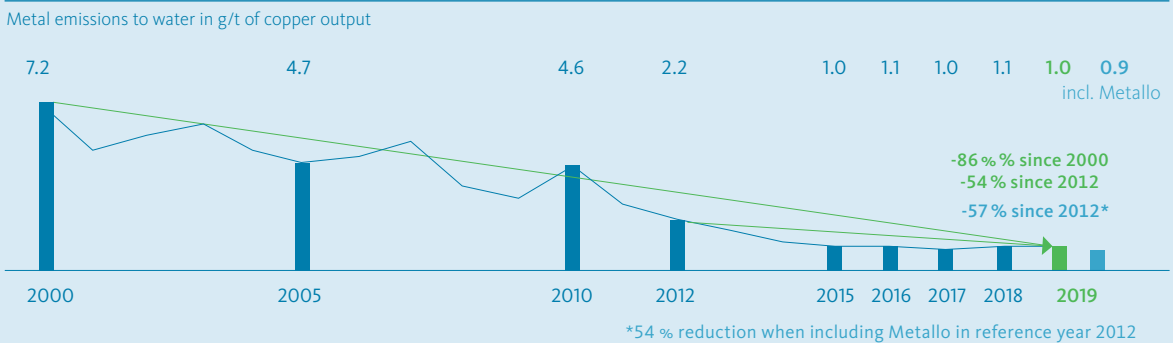


Fig. 1.13: Metal emissions to water in Aurubis Group copper production



water resources. We have reduced specific water withdrawal in copper production by a total of 15 % since 2000 thanks to more efficient facilities.

If Metallo's water withdrawal is included in 2019, a 24 % reduction in specific water withdrawal has been achieved compared to the Aurubis reference year 2012 (excluding Metallo). If Metallo is included in reference year 2012, an 18 % reduction has been achieved (see Fig. 1.12).

Apart from conserving water, treating wastewater and thus avoiding environmental pollution is one of our fundamental responsibilities in industrial environmental protection since water may contain metals after use. We have reduced metal emissions to water in copper production processes from 7.2 to 1.0 g per t of copper output since 2000. This is a decline of 86 %.

If Metallo is included, metal emissions to water in 2019 have been reduced by 57 % compared to the Aurubis reference year 2012 (excluding Metallo). If Metallo is included in reference year 2012, a 54 % reduction has been achieved (see Fig. 1.13).

### Biodiversity

We are actively involved in creating and maintaining good conditions for species conservation and biodiversity in our plants and their surroundings. Protecting biodiversity is one of our environmental targets.

The aspect of biodiversity was also inspected by governmental authorities as part of authorization procedures with environmental compatibility tests. If any impacts on biodiversity were expected, we implemented the required compensating measures. Furthermore, we conserve the habitats of animals and plants in the areas surrounding our sites with our extensive water treatment, air emission reduction, and waste treatment methods.

Wherever possible, we maintain or expand green areas on the grounds of every plant: for instance, we take part in the Hamburg initiative UnternehmensNatur to promote biodiversity at our site there. Due to long-time industrial use, however, there can be soil contamination typical for industrial areas, which we work to prevent from mobilizing and spreading. We commissioned a new sewer line at the Olen site to protect the nature conservation area Olen

Fig. 1.14: Conservation areas in close proximity (copper production sites) GRI 304-1

	Name	Distance	Direction
<b>Hamburg</b>	Hamburger Untereibe	200–600 m	Southeast
	Holzhafen	600 – 1,000 m	East
	Heuckenlock/Schweenssand	3,600 m	South
<b>Pirdop</b>	Tsentralen Balkan – bufer (nature conservation area)	approx. 1,000 m	North
	Tsentralen Balkan – bufer (bird conservation area)	approx. 1,700 m approx. 2,300 m	North East
	Sredna gora	approx. 2,300 m	South
<b>Lünen</b>	In den Kaempen, Im Mersche, and Langerner Hufeisen	< 2,000 m	Northeast
	Lippeaue	< 5,000 m	Northwest
	Lippe-Unna, Hamm, Soest, Warendorf	< 2,500 m	Northwest
<b>Olen</b>	Valleigebied van de Kleine Nete met haar brongebieden, moerassen en heiden	approx. 1,000 m	North
	De Vallei van de Kleine Nete Benedenstroom	approx. 1,000 m	North
	Het Olensbroek-Langendonk	approx. 1,000 m	North

Broek in late 2015. When we have to expand the usable area on any plant premises, we choose areas that naturally have limited biodiversity.

Additional measures are currently being devised to protect and reinforce biodiversity. For example, we are planning to ecologically restore a fayalite landfill that was closed at the Pirdop site in late 2018. After we receive the construction permit, we expect to finish the restoration efforts by the end of 2020. At the Hamburg site, a pilot project to set up a green facade was implemented to promote biodiversity and improve the ambient air.

#### A comparison – Life cycle assessment for Aurubis copper cathodes

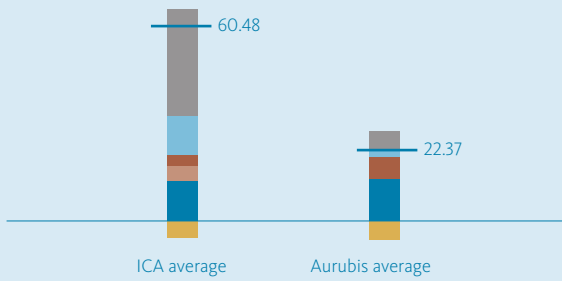
To evaluate our environmental protection performance, we carried out a life cycle assessment for our main product, the copper cathode. When observing the entire life cycle up to the finished cathode, Aurubis production has lower impacts than the global average in all of the environmental categories considered.\* A key reason for this lies in the modern plant technologies at Aurubis, which enable particularly environmentally sound production. Moreover, the high input of recycling materials and the nearly complete conversion of raw materials into marketable products at Aurubis also help make environmental impacts lower than the global average.

The following diagrams show the industry's average results of the life cycle impacts for copper cathode production (ICA, left bar) and the Aurubis average (right bar).

Fig. 1.15: Life cycle assessment for the copper cathode

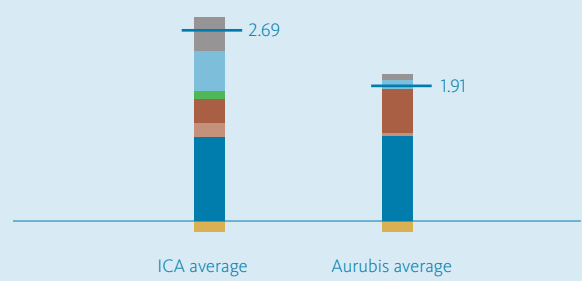
### Acidification potential (AP)

kg SO<sub>2</sub> eq.



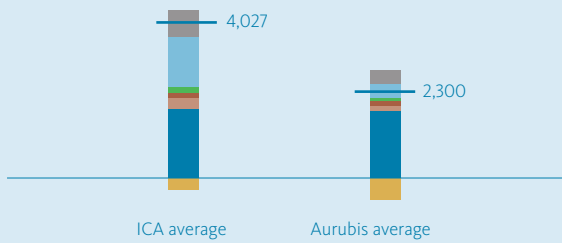
### Eutrophication potential (EP)

kg phosphate eq.



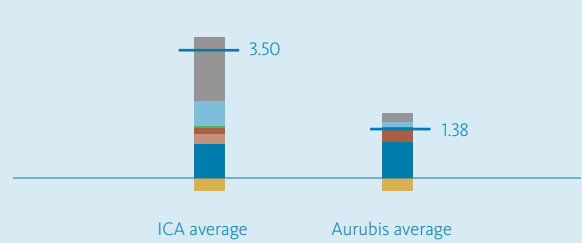
### Global warming potential (GWP)

kg CO<sub>2</sub> eq.



### Photochemical ozone creation potential (POCP)

kg ethene eq.

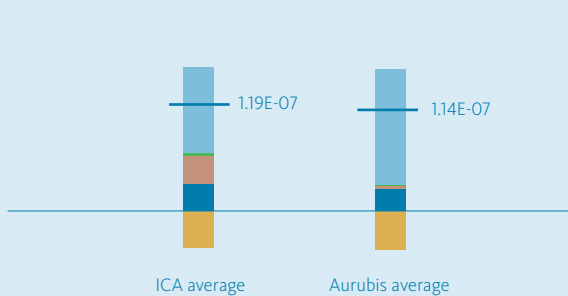


- Direct emissions
- Electricity
- Upstream energy
- Transport
- Auxiliary materials
- Concentrate
- Credit
- Total

\* Source: ICA – International Copper Association: Copper Environmental Profile, Sept. 2017

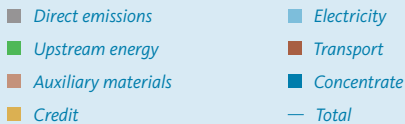
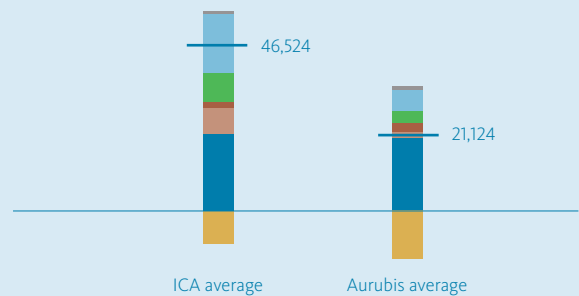
## Ozone layer depletion potential (ODP)

kg R11-e



## Primary energy demand (non-renewable sources)

MJ



\* Source: ICA – International Copper Association: Copper Environmental Profile, Sept. 2017

The system boundary of the ICA study comprised a cradle-to-gate life cycle inventory of the recovery of copper ore in the mine to the production of the primary and secondary copper cathode. The ICA study was carried out in compliance with the ISO 14040 (Environmental management - Life cycle assessment - Principles and framework) and ISO 14044 (Environmental management - Life cycle assessment - Requirements and guidelines) eco-balance standards and was then subjected to a critical review by a committee of experts.

The data collected included representative annual data for the year 2013 for all technological routes in the copper production process. The background data was representative for the years 2010-2013. The ICA is currently

working on an update and Aurubis is once again providing active support. Copper is produced in a pyrometallurgical method at the Aurubis sites in Hamburg, Pirdop, Lünen, and Olen.

Estimates of potential environmental impacts are separated into five main impact categories and energy demand. These impact categories were selected because they represent a broad spectrum of environmental impacts and are each determined by an established scientific approach. For characterization purposes, the LCIA method from the Centre for Environmental Studies (CML) at the University of Leiden in the Netherlands was used due to its wide acceptance in the global LCA community.

# At a Glance – Environmental KPIs for the Aurubis Group<sup>1</sup>

	Unit	2015	2016	2017	2018	2019
<b>Emissions to air</b>						
Dust	t	90	93	101	110	99
NO <sub>x</sub>	t	868	870	809	846	769
SO <sub>2</sub>	t	4,986	4,648	5,145	4,859	4,154
<b>Water consumption</b>						
<b>Total water withdrawal</b>	<b>million m<sup>3</sup></b>	<b>81.0</b>	<b>77.7</b>	<b>82.6</b>	<b>80.5</b>	<b>71.0</b>
<b>Water withdrawal by source</b>						
Surface water	million m <sup>3</sup>	77.2	74.1	79.0	76.6	67.7
Rainwater	million m <sup>3</sup>	0.4	0.4	0.4	0.4	0.3
Groundwater	million m <sup>3</sup>	0.6	0.6	0.5	0.6	0.5
Municipal water	million m <sup>3</sup>	2.5	2.3	2.1	2.6	2.1
Other	million m <sup>3</sup>	0.2	0.4	0.5	0.3	0.3
<b>Total water discharge</b>	<b>million m<sup>3</sup></b>		<b>72.9</b>	<b>77.1</b>	<b>77.0</b>	<b>66.1</b>
<b>Water discharge by destination</b>						
Surface water	million m <sup>3</sup>		71.5	75.8	75.6	64.7
Municipal wastewater system	million m <sup>3</sup>		1.4	1.3	1.4	1.3
Wastewater to third parties	million m <sup>3</sup>		<0.1	<0.1	<0.1	<0.1
<b>Waste</b>						
<b>Hazardous waste<sup>2</sup></b>	<b>t</b>		<b>41,423</b>	<b>51,799</b>	<b>48,886</b>	<b>48,634</b>
Landfilling	t		27,430	34,417	34,032	36,429
Disposal (thermal)	t		197	139	81	112
Thermal utilization	t		365	452	447	391
Recycling	t		9,220	13,063	10,457	8,717
Storage	t		3,722	1,264	1,846	1,682
Internal utilization/recycling	t		487	2,464	24	1,303
<b>Non-hazardous waste</b>	<b>t</b>		<b>44,494</b>	<b>45,350</b>	<b>42,966</b>	<b>46,992</b>
Landfilling	t		1,991	1,899	2,134	1,739
Disposal (thermal)	t		197	139	428	542
Thermal utilization	t		499	446	472	590
Recycling	t		33,916	35,768	32,947	38,494
Storage	t		1,265	184	128	89
Internal utilization/recycling	t		6,626	6,914	6,857	5,537
<b>Construction waste</b>	<b>t</b>		<b>51,029</b>	<b>38,826</b>	<b>46,558</b>	<b>123,348</b>
<b>Energy &amp; CO<sub>2</sub></b>						
Primary energy consumption <sup>3</sup>	million MWh		1.72	1.66	1.75	1.69
Secondary energy consumption <sup>4</sup>	million MWh		1.73	1.88	1.77	1.78
<b>Total energy consumption</b>	<b>million MWh</b>		<b>3.45</b>	<b>3.54</b>	<b>3.51</b>	<b>3.47</b>
Direct CO <sub>2</sub> emissions <sup>5</sup>	kt CO <sub>2</sub>		508	517	522	503

<sup>1</sup> These KPIs include all production sites that are majority-owned by Aurubis (>50 %), excluding Metallo

<sup>2</sup> Deviations from the Environmental Statement 2019 are the result of a recount of one waste stream

<sup>3</sup> Energy consumption for on-site vehicle traffic included

<sup>4</sup> Electricity for oxygen generation included

<sup>5</sup> In line with the emission trading system excluding CO<sub>2</sub> emissions from vehicles



# Consolidated Aurubis AG Environmental Statement 2020

## Hamburg Site





### The Hamburg plant

The largest Aurubis AG production site and the Group headquarters is located on the Elbe island Peute, only about four kilometers, as the crow flies, from Hamburg's city hall. At the Hamburg plant, Aurubis operates facilities to produce copper and other non-ferrous metals as well as to process copper.

The plant was constructed in 1908 on an area of about 870,000 m<sup>2</sup> in Peute, an industrial inland harbor area in the Veddel district. Following reconstruction after World War II, the production facilities were continuously expanded and steadily modernized. Today, Aurubis AG's Hamburg site is one of the world's most state-of-the-art primary and secondary copper smelters and has an authorized production capacity of 450,000 t of copper cathodes each

year. A total of 2,550 personnel are employed at the Hamburg site, including around 170 apprentices (as of March 2020).

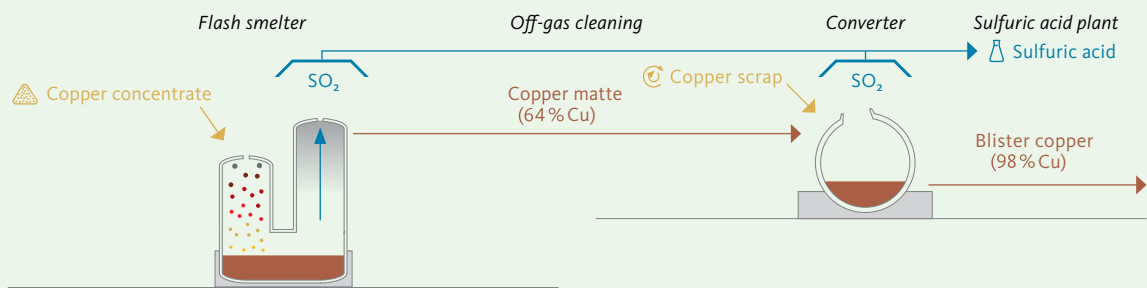
The individual production sectors at Aurubis AG in Hamburg are divided into three plant areas (see Fig. 2.1): Plant North (RWN) is mainly comprised of the administrative building, the workshops, the secondary copper smelter, and precious metal production. Plant South includes the sludge decomposition plant, the cracking acid cleaning facility, the wastewater treatment facility, the concentrate delivery area, the chemical plants, and the casting lines in particular. Plant East includes the main primary copper production facilities: the primary smelter (RWO), the sulfuric acid production plants, and the tankhouse. This section also houses the rod plant.

Fig. 2.1: The main Aurubis plant in Hamburg – a downtown copper smelter



1 Continuous casting plant 2 Secondary copper smelter/precious metals 3 Rod plant 4 Tankhouse 5 Primary smelter (RWO)

Fig. 2.2: From copper concentrate to cathode



### Processes at the Hamburg plant

The main raw materials for copper production are copper concentrates (processed copper ores) and recycling materials (including electrical and electronic scrap).

In the primary copper smelter, copper anodes (with a copper content of about 99%) are produced from the primary raw material, copper concentrates, in multi-step pyrometallurgical processes. The metals in recycling materials can be drawn out in each step of the existing processes. The sulfur in the primary and secondary raw materials is oxidized into sulfur dioxide and converted in the downstream double absorption contact acid plant into sulfuric acid and oleum, two marketable products that are primarily used in the fertilizer and chemical industries.

Copper cathodes with a copper content of over 99.99% are produced from the copper anodes in the copper tankhouse using electrochemical methods. The cathodes are used to manufacture copper intermediates (continuous cast rod, copper shapes, and copper powder) (see Fig. 2.2). The cathodes can be traded on the global metal exchanges.

Intermediates primarily produced in copper refining, such as flue dusts and slimes, are further treated in an electrothermal process in the secondary smelter's electric furnace.

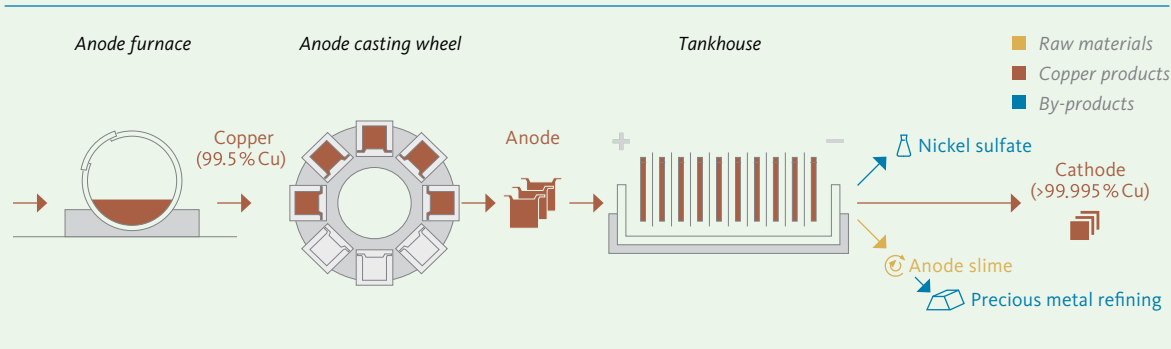
Minor metals such as zinc, nickel, antimony, selenium, and tellurium are collected and enriched in a targeted way in the matrix metals copper and lead. In the subsequent pyro- and hydrometallurgical processes of multi-metal recovery, these elements are brought out in metallic form or as metal compounds.

Internal intermediates and purchased recycling materials rich in precious metals are processed to extract precious metals. In the process, primarily internal and external anode slimes from the copper tankhouse, as well as skimmings rich in precious metals and bullion containing sulfur, are used as input in the top blown rotary converter.

In the precious metal smelter, precious metals (silver, gold, platinum group metals) are separated using hydrometallurgical procedures and then extracted as commercial products.

Aurubis is currently planning the Group's medium-term development with "Vision 2025." Apart from the main metal, copper, additional metals will be recovered in larger quantities in the future.

As part of the modernization of process technology and infrastructure, extensive measures will be carried out to reduce fugitive emissions and the level of separation will be improved in the case of collected sources. The improvements will be implemented in different areas of Plant North, the primary smelter (RWO), sampling, and precious metal production. The total dust emissions at the Hamburg site will be significantly reduced.



### Environmental protection organization at the Hamburg site

As the operator of facilities requiring a permit in accordance with Section 52a of the Federal Immission Protection Law and Section 53 of the Recycling Management Law, the Aurubis AG Executive Board or an appointed member of the Executive Board is responsible for compliance with environmental protection and radiation protection regulations.

All environmental protection issues are coordinated, organized, and monitored in the Hamburg Environmental Protection Department to support the different business sectors. The department also serves as a contact for industrial environmental protection.

In order to fulfill corporate duties, the company management has appointed officers or specified individuals responsible for the following issues, who work closely with the Environmental Protection Department (see Fig. 2.3).

Fig. 2.3: Plant officers at the Hamburg site



### The integrated management system (IMS) for the environment, quality, and energy

In 2017, the three separate management systems for the environment, energy, and quality were combined into an integrated management system (IMS) and jointly certified.

Aurubis has had an environmental management system at the Hamburg site since 2002, which is certified in accordance with ISO 14001 and EMAS.

The energy management system at the Hamburg site was implemented in 2005. It had been reviewed within the scope of environmental management until 2013. Because of the increasing significance of certified management systems and the energy policy conditions, it was certified in accordance with ISO 50001 for the first time in May 2013. The switch to the revised 2018 standard took place in 2019, accompanied by internal workshops and coordinated dialogue about experiences within the Aurubis Group.

Quality management in accordance with ISO 9001 has been established in Hamburg since 1996 for the following sub-areas: tankhouse, continuous casting plant, wire rod plant, contact acid plant (sulfuric acid production), lead plant, analytical laboratories, and sampling. In 2017 the primary smelter (RWO) was also certified in accordance with the norm's specifications, as was the precious metal smelter in 2018.

### Targets and tasks of the environmental management system

Within the scope of the environmental management system, targets and measures are defined and their implementation is monitored. The environmental management processes include the documentation of operational processes, external environmental inspections, internal audits, routine recordings, and site inspections. Situational evaluations form the basis for decisions about the type, extent, suitability, and execution of environmental protection measures.

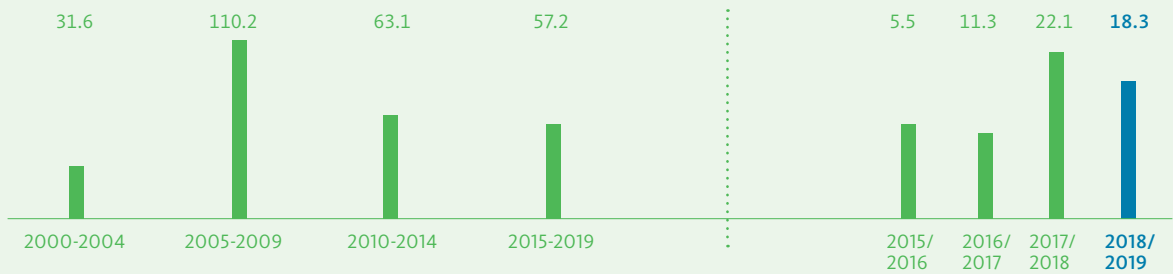
An employee of the Environmental Protection Department at the Hamburg site holds the position of Environmental Management Officer. This individual ensures that the requirements for the environmental management system conform to the ISO 14001 and EMAS standards. The Hamburg Environmental Protection Department tracks changes in legal requirements, reviews their effects on the different areas of our company, and ensures that our facilities are operated in conformity with the law. To make sure that operations comply with the law, the Environmental Protection Hamburg Department regularly organizes internal training sessions for department heads and employees to explain current environmental law issues, such as pending amendments to laws and their consequences. Because of the high complexity of the legal standards and requirements that have to be applied, the existing legal register has been supplemented by an IT-supported derivation of legal obligations that also cover technical inspections of facilities and buildings. The new system can be used to generate facility-specific action recommendations, designate responsibility to individuals, and track implementation.

Our environmental management system ensures that the applicable legal requirements are fulfilled with respect to environmental protection. Furthermore, it supports the continuous improvement of our environmental protection efforts with economically reasonable product and process design that takes the environment and occupational safety into account. Saving energy is also part of environmental protection for us.

The systems and organization of the IMS are described extensively and understandably in two handbooks available to employees. The general IMS handbook governs procedures that apply to the Aurubis AG sites, Hamburg and Lünen. The integrated management system handbook for the Hamburg plant describes the site-specific procedures. The environmental management system EMAS also helps

**Fig. 2.4: High level of capital expenditure for environmental protection measures since 2000**

Capital expenditure for environmental protection measures at the Hamburg site in € million



in the implementation of the Aurubis Group sustainability targets, which were newly defined in 2018, at the Hamburg site (see [www.aurubis.com/sustainabilitystrategy](http://www.aurubis.com/sustainabilitystrategy)).

The Hamburg Environmental Protection Department provides employees with training and information related to environmental protection.

### Monitoring and internal auditing of environmental management

The effectiveness of the integrated management system is reviewed with internal audits pursuant to EMAS regulations, ISO 14001, and ISO 50001. ISO 9001 is audited in sub-areas of the plant. The approach for the internal audits is defined in specific process instructions. Internal and external audits take place regularly in compliance with the requirements of the standards.

Within the scope of internal audits of the various plant sectors, the fulfillment of legal obligations and collateral clauses from permits is reviewed and confirmed, among other things. Furthermore, the audits ensure that inspection and maintenance requirements are followed.

The external audit involves verifying the description of operating processes and reviewing the environmental data provided.

The plant manager of Aurubis AG, Hamburg, evaluates the fulfillment of the handbook requirements and the current management standards, as well as the validity of business policy, at least once a year in the management review.

The status of follow-up measures from the last management reviews, goals and key figures, changes involving the management system, information about the performance and effectiveness of the management system, summaries of the results of internal audits, the status of preventive

and corrective measures, risk assessments, and information about resources and potential improvements form the basis of the management review.

### Environmental aspects and performance

Following fundamental investments in filtering technologies in the 1980s and 1990s, an additional € 283 million has been invested in environmental protection in the Hamburg plant since 2000. With total capital expenditure of more than € 1 billion, environmental measures account for 30 % of overall capital expenditure on average. Among other things, dust emissions have been reduced by about 33 % with these investments. This makes a significant contribution to improving air pollution control in the environment. Investments are being made in the areas of water and noise as well (see Fig. 2.4).

The facilities at Aurubis Hamburg are operated in line with the current state of the art. The state of the art was updated and the new BAT conclusions were published in 2016. They have to be implemented by 2020. Most of the new requirements are already being observed or exceeded today.

When compared worldwide, Aurubis Hamburg holds a top position in environmental protection. Additional improvements require higher and higher capital expenditure for the same level of reduction and the development of modern technologies. The objective of plant management is to continue improving the plant's environmental performance and the expansion of its top position in environmental protection. Consequently, corresponding environmental protection projects were planned and initiated in 2019 as well.

It also has to be considered that operating new environmental protection equipment is always connected with relevant operating costs and energy costs.

## Air – Emissions

It is crucial for Aurubis to develop innovative technologies for air pollution control and to enter new technical territory in the process. Almost 80 % of the remaining metal emissions from the Hamburg production site come from fugitive sources, the majority of which stem from hall ventilation facilities.

The permanent 9 t/year reduction that was agreed upon in the sixth emission reduction agreement between the city of Hamburg and Aurubis in 2011 was also confirmed with the 2019 emissions declaration after the associated measures were implemented. The Hamburg site emissions were reduced further in 2019.

The draft of an additional seventh public agreement with the city of Hamburg that establishes further steps to reduce dust emissions is still being discussed. A decision about the follow-up agreement should be made in 2020. Additional investments in air pollution control were made in both primary and secondary copper production in 2019.

In 2017, the 5S methodology<sup>1</sup> was introduced at the entire Hamburg plant. 5S serves as an instrument to keep workplaces and their environment safe, clean, and well organized, with the goal of optimizing operating procedures and promoting safe, low-emission work. In 2019, the implementation in all production and service areas was further intensified and expanded.

All of the information in this chapter is based on the current Emissions Report, which is issued annually by the immission protection officer. The values outlined on the following pages are made up of a number of individual recordings. Directed emissions are mostly recorded as classified values from continuous measurements taken with a system provided by Durag data systems GmbH.

Fugitive emissions from hall ventilation facilities, etc. are determined on a representative basis in recording campaigns carried out by both external recording institutes and the company's own Environmental Monitoring Department and are used to calculate the annual loads. Fugitive emissions due to transshipments in storage areas, etc. are calculated using the corresponding emission factors from the technical literature and from measurements.

Specific dust emissions have been reduced by 83 % since 1990 and by 32 % since 2000 (see Fig. 2.5).

Copper is the main metallic substance in the dust at the Hamburg production site. Specific copper emissions have been reduced by 78 % since 1990 and by 25 % since 2000. This low level was maintained, as the changes compared to the previous year were in the expected range (see Fig. 2.6).

Specific lead emissions have been reduced by 91 % compared to 1990 and by 47 % since 2000. They therefore continue to be at a low level. The fluctuations observed are due to the use of various concentrates (see Fig. 2.7).

Arsenic is a natural component of copper concentrates. Specific arsenic emissions have been reduced by 91 % since 1990 and by 46 % since 2000 in various steps of the copper refining process and have been at a low level in the last several years (see Fig. 2.8).

<sup>1</sup>5S is the designation for the five steps of this method: sort, set in order, shine, standardize, sustain

Fig. 2.5: Dust emissions at the Hamburg site

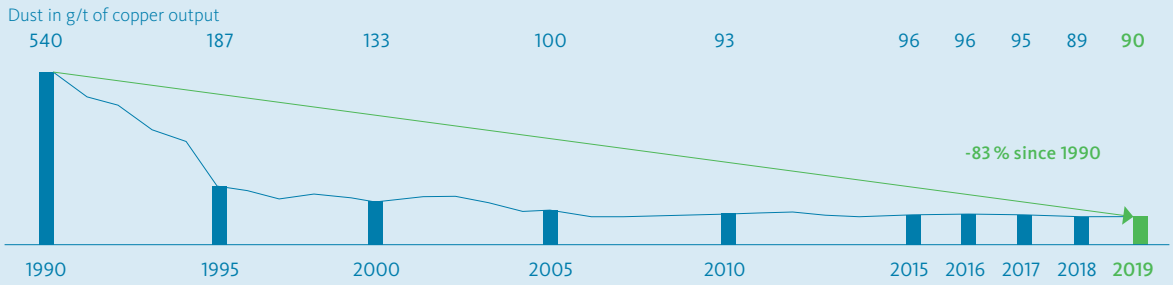


Fig. 2.6: Copper emissions at the Hamburg site

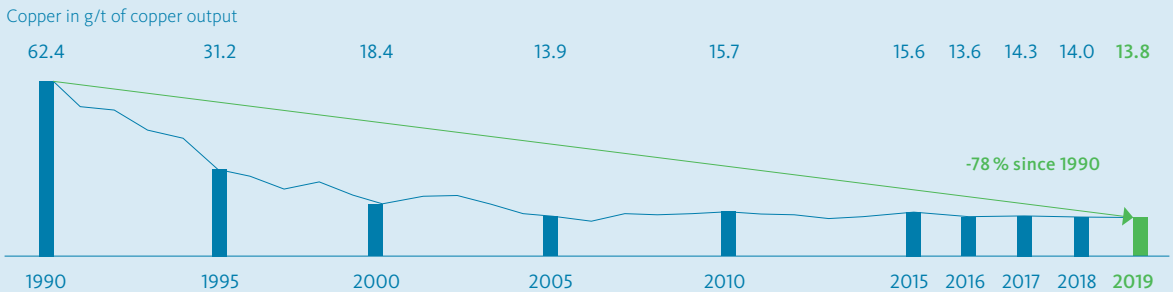


Fig. 2.7: Lead emissions at the Hamburg site

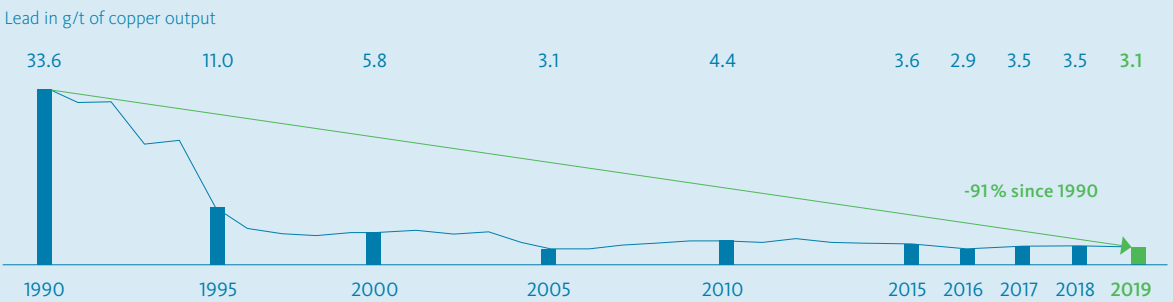


Fig. 2.8: Arsenic emissions at the Hamburg site

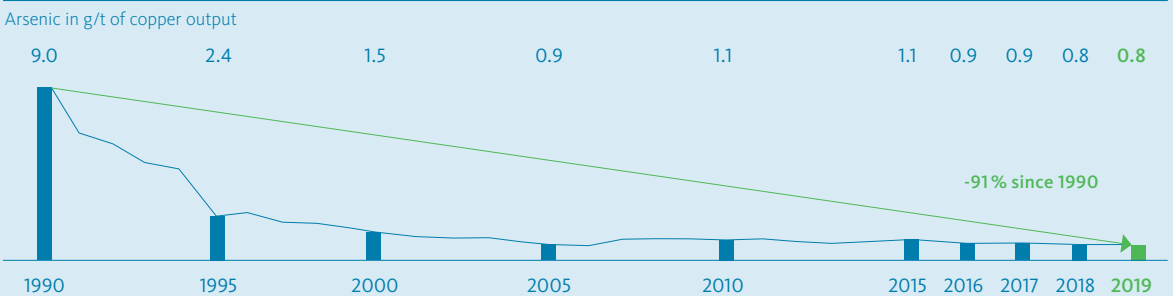
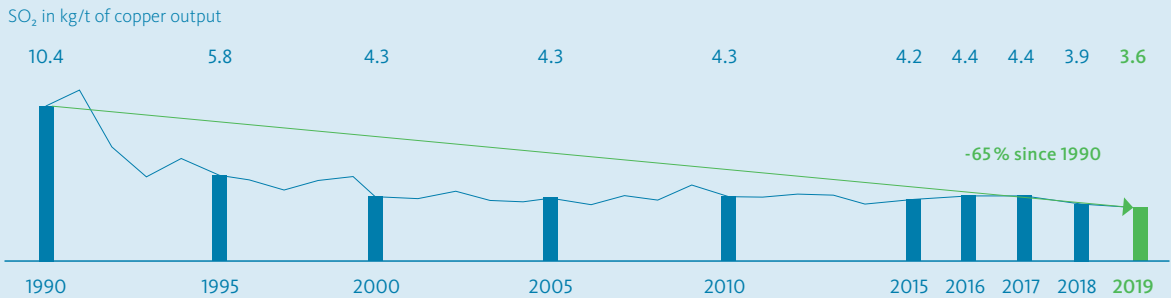




Fig. 2.9: SO<sub>2</sub> emissions at the Hamburg site



Apart from copper, sulfur is one of the main components of copper concentrates. The gaseous sulfur dioxide produced when ore is smelted is converted into sulfuric acid in the sulfuric acid plant using the modern double catalysis process. The sulfuric acid is mainly used in the chemical industry. Specific sulfur dioxide emissions have been reduced by 65% since 1990 and by 17% since 2000 and tend to vary at a low level (see Fig. 2.9).

The Aurubis Hamburg site continues to be a forerunner in reducing specific sulfur dioxide emissions (see Fig. 2.9).

Aurubis adhered to and fell significantly below the emission limits established in the Technical Instructions on Air Quality Control (TA Luft) and in the relevant permits for sources of collected and fugitive emissions in 2019. The relevant limit values of the TA Luft are featured in chapters 5.2.2, 5.2.4, 5.2.5, 5.2.7, and 5.4.3.3.1 in particular.

### Air – Immissions

Projects to reduce fugitive emissions have high priority. The success of measures to reduce fugitive emissions is illustrated by the fact that the suspended particulate recordings taken by the Hamburg environmental authority have been kept at a low level. The Veddel measuring station of the Hamburg Air Quality Measurement Network is relevant for the official air quality recordings. It is located in the adjacent neighborhood, about 500 m west of the plant premises.

Due to extensive investments in emission reduction, the immission situation has improved continuously since the 1990s. Limit values for air pollutants in the ambient air haven't been exceeded in the area surrounding Aurubis for many years.

After the target level for arsenic (a yearly average of 6 ng/m<sup>3</sup>) was slightly exceeded at the Veddel measuring station in 2018 for the first time in 12 years, the value measured for arsenic was well below the target level again in 2019.

On January 15, 2019, employees of a neighboring company complained about poor air quality north of the street Muggenburger Hauptdeich, stating that this air came from the Aurubis Hamburg plant premises. The Plant Fire Department brought two of these employees to the company Medical Department for a check-up. The check-up did not result in any indications of health impacts. No causes of a possible gas leak were determined.

Fig. 2.10: Plant premises at the Hamburg site

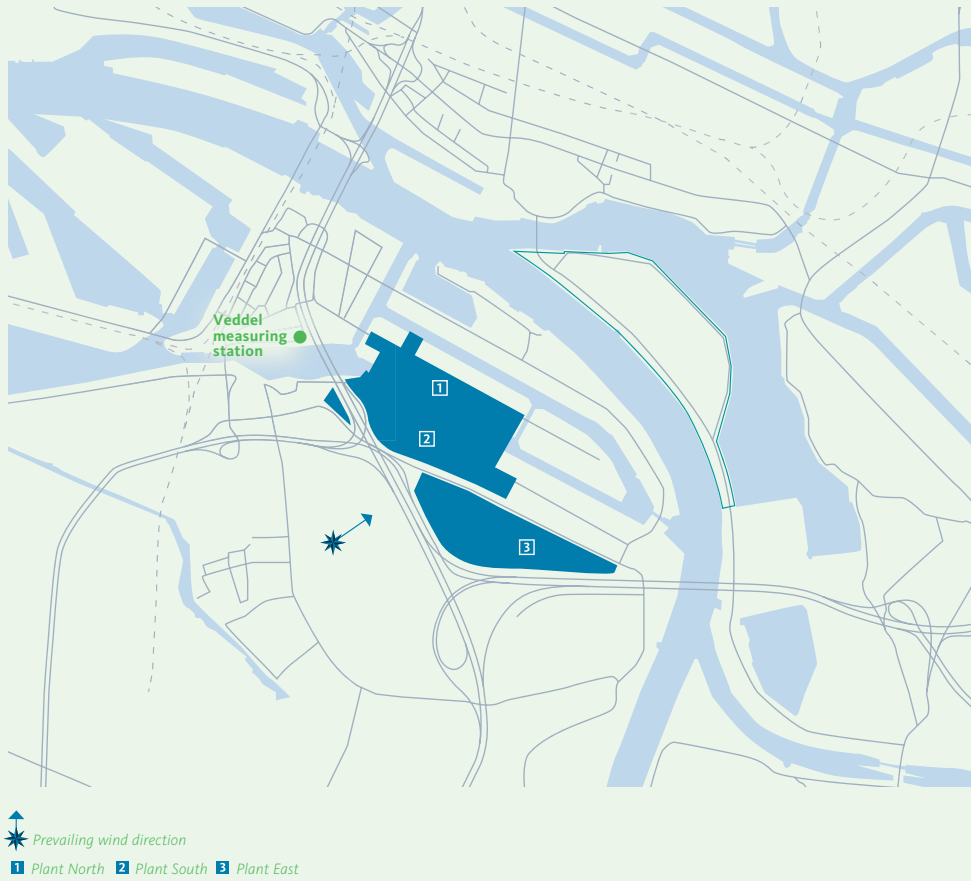


Fig. 2.11: Low immission values (arsenic) at the Veddel measuring station<sup>1</sup>

Arsenic load at Veddel measuring station in ng/m<sup>3</sup>

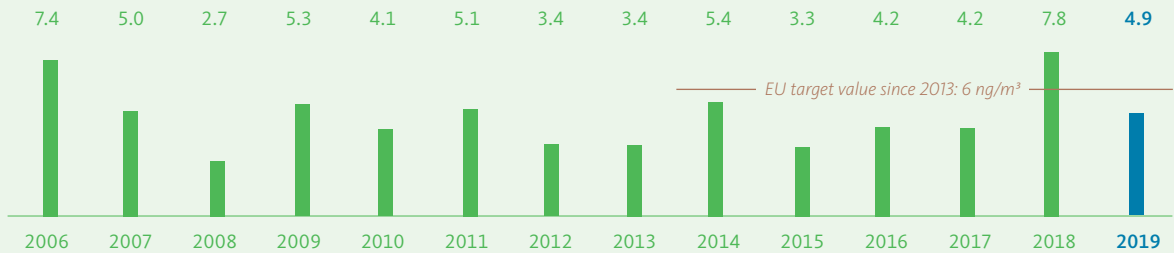
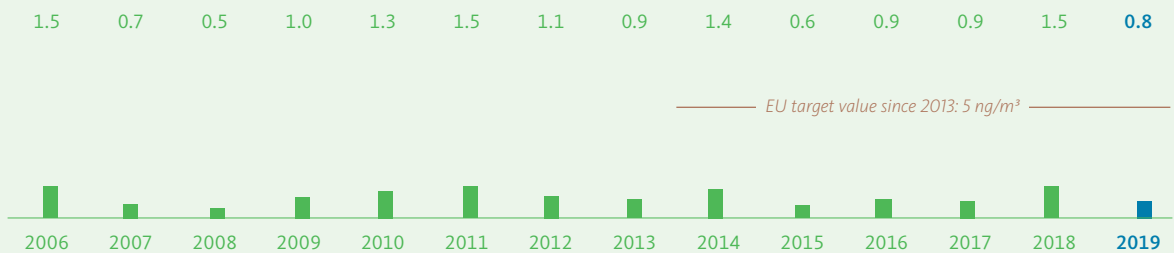


Fig. 2.12: Low immission values (cadmium) at the Veddel measuring station<sup>1</sup>

Cadmium load at Veddel measuring station in ng/m<sup>3</sup>



<sup>1</sup> Data published by the State Ministry for the Environment, Climate, Energy, and Agriculture  
1 gram (g) = 1 billion nanograms (ng)

## Water

The wastewater from Aurubis AG's entire Hamburg plant is composed of precipitation, indirect and direct cooling water, condensate, process wastewater, and desludging water. All of the plant's precipitation is collected separately and cleaned in two separate processing facilities. Precipitation is reused in some cases, for instance as cooling water. Sanitary wastewater is discharged into the city sewer system.

## Direct discharge

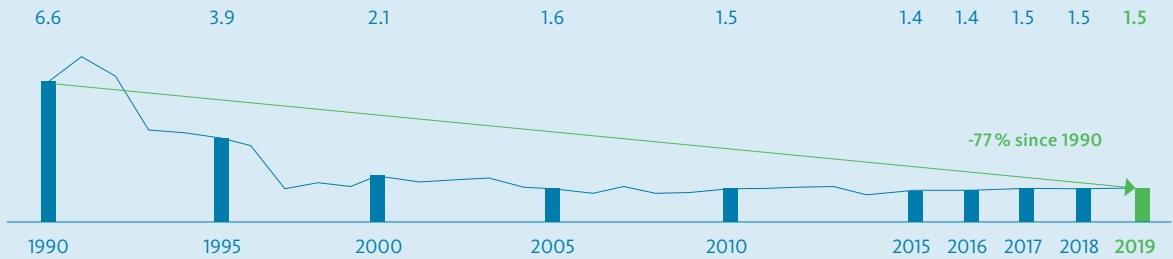
In the plant's internal wastewater treatment facility, process wastewater and precipitation are cleaned using state-of-the-art technology. The Hamburg plant has water law permits for direct discharge into the Elbe River and observes their requirements. Compliance with these requirements is closely monitored both as part of the internal company audits and through the audits performed by the governmental authorities.

At 1.5 g/t of copper products, the metal loads connected to direct discharge, which are related to production volumes, were once again at a low level in 2019. Since 2000, this KPI has decreased by nearly 30 % due to investments and process improvements and, in the meantime, is close to the technically feasible minimum. The figure has been below the stricter requirements of the BAT (best available techniques) conclusions for many years already. In the last several years, there has thus been only a marginal downward trend despite further optimization measures.

The proportion of heavy metals discharged by Aurubis in the Elbe's total load is currently less than 0.1%.

Fig. 2.13: Metal emissions in water at the Hamburg site since 1990

Metal emissions in g/t of copper output



### Indirect discharge and potable water

The declining long-term trend for the discharged wastewater load continued for indirect discharge in the city sewer system, partly due to the building cleaning process, which results in little wastewater, as well as the centralization and modernization of sanitary installations. Compared to the year 2000, the wastewater volume entering the city sewer system decreased by over 20 %, while the metal loads even fell by about 70 %.

Accounting for 85 %, most of the wastewater is used in production and for measures to reduce dust (sprinklers, misters, cleaning streets and open areas with a sweeper). A total of 15 % is used in kitchens and sanitary installations and are discharged indirectly after use.

The consumption of potable water has declined by over 40 % since 2000. Potable water hasn't been used to produce steam since 2002. A comparable substitution with process water from cooling water withdrawal is also planned for the operation of the sweepers in 2020.

### Cooling water

In 2019, the cooling water volume discharged into the Elbe River decreased by over 10 million m<sup>3</sup> as a result of the industrial heat project that was commissioned in late 2018.

As in the previous year, over 60 % of the precipitation was used as cooling water prior to discharge.

The 42nd German Federal Immission Protection Ordinance on the safe operation of evaporative cooling facilities to prevent the spread of legionella went into effect on August 19, 2017. In 2019, the legally required external hygiene audit in accordance with VDI Guideline 2047 Part 2 was successfully carried out.



Expert inspection of the evaporation coolers

### Facilities Handling Substances Hazardous to Water

At the Hamburg plant, Aurubis operates about 300 installations to handle substances hazardous to water that fall under the scope of the Ordinance on Equipment Handling Substances Hazardous to Water. During the technical audits carried out in 2019, the TÜV once again didn't find any safety-relevant deficiencies whatsoever.

The TÜV recertified the Aurubis Hamburg plant as a specialist company under the Water Management Act in 2019.

### Soil and groundwater

There are soil impurities typical for industrial areas at the Hamburg plant owing to many years of industrial use. The heavy metal pollution values are so low that no clean-up is required from the authorities' view. The plant premises are mostly paved so that soil impurities cannot mobilize.

Furthermore, the groundwater is protected from soil impurities by a water-resistant layer of clay. A sheet pile wall has also been erected in the primary smelter that effectively prevents backwater from flowing beyond the plant premises. This protective measure is regularly inspected to ensure that it is working properly through advisory backwater monitoring.

To prevent negative changes in the soil and groundwater, Aurubis operates systematic soil and groundwater monitoring, which is also a component of the valid report on the initial condition that was issued on May 4, 2018 for the entire plant premises.



Adding greenery to vertical surfaces of an office and production building in the plant

### Noise

Aurubis constructs and operates its production facilities in accordance with the current noise reduction technology. The noise register developed for the Hamburg site lists all of the relevant noise sources. The local environmental authority has defined noise immission limits for 20 immission areas surrounding the site. These requirements are established in the permits. The impact on the noise situation in the neighborhood is evaluated for all facility modifications and, if necessary, measures are derived and implemented. Aurubis is planning to update the noise register in the scope of an upcoming project.

There were no noise complaints in 2019. In the continuous casting plant area, additional noise reduction measures were implemented on the combustion air compressors and the compressor air production equipment.

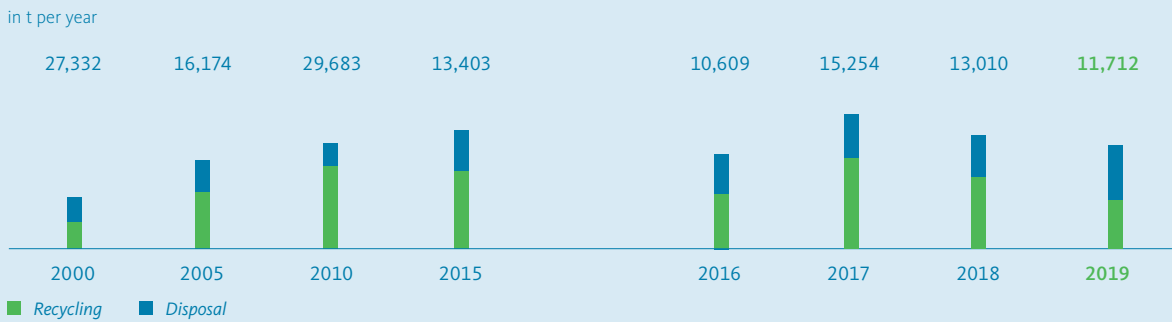
### Biodiversity

As an industrial site, Aurubis would like to promote biodiversity. We want to leave unpaved areas close to their natural state whenever this is feasible, carrying out the minimum amount of maintenance required. By participating in the project UnternehmensNatur supported by NABU, the Hamburg environmental authority, and the Hamburg Chamber of Commerce, we utilize an idea network for useful contributions to promoting biodiversity.

We plan to maintain the number of trees we currently have for the long term. The plant has its own tree registry. Wherever possible, new plants and greenery are integrated into project planning.

We prioritize native plant species when we plant new greenery. Because of the limited amount of space available, we will grow upwards in the future. We want to spruce up suitable building facades with vertical gardens,

Fig. 2.14: Disposal methods for waste produced at the Hamburg site



improving their appearance and also creating new habitats for birds and insects. In 2019, native plants were planted on the outer facade of the lead refinery's production and office building as part of an initiative to provide greenery on vertical surfaces.

### Waste

A total of 121,323 t of waste were accepted and recycled at the Hamburg site in 2019, of which 8,811 t were classified as hazardous waste. A total of 3,976 t of this came from other countries and was registered.

Overall, 9.7 % of the waste accepted was used as a slag former (e.g., spent abrasives, sand, and excavation residues), and 90.3 % was used for metal recovery (dust, slimes, slags, and precious metal-bearing sweeps). At about 109,578 t, the use of metal-bearing secondary raw materials decreased slightly compared to the previous year. This was due in particular to the 40-day maintenance shutdown at the site's main facilities in the fall.

In the 2019 calendar year, about 1.4 million t of input materials were processed at the Hamburg site. During processing, 11,712 t of production-related waste accumulated, which was disposed of in an environmentally sound manner (see Fig. 2.14). The conversion of raw materials into products thus remained at a high level. Of the entire volume, 5,319 t was directed to recycling and 6,393 t to external disposal. This corresponds to a recycling rate of 45 %.

Most of the waste that is disposed of is slimes from off-gas cleaning, as well as washing fluid and emulsions.

With an output of 440,896 t of copper output for the year, the specific waste level is 26.56 kg per ton of product (2018: 27.48 kg/t).

A total of 36,164 t of olivine pyroxene rock from the secondary smelter (RWN) and 25,474 t of slag material from the primary smelter (RWO) couldn't be marketed as a substitute construction material product and were taken to landfills. In the process, large pieces were recycled for use as landfill construction material.

Due to various construction activities to modernize the site, 109,513 t of construction waste accumulated during the past year.

### Energy and climate protection

We act responsibly towards future generations by economically using raw materials and energy. Our main energy sources are electricity and natural gas. Aurubis AG consumed a total of 1,171 GWh of energy at the Hamburg site in 2019. With an annual copper output of 440,896 t, this amounts to specific energy consumption of approximately 2.66 MWh/t of copper output. This is slightly higher than in previous years. This includes the electricity used to produce the oxygen necessary for the processes.

Furthermore, landfill gas was used in the production processes instead of natural gas (2019: 2.4 GWh). Aurubis thus uses 100 % of the landfill gas collected in the former Georgswerder landfill.

Specific energy consumption has stagnated at the Hamburg site in the past several years despite the energy efficiency measures that have been implemented. An important reason for this is the higher level of multi-metal recycling in the meantime and the commissioning of new facilities, such as the ridge turret suction system in the secondary smelter.

Fig. 2.15a: Energy consumption at the Hamburg site

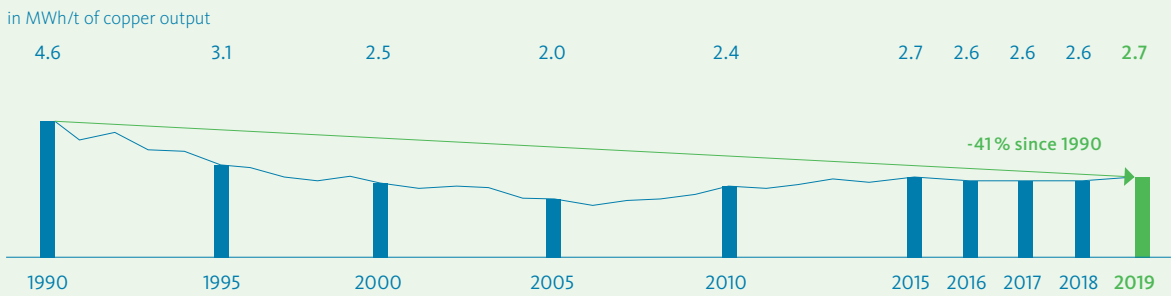
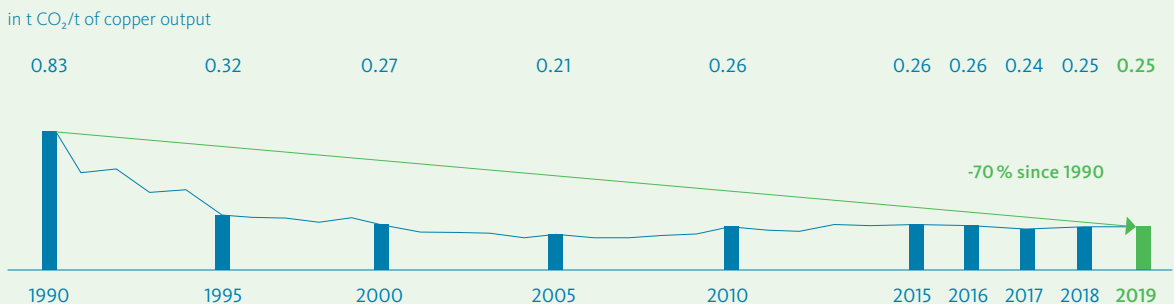


Fig. 2.15b: CO<sub>2</sub> emissions from fuels at the Hamburg site



Taking a longer-term view, specific energy consumption has been significantly reduced at the Hamburg production site in the last few decades, falling by 44% compared to 1990. It has even been possible to reduce fuel-related specific CO<sub>2</sub> output by 70% since 1990. The reason for this is the strongly reduced use of particularly CO<sub>2</sub>-intensive fuels, especially coal.

With an output of 440,896 t of copper output in the calendar year, specific CO<sub>2</sub> emissions from fuel amounted to 0.25 t CO<sub>2</sub>/t of product in 2019 (see Fig. 2.15a and 2.15b). This corresponds to 112,244 t of CO<sub>2</sub>.

When it comes to maintenance measures and new investments, engines and other energy-consuming equipment with as high an energy efficiency class as possible are used.

The calculation is based on CO<sub>2</sub> emission factors from the following sources:

- » for natural gas: GasCalc calculation program, version 2.3.2, distributed by e.on Ruhrgas AG
- » for all other fuels: German Emission Trading Office data, last reviewed in January 2020.

To enable the use of renewable energies, we are arranging a more flexible electricity feed-in to be able to react to fluctuating availability. In 2019, the first “power-to-steam” installation at the Hamburg plant was commissioned. This is an electrode steam boiler that can be hooked up to the grid in phases in which there is a surplus of renewable energy. In parallel, the existing steam boilers powered by natural gas are ramped down accordingly. This allows for a heat output of 10 MW created by fossil fuels to be substituted by the use of renewable energy at the site. This reduces the load on the energy grid at the same time.





## New "power-to-steam" facility in the Hamburg plant

The extraction of CO<sub>2</sub>-neutral industrial waste heat from line 1 of the acid plant to heat the HafenCity East neighborhood, which was commissioned on October 29, 2018, was successfully continued in 2019. In the meantime, additional residents along the pipeline are planning to connect their heating systems to it. Furthermore, the pipeline was extended toward the district Rothenburgsort north of Aurubis to make the 20 MW of CO<sub>2</sub>-neutral heat available to other neighborhoods.

The planning of implementation steps 2 and 3 for the use of the remaining potential for extracting CO<sub>2</sub>-neutral industrial heat is scheduled for 2020. Negotiations with the city's district heating grid operator have started. After completion, an additional 40 MW of heat can be used in the entire city of Hamburg. When all three stages are in operation, a total of about 140,000 t of CO<sub>2</sub> will be saved annually. This project is another important contribution to achieving the climate protection targets set in Hamburg and Europe.

### Waste heat use

Aurubis strives to use process waste heat to the greatest possible extent. It is used to heat buildings, to facilitate the production processes, and to generate electricity. In 2019, 74% of the steam needed was produced from waste heat and only about a quarter was produced from fossil fuels.

Copper production from ore concentrates begins in the primary smelter's flash smelter. Its exhaust gases have a temperature of 1,400° C and contain about 35% sulfur dioxide, which is processed into liquid sulfuric acid in a so-called contact acid plant.

The flash smelter's hot exhaust gases are initially cooled in a waste heat boiler, producing 60 bar steam.

Several steam turbines have been installed at the Hamburg site as an effective energy-saving measure. The 60 bar steam is first depressurized to 20 bar in the Interplant turbine, which was commissioned in 2014. The 20 bar steam serves as process steam for various procedures in the plant. The remaining steam volume is depressurized to 3 bar in the first stage of another steam turbine in the thermal power plant. This steam is then available as process and heating steam in the plant and administrative buildings. A total of 5.8 GWh of electricity was produced from waste heat in 2019, or approximately 1% of total electricity consumption (2018: 1%). The reason for the slight decline in electricity produced from waste heat was a longer maintenance shutdown in 2019, as well as the breakdown of a turbine.

On October 29, 2018, the supply system for providing the district HafenCity East with industrial heat from Aurubis was commissioned in an inauguration ceremony. With the implementation of this joint project, which is unique in Germany and is supported by the climate alliance of Aurubis and the energy service provider enercity, up to about 160 million kWh of heat per year can be transferred to consumers via pipeline. This is equivalent to the heat demand of about 8,000 four-person households. A total of 40 million kWh of this is used in Aurubis' production facilities. Aurubis and enercity each invested about € 21 million.

The heat is CO<sub>2</sub>-free. It is formed without the use of fossil fuels and is released as heat of reaction in sulfuric acid production. This forward-looking use of waste heat can save up to 20,000 t of CO<sub>2</sub> annually. The Elbe River benefits as well: recovering the heat saves about 12 million m<sup>3</sup> of cooling water per year.

The pipeline has already been dimensioned to accommodate the entire waste heat potential of sulfuric acid production and additional potential sources of waste heat. We could thus provide up to 60 MW or 500 million kWh of industrially generated, climate-neutral district heat to supply the city. The CO<sub>2</sub> savings potential would then amount to 140,000 t per year.

The heat shift is an important part of the energy shift. This is especially true for a metropolis like Hamburg, which has about 900,000 apartments. The energy needed for providing heating, warm water, and lighting to the city's buildings makes up 40% of the total energy demand and is therefore significantly higher than the energy demand in the transport and industry sectors. Today, the heat supply

in Hamburg is dominated by decentralized, gas-fueled heating systems and by a large central district heating network whose thermal output is based on conventional large-scale power plants and heat generation from coal, gas, and waste. The implementation of the project is therefore a central milestone on the path to more sustainability and better climate protection.

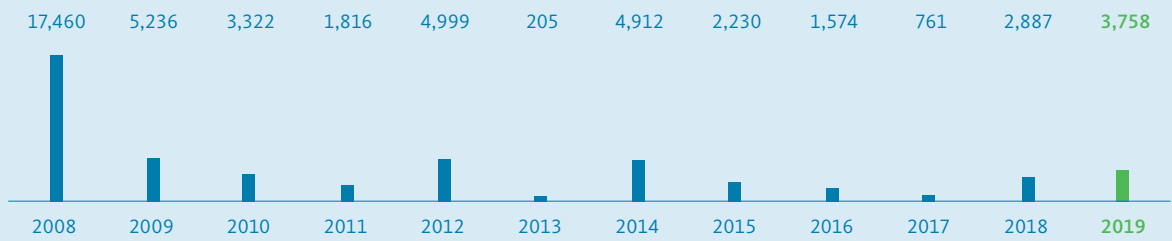
The German Energy Agency distinguished the joint project as a flagship project and gave it the Energy Efficiency Award 2018 in the category "Energy Transition 2.0." Furthermore, the project was distinguished with the German Renewables Award 2018 from the Renewable Energies Cluster, the Ener.con Europe Award 2019, and the Responsible Care Award 2019 from the VCI. The climate alliance

Fig. 2.16: District heating pipeline route from the Aurubis plant to HafenCity East



Fig. 2.17: Annual CO<sub>2</sub> reduction at the Hamburg site in the context of the Hamburg Climate Protection Concept

First and second climate protection agreement (t CO<sub>2</sub>/year)



was honored as a finalist for the EUSEW Awards by the European Commission and the Innovation Prize for Climate and the Environment by the German Federal Ministry for the Environment in 2019 and 2020, respectively.

Additional projects to use waste heat are being reviewed, such as the use of the heat from iron silicate stone and the process gases from secondary copper production.

#### Direct CO<sub>2</sub> emissions – Emissions Trading System (ETS)

As an energy-intensive company, the Hamburg site has been required to participate in the European Emissions Trading System (ETS) since 2013. The direct CO<sub>2</sub> emissions, mainly from natural gas consumption, are verified by TÜV-Nord and reported to the German Emissions Trading Authority (DEHSt).

Registered CO<sub>2</sub> emissions amounted to 156,601 t for 2019. More than 70% were caused by the fuels used, mainly natural gas, while the remainder was caused by the carbon contained in the raw materials, recycling materials, and additives.

#### Indirect CO<sub>2</sub> emissions

Copper production is an energy-intensive process, so a reliable electricity supply is very important. Aurubis therefore has a long-term cost-based electricity supply contract with the coal power plant Moorburg (a so-called virtual power plant slice). This is one of the most state-of-the-art and efficient power plants of its kind. Electricity production in this power plant nevertheless leads to CO<sub>2</sub> emissions, which are indirect CO<sub>2</sub> emissions for Aurubis, and therefore indirect environmental effects. In 2019, these indirect CO<sub>2</sub> emissions totaled 274,482 t (pursuant to ETS reporting).

The electricity producer already reported these indirect CO<sub>2</sub> emissions to the trading authority. Any costs were passed on via the electricity price. Therefore, these indirect CO<sub>2</sub> emissions are not included in the amount reported by Aurubis to the trading authority.

#### Climate protection agreement with the Hamburg Senate on CO<sub>2</sub> reduction

In August 2007, the Hamburg Senate approved the Hamburg Climate Protection Concept 2007–2012 and presented it to the public. A major part of the concept was based on the participation of Hamburg industry.

Aurubis AG was one of the first Hamburg companies to participate in the Climate Protection Concept and implemented a number of projects between 2007 and 2012 that cut CO<sub>2</sub> by 32,000 t each year (see Fig. 2.17).

With the agreement to reduce an additional 12,000 t of CO<sub>2</sub>, Aurubis participated in the follow-up agreement for the period from 2013 to 2018.

Aurubis achieved a roughly 12,569 t reduction in CO<sub>2</sub> by the end of 2018. The city isn't planning an additional follow-up agreement. Nevertheless, additional reduction potential has been identified and accompanying measures have been implemented, saving 3,758 t of CO<sub>2</sub> in 2019.

Aurubis continues to participate in the IVH Energy Efficiency Network of Hamburg industry. The network serves to create a best practice dialogue, leading to a mutual innovation boost. The identified potential is coordinated with Hamburg's central climate office.

Thanks to industrial heat extraction from the contact acid plant to deliver district heating to the new HafenCity East neighborhood and for internal use, up to 20,000 t of additional CO<sub>2</sub> can be saved annually.

#### **Audits and inspections by governmental authorities**

The production facilities at the Hamburg site are monitored by the relevant governmental authorities as part of inspections and emissions surveillance. The reports on the inspections pursuant to the IED directive have been published online in the city of Hamburg's Transparency Portal since 2016. Inspections were carried out in the following areas in 2019:

- » Lead refinery
- » Chemical plants
- » Rod plant
- » Precious metal production
- » Tankhouse, Plant East
- » Energy management
- » Contact acid plant, Plant East, including Plant East washing and cooling plant
- » Warehouse for very toxic materials
- » Primary Smelter Plant North

- » Primary smelter (RWO)
- » Selenium plant/SO<sub>2</sub> warehouse
- » Cracking plant including Plant South washing and cooling plant
- » Continuous casting plant
- » Top-blown rotary converter south
- » Central wastewater treatment plant

All inspections were carried out without the identification of any defects. Operation in conformity with the respective permits was verified in each case. Depending on the requirements, the inspections included immission control, water pollution prevention, waste management, and plant safety. Inspection reports for IED facilities are published.

Furthermore, the relevant authorities carried out audits as part of permit processes.

#### **Indirect environmental aspects**

Indirect environmental impacts are not directly caused by our production processes on site and therefore can't be directly influenced by Aurubis. They arise first and foremost from the transport of material and from the mines supplying Aurubis with copper concentrates. Nevertheless, the supply chain for products and raw materials is very important to the Aurubis Group. In this context, we refer to our Sustainability Strategy and sustainability communication, which provides detailed information about our supply chain management.

### Transporting hazardous materials

A separate internal hazardous materials officer was appointed for the Hamburg site, and the relevant authorities have been informed.

In the 2018/19 fiscal year, approximately 1,042,321 t of outgoing hazardous materials were registered at the Hamburg site of Aurubis AG. Of the total amount of hazardous materials, approximately 68% are shipped by inland vessel, 17% by truck, and 15% by train.

During the reporting period, there were no reportable incidents in the course of hazardous material transports. Monitoring and training were carried out again in 2019 in order to maintain this high safety standard.

### Commitment to the environment – Partnership for Air Quality and Low-Emission Mobility

In 2012, the city of Hamburg, Aurubis, and eleven other companies established the Partnership for Air Quality and Low-Emission Mobility. The objective is to reduce pollution, especially NO<sub>x</sub>, resulting from individual transport.

In order to bundle existing ideas and projects in the area of mobility, Aurubis Hamburg participated in the Mobil.Pro.Fit model project in 2016 and was certified as a Mobil.Pro.Fit company in 2017. The mobility management system that was developed was integrated into the existing management system.

To promote the use of bikes and public transport, a city bike station was set up at the Hovestrassen plant entrance in 2019. The intention is to encourage bike use for employees in their daily commutes between home and work or between home and subway or train stations. The station connects the plant to Hamburg's city-wide bike borrowing system.

Moreover, Aurubis rents 20 lockable bike spaces each at the closest train station, Veddel, and the new train/subway station Elbbrücken. This provides employees with an option for free bike parking so that they can travel quickly and conveniently from public transport stations to work. Furthermore, there are plans to build bike parking areas with locks at the nearby train and subway stations.

In order to promote e-mobility, efforts are still being made to set up charging stations at the employee parking lots on the streets Hovestrassen and Muggenburger Hauptdeich. E-mobility for internal plant traffic is also being emphasized. For instance, four new electric vehicles were purchased in fiscal year 2018/19.

In 2019, over 15% of the vehicles used within the plant were electric. Electric vehicles are given preference when new purchases are made.

### Emergency measures and crisis management

There are currently 64 so-called “hazardous incident companies” in Hamburg. A hazardous incident is any event in which a fire, explosion, or similar occurrence releases hazardous substances that put people and the environment at a serious risk. Because of the type and quantity of materials handled, the Hamburg production site is subject to the expanded obligations of the German Hazardous Incident Ordinance. The site is therefore subject to particularly strict safety precautions to prevent serious operational disruptions. Furthermore, for the case that hazardous incidents occur despite the safety precautions, measures to limit impacts have to be available. The safety report outlines the technical and organizational safety precautions and is reviewed and updated whenever there are changes to any facilities, at the latest every five years.

Beyond establishing safety measures, hazardous incident companies also have to regularly inform the public about the company's operations, its risk potential, safety measures, and correct conduct in case of an accident as a precaution.

The brochure “Safety for Our Neighbors” issued to inform the public was expanded and updated in 2018 in cooperation with the Hamburg Chamber of Commerce and 64 local companies that are also subject to the Hazardous Incident Ordinance. The Hamburg Chamber of Commerce published the brochure online in 2018. A printed version of the brochure was additionally distributed to neighbors within 500 m of the plant in 2019.

The Hamburg environmental authority also subjected selected facilities to an inspection last year. No deviations from their intended operational use or safety deficiencies were found.

There were no incidents or reportable malfunctions within the meaning of the Hazardous Incident Ordinance during the reporting period. No direct environmental damages were identified. The results are published on the government agency's website.



## **Environmental Program**

The targets set in the context of the Environmental Statement 2019 were reviewed to determine the extent to which they had been achieved and implemented. Discussions with employees, training, audits, and quality circles served as a basis for discussing and evaluating the environmental protection measures, as well as developing a new environmental protection program for 2020. The results are presented in the following Environmental Program.

## Reducing emissions

Target	Planned measure	Degree of implementation/date
Additional improvements to reduce fugitive emissions	Improving suctioning near the source	Suctioning of the relevant part of the ridge turrets in the RWO in connection with a flow improvement in the converter hall and improvement measures in the existing auxiliary hood filter system; permit has been issued; commissioning scheduled for 2021, additional stages until 2023
	Improving the process for internal cycles	
	Suctioning of the ridge turrets in the primary smelter (RWO) to capture residual fugitive emissions	
	Improvement in filters' cleaning efficiency by using new filter materials and filter fixtures	RWN filter improved in 2019
	Constructing an additional closed storage hall in secondary copper production as part of FCM project implementation	Deferred
Efficiency improvement in reducing gas emissions	Optimizing wet gas cleaning in hydrometallurgical precious metal recovery to reduce NOx emissions	Implementation by mid-2020 planned
	Optimizing the adsorbent injection control system to reduce SO <sub>2</sub> peaks in the off-gas of the RWO auxiliary hood filters	Tests started in 2020, implementation planned for 2021
Improving raw material logistics and sampling, replacement for the former concentrate warehouse 1	Construction of a hall for sampling concentrates and other raw materials	Implementation by late 2022 planned

The above, or equally effective, measures should be established in the continuation of the public contract to reduce emissions in 2020. The coordination talks with the governmental authorities started in 2017. Permits under the German Federal Immission Protection Ordinance have been issued for individual measures.

## Climate protection

Target	Planned measure	Degree of implementation/date
Participation in the Hamburg Senate's Climate Protection Concept	Implementing projects to cut 12,000 t of CO <sub>2</sub> from 2013 to 2018	Through individual measures, a reduction of 12,569 t of CO <sub>2</sub> per year was achieved until the end of 2018. Furthermore, the industrial heat project created the conditions for recurring CO <sub>2</sub> savings of 20,000 t per year.
Voluntary pledge among Hamburg industrial companies		2019 savings of 3,758 t of CO <sub>2</sub>
Participation in the second round of the IVH Energy Efficiency Network	Voluntary savings potential of 75,000 t of CO <sub>2</sub> among the 15 participating companies.	Runtime 2019-2021
Decarbonization	Developing an action plan for decarbonization	In 2019, the study "Reducing Greenhouse Gases in the Copper Industry" was carried out at Aurubis Hamburg.

## Energy optimization

Target	Planned measure	Degree of implementation/date
Extracting industrial heat for internal use and supplying district heating to the HafenCity East neighborhood – reducing heat discharge in the Elbe River	Using extracted industrial heat internally	The heating of the tankhouse cells in the Plant East tankhouse, as well as the heating of the copper sulfate crystallization facility, was implemented internally in 2019.
	Review of additional potential for extracting industrial heat and delivering district heating from lines 2 and 3 to the city of Hamburg's district heating grid	The basic engineering for lines 2 and 3 is being commissioned in 2020.
Measures to adjust to the energy turnaround in Germany	Planning the installation of an electrode steam boiler as an alternative to the gas-fired standby boiler to adjust to more flexible consumption in the scope of the project NEW 4.0	The electrode steam boiler was installed and inaugurated on August 22, 2019.

## Water pollution control

Target	Planned measure	Degree of implementation/date
Cooling water management compatible with bodies of water	Assessment of the three-year monitoring of bodies of water with proof of the ecological soundness of the cooling water discharge in bodies of water	2020 in coordination with the governmental authority
Continuously optimizing wastewater management	Increasing the level of detail of the operating source register as the basis for demand-based focus optimization	Implemented in 2019, initial measures have been derived. Continuation within the scope of cost improvement
	Investigative program to boost efficiency and minimize wastewater in precious metal production's wastewater management	Starting in 2020
Improvement in ZABA cleaning efficiency	Continuous 2-line design; increase in dwell times for metal precipitation and sedimentation; expansion of hydraulic throughput area	→ Deferred
	Increasing redundancy in the use of individual process stages (thickeners)	Implemented by 2020
Substitution for potable water	Switching sweeper operation to process water from cooling water withdrawal. Savings of 10,000 – 12,000 m <sup>3</sup> of potable water annually	Planned for 2020

## Partnership for Air Quality and Low-Emission Mobility

Target	Planned measure	Degree of implementation/date
Sustainable, efficient, and climate-friendly mobility	Commissioning a Mobility Group that regularly develops measures	Takes place monthly
Promoting public transport	Renting two bike boxes at the train/subway stations Veddel and Elbbrücken	Bike boxes were rented (2 locations with 20 spaces each) and have been in use since October 2019. These are made available to employees free of charge.
	Achieve full use of boxes	End of 2020
Promoting sustainable mobility	Working towards the setup of a city bike station at the east plant exit	City bike station for the north plant exit has already been established (October 2019). Talks planned for 2020 with the city bike station operator regarding the setup of a station at the east plant exit
	Reviewing options for carsharing	2020
Promoting e-mobility	Installing charging points (car & e-bike) at the employee parking lots in Plant North and Plant East.	Start of Plant North infrastructure construction planned for 2020
	Successive replacement of all fuel-driven vehicles within the plant with electric vehicles	Purchase of four new electric vehicles in 2019

## Promoting biodiversity

Target	Planned measure	Degree of implementation/date
Promoting biodiversity at the Hamburg plant	Routinely reviewing possibilities for designing plant surfaces "close to nature" within the scope of projects	Collaboration with NABU in the UnternehmensNatur project continues, next steps will be reevaluated in 2020
	Planting greenery in suitable places on facades	Repeat inspection of open areas with regard to vegetation in 2020

## Plant safety

Target	Planned measure	Degree of implementation/date
Ensuring safety	Drills for the alarm and danger prevention plan	Takes place every three years at the most, in March 2019 most recently  "Safety for Our Neighbors" brochure distributed to local residents in 2019

## Waste management

Target	Planned measure	Degree of implementation/date
Promoting the circular economy	Introducing the collection of an additional material fraction for recycling substances	Dec. 2020

## Continuous improvement of environmental management system

Target	Planned measure	Degree of implementation/date
Further development of an integrated management system (IMS) for Aurubis AG for the environment, quality, and energy	Introduction of general IMS handbook	
	Introduction of Hamburg IMS handbook	
	Introductory phase – taking advantage of synergies	
	Start-up of ISO 45001	By 2021
	Continuing the implementation of the Aurubis Operating System (AOS) in the entire Hamburg plant.	Continuous process
	Developing and implementing additional processes to determine and update company-specific environmental aspects as well as opportunities and risks	Currently in progress



	<p>Expanding the legal register by implementing an IT-supported legal and regulatory management system to ensure lawful plant operation as regulations become increasingly complex, as well as with regards to:</p> <ul style="list-style-type: none"> <li>» Centrally recording and evaluating environmental law obligations and documents relevant from an environmental law aspect (permits, collateral clauses, process instructions, work instructions, risk assessments, operating instructions)</li> <li>» Centrally managing internal audit reports and audit plans</li> </ul>	Introduced for the legal areas in FM and OHS. Complete system integration in environmental law scheduled for 2020
	Introducing the “10 Golden Rules” of occupational safety	A new rule has been presented each month since January 2020
Informing employees working in all plant areas relevant for environmental protection about current environmentally relevant topics	<p>Annual training for employees in environmentally relevant departments</p> <p>Supplementary introduction of e-learning until 2021 for employees to deepen their knowledge and make participation more flexible</p>	<p>Repeated annually</p> <p>Verifying requirements in 2020, roll-out date planned for 2021/22</p>
Information and training sessions for departmental heads and plant managers on environmentally relevant topics	Further developing information transfer regarding relevant operator obligations using IT-supported legal and regulation management systems	By the end of 2021
Plant tours by employees in the Environmental Protection Department	Further developing the monitoring of plant operations with regard to environmental effects and compliance of Environmental Protection Department with regulations using IT-supported legal and regulation management systems	By the end of 2020 (planned)

## Responsible supply chain

Key measures regarding responsible supply chains are documented in the separate Non-Financial Report within the scope of the Sustainability Strategy 2018–2023.

**Key figures for Aurubis AG, Hamburg site,  
in the 2019 calendar year**

Input	Unit	2017	2018	2019
<b>Raw materials</b>				
Copper concentrates	t	1,287,268	1,191,475	1,037,382
Copper scrap/refining material	t	49,125	54,933	48,897
Other Cu-bearing raw materials	t	112,897	140,365	146,718
Precious metal-bearing raw materials	t	27,347	28,446	12,251
Lead concentrate, scrap, and waste	t	26,438	25,013	20,575
Other waste for recycling	t	823	1,179	4,005
<b>Total TC/RC-earning raw materials</b>	<b>t</b>	<b>1,503,897</b>	<b>1,441,411</b>	<b>1,269,827</b>
<b>Operating supplies and materials</b>				
Sand and additives incl. cyclone sand	t	182,957	176,865	122,033
Iron as an additive	t	13,586	15,626	13,162
<b>Total input materials</b>	<b>t</b>	<b>1,700,440</b>	<b>1,633,902</b>	<b>1,405,022</b>
<b>Input material per t copper</b>	<b>t/t Cu</b>	<b>3.7</b>	<b>3.5</b>	<b>3.2</b>
<b>Energy</b>				
Electricity consumption	MWh	549,957	552,307	520,765
Additional electricity consumed to produce oxygen (informative)	MWh	119,594	127,278 <sup>1</sup>	125,441 <sup>1</sup>
Natural gas	MWh	439,834	480,771	465,037
Coke	MWh	49,513	47,857	43,912
Other energy sources	MWh	17,205	16,269	15,982
<b>Total energy consumption</b>	<b>MWh</b>	<b>1,176,104</b>	<b>1,224,482</b>	<b>1,171,143</b>
<b>Energy consumption per t copper</b>	<b>MWh/t Cu</b>	<b>2.6</b>	<b>2.6</b>	<b>2.7</b>
<b>Water withdrawal/uptake</b>				
River water*	m <sup>3</sup>	67,277,000	64,033,000	56,896,000
Potable water*	m <sup>3</sup>	332,000	340,000 <sup>2</sup>	362,000
Precipitation*	m <sup>3</sup>	514,000	319,000	348,000
<b>Total water uptake*</b>	<b>m<sup>3</sup></b>	<b>68,123,000</b>	<b>64,951,000</b>	<b>57,606,000</b>
<b>Water consumption per t copper</b>	<b>m<sup>3</sup>/t Cu</b>	<b>150</b>	<b>137</b>	<b>131</b>
<b>Area used at the Hamburg site</b>				
Total plant area		871,000	871,000	871,000
Buildings and paved area		766,000	766,000	766,000
			(equivalent to 88 %)	(equivalent to 88 %)

\* Figures rounded to the nearest 1,000

<sup>1</sup> The compressors used to produce oxygen haven't been operated internally since 2018, but they are still monitored.

<sup>2</sup> The figure provided is the actual consumption of potable water for production purposes and sanitary facilities.

Output	Unit	2017	2018	2019
<b>Products</b>				
Copper output	t	455,406	473,367	440,896
Sulfuric acid products as H <sub>2</sub> SO <sub>4</sub> (from exhaust gas cleaning, standardized to 100 % acid)	t	1,074,468	989,091	922,260
Iron silicate stone (incl. granules)	t	786,787	717,375	689,790
Silver, gold, and PGMs	t	1,866	1,273	1,357
Nickel sulfate	t	3,087	2,041	2,432
Other metal compounds	t	1,044	932	1,009
Lead	t	11,349	11,891	11,415
<b>Total products</b>	<b>t</b>	<b>2,332,962</b>	<b>2,195,970</b>	<b>2,069,159</b>
<b>Waste</b>				
Recycling	t	10,294	7,905	5,319
Disposal	t	4,960	5,105	6,393
<b>Total recycling &amp; disposal</b>	<b>t</b>	<b>15,254</b>	<b>13,010</b>	<b>11,712</b>
of which hazardous waste		11,652	9,590	8,648
<b>Waste per t copper output</b>	<b>kg/t Cu</b>	<b>33</b>	<b>27</b>	<b>27</b>
<b>Waste per t input material</b>	<b>kg/t</b>	<b>9</b>	<b>8</b>	<b>8</b>
Construction waste (informative)	t	24,027	37,925	109,513
<b>Total waste</b>	<b>t</b>	<b>39,281</b>	<b>50,935</b>	<b>121,225</b>
<b>Conversion into products</b>		<b>99.1 %</b>	<b>99.2 %</b>	<b>99.2 %</b>
<b>Emissions</b>				
Dust	t	43	42	40
Dust per t copper	g/t Cu	95	89	90
SO <sub>2</sub>	t	2,046	1,830	1,591
NO <sub>x</sub> per t copper	g/t Cu	564	450	425
Direct CO <sub>2</sub> emissions (ETS, excluding diesel)	t	166,732	165,029	156,601
of which CO <sub>2</sub> from fuels	t	109,721	116,767	112,244
CO <sub>2</sub> from fuels per t copper	t/t Cu	0.24	0.25	0.25
Direct CO <sub>2</sub> emissions (diesel for vehicles)	t	3,865	3,454	3,565
Indirect CO <sub>2</sub> emissions from electricity consumption (incl. oxygen production) <sup>3</sup>	t	496,098	504,672	480,312
Metal discharge in water	kg	684	718	678
Metal discharge in water per t Cu	g/t Cu	1.5	1.5	1.5
<b>Water discharge</b>				
Direct discharge	m <sup>3</sup>	65,364,198	63,676,000	54,941,141
Indirect discharge	m <sup>3</sup>	50,288	42,000	51,220
<b>Total water discharge</b>	<b>m<sup>3</sup></b>	<b>65,414,486</b>	<b>63,718,000</b>	<b>54,992,361</b>
<b>Water discharge per t copper</b>	<b>m<sup>3</sup>/t Cu</b>	<b>144</b>	<b>135</b>	<b>125</b>

<sup>3</sup> The supplier's CO<sub>2</sub> emission factor is taken as a basis.

# Consolidated Aurubis AG Environmental Statement 2020

Lünen Site





### The Lünen plant

Aurubis AG's Lünen plant is located in the south of the city of Lünen about one kilometer from the town hall.

The plant was built and commissioned on undeveloped land between the Cologne-Minden railway and the Datteln-Hamm Canal in 1916 as a branch plant of Hüttenwerke Kayser AG in Berlin. After the loss of the Berlin plants and reconstruction after the end of World War II, the production facilities were continuously expanded and steadily modernized. After the then-Norddeutsche Affinerie AG acquired the majority of Hüttenwerke Kayser shares in 2000, the plant was initially integrated into the

company structure and expanded to become the Group's recycling center. Today Aurubis AG's Lünen site is the largest secondary copper smelter in the world, with an authorized production capacity of 250,000 t of copper cathodes annually.

### The processes at the Lünen plant

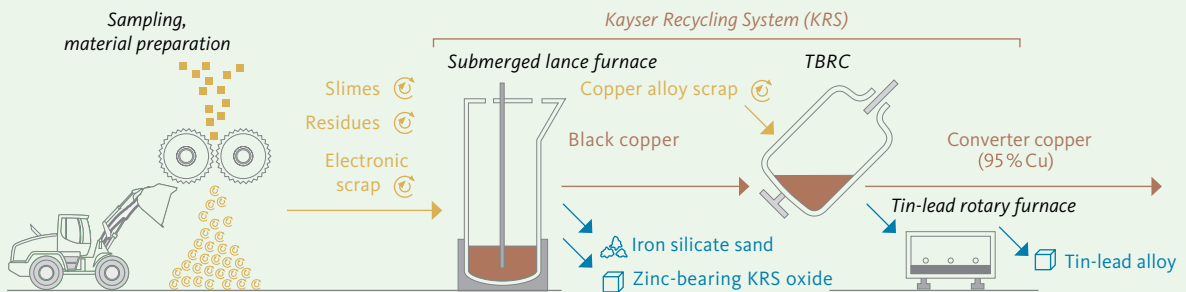
Lünen's smelting and refining processes involve recycling raw materials almost exclusively. These include traditional raw materials such as copper scrap and alloy scrap, slimes, and industrial residues, as well as high quantities of complex materials and other processing products from e-scrap, old cars, and ashes from garbage incineration. The feed

Fig. 3.1: Overview of Lünen site facilities



- 1 South plant entrance with noise protection wall 2 Rainwater retention facility 3 Material preparation 4 Sampling 5 E-scrap preparation 6 Warehouse 4  
7 KRS 8 TBRC 9 Leaching plant 10 Anode smelter 11 Copper tankhouse 12 Cathode warehouse 13 Kupferstrasse plant entrance 14 ATASI  
15 Administrative building

Fig. 3.2: Multi-metal recycling at the Lünen site



materials, which are primarily delivered by truck, are first sampled, in some cases crushed and separated in a material preparation plant, and then processed in a multi-step metallurgical process. The copper anodes produced in this way are then refined electrolytically into cathodes, which are the final product at the Lünen site. Anode quantities from other Aurubis sites are also processed in the copper tankhouse (see Fig. 3.2).

The core facility for metallurgical processes has been the Kayser Recycling System (KRS) since 2002, which gained a TBRC (top blown rotary converter) in 2011 as part of the KRS-Plus project. The converter copper produced in the TBRC is refined together with copper scrap in the anode furnace and cast into anodes in a casting plant. The anodes are dissolved electrochemically and precipitated as cathodes. Zinc-bearing KRS oxide, iron silicate sand (slag granules), a lead-tin alloy, nickel and copper sulfate, and anode slimes are produced as by-products of “multi-metal recycling.” The anode slimes are processed into gold and silver metal as well as a PGM solution in the Hamburg site’s precious metal recovery process. The ratio of copper cathodes to by-products is about 1:1, though the increasingly complex recycling raw materials are steadily shifting the ratio to more by-products with minor metals relative to copper production. Production waste is not generated during the processes.

There are about 650 employees at the Lünen site, around 40 of whom are apprentices.

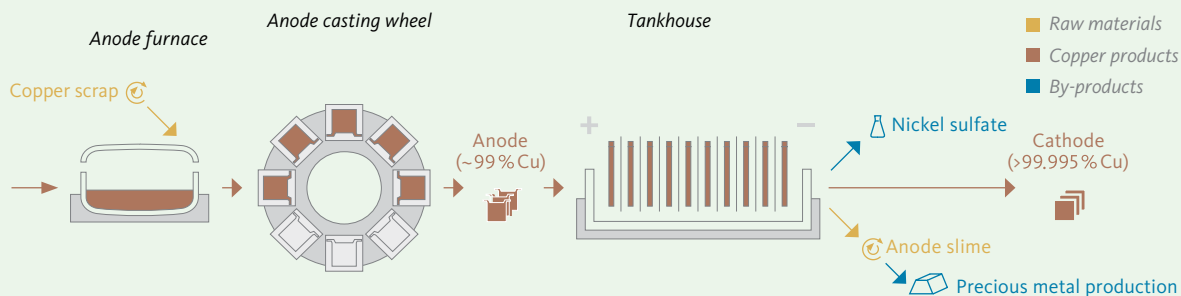
### The integrated management system (IMS) for the environment, quality, and energy

An environmental management system exists at the Lünen site as well. It has been certified in accordance with ISO 14001 and EMAS since 1997 and is incorporated in an IMS (integrated management system) in connection with quality management pursuant to ISO 9001 and the certified energy management system pursuant to ISO 50001. For the near future, there are also plans to introduce an occupational health and safety management system in accordance with ISO 45001.

Therefore, the management system and handbook and their process and work instructions are related not only to environmentally relevant issues, including accident prevention and health protection, but also to quality assurance and energy management measures.

The IMS continues to fulfill the requirements of the waste disposal regulation (EfbV) and the law on circulation, withdrawal, and environmentally sound disposal of electrical and electronic devices (German Electrical and Electronic Equipment Act, ElektroG) for the material preparation plant. Since August 2016, the plant has been a certified primary treatment facility in accordance with the ElektroG. Since December 2018, the Lünen plant is also certified as a pre-processor and end processor of electrical and electronic scrap in accordance with the WEEELABEX/CENELEC standard 50625.

The effectiveness of the environmental and energy management system is reviewed with internal audits pursuant to EMAS regulations and ISO 14001/ISO 50001. The approach for the internal audits is defined in specific process instructions. Internal and external audits take place annually in compliance with the EMAS and ISO 14001/ISO 50001 requirements.



The external audit involves verifying the description of operating processes and reviewing the environmental data provided. The results of the company environmental audits and internal audits are compiled in a report and presented to the plant management, as the representative of the Executive Board, for assessment (Management Review). The management evaluates how suitable, appropriate, and effective the management system is and whether the principles for environmental protection, health protection, occupational safety, and energy management are being successfully implemented.

In 2017, the shift to the new system standard ISO 14001:2015 and the consolidation of the IMS for the Hamburg and Lünen sites were completed and successfully audited.

### Targets and tasks of the environmental management system

The production processes are securely managed via the environmental management system at the Lünen plant. The targets and measures are defined and their implementation is monitored. The environmental management system includes the documentation of operational processes, internal audits, routine recordings, and site inspections.

The environmental management system ensures that the applicable legal requirements are fulfilled with respect to environmental protection. Furthermore, it supports continuous improvement through product and process design that takes the environment and occupational safety into account. Saving energy is also an essential element of environmental protection. Therefore, the energy management system is also certified according to DIN EN ISO 50001. The energy flows are presented transparently and optimization potential is documented. The systems and organization of the IMS are described extensively and understandably in a handbook available to employees. This

management handbook guarantees that all activities that concern environmental aspects and occupational safety issues are planned, managed, monitored, and continuously improved with due regard to legal requirements.

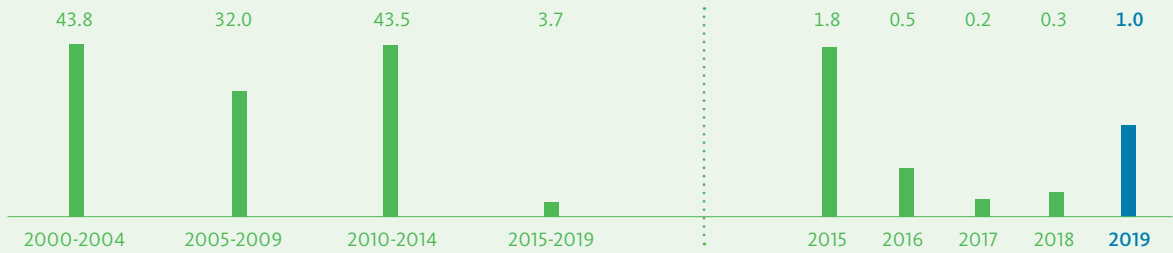
The environmental management system EMAS also helps in the implementation of the Aurubis Group sustainability targets, which are regularly updated, at the Lünen site.

In order to achieve these targets, the IMS is regularly reviewed using a number of key figures, which are usually determined and discussed on a Group-wide basis and therefore provide a good estimate of the site's performance. These key figures include emissions to air and water, for instance. In addition, registers for operating incidents and neighborhood complaints are maintained in Lünen. The registers make performance easier to track, for example by recording the response to each incident and documenting the solution that was found. The goal is to make as direct contact as possible with those submitting the complaints.



Fig. 3.3: Aurubis AG investments in environmental protection measures at the Lünen site

in € million/fiscal year



### Environmental management organization

As the operator of facilities requiring a permit in accordance with Section 52a of the Federal Immission Protection Law and Section 53 of the Recycling Management Law, the Aurubis AG Executive Board or an appointed member of the Executive Board is responsible for compliance with environmental protection and radiation protection regulations.

The IMS team consists of the quality and energy management officer, the environmental management officer, and other delegated individuals and employees. The officer functions for

- » Immission protection and accident prevention
- » Waste management
- » Radiation protection
- » Specialist company under the Water Management Act

are carried out by the site's employees. The same applies to the occupational safety specialist. The function of hazardous goods officer has been organized as a corporate function since 2018, but the responsible employee is located on site in Lünen. The Lünen site has had its own plant medical services since 2017, which further improves employees' occupational health.

The officer function for REACH and CLP (Classification, Labeling, and Packaging) is still carried out centrally for all of Aurubis AG by the corporate departments.

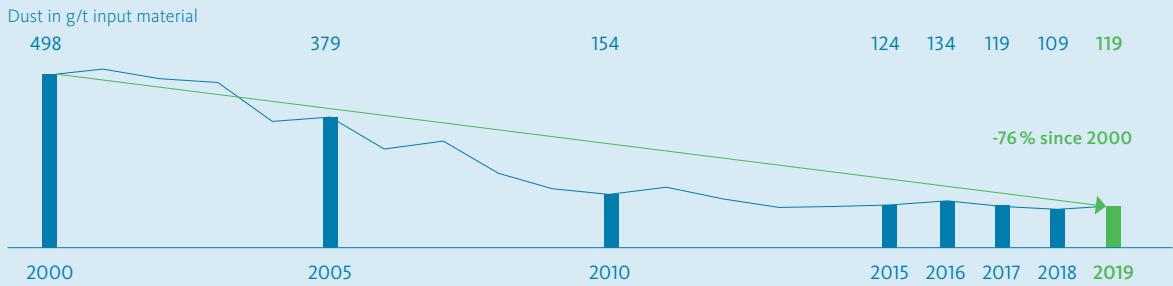
### Environmental aspects and performance

Investments in environmental protection have a high level of significance in Lünen. The Kayser Recycling System (KRS) initially set new precedents with a capital expenditure volume of around € 40 million. Additional capital expenditure followed, especially for reducing fugitive emissions in metallurgical facilities and in the storage and handling of feed materials.

The emission reduction concept agreed on with the governmental authorities for the period from 2005 to 2009 was initially estimated at about € 10 million but was then supplemented with further capital expenditure of € 25 million with additional measures. Significant projects included the e-scrap warehouse and warehouse 4 for dust-forming KRS input materials, comprehensive paving of storage areas, and the additional KRS filter 5. Environmental protection accounted for € 17.5 million of the investment costs of the KRS-Plus project as well.

Overall, around € 123 million has been invested in environmental protection from 2000 to 2019 (see Fig. 3.3). Starting in 2000, following the acquisition of Hüttenwerke Kayser, Aurubis AG made huge investments in new and improved facilities. In the last several years, process optimizations were the focus at the plant, so investments in new facilities decreased accordingly. The lower investments in the years 2015-2019 make sense in light of this fact. Aurubis will continue to invest in modernizing the facilities and possibly building new facilities in the coming years, though this won't reach the investment level of the plant modernization that took place starting in 2000.

Fig. 3.4: Dust emissions at the Lünen site



### Air – Emissions

The emissions from directed sources (chimneys) are monitored with continuous measuring devices in connection with emission data transfer. Dust, sulfur dioxide, nitrogen oxides, hydrogen chloride, hydrogen fluoride, and mercury are measured continuously depending on relevance. Other off-gas and dust components are measured manually.

The TA Luft regulation establishes emission limits for air pollutants. However, the permit requirements of many facilities are even lower than the TA Luft guidelines. The relevant limit values of the TA Luft are featured in chapters 5.2.2, 5.2.4, 5.2.5, 5.2.7, and 5.4.3.3.1 in particular.

Consequently, the measurements comply with the limit values overall or fall significantly below them in some cases. The same applies to additional substances listed in the permits, such as NO<sub>x</sub>, HCl, HF, etc.

The long-term goal of the Lünen plant is to achieve a continued reduction in emissions despite the input materials, which are becoming ever more complex. Contributing to the difficulty here is that for many areas, the measured values already lie within the margin of error, which can lead to significant fluctuation ranges for annual values.

Emissions of dust and especially dust components (copper, lead, arsenic, etc.) have been considerably reduced at the Lünen site in the past several years due to mitigation measures. The figures presented here incorporate the fugitive emissions including storage and handling.

The dust emissions in 2019 were again at about the same low level of the past several years.

Overall, emissions are still at a very low level. However, shifts are expected for specific emissions in the coming years. This has already been the case for a long time for

emissions per ton of copper output because the Lünen plant works with increasingly complex input materials, and the miniaturization of technical devices has also resulted in an increase in the number of processing steps. This leads to less copper in exchange for more by-products per ton of material input.

The Lünen plant's KPIs will therefore be adjusted in the years to come to optimally depict the shift in the plant's strategy towards increasingly complex input materials. These alternative KPIs have already been reviewed within the context of energy management, for example to evaluate energy performance and energy efficiency that includes minor metal production.

As a first result of these adjustments at the Lünen plant, the processed external bleed was included in the input streams since it constitutes a substantial portion of both plant traffic and the metal loads of wet chemistry. Furthermore, copper production as it is shown in the KPIs was expanded to include the volumes of purchased anodes and blister copper, as growing volumes of these preliminary products are increasingly being delivered to other Aurubis sites and not being directly processed into cathodes in Lünen anymore.

Another development is clear when observing the emission curves: they seem to be transitioning to an asymptotic trend in the meantime. Slight increases in emissions can also be observed in places. It's important to mention here that the measured emissions from the Lünen plant's facilities are meanwhile at low concentrations that are within the range of measuring inaccuracy. Fluctuations in annual emissions in these areas can therefore be due to calibrations of measuring devices, among other reasons. Moreover, reductions of the magnitude reflected in the past can't be expected through individual technical measures anymore.

Fig. 3.5: Copper emissions at the Lünen site

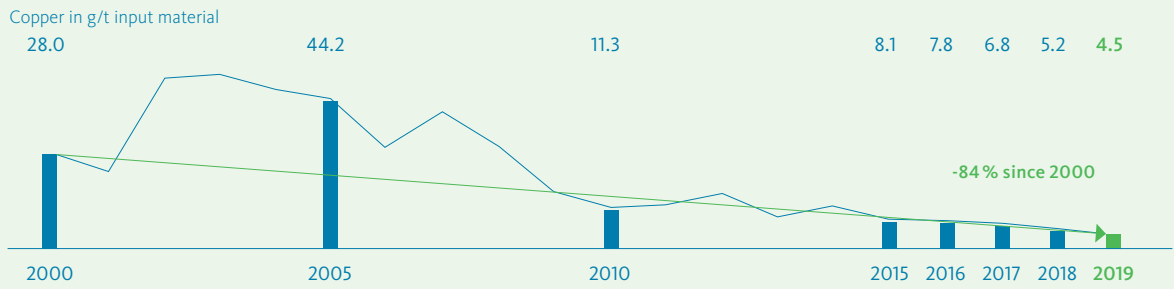


Fig. 3.6: Lead emissions at the Lünen site

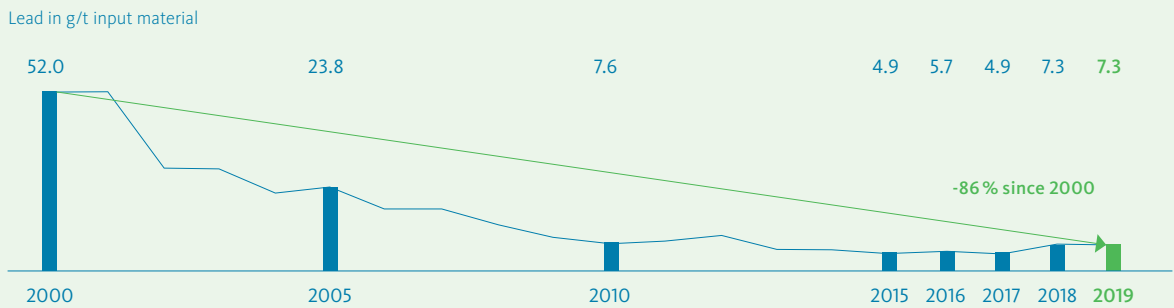


Fig. 3.7: Arsenic emissions at the Lünen site



Note on the selection of years presented here: Fugitive emissions in particular have been determined or calculated since 2004 in accordance with the methods used at the Hamburg site. The values for 2002, and 2003 were estimated in a comparable manner, but there are no reliable values for the missing years.

Fig. 3.8: Locations of immission measurement points near the Aurubis plant in Lünen



*"Bergerhoff" measurement points in Lünen*

001 Buchenberg

002 Kleine Bergstrasse

003 Bergstrasse 48

005 Bebelstrasse/Süggelbach

006A Rail line/mosque

007 Lünen South freight yard

009A B 236/Lippebrücke

010 Im Wiesengrund

011 Builders' association/building yard

012 Rail line/Kantstrasse

015 Im Engelbrauck/north side

016 Im Siepen

■ Aurubis plant building

Source: LANUV

### Air – Immissions

To measure the immissions of dust precipitation including metallic components, the LANUV (NRW State Agency for Nature, the Environment, and Consumer Protection) operates a network of currently 12 so-called “Bergerhoff” measurement points in the area surrounding the Lünen plant (see Fig. 3.8).

In the last ten years, there has been a significant reduction in dust emissions, but primarily in dust components. Although individual deposition values of the TA Luft regulation are still being exceeded, the deposition involves a complex situation and not immissions that can be directly assigned to an individual emitter. In the past several years, an immission study that was designed to provide clearer indications of possible mitigation measures has been conducted at the behest of the governmental authorities, Aurubis, and other industrial enterprises in the Kupferstrasse industrial area. Aurubis will work closely with the responsible governmental authorities on implementing the resulting mitigation measures.

In addition, a LANUV measurement station for particulate matter (PM10) is located on Viktoriastrasse (northeast of the plant). The position corresponds to that of the plant's calculated immission maximum (see Fig. 3.9).

The measurements of air quality for suspended particulates and their content indicate that the levels are significantly and consistently below both the limit values for PM10 and lead, as well as below the EU target values for arsenic, cadmium, and nickel (see Fig. 3.10 – 3.13). The LANUV measurement station at Niederaden is listed for comparison; it serves LANUV as a reference measurement station without industrial impact.

In April 2019, the results of the investigations of leafy vegetables from small gardens in Lünen near the plant were released for 2018. The assessment took place on the basis of Commission Regulation (EC) No 1881/2006 on setting maximum levels for certain contaminants in foodstuffs. This regulation is based on the assumption of regular consumption of the tested foodstuffs, which, due to the actual vegetation period of the leafy greens in question, can't actually be achieved by the harvested plants from the gardens.

Unfortunately, the established limit was exceeded slightly at one measuring point (MP 5) in 2018 as well, so the LANUV continues to uphold the recommendation not to consume plants from the entire area. It should be pointed out that this measuring point is several hundreds of meters east of the Aurubis plant premises and should therefore mainly be influenced by other sources, as there are hardly any (north-)eastern winds on an annual average. For lead and arsenic, the LANUV continues to assume a considerable influence on immissions due to the air. For copper, nickel, cadmium, and chrome, the report states (as in previous years) that a contribution to immissions can't be assumed, as the plants only absorb the substances through the soil.

The LANUV measuring program continued in 2019.

Fig. 3.9: Immissions of particulate matter (PM<sub>10</sub>) compared to the plant's calculated immission maximum

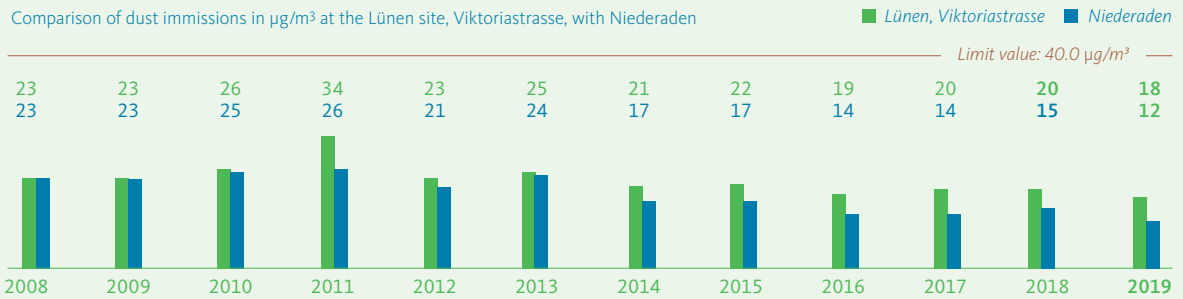


Fig. 3.10: Lead

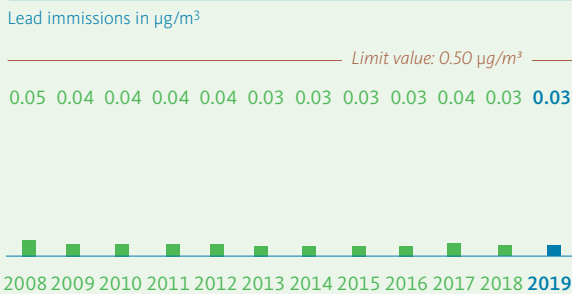


Fig. 3.11: Cadmium

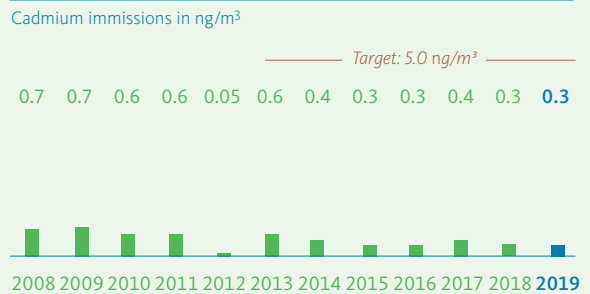


Fig. 3.12: Arsenic

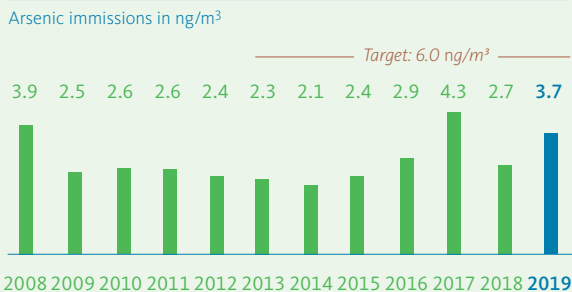


Fig. 3.13: Nickel



The measurements of air quality for suspended particulates and their components indicate that the levels are significantly and consistently below both the limit values for PM<sub>10</sub> and lead, as well as below the EU target values for arsenic, cadmium, and nickel. The LANUV measurement station at Niederaden is listed for comparison; it serves LANUV as a neutral point measurement station without industrial impact.

Fig. 3.14: Water consumption and wastewater discharge at the Lünen site



\* Calculation formula in coordination with the Lippe Association

## Water

Water is used in the Lünen plant for various cooling purposes, including anode cooling and slag granulation, as feed water for the steam boiler, and increasingly for operating several sweepers, as well as sprinkling driveways, plant/storage surfaces, and input materials. Particularly these latter measures to reduce dust emissions make it difficult to significantly reduce water consumption.

To ensure that this consumption conserves resources, Aurubis operates a facility for rainwater retention, treatment, and utilization in Lünen, which covers a large part of the internal cooling and process water needs with collected rainwater.

The rainwater volume used in this way has increased continuously during the past several years. In 2019, more than 100,000 m<sup>3</sup> of process water was used for internal purposes. Overall, the rainwater-use project has significantly surpassed the projected quantities. The wastewater discharge is nevertheless still at a high level, even though the established deficiencies have been improved (see Fig. 3.14). In 2015 and 2016, the wastewater discharge from

the rainwater retention hadn't been included in the figures yet, which explains why they are substantially lower than in comparable years.

## Soil – Remediation measures

Since the plant opened in 1916, facilities producing non-ferrous metals have been operated continuously at the site. In conjunction with war damages, this led to soil pollution in the past.

On the basis of comprehensive tests, a remediation plan was developed, which was coordinated with the responsible authorities and has been partly implemented. Because of the sulfate content, it will not be possible in the future to discharge sanitation water via the city sewer system, so direct discharge into a body of water nearby is required.

In late 2014, a remediation agreement was ultimately signed with the Unna district describing the further agenda and the steps planned to remediate the soil and groundwater at the Lünen site.



The remediation concept includes encapsulating the contaminated area with the help of a sealing wall, as well as a drainage facility that requires the discharged water to be purified. Part of the sealing wall and some extraction wells have already been completed in the run-up to construction measures.

In 2019, the overall remediation concept was submitted to the Unna district in a related draft permit. Upon the district's request, however, this should be supplemented with the exact technical data of the remediation equipment, which requires detailed engineering with the company providing it. The bidding process for the remediation is planned for summer 2020. At the moment, the technical specifications are being drawn up, which include all canal networks in the plant and the connections of the remediation wells. The application for the permit will therefore be delayed until the turn of the year 2020/21.

Nevertheless, an initial remediation measure for a sub-area near a former oil storage facility (with groundwater locally polluted by an oil phase) started in 2019. The oil damage remediation equipment successfully completed a test run in late 2019 and went into operation in 2020.

### Soil – Preventative measures

Preventative and protective measures have been developed for several decades in order to eliminate future strains on the soil. They are primarily related to the facilities dealing with materials hazardous to water, such as the tankhouse and oil storage. Furthermore, the storage spaces for input materials are being designed so that not even traces of deposits or components of input materials hazardous to water can end up in the soil.

### Noise and odors

Noise protection measures take high priority in the conception of new facilities in particular. The additional noise pollution in the area in terms of the TA Lärm regulation should be marginal, i.e., the levels should be at least 10 db(A) lower than the TA Lärm immission reference

values. This requirement was fulfilled in the last few years in all projects, and noise reduction measures are continuously carried out at existing facilities as well.

The measurements carried out in 2012 showed that the reference values relevant for the respective applications were observed at all assessment points predetermined by the governmental authorities. In the areas classified as mixed-use areas surrounding the plant, this is 60 dB(A) maximum during the day and 45 dB(A) maximum at night.

The noise complaints due to the newly purchased cleaning vehicles have been resolved in the meantime; there have been no complaints from the neighborhood about this since early 2019. In the entire year 2019, there was one single additional noise complaint that was quickly handled through technical improvements on a suction opening on the KRS building.

There were no odor complaints in 2019. The measures carried out over the past several years, such as improved suctioning in individual areas, appear to be taking effect already.

### Biodiversity

Aurubis AG Lünen's plant premises are adjacent to agricultural land and are just a few kilometers from multiple Natura 2000 nature conservation areas (In den Kämpen, Cappenberger Wälder, and Lippeaue). Respecting and promoting biodiversity is therefore a high priority for us. For example, Aurubis has reviewed larger expansion projects such as the KRS-Plus project with extensive assessments pursuant to the EU Habitats Directive in order to identify possible impacts on biodiversity. In smaller projects in the plant and in the neighborhood, we continue to take active steps to promote and preserve biodiversity, for example by planting greenery on plant surfaces that aren't in use (noise protection wall, landfill for blast furnace slag) and setting up nesting sites on buildings and chimneys.

Fig. 3.15: Waste generated at the Lünen site

in t p.a.	2013	2014	2015	2016	2017	2018	2019
Packaging and other waste	1,338	909	794	910	1,745	1,301	1,201
Construction waste	23,706	9,914	8,925	4,313	10,988	3,235	10,484
Spent potlining	343	272	201	319	267	286	322
Sales products from the material preparation plant	6,683	4,849	3,712	5,808	7,366	4,241	2,929
<b>Total</b>	<b>32,070</b>	<b>15,944</b>	<b>13,632</b>	<b>11,350</b>	<b>20,366</b>	<b>9,064</b>	<b>14,937</b>
of which hazardous waste	1,513	2,996	276	3,287	367	363	5,820

### Waste

The waste from the Lünen plant mainly results from packaging from delivered materials, from construction measures, and from spent potlining from the KRS, anode furnaces, etc. The externally marketed contingents of the material preparation plant, such as aluminum for continued recycling, are also inevitably among the waste from the site, as they do not lose their waste properties through preparation. In the interim, sorting in the facility has become so homogeneous that for several years it has been possible to deliver all contingents completely as raw material for recycling to the respective industries.

The waste volume converged with the level of the years prior to 2017 again, so the volumes are significantly lower overall than in the previous year. The main reason was the comparatively lower level of construction activity. Because of the current construction measures, it can be expected that the volumes will rise notably again in 2019.

A total of 5,820 t of hazardous waste accumulated in 2019. However, just 433 t of this originated from the production facilities, mainly spent furnace lining material. Most of the rest is construction waste, in particular about 5,000 t of excavated soil.

### Energy and climate protection

Energy is required first and foremost for the metallurgical processes (primarily heating oil and natural gas), as well as for the tankhouse (electricity). Steam or thermal energy for leaching and electrolysis is mainly produced in the waste heat boilers of the KRS submerged lance furnace and anode furnace. There are also two auxiliary boilers primarily fueled with natural gas.

Since 2015, a two-stage condensation turbine has been in operation to produce electricity for internal use from waste heat steam through cogeneration. The steam from the process waste heat is initially depressurized from about 18 bar to 5 bar in the first turbine stage. Steam is removed for thermal use and the remaining volume is then depressurized to 0.85 bar in the second turbine stage. The German Federal Office of Economics and Export Control (BAFA) licensed the turbine in accordance with Section 5(2) of the German Act on Combined Heat and Power Generation (KWKG). For this project, Aurubis won the German Energy Agency's (dena) award for Best Practice in Energy Efficiency at the end of 2015. Due to unscheduled shutdowns, a complex turbine overhaul, and process adjustments in KRS operation due to the raw materials and equipment, only 3.8 GWh of power was generated internally in 2019, another significant decrease compared to 2018. For 2020, we expect to generate a substantially higher amount of power internally again.

Developments and background on the use of primary energy sources:

- » At 493 GWh, the entire quantity of energy needed from primary energy sources was under the 500 GWh threshold for the first time in 2019
- » The overall input of heating oil was reduced by 6 % year-over-year.

Fig. 3.16: Energy consumption<sup>1</sup> at the Lünen site

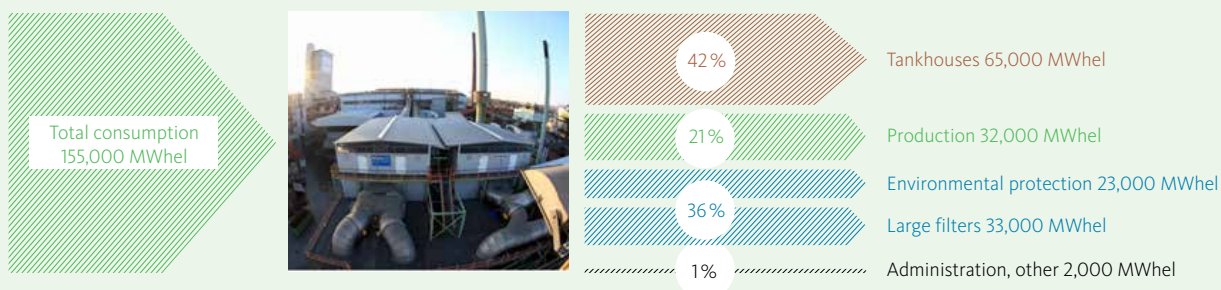
in GWh/year	2012	2013	2014	2015	2016	2017	2018	2019
Heating oil	291	266	266	242	260	257	230	216
Coal, coke, etc.	6	13	9	27	24	29	23	23
Natural gas	81	77	105	135	106	105	107	99
Electricity	154	156	162 <sup>2</sup>	161 <sup>2</sup>	155 <sup>2</sup>	165 <sup>2</sup>	165	155
Total	532	512	542	565	545	557	525	493

<sup>1</sup> Calculated using DEHSt (German Emissions Trading Authority) standards

<sup>2</sup> Also included: internal electricity production from the steam turbine (2017: 17.8 GWh)

The table may include slight deviations in the totals due to rounding.

Fig. 3.17: Environmental protection facilities – including those at the Lünen site – are very energy-intensive



Aurubis uses more than 30 % of the electricity for environmental protection measures.

Fig. 3.18: CO<sub>2</sub> emissions at the Lünen site

in t p.a.	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Total CO <sub>2</sub>	152,696	166,304	172,870	168,297	172,461	174,549	176,067	186,544	169,415	163,572
Biogenic CO <sub>2</sub>	653	457	0	568	569	0	480	324	300	295
CO <sub>2</sub> subject to DEV 2020 <sup>1</sup>	152,018	165,847	172,870	164,995	169,134	171,858	173,202	183,839	166,918	161,113

<sup>1</sup> 2020 Data Collection Regulation for the third emissions trading allocation period

Fig. 3.19: Energy consumption at the Lünen site

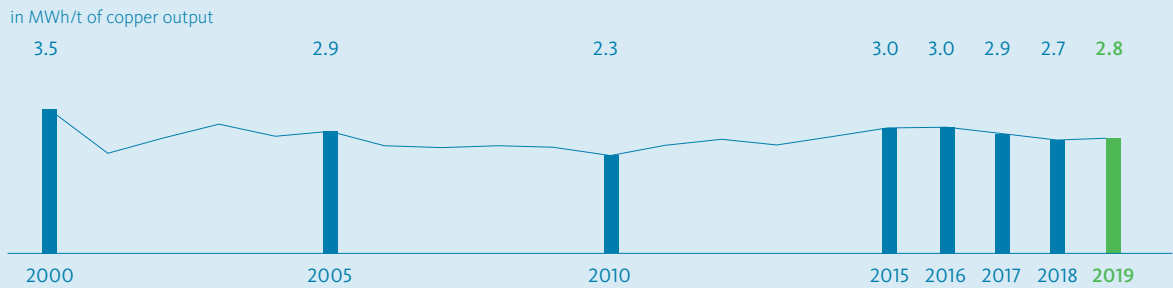
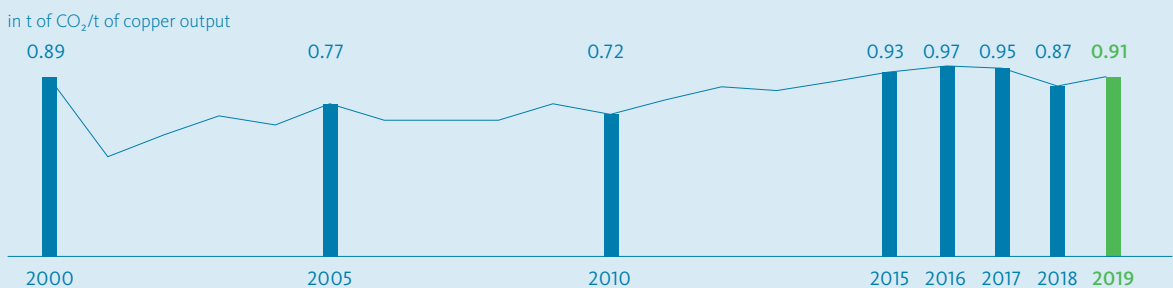


Fig. 3.20: Direct CO<sub>2</sub> emissions at the Lünen site



- » A continued high input of energy-intensive, complex raw materials such as shredder materials and residues
- » Electricity demand fell to 155 GWh. However, this is primarily due to the start of an extensive remediation measure in the tankhouse that has rendered about one-fifth of the tankhouse capacity unavailable since April 2019

The electricity demand for environmental protection measures remains unchanged at roughly one-third of total electricity demand.

The site's absolute energy demand has been relatively constant for ten years. At 493 GWh in 2019, the energy input is around 8 % lower than the seven-year average of 535 GWh. At the same time, the plant's direct CO<sub>2</sub> emissions fell from 170,000 t (2018) to 164,000 t (2019), or by 7 %. The lower energy demand is the result of three overlapping effects.

1. There has been a fundamentally positive trend in process-related primary energy needs in smelting operations. Anode output in Lünen was at 193,000 t, as it had been in the previous year, and the converter

copper output from the KRS system was even boosted by 10 %. Heating oil demand declined by 6 % compared to 2018, gas demand by 7 %.

2. Additional unplanned and planned maintenance work led to interruptions of operations, so it wasn't possible to fulfill the full raw material processing potential.
3. The project to overhaul the tankhouse started in April 2019. About 20 % of the tankhouse capacity was unavailable until year-end. This had a significant impact on energy and heating needs.

Due to equipment and market factors, the Lünen plant wasn't able to fully utilize its possibilities for inputting complex raw materials. As planned, copper cathode output decreased to 158,000 t due to the overhaul. At the same time, 11,000 t of converter copper and 7,000 t of copper anodes, or about 11 % of the copper output, was delivered as intermediate products to other Group sites for refining. The strategic objective of the site and of Aurubis continues to be to push the use of complex raw materials, some of which require a great deal of energy.

The CO<sub>2</sub> emissions were determined in accordance with DEHSt (German Emissions Trading Authority) standards. The increase in the absolute figures compared to reporting year 2010 and the allocation of certificates is mainly a result of a higher quantity of complex input materials with lower copper contents. This trend led to an increase of more than 10,000 t starting in 2011 due to the implementation of the KRS-Plus project. The total CO<sub>2</sub> emissions include biogenic emissions and emissions from mobile production equipment, i.e., the diesel consumption of plant vehicles, which are not considered in emissions trading.

According to the reporting methods of the DEHSt, the organic components in the raw materials contribute more to the site's CO<sub>2</sub> emissions than the main energy source, SE oil (45% compared to 35%). We expect this trend to continue.

#### **Audits and inspections by governmental authorities**

The following environmental inspections were carried out by the relevant authorities in 2018:

- » Inspection on compliance with the obligations pursuant to the Hazardous Incidents Ordinance, local Arnsberg government, March 8, 2018
- » IED inspection of the HOS landfill, local Arnsberg government, July 3, 2018

In 2018, the IED inspection for the plant was postponed to spring 2019 due to scheduling reasons. All inspections were completed successfully. The reports from the IED inspections are publicly available online.

#### **Indirect environmental aspects**

With the extension of the plant railway and the two-track expansion on the northern plant premises completed in 2011, the anodes delivered to the plant and the cathodes delivered from the plant by train increased distinctly.

Nevertheless, the delivery of most input materials and auxiliary materials with trucks cannot be avoided. The main reason is that the type of delivery is the supplier's choice. About 70% of deliveries arrive through the "Buchenberg" entrance, which is completely located in an industrial area of the Lünen city harbor and is separated from residential areas with an effective noise protection wall.

#### **Emergency measures and crisis management**

Because of the type and quantity of materials handled, the Lünen site is subject to what are called the expanded obligations of the German Hazardous Incident Ordinance. Aurubis therefore developed a comprehensive safety report together with external experts and in close coordination with the responsible governmental authority, in which all incident scenarios are addressed and concrete safeguards are derived from them. The safety report is regularly reviewed and updated so that it accounts for current developments at all times.

The Lünen plant's incident information is provided to neighbors near the plant and can also be accessed online on the Aurubis homepage at any time.

There were no incidents or malfunctions with significant environmental effects within the meaning of the Hazardous Incident Ordinance at the Lünen plant during the reporting period. The safety report was last adjusted in February 2018 and will be updated again by summer 2020, in particular with the addition of statements about snow and ice loads.

## **Environmental Program**

The targets set in the context of the Environmental Statement 2019 were reviewed to determine the extent to which they had been achieved and implemented. Discussions with employees, training, audits, and quality circles served as a basis for discussing and evaluating the environmental protection measures, as well as developing a new environmental protection program for 2020. The results are presented in the following Environmental Program.

## Air pollution control

Target	Planned measure	Degree of implementation/date
Closing the KRS roof ventilation	Analysis of the emission effects after closing the smelting operations hall and possibly closing the KRS roof ventilation	Following the technical inspection, a complete closure does not appear to be necessary. The measure is being postponed in light of planned discussions with the monitoring authorities about further immission reductions in the plant surroundings, and it is being reprioritized compared to other measures such as additional warehouses.
Improving odor immissions in the plant surroundings	Measures for ventilating individual production halls as well as additional storage halls in the southern plant area	The measures have been budgeted and will be implemented when there are suitable upcoming renovation or construction measures

## Water pollution control

Target	Planned measure	Degree of implementation/date
Optimizing wastewater flows	Separately treating sanitation water, improving the ratio of used surface water to drained surface water to >60 %	Details for environmental remediation are currently being coordinated with the responsible governmental authorities. The permit applications were agreed on with the authorities in 2019 and were used as a basis to develop specifications for the facility. The use of surface water continues to rise significantly.



## Energy optimization

Target	Planned measure	Degree of implementation/date
Enhancing energy efficiency	Developing an assessment basis that takes the following aspects into account: <ul style="list-style-type: none"> <li>» Form of energy</li> <li>» Raw material structures</li> <li>» Raw material availability</li> <li>» Raw material composition (complexity)</li> <li>» Price volatility</li> </ul>	The ENPIs are reliable and sound. In the coming years, standards-based assessment benchmarks will be introduced for the entire process to be able to better monitor sustainable development.
Optimizing the anode smelter cycles and primary smelter cooling cycles	Heat utilization and water quality (including expansion of process water use) have to be optimized to enhance performance	Concepts are being developed with external support. Projects are taken into account in the investment budget

## Plant safety

Target	Planned measure	Degree of implementation/date
Adaptation of the requirements to the Seveso III Directive	Public disclosure	Documents can be accessed online and the visitor and external company guidelines were revised together with Health & Safety. There are plans to issue a general policy about conduct and dress code for external employees in the individual plant sectors.
	Preparation of a new hazardous substances register	The report pursuant to the new Hazardous Incident Ordinance was submitted to the governmental authorities. The hazardous materials register will be entered into a new EHS software that has already been purchased at AG level and is in use at the Hamburg site.

## Environmental management system

Target	Planned measure	Degree of implementation/date
Improved organization	Earnings improvement projects and project organization	The plan is to bring the AOS system (continuous improvement of operations and processes) together with the IMS in an overarching department for management systems to better coordinate and agree on measures.

Key figures for Aurubis AG, Lünen site,  
in the 2019 calendar year

Input	Unit	2017	2018	2019
<b>Raw materials</b>				
Recycling raw materials	t	392,420	323,519	295,343
Blister, etc.	t	15,138	19,013	19,479
Copper anodes from other Aurubis sites	t	25,404	29,438	29,690
Bleed	t		27,598	43,000
<b>Total raw materials</b>	<b>t</b>	<b>432,962</b>	<b>399,568</b>	<b>387,512</b>
<b>Input material/t Cu output</b>	<b>t/t Cu</b>	<b>2.24</b>	<b>1.82</b>	<b>2.20</b>
<b>Operating supplies and materials</b>				
Oxygen	million m <sup>3</sup>	43	38	39
Rhine sand	t	15,199	19,894	20,969
Limestone	t	6,814	6,671	3,493
<b>Energy</b>				
External power sources	MWh	147,351	153,95	151,274
Internal power sources	MWh	17,766	10,641	3,793
Natural gas, oil, coal	MWh	391,679	360,990	337,970
<b>Total energy consumption</b>	<b>MWh</b>	<b>556,796</b>	<b>525,583</b>	<b>493,036</b>
<b>Energy consumption/t Cu output</b>	<b>MWh/t Cu</b>	<b>2.89</b>	<b>2.73</b>	<b>2.79</b>
<b>Water withdrawal/uptake</b>				
Potable water	m <sup>3</sup>	626,462	739,701	617,327
Precipitation	m <sup>3</sup>	126,302	112,286	137,784
<b>Total water uptake</b>	<b>m<sup>3</sup></b>	<b>795,961</b>	<b>711,791</b>	<b>592,024</b>
<b>Water consumption/t Cu output</b>	<b>m<sup>3</sup>/t Cu</b>	<b>4.1</b>	<b>3.7</b>	<b>3.4</b>
<b>Area used</b>				
Total plant area (incl. south plant entrance)	m <sup>2</sup>	316,000	316,000	316,000
Buildings and paved area	m <sup>2</sup>	247,000	247,000	252,784
			(equivalent to 78 %)	(equivalent to 80 %)

Output	Unit	2017	2018	2019
<b>Products</b>				
Copper products sold (cathodes, anodes, and blister)	t	192,516	192,323	176,446
KRS oxide	t	23,022	18,982	20,887
Iron silicate sand	t	153,294	146,982	174,448
Other (tin composite, nickel sulfate, etc.)	t	26,289	23,401	23,048
<b>Total products</b>	<b>t</b>	<b>395,121</b>	<b>381,688</b>	<b>395,190</b>
<b>Waste</b>				
Recycling	t	9,378	5,829	4,736
Disposal	t	0	0	539
Waste/Cu output	kg/t	49	30	30
Waste/input material	kg/t	46	15	14
Construction waste	t	10,988	3,234	10,484
<b>Total waste</b>	<b>t</b>	<b>20,366</b>	<b>9,063</b>	<b>15,759</b>
<b>Emissions</b>				
CO <sub>2</sub> (direct emissions)/Cu output	t CO <sub>2</sub> /t Cu	0.95	0.87	0.91
Dust/Cu output	g/t	119	109	119
SO <sub>2</sub> /Cu output	kg/t	5.3	4.0	4.4
NO <sub>x</sub> /Cu output	kg/t	1.3	1.4	1.7
<b>Water discharge</b>				
Wastewater (indirect discharge)	m <sup>3</sup>	139,000	186,000	198,000
Water discharge/Cu output	m <sup>3</sup> /t	0.72	0.97	1.13

# GÜLTIGKEITSERKLÄRUNG

gemäß den Vorgaben der

**Verordnung (EG) Nr. 1221/2009 i.d.F. vom 25.11.2009**

**über die freiwillige Teilnahme von Organisationen an einem Gemeinschaftssystem für Umweltmanagement und Umweltbetriebsprüfung (EMAS)**



Die unterzeichnenden Umweltgutachter Wolfgang Wielpütz, Dr. Erwin Wolf und Ralph Meß, zugelassen für den Bereich "NACE-Code 24.44", bestätigen, begutachtet zu haben, dass die gesamte Organisation wie in der Umwelterklärung der Organisation

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Deutschland

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Kupferstraße 23  
44532 Lünen  
Deutschland


mit der Registrierungsnummer D-131-00035 angegeben, alle Anforderungen der Verordnung (EG) Nr. 1221/2009 des Europäischen Parlaments und des Rates vom 25. November 2009 über die freiwillige Teilnahme von Organisationen an einem Gemeinschaftssystem für Umweltmanagement und Umweltbetriebsprüfung (EMAS) in der durch die Verordnung (EU) 2017/1505 der Kommission und der Verordnung (EU) 2018/2026 der Kommission geänderten Fassung erfüllt.

**Mit der Unterzeichnung dieser Erklärung wird bestätigt, dass**

- die Begutachtung und Validierung in voller Übereinstimmung mit den Anforderungen der Verordnung (EG) Nr. 1221/2009 durchgeführt wurden,
- das Ergebnis der Begutachtung und Validierung bestätigt, dass keine Belege für die Nichteinhaltung der geltenden Umweltvorschriften vorliegen,
- die Daten und Angaben der Umwelterklärung der Standorte ein verlässliches, glaubhaftes und wahrheitsgetreues Bild sämtlicher Tätigkeiten der Standorte innerhalb des in der Umwelterklärung angegebenen Bereichs geben.

Diese Erklärung kann nicht mit einer EMAS-Registrierung gleichgesetzt werden. Die EMAS-Registrierung kann nur durch eine zuständige Stelle gemäß der Verordnung (EG) Nr. 1221/2009 erfolgen. Diese Erklärung darf nicht als eigenständige Grundlage für die Unterrichtung der Öffentlichkeit verwendet werden.

Hannover, 15.07.2020

  
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# CERTIFICATE



Aurubis AG

Hovestrasse 50  
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D-44532 Lünen

Registration-No.: DE-131-00035

Date of first registration  
1<sup>st</sup> November 2005

This certificate is valid until  
19<sup>th</sup> May 2023.

This organisation has established an environmental management system according to Regulation (EC) No 1221/2009 and EN ISO 14001:2015 (sections 4 to 10) to promote the continual improvement of environmental performance, regularly publishes an environmental statement, has let the environmental management system be verified and the environmental statement be validated by an independent and accredited verifier, is registered under EMAS ([www.emas-register.de](http://www.emas-register.de)) and therefore entitled to use the EMAS-Logo.

Hamburg, 10<sup>th</sup> September 2020  
HAMBURG CHAMBER OF COMMERCE



**HK**

**Hamburg**  
Chamber of Commerce

Prof. Norbert Aust  
Präsident

Dr. Malte Heyne  
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This Environmental Statement comprises Aurubis AG, which includes the Hamburg and Lünen sites.

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**Metals for Progress**

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