



# Environmental Protection in the Aurubis Group

and updated Aurubis AG Environmental Statement 2022,  
Hamburg and Lünen Sites





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**DR. HEIKO ARNOLD**

Chief Operating Officer

**Dear readers,**

The economy, industry, and society now face enormous challenges, which is most clearly demonstrated by the war in Ukraine at the beginning of the year. Climate change, energy supply, and raw material security are the buzzwords of the 21st century. As a leading multimetal company, we're looking to be part of the solution – because “there's no sustainable future without metals.”

For us, sustainability is so much more than just a slogan, as sustainability is an integral part of our corporate activities and is firmly rooted in our corporate culture. This is underscored by our realigned strategy “Metals for Progress: Driving Sustainable Growth.” Based on binding targets and appropriate measures related to the environment, social issues, and corporate governance, we are further incorporating sustainability throughout the entire company and all of our workflows, processes, and new projects.

Thanks to its strategic focus on recycling, Aurubis is making an important contribution to the circular economy in Europe. Further development and improvement of environmental protection are always key components of our efforts to improve and optimize our processes and plants, all of which is part of our core business. Aurubis is thus doing its part to gradually reduce the environmental footprint of copper production. Our objective is to further consolidate and expand our position as the world's most sustainable and efficient smelter network.

Aurubis is committed to the European Green Deal and its targets. Our activities contribute to the more efficient use of resources, increased recycling, environmentally friendly production, the fabrication of environmentally compatible products, and the development of a circular economy that is friendly to the climate. Our plan is to drastically reinforce our recycling capabilities once again with the implementation of various strategic projects, including the development of the largest multimetal recycling plant in the United States and the innovative electrolyte reprocessing plant for nickel in Belgium. Because one thing is certain: recycling is crucial for ensuring a sustainable society in the future.

In late 2019, we joined the UNGC initiative Business Ambition for 1.5°C, committing the Group to setting science-based targets for reducing the greenhouse gas CO<sub>2</sub>. By taking part in this initiative, we contribute to achieving the 1.5 °C target of the Paris Climate Agreement. But our ambitious goal goes far beyond – we plan to make our production processes carbon-neutral well before 2050. The carbon footprint of our cathode copper is already far below the global average of all copper smelters and refineries.

We maintain a leading position when it comes to the efficient use of energy and have also set our sights on projects beyond our plant borders. Together with energy supplier enercity AG, we've been supplying Hamburg's HafenCity East neighborhood exclusively with CO<sub>2</sub>-free heating derived from chemical subprocesses of copper production since 2018. But we can do even more: We started by expanding our Industrial Heat project in Hamburg at the beginning of 2022, where we plan to reduce CO<sub>2</sub> emissions

by 100,000 t annually with an investment of approximately € 100 million. We invest amounts in the double-digit million euro range in environmental measures annually and thus underline our role as an industry leader in environmental protection. We've implemented what are known as the best available techniques (BATs) at all of the production sites. But here, too, we go one step further. We're acting as a role model and setting new benchmarks with innovative environmental protection technologies like those of the RDE project in Hamburg, which reduce fugitive emissions in smelting buildings.

Like I said: Sustainability is not simply a slogan, but also a part of our daily operations and efforts. We plan to respond to the challenges of the future with our motivated employees and a clear strategic roadmap and make our contribution as part of the solution.

With this Environmental Report, I personally would like to invite you to get better acquainted with environmental protection at Aurubis.

I hope you enjoy reading this report.

Sincerely,

  
**DR. HEIKO ARNOLD**  
Chief Operating Officer

## Company profile and business model

### THE AURUBIS GROUP

Aurubis is a company in the basic materials industry that operates worldwide. As an integrated Group, we process complex metal concentrates, scrap metals, organic and inorganic metal-bearing recycling raw materials, and industrial residues into metals of the highest purity. In addition to our main metal, copper, our metal portfolio also includes gold, silver, lead, nickel, tin, zinc, minor metals such as tellurium and selenium, and platinum group metals. Sulfuric acid, iron silicate, and synthetic minerals round off the product portfolio.

The company's headquarters, which is also home to one of our two primary smelters, is located in Hamburg, Germany. Our sites are mainly located in Europe, with larger production sites in Germany, Belgium, Bulgaria, and Spain, as well as cold rolling mills for flat rolled products, slitting centers, and rod plants in Germany and other European countries. Outside Europe, Aurubis also has a production site in the US, and a global sales and service network. Effective May 29, 2020, Aurubis AG acquired the recycling company Metallo with production sites in Beerse (Belgium) and Berango (Spain). The two sites have operated under the names Aurubis Beerse nv (Belgium) and Aurubis Berango S.L.U. (Spain) since December 1, 2021. Aurubis has approximately 7,200 employees throughout the Group.

Sustainable conduct and business activity are integral components of Aurubis' strategy and are firmly rooted in our corporate culture. Based on binding targets and appropriate measures related to the environment, social issues, and corporate governance, we are further enshrining sustainability throughout the entire company and all of our workflows, processes, and new projects. Our production techniques already make a pivotal contribution to responsibly handling resources and thus play a role in the energy transition, in addition to our products.

### BUSINESS MODEL AND GROUP STRUCTURE

Metals play a pivotal role in a number of forward-looking applications. Following industrialization, automation, and digitalization, the transformation to a sustainable, carbon-neutral economy and society is currently posing significant challenges. Many of the solutions in this area – such as electric vehicles and wind turbines – are based on the use of metals.

Aurubis' business model rests on three fundamental pillars: the processing of raw materials from the mining industry, the processing of recycling materials, and product business. This provides Aurubis with a great deal of efficiency and flexibility in managing raw material procurement, production, and sales. Different market cycles influence each of the three fundamental pillars as well.

We process copper concentrates that are obtained from ores and are offered by mining companies and trading companies on the global market. The necessary raw materials for our two primary smelters in Hamburg and Pirdop are purchased worldwide. Aurubis doesn't hold any stakes in mines and has a globally diversified supplier portfolio. We source a significant portion of our copper concentrates from South American countries such as Peru, Chile, and Brazil. We also purchase raw materials from other countries like Bulgaria, Georgia, and Canada. As a buyer, Aurubis competes with other international primary smelters, particularly in China and Japan. Copper concentrates for the Hamburg site reach us primarily by waterway and are transshipped via the port terminal in Brunsbüttel. There, the different copper concentrates are also pre-mixed in accordance with the requirements of our production process. At the site in Pirdop, Bulgaria, concentrates reach us by land and sea via the port of Burgas.

In addition to copper concentrates, we use copper scrap and various types of organic and inorganic metal-bearing recycling raw materials, industrial residues, and bought-in metallurgical intermediates as feed material. Most of the copper scrap and metal-bearing recycling raw materials for our four secondary smelters in Lünen (Germany), Olen and Beerse (both in Belgium), and Berango (Spain) are sourced in the European and North American market. Metal trading companies are the main actors on the supply side for recycling materials, though some recycling raw materials also reach us directly from our customers through our "closing-the-loop" approach.

In the course of our production processes, we convert copper concentrates and recycling materials into copper cathodes. This is the standardized product format that is traded on the international metal exchanges. Copper cathodes are the starting product for fabricating additional copper products, but they can also be sold directly. Our product portfolio mainly comprises standard and specialty products made of copper and copper alloys. In terms of processing capabilities, we have manufacturing capabilities for continuous cast copper wire rod, continuous cast shapes, rolled products, strip, specialty wire, and profiles.

Additional products result from processing the tramp elements that accompany copper in the input materials, which in some cases are purchased on purpose as part of our multimetal approach. In particular, these include different metals such as gold, silver, lead, nickel, tin, zinc, minor metals like tellurium and selenium, and platinum group metals. We also produce copper products such as sulfuric acids, which occur when processing copper concentrate, as well as the mineral iron silicate. Sulfuric acid customers are very diverse and include international companies from the chemical, fertilizer, and metal processing industries.

The sales markets for our products are varied and international. Aurubis' direct customers include companies from the copper semis industry, the cable and wire industry, the electrical and electronics sectors, and the chemical industry, as well as suppliers from the renewable energies, construction, and automotive sectors. To close the value chain for copper and other metals, we place a high priority on the "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.

## OUR GROUP STRUCTURE

Until September 30, 2021, the Aurubis Group's organizational framework was based on the underlying business model. The Group's structure is made up of two operating segments: the Metal Refining & Processing segment and the Flat Rolled Products segment.

The Metal Refining & Processing (MRP) segment processes complex metal concentrates, copper scrap, organic and inorganic metal-bearing recycling raw materials, and industrial residues into metals of the highest quality. The MRP segment includes the Commercial, Supply Chain Management (SCM), and Operations divisions.

The Commercial division is commissioned by the plants to purchase input materials and sell products. The SCM division's responsibility to the plants is to carry out production planning, logistics management, and sampling, and to improve the Group-wide metal flows and inventories.

The Operations division is responsible for the ongoing optimization of the integrated smelter network and the production of all basic products and metals, as well as for their further processing into other products such as continuous cast wire rod and shapes. Among other items, copper cathodes are manufactured at the sites in Hamburg and Lünen (both in Germany), Pirdop (Bulgaria), and Olen and Beerse (both in Belgium). The cathodes produced at the smelters are processed further into wire rod and shapes at the Hamburg (Germany), Olen (Belgium), Emmerich (Germany), and Avellino (Italy) sites. The MRP segment also includes the Metallo Group, the company acquired in 2020 with production sites in Beerse (Belgium) and Berango (Spain).

The second segment, Flat Rolled Products (FRP), processes copper and copper alloys – primarily brass, bronze, and high-performance alloys – into flat rolled products and specialty wire, which it then markets. The main production sites are Stolberg (Germany), Pori (Finland), Zutphen (Netherlands), and Buffalo (US). Furthermore, the segment also includes slitting and service centers in Birmingham (UK), Dolný Kubín (Slovakia), and Mortara (Italy), as well as sales offices worldwide.

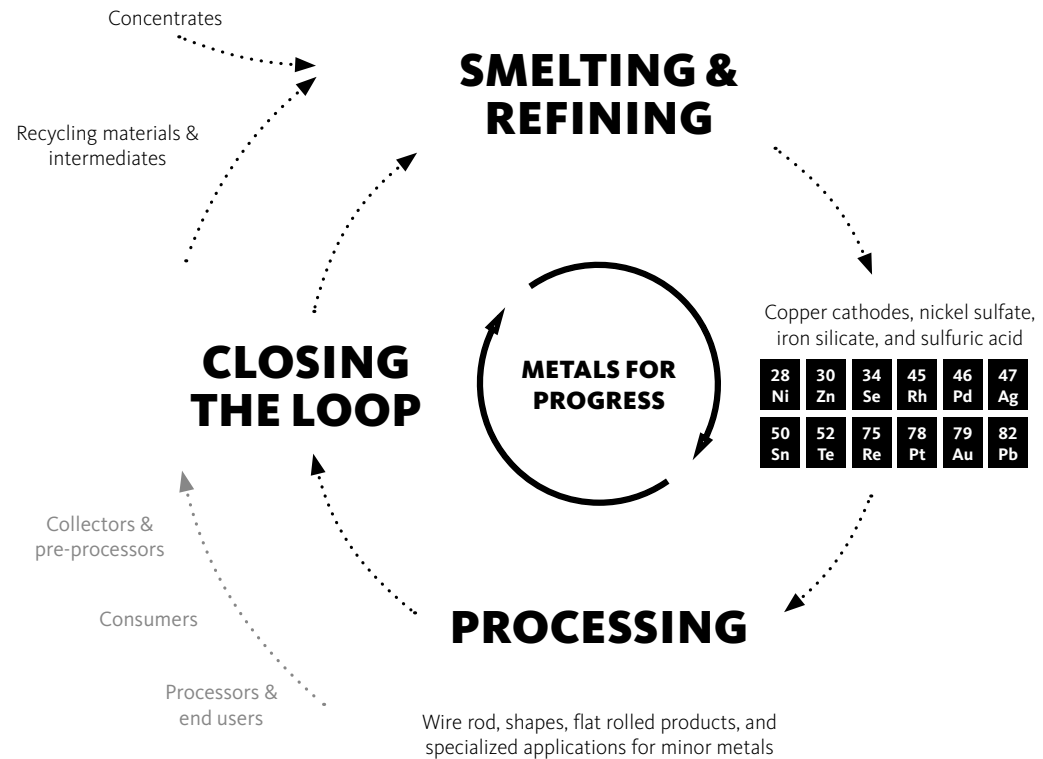
After signing a term sheet in August 2021, Aurubis AG took the next step and, following the approval of the relevant decision-making bodies, signed and notarized the sales and purchase agreement (SPA) for the partial sale of its Flat Rolled Products (FRP) segment with KME SE. According to the agreement, the Zutphen (Netherlands) site and the slitting centers in Birmingham (United Kingdom), Dolný Kubín (Slovakia), and Mortara (Italy) with a total of about 360 employees will be sold. As announced, the FRP plants in Stolberg, Pori, and Buffalo will remain in the Aurubis Group. The closing of the transaction is expected in summer 2022 following approval by the national competition authorities.

In the course of developing the Aurubis Group's strategy, the segmentation was adjusted with effect from October 1, 2021. The two segments Multimetal Recycling and Custom Smelting & Products have formed the organizational structure ever since.

The Multimetal Recycling segment comprises the recycling activities in the Group and thus the processing of copper scrap, organic and inorganic recycling raw materials containing metal, and industrial residues. The segment mainly includes the sites in Lünen (Germany), Olen and Beerse (both in Belgium), and Berango (Spain).

The Custom Smelting & Products segment joins the production facilities for processing copper concentrates and manufacturing and marketing standard and specialty products such as cathodes, wire rod, shapes, strip products, sulfuric acid, and iron silicate. The Custom Smelting & Products segment is also responsible for precious metal production. The sites in Hamburg (Germany) and Pirdop (Bulgaria) manufacture copper cathodes, which are processed further into wire rod and shapes at the Hamburg (Germany), Olen (Belgium), Emmerich (Germany), and Avellino (Italy) sites. The Buffalo (US), Stolberg (Germany), and Pori (Finland) sites produce flat rolled products and specialty products.

Fig. 1.1: The Aurubis AG business model





## 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 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 strain on the environment and our employees and reduce it to the lowest level technically possible.
- » 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.

- » Technical and organizational measures 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.
- » External companies 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. Ongoing improvement in environmental protection is enshrined in our corporate strategy and is one of our key responsibilities.

## Environmental protection in the Aurubis Group

### ENVIRONMENTAL PROTECTION IS PART OF THE GROUP STRATEGY

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 "Responsibly transforming raw materials into value – to provide metals for an innovative world."

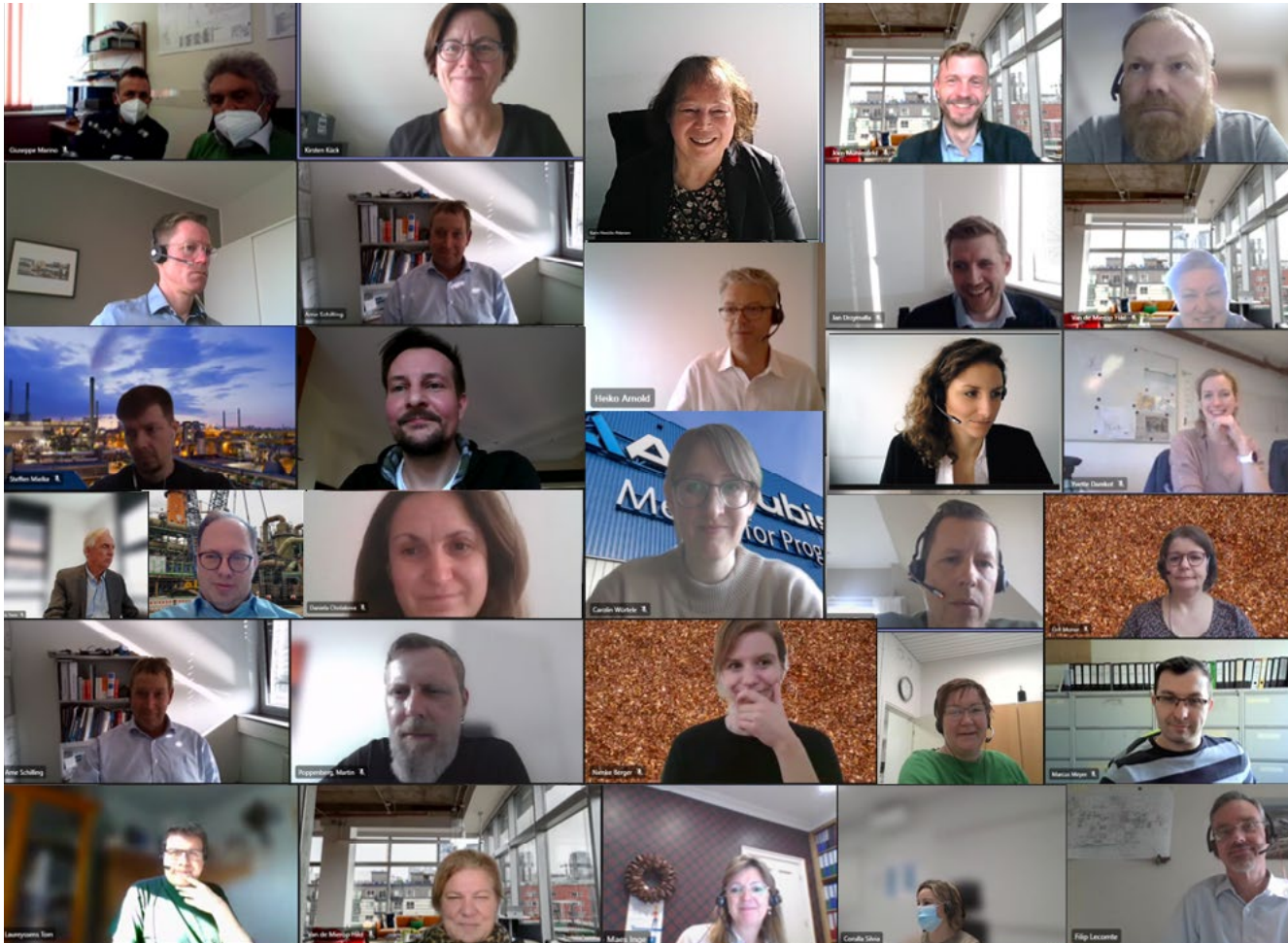
The previous corporate strategy was updated in fiscal year 2020/21 and is now aligned with the motto "Metals for Progress: Driving Sustainable Growth." The key elements of the strategy are securing and strengthening the core business, pursuing growth potential, and expanding our role as industrial forerunner in sustainability. With the development of the corporate strategy, our sustainability aspirations will be further integrated throughout all areas and activities of the company.

Our role as industrial forerunner in sustainability focuses on people, environment, and economy with our nine areas of action. For each action area, new or continuing targets were defined for 2030. The existing Sustainability Strategy with its 2018–2023 targets is incorporated as a milestone into the new Group strategy for 2030.

We are leaders in environmental protection and are continuously improving in our industry. Environmentally sound multimetal production from primary raw materials such as ore concentrates and recycling form the foundation for a responsible and demand-oriented metal supply. By doing so, we are safeguarding our sites and creating the basis for forward-looking investments.

As a multimetal Group, Aurubis assumes responsibility for protecting the environment and the climate. The efficient use of natural resources and energy and the reduction of CO<sub>2</sub> emissions are an important part of the company's ecological and economic





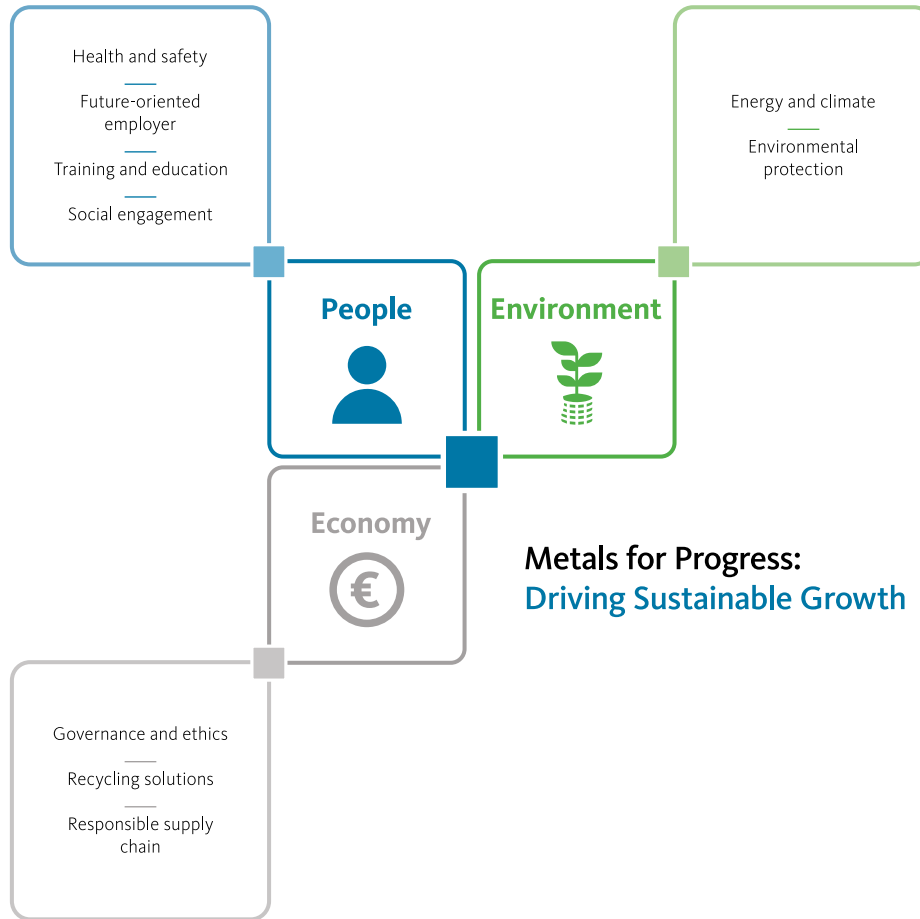
Dr. Karin Hinrichs-Petersen, Head of Corporate Environmental Protection:

**“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 projects.”**

responsibility and have been part of our corporate culture for many years. Aurubis views the value chain as a whole and pursues the goal of striking a balance between the economy, the environment, and people.

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 set new benchmarks worldwide and often form the basis for establishing best available techniques (BAT) at the European level.

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 even 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**

When specifying the environmental protection targets in the revised Sustainability Strategy, we take into account the Group's transformation from a copper to a multimetal manufacturer. In the future, our new specific reduction targets and the associated reporting of specific emissions will no longer be based on the quantities of copper produced, but rather on a multimetal KPI, the so-called copper equivalent.

The calculation is based on an approach that has already been established on a European level with the EU projects "Organisation Environmental Footprint" and "Product Environmental Footprint," which seek to achieve an environmental balance in organizations and products. The copper equivalent describes the metals produced by Aurubis, thus standardizing the entire multimetal production using a weighting factor based on the corresponding metal prices. To avoid the influences of fluctuations in value, the average prices of the metals used are defined for the entire target horizon of the Sustainability Strategy.

The reporting will feature the new KPIs as of the next Environmental Report. We will also continue to report on emissions on the basis of the previous copper production quantity until the end of the original Sustainability Strategy 2018–2023.

Within the scope of the Sustainability Strategy 2018–2023, we had set Group-wide targets in environmental protection and defined concrete targets for the individual sites. The effectiveness of these targets and measures is reviewed continuously.

In 2021, dust emissions per ton of copper output in copper production were reduced by 36 % compared to 2012 (target: 15 %). Our goal is to continue maintaining this very low level and to improve it wherever possible.

<b>Environment</b>			
<b>Energy and climate</b>	We will be carbon-neutral well before 2050.	<b>-50%</b> absolute Scope 1 and Scope 2 emissions (base year 2018) <b>-24%</b> Scope 3 emissions per ton of copper cathodes (base year 2018)	» ISO 50001 at all production sites
<b>Environmental protection</b>	We produce with the smallest environmental footprint in our sector.	<b>-15%</b> specific dust emissions in g/t of multimetal copper equivalent (base year 2018) <b>-25%</b> specific metal emissions to water in g/t of multimetal copper equivalent (base year 2018)	» ISO 14001 at all production sites » Reducing specific metal emissions to water by 50 % in g/t of copper output (Cu) (base year 2012) » Reducing specific dust emissions by 15% in g/t of Cu output (base year 2012)

Similarly, SO<sub>2</sub> emissions in primary copper production were reduced by 10 % in the same period under review.

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 0.9 g per ton of copper output since 2012. This is a decline of 59 % (target: 50 %).

These successes were only possible with continuous investments: we have invested more than € 730 million since 2000 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 and the photovoltaic system in Pirdop. This long-term commitment has been successful: we have considerably reduced our CO<sub>2</sub> emissions per ton of copper at the sites. The carbon footprint of Aurubis' cathode copper is already an impressive 40 % below the global average of all copper smelters and refineries\* [see "A comparison – Life cycle assessment for Aurubis copper cathodes"](#).

The Group-wide introduction of the environmental management system based on the ISO 14001 standard continues to make headway. For example, the Peute site successfully passed the certification audit in March 2022. The Buffalo, Stolberg, and Retorte (Röthenbach an der Pegnitz) sites are in the process of preparing for certification, which should be completed by the end of 2022.

\*Sources: International Copper Association (ICA), Copper Environmental Profile, Sept. 2017/Aurubis, supported by Quantis. Reference years 2013 and 2019. Currently being updated by the ICA.

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

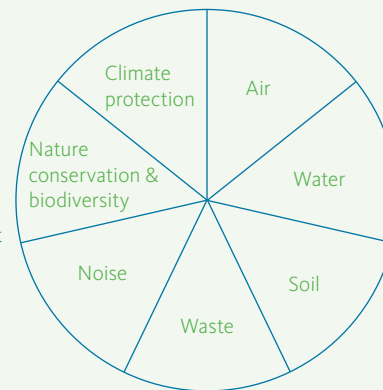
#### Nature conservation & biodiversity

- » **Target: Improving 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**



#### Waste

- » **Target: Increasing recycling rates**

» Example: Stronger marketing of iron silicate (fayalite) in Pirdop

#### Air

- » **Target: Reducing dust emissions in copper production by 15% until 2022 compared to 2012**

36 % reduction achieved in 2021\*

» Example: Reduction of fugitive emissions

#### Water

- » **Target: Reducing metal emissions to water in copper production by 50% until 2022 compared to 2012**

59 % reduction achieved in 2021\*

» 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.

#### Environmental management

- » **Target: Introducing ISO 14001 standard across the Group**

\* The Aurubis sites in Beerse and Berango have been included since 2020.



## A FOCUS ON OUR FLAGSHIP PROJECTS IN ENVIRONMENTAL PROTECTION

### Producing with new, innovative environmental protection technologies

We are a leader in reducing our environmental impact on air, water, and soil in multimetal production. We have a long tradition of developing new and innovative environmental protection technologies.

We want to reach a new milestone at the Hamburg plant, where € 85 million has been invested in measures to continue reducing emissions in the primary smelter with our Reducing Diffuse Emissions (RDE) project, one of the biggest environmental protection projects since the 1980s. 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. For RDE, new technologies are being used and combined in completely new ways. The specially developed, needs-based control of the ridge turrets uses a level of digitalization in environmental protection that is unique in the metals industry thus far, and ensures efficient implementation with the high volumes of exhaust air. Once our plans are fully implemented, we will reduce fugitive emissions from the primary smelter by more than 70 %. All of this contributes to the targets of our Sustainability Strategy – and makes the site ready for the future in the long term.

With this project, we prove once again that modern urban development and copper production – just a few kilometers from downtown Hamburg – can sustainably coexist.



View of the new exhaust system (highlighted in color) at the Hamburg site in direct vicinity to the city

## IN A NUTSHELL: ADDITIONAL ENVIRONMENTAL PROTECTION PROJECTS

- » One of the largest charging parks for e-mobility in northern Germany was built in collaboration with HAMBURG ENERGIE at the Hamburg site and launched in June 2021. A total of 150 charging stations with green energy were set up for employees, company cars, pool vehicles, and guests in two parking lots at the plant. Since many places do not yet have any charging options for electric cars, Aurubis wants to use the construction of the charging park to motivate its employees to buy electric cars. But aside from e-mobility, additional options such as bicycle leasing, subsidized public transportation tickets, sustainable company car arrangements, and the introduction of minimum distances for flights are available to encourage employees to do their part to promote eco-friendly mobility.
- » Likewise in Pirdop, Bulgaria, a new **sand filter** was commissioned in the existing treatment facility for industrial wastewater in 2020. This reduces the discharge of undissolved substances into bodies of water.
- » Following a 50 % reduction in the volume of discharged wastewater at the Lünen site compared to 2019 thanks to optimized water collection and provision, a new water concept will make **water usage more sustainable**. For the coming years, additional optimizations are planned for internal water use such as reviewing the further treatment of internal process water (reverse osmosis, evaporation). The goal is to use water internally to the greatest extent possible and entirely prevent the discharge of process water into the public sewer system. A feasibility study is currently underway and should be completed by summer 2022, with project implementation planned for 2023/2024.
- » To promote **biodiversity**, a pilot project to add greenery to facades on the plant premises was concluded at the Hamburg site. The Pirdop site is taking the initiative to restore certain areas by planting grasses, bushes, and trees. Defunct landfill areas on the premises are renaturated while they are closed.



### Solar energy for copper production

As part of Aurubis' strategic goal to achieve carbon-neutral production no later than 2050, a 10 MW photovoltaic system has been built on the premises of the Bulgarian site, making Aurubis Bulgaria the first industrial consumer in Bulgaria to invest this much in in-house production of green energy. The system will be commissioned in March 2022. We plan to produce 20 % of the energy we require at the site with internal renewable sources by mid-2030.



### First copper anode produced with hydrogen

We tested using hydrogen on an industrial scale at the Hamburg site in spring 2021 and are the first company in the copper industry to do so. A gaseous mixture of hydrogen and nitrogen was used in place of natural gas to pole copper melt in the anode furnace, without interrupting production. Poling refers to a metallurgical purification process or a reduction process in molten metal.

The pilot project, which replaced natural gas with hydrogen and nitrogen at the production facility, went according to plan. By consistently using hydrogen, Aurubis was able to reduce its CO<sub>2</sub> emissions from the Hamburg anode furnace alone by about 6,200 t per year. This reduction could be multiplied many times over throughout the Group. This pilot project tested the facility's reaction to the hydrogen introduced and ensured smooth operation in this stage of production. This experience has allowed Aurubis to lay the foundation for additional Group activities associated with the use of hydrogen [see "Hydrogen as an opportunity for energy-intensive industry"](#).

### Industrial heat for Hamburg

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 residual heat is now used for heating purposes. But there's room for more: the total potential heat volume that could be extracted at Aurubis amounts to up to 500 million kWh per year. We started by expanding the Industrial Heat project in Hamburg at the beginning of 2022, where we plan to reduce CO<sub>2</sub> emissions by 100,000 t annually with an investment of approximately € 100 million [see the "Energy and climate protection" chapter](#).

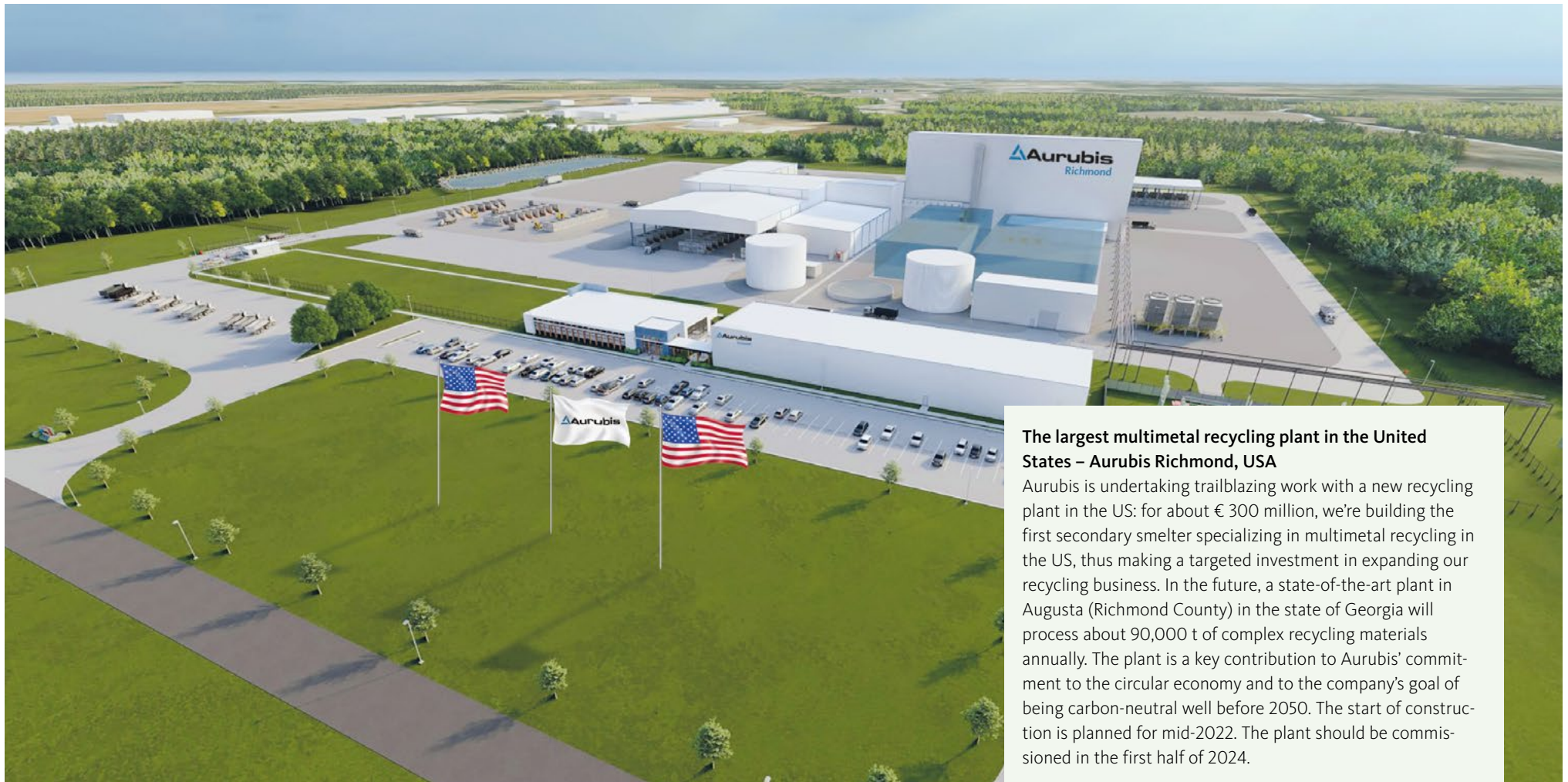
### IN A NUTSHELL: ADDITIONAL ENVIRONMENTAL PROTECTION PROJECTS

- » To reduce **sulfur dioxide emissions and fugitive emissions** from the smelting process, a new facility for cooling converter slag was built at the site in Pirdop, Bulgaria, and went into regular operation in early 2020. This project will be expanded in the coming years to optimize cooling of the slags from the flash smelting furnace as well.
- » A regenerative thermal oxidizer (RTO) is being built at the Beerse site to further reduce the volume of **carbon monoxide and volatile organic compounds** released through smelting operations. The technology was selected, and the supplier commissioned following careful consideration. The approval process will begin in the first quarter of the 2022/23 fiscal year, with the start of construction planned for the third quarter of the 2022/23 fiscal year.
- » 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. Transport that was previously performed by truck is now carried out in an energy-efficient and environmentally friendly manner by waterway. This prevents a total of about 20,000 truck transports per year and thus over 230 t of CO<sub>2</sub> emissions annually. The strategic Bleed treatment Olen Beerse (BOB) project, which includes a hydrometallurgical electrolyte cleaning system, will help reduce noise and CO<sub>2</sub> emissions. Once processed by a different site in the Aurubis smelter network, the electrolyte will be treated at the Olen site in the future, thereby preventing around 2,600 truck transports and thus approximately 1,500 t of CO<sub>2</sub> emissions annually.
- » Within the scope of an EU project, Aurubis helped develop the organizational **environmental footprint** for copper production. In this context, rules for determining the environmental footprint were developed and tested. Production at Aurubis has one of the smallest environmental footprints worldwide [see "A comparison – Life cycle assessment for Aurubis copper cathodes"](#).

### Expansion of our forerunner role in recycling

The economy, industry, and society face enormous challenges. As a leading multimetal company, we're looking to be part of the solution – because “there's no sustainable future without metals.”

With our updated strategy “Metals for Progress: Driving Sustainable Growth,” we continue to focus on growth and invest extensively in recycling, which represents an important contribution to the circular economy in Europe and beyond and another step on our path to becoming the most efficient and most sustainable integrated smelter network worldwide.



#### The largest multimetal recycling plant in the United States – Aurubis Richmond, USA

Aurubis is undertaking trailblazing work with a new recycling plant in the US: for about € 300 million, we're building the first secondary smelter specializing in multimetal recycling in the US, thus making a targeted investment in expanding our recycling business. In the future, a state-of-the-art plant in Augusta (Richmond County) in the state of Georgia will process about 90,000 t of complex recycling materials annually. The plant is a key contribution to Aurubis' commitment to the circular economy and to the company's goal of being carbon-neutral well before 2050. The start of construction is planned for mid-2022. The plant should be commissioned in the first half of 2024.



### Recycling plant for nickel and copper in Belgium

With an investment of € 70 million, we're implementing the Bleed treatment Olen Beerse (BOB) strategic project at the Olen site, which complements an energy-efficient and effective process step in the extraction of nickel, an indispensable metal for lithium-ion batteries and thus a key component for the megatrend of e-mobility. The new facility in Belgium is another shining example of how Aurubis implements synergies in its smelter network and makes an important contribution to the circular economy in Europe. Construction of the facility is scheduled to start in September 2022, with commissioning planned for summer 2024.



### Growth area of battery recycling

In March 2022, we commissioned an innovative pilot plant for battery recycling at the Hamburg site. Battery recycling will gain substantial importance in the years to come since the push for e-mobility will continue, causing demand for lithium-ion batteries and raw materials for their production to rise rapidly. Recycling can counter the expected shortage of valuable metals and fulfill the growing demand. The pilot plant will extract metals such as lithium, nickel, cobalt, manganese, and graphite from so-called black mass in a hydrometallurgical process. Black mass is a powdery material that forms when battery modules and battery cells are mechanically recycled. The next step after the pilot plant is a feasibility study. Our goal is to commission an industrial-scale battery recycling plant in the next five years.

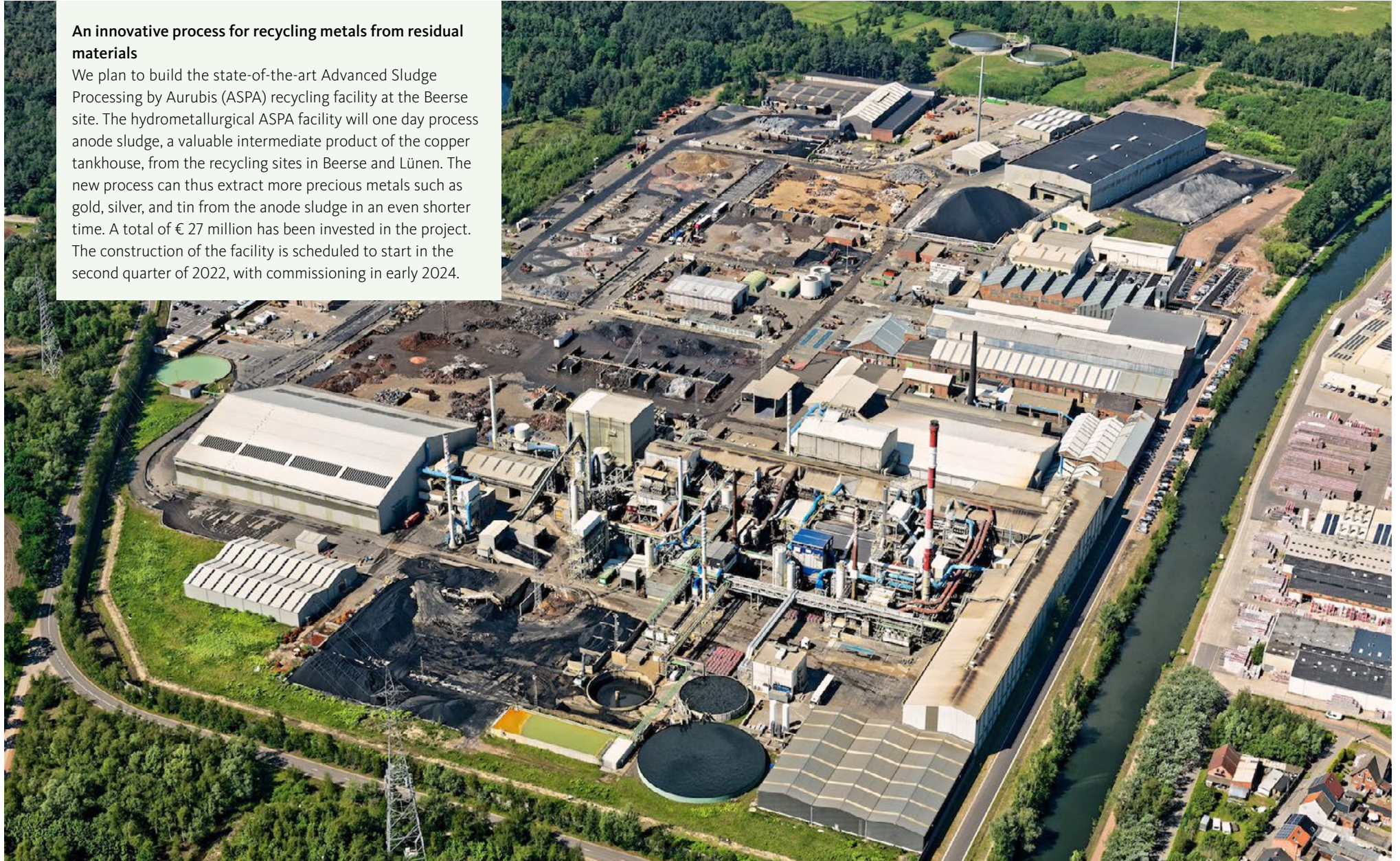
#### Black mass





### An innovative process for recycling metals from residual materials

We plan to build the state-of-the-art Advanced Sludge Processing by Aurubis (ASPA) recycling facility at the Beerse site. The hydrometallurgical ASPA facility will one day process anode sludge, a valuable intermediate product of the copper tankhouse, from the recycling sites in Beerse and Lünen. The new process can thus extract more precious metals such as gold, silver, and tin from the anode sludge in an even shorter time. A total of € 27 million has been invested in the project. The construction of the facility is scheduled to start in the second quarter of 2022, with commissioning in early 2024.





## DIALOGUE WITH INTERESTED PARTIES AND 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 participate in various environmental projects.

Since 2013 we have participated in the EU projects Organisation 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, test, and possibly implement the methods for determining the environmental footprint. In 2018, the two pilot projects we participated in were successfully concluded after the results were accepted by the official supervisory bodies. We're also contributing our experience to further develop the environmental footprint. For example, we're actively involved in the further development of industry rules for copper production.

Since 2003, we've been a member of Hamburg's Environmental Partnership 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 2016 in collaboration with 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, a bike rental station was set up in front of a plant entrance, and "JobRad" bicycle leasing has been supported at the site since 2021.

Aurubis has successfully participated in the Carbon Disclosure Project (CDP) investor initiative since 2015, which surveys

companies about risks and opportunities related to the climate as well as CO<sub>2</sub> reduction potential. In 2021, we took part in the CDP water security survey for the first time, which addresses current and future water-related risks and opportunities. Participation initially included a basic version of the questionnaire that is not evaluated. Completion of the full version with subsequent evaluation by the CDP is planned for 2022.

## ENVIRONMENTAL MANAGEMENT ORGANIZATION

Chief Operating Officer Dr. Heiko Arnold and Head of Corporate Environmental Protection Dr. Karin Hinrichs-Petersen are responsible for the strategic positioning of environmental protection in the Group. Environmental protection 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 Lünen 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.

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 Federal Immission Control Act (BImSchG), the Circular Economy Act (KrWG), the Federal Water Act (WHG), 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.

In 2017, an integrated management system (IMS) was developed for Aurubis AG for the areas of environment, energy, quality management, and occupational health and safety, with the first three areas certified that same year. The IMS utilizes synergies, harmonizes processes, and improves management in these areas.

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 Hamburg site, 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 Policy 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. For this purpose, we regularly carry out environmental risk assessments at every production site through an external expert. Topics of the assessments include emissions to air and water, water management, and handling hazardous substances, but also the challenges that climate change poses. In recent years, we've expanded the assessment to include the additional topics of biodiversity, nature conservation, and water availability and water stress.

Fig. 1.3: Aurubis environmental protection organizational chart

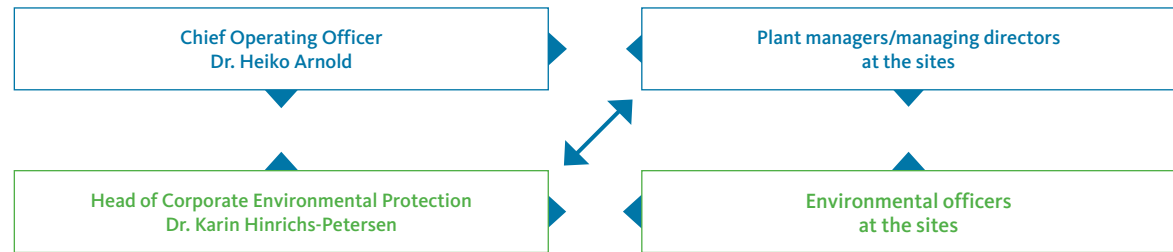


Fig. 1.4: Environmental management in the Aurubis Group

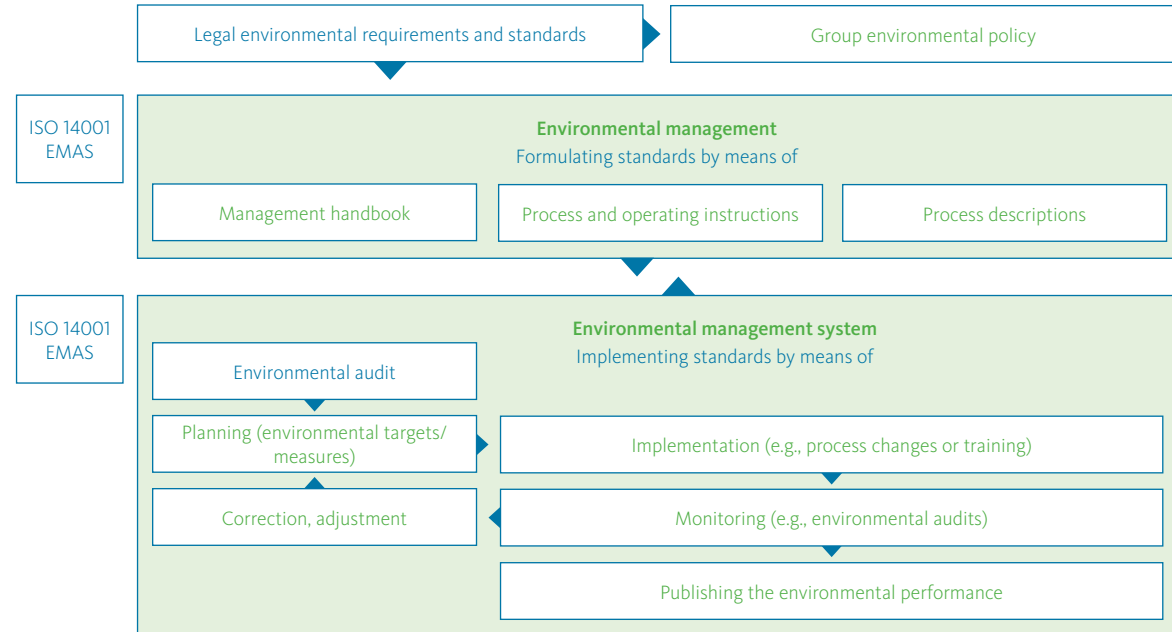


Fig. 1.5: Site certifications

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

<sup>1</sup> Not majority-owned by Aurubis (50 % stake).

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

<sup>3</sup> WEEE LABEL of EXcellence.

#### Explanation

<b>EMAS:</b>	System of specifications for environmental management systems and environmental audits
<b>ISO 14001:</b>	Standard for environmental management systems
<b>ISO 50001:</b>	Standard for energy management systems
<b>ISO 45001:</b>	Standard for occupational safety management systems
<b>ISO 9001:</b>	Standard for quality management systems
<b>IATF 16949:</b>	Standard for quality management systems in the automotive industry, based on ISO 9001
<b>EfbV:</b>	Ordinance on Specialized Waste Management Companies (German certificate)
<b>WEEELABEX:</b>	Standards regarding the collection, sorting, storage, transport, treatment, processing, and disposal of electrical and electronic devices and their preparation for reuse
<b>Copper Mark:</b>	Quality seal for the copper sector for responsible copper production based on 32 internationally recognized sustainability criteria

## Energy and climate protection

### OUR CLIMATE, OUR CONTRIBUTION

With the Green Deal, the EU has an ambitious target for 2050: a resilient economy and society that achieves carbon neutrality through high innovative strength and competitiveness. We demonstrate that this aligns with our targets with our affirmation of the Science-Based Targets initiative. We have committed to setting science-based CO<sub>2</sub> reduction targets, contributing to the 1.5 °C goal of the Paris Climate Agreement. And we want to become carbon-neutral well before 2050.

At all of the relevant production sites, we have been successfully implementing CO<sub>2</sub> reduction projects through different energy efficiency measures for years. Furthermore, we are working on making our electricity uptake more flexible, so that we can react to fluctuating electricity availability and use more renewable energies. Shifting the electricity supply to renewable energies, utilizing hydrogen as a reducing agent in the copper process, and investing in new facilities: this is what the future holds. And we also provide solutions outside of our plants, solutions that save energy and thus CO<sub>2</sub> – such as the Industrial Heat project.

### MANAGEMENT APPROACH

The individual production steps in the Aurubis value chain are complex and very energy-intensive overall. Accordingly, the effective and efficient use of energy is an issue of ecological and economic responsibility. The use of energy is the main source of CO<sub>2</sub> emissions in the Group. Taking the entire value chain into consideration, over half of the CO<sub>2</sub> emissions are upstream and downstream – i.e., they originate from our suppliers, customers, and service providers (Scope 3 emissions). Most of the Scope 3 emissions originate from the activities of the mining companies from which we source ore concentrates.

At the same time, the products we manufacture contribute to reducing CO<sub>2</sub> emissions in our society because they play an important role in renewable energies, applications that boost energy efficiency, and electric vehicles: Electric cars contain nearly four times more copper than vehicles with conventional combustion engines, and building and connecting an offshore wind turbine to the energy grid requires up to 30 t of copper.

Determining climate-related opportunities and risks and deriving related measures are two issues that link our risk management and our energy and climate strategy. When doing this, we consider (pending) legal requirements, technological developments, and compliance-related, reputational, and physical risks.

The development and implementation of the Group-wide energy and climate 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 CEO. The corporate department also coordinates the development of the energy management and monitoring systems across the Group, providing for a uniform approach and facilitating the exchange of expertise regarding best practice examples – for instance, in the form of an energy efficiency network for the German Aurubis sites' energy management officers and a regular international Aurubis workshop. Topics include completed and planned energy efficiency projects, results of energy audits, the current legal situation, and aid programs and implementation assistance related to new requirements.

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 further optimize energy demand. 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 using energy performance KPIs and identify additional energy savings potential with the goal of continuous improvement, the main German sites are certified in accordance with DIN EN ISO 50001:2018. 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 EFFICIENCY AND REDUCING THE USE OF FOSSIL FUELS

To prevent CO<sub>2</sub> emissions, we primarily focus on energy efficiency measures. 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.



The more steps that have been implemented in energy efficiency in the past, the more challenging a further optimization is. Because there are technological limits to reducing energy consumption and emissions, the improvements achieved today inside the plants are only marginal compared to previous years, despite equally high investments. For example, complex recycling raw materials with relatively low metal contents and complex copper concentrates require a higher specific energy input to be processed. As a result, we focus not only on further increasing efficiency, but also on solutions that save energy and thus prevent CO<sub>2</sub> emissions outside of our plant, as well as on projects that contribute to the energy shift.

Furthermore, we are increasingly considering measures to replace fossil fuels with alternatives. Green hydrogen is considered a key technology for decarbonizing industry. Hydrogen is an energy source that can be used to store and transport energy. It can be converted into electricity and replace crude oil and natural gas in production – without releasing CO<sub>2</sub> in the process. Aurubis is investigating how hydrogen can be efficiently and cost-effectively integrated into production and currently sees the biggest potential in the material use of hydrogen in the anode furnaces. In this process step, the copper's purity is enhanced by using natural gas as a reducing agent. When the natural gas is substituted by hydrogen, the hydrogen reacts with the copper and reduces copper oxide in the process. This forms water vapor alone, and not CO<sub>2</sub> as before. Testing the use of ammonia as a substitute for natural gas is also in the pipeline. Ammonia is much easier to transport over longer distances than hydrogen. ADNOC will provide Aurubis with a test supply of ammonia via HHLA for the purpose of testing the supply chain and the use of ammonia as a fuel in the production of copper.

The use of renewable energies on a large scale is a challenge for us, since generating them is associated with energy supply fluctuations. However, our production processes require a constant energy supply. We are therefore working on measures to make our energy uptake more flexible so that we can react to fluctuating energy availability and thus use more renewable energies.





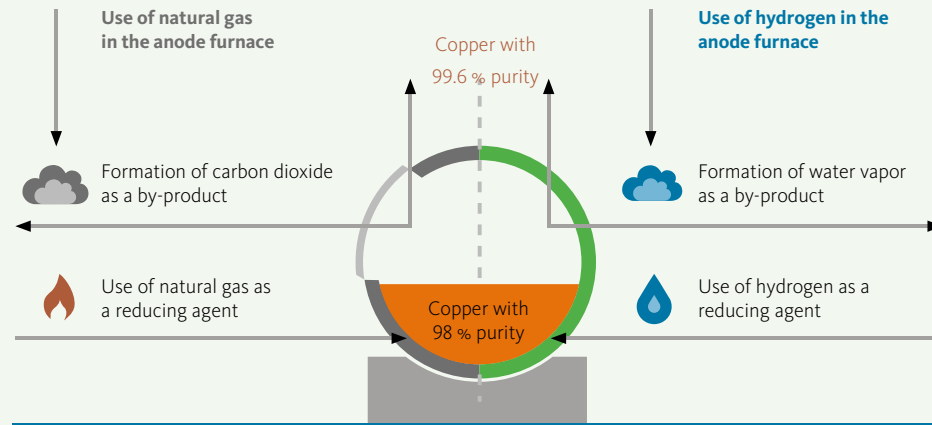
Groundbreaking ceremony for the photovoltaic system at the Pirdop plant on June 24, 2021, with Prime Minister Kiril Petkov and Aurubis CEO Roland Harings

The Aurubis-1 photovoltaic system at the Pirdop site will optimize the smelter's external energy consumption by 11,000 MWh annually. The electricity generated is equivalent to the annual requirements of 3,500 households or a city with a population of 14,000. Compared with the use of coal-generated power, this will reduce CO<sub>2</sub> emissions by 15,000 t per year – and over 225,000 t for the planned period of operation.

Aurubis is participating in the Living Lab Northern Germany and, within the scope of this project, investigating the cost-efficiency of producing and using hydrogen in copper production. The goal of the Living Lab Northern Germany is to continue carrying out trials related to the energy system transformation and decarbonization possibilities. One focus in this context is integrated energy with a concentration on hydrogen.



Fig. 1.6: Possibility of using hydrogen instead of fossil fuels



### Hydrogen as an opportunity for energy-intensive industry

Green hydrogen is considered a key technology for decarbonizing industry. It can store energy, be converted into electricity, and replace crude oil and natural gas in production – without forming greenhouse gases.

Aurubis successfully completed the series of tests for hydrogen use on an industrial scale in copper anode production at the Hamburg plant in 2021. The pilot project, which replaced natural gas with hydrogen and nitrogen at the production facility (anode furnace), was successful. Initially, the current tests will gauge the behavior of the facilities in response to the introduced hydrogen and ensure that the individual production steps, which are highly sensitive in the energy-intensive metal production process, run smoothly. CO<sub>2</sub> emissions were reduced by 6,200 t annually in regular operation.



Green light for the series of tests for first-time use of hydrogen on an industrial scale in the copper industry

## OUR SUCCESSES

### Successful participation in the CDP investor initiative since 2015

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 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 residual heat – that is, converting it into electricity and using the residual heat – the recycling center achieves optimum energy recovery. The installation can produce up to around 23 million kWh of electricity (about 14 % of the site's annual energy needs or the average annual energy demand of around 6,500 three-person households). It therefore simultaneously manages to prevent up to 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, in 2015, awarded it the label Best Practice in Energy Efficiency.



### The 2021 VCI Responsible Care Competition for the Hamburg site

Aurubis AG won the Responsible Care Competition of the German Chemical Industry Association (VCI) in 2021. The association is therefore recognizing an innovative pilot project to decarbonize the copper process. Aurubis started the project at its Hamburg plant in May 2021. For the first time, the multimetal company is using carbon-neutral hydrogen as a reducing agent for copper in the anode furnace, replacing the natural gas currently used in the process without a loss of quality.



## OUR FLAGSHIP PROJECT – AURUBIS INDUSTRIAL HEAT

Hamburg's Hafencity East is the first urban neighborhood to be fully supplied with CO<sub>2</sub>-free industrial heat. Aurubis extracts CO<sub>2</sub>-free heat from a chemical subprocess of copper production and, working with the energy supplier enercity, delivers it to Hafencity East through a pipeline that's roughly 3.7 km long.

In its size and complexity, the project is unique in Germany. It cuts up to 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 each invested over € 20 million in the project, 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).

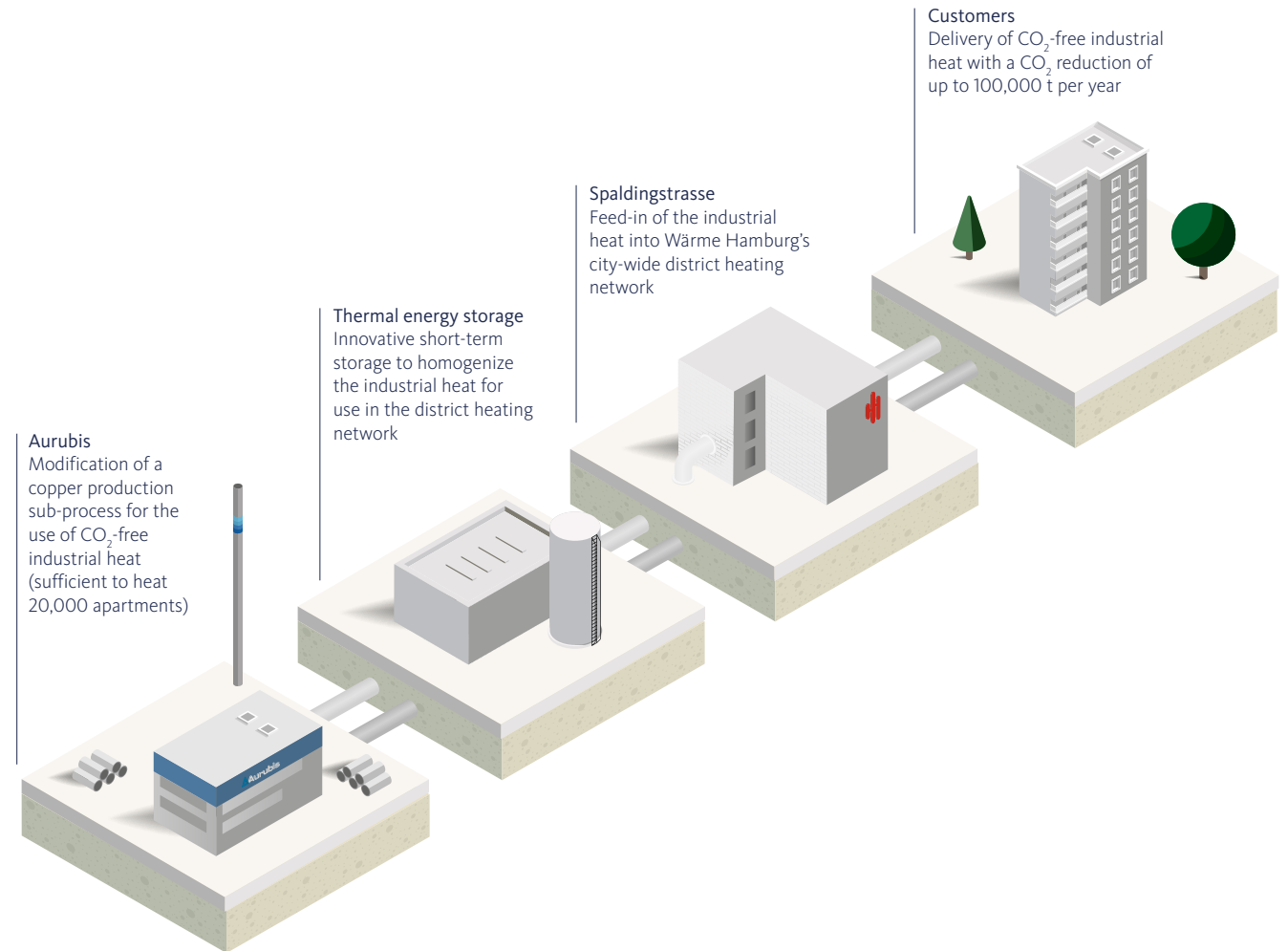
As of the 2024/25 heating period, about 20,000 more households will be supplied with CO<sub>2</sub>-free industrial heat. This is part of a heat supply contract that Aurubis and Wärme Hamburg signed in December 2021. The use of CO<sub>2</sub>-free industrial heat in the Wärme Hamburg heating network will replace heat that is currently generated from fossil fuels, which can reduce CO<sub>2</sub> emissions by up to 100,000 t annually in Hamburg starting in 2025. The planned heat supply represents the biggest use of industrial heat in Germany.

Calculations by the German Energy Agency (dena) show: throughout Germany, companies could reduce CO<sub>2</sub> by up to 37 million t and save roughly € 5 billion in energy costs per year 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.



Fig. 1.7: Integration of Aurubis AG industrial heat





## Our raw materials – Responsibility in the supply chain

As a producer of copper and other non-ferrous metals, we are aware of our responsibility toward the environment and people who could be directly or indirectly impacted by our business activities. It is important to us to carry out a risk assessment and select business partners carefully in Germany and abroad. This is all the more important because we source raw materials from around the world for our business. With our Sustainability Strategy, we promote responsible management of our supply chain. We have set ourselves the goal of removing all high-risk suppliers from our portfolio by 2030. 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.

We use copper concentrates, copper scrap, other metal-bearing recycling materials, and bought-in intermediates as feed material, which we largely source on the European market. Aurubis has a globally diversified supplier portfolio. We source a significant portion of our copper concentrates from South American countries such as Chile, Peru, and Brazil. For primary raw materials, we value long-term relationships and strategic cooperation with our suppliers. Most of the copper scrap and metal-bearing recycling raw materials for our four secondary smelters in Lünen (Germany), Olen and Beerse (both in Belgium), and Berango (Spain) are sourced in the European and North American markets. Compared to primary raw materials, secondary raw materials are largely purchased on the basis of short-term supply contracts.

To close the value chain for copper and other metals, we place a high priority on the “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. We therefore provide the downstream value chain with solutions to conserve resources while promoting waste prevention.

Aurubis has participated in the United Nations Global Compact (UNGC) since 2014 and is therefore committed to implementing its Ten Principles related to human rights, labor, the environment, and anti-corruption. In fiscal year 2019/20, the Aurubis Business Partner Code of Conduct was introduced across the Group. This outlines our requirements regarding human rights and labor standards, occupational health and safety, environmental and climate protection, business integrity, and responsible mineral sourcing, as well as reporting procedures and the monitoring of the business partner's due diligence obligation. Aurubis AG expects its business partners to follow the fundamental conventions of the International Labour Organization (ILO), the United Nations Declaration of Human Rights, and applicable national and local laws and regulations.

We have implemented Aurubis Business Partner Screening to fulfill our due diligence obligation. Using this tool, we subject our business partners to a screening process and analyze them with regard to their integrity in relation to social and ecological criteria. The focus of the process is on the topics of compliance, corruption, human rights violations, and environmental and climate protection. Based on this assessment, management decides on possible contracts or restrictions. For existing business partnerships, the analysis is repeated regularly depending on the original risk. The screening is based on the principles of the OECD. We are planning to introduce an updated and uniform Business Partner Screening system for fiscal year 2021/22.

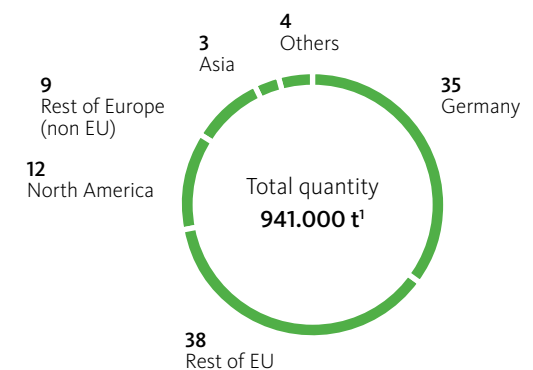
**Fig. 1.8: Origin of concentrates and throughput**

for the Aurubis Group in 2020/21, in %



**Fig. 1.9: Origin of recycling materials and throughput**

for the Aurubis Group in 2020/21, in %



¹ exkl. FRP

## REGULATION AND STANDARDS FOR RESPONSIBLE METAL PRODUCTION

On January 1, 2021, the EU's Conflict Minerals Regulation went into effect, making extensive due diligence/audit obligations along the supply chain binding for EU importers of tin, tantalum, tungsten, their ores, and gold. The intention is – as previously addressed through the US Dodd-Frank Act from 2012 – to curb the financing of violence and human rights violations in conflict or high-risk areas. The regulation requires European importers of these metals to have implemented risk management in their raw material purchasing and to have this audited by third parties.

Since 2013, Aurubis' gold production has been annually certified as conflict-free according to the standards of the London Bullion Market Association (LBMA). The certificate verifies that we carry out our due diligence processes in accordance with the OECD standards promoting responsible supply chains for minerals from conflict and high-risk areas in connection with the procurement of gold-bearing raw materials. This certification option has also been available for silver since 2019, and Aurubis has been certified as conflict-free in this area since then as well. Tin production at our Beerse and Berango sites has been certified as conflict-free in accordance with the Responsible Minerals Assurance Process (RMAP) standard of the Responsible Minerals Initiative (RMI) since 2015. This standard is also based on the OECD standard for conflict minerals. Suppliers of other raw materials go through a comparable process to those who supply gold- and silver-bearing raw materials.

The Copper Mark is an initiative that entails a review of the sustainability standards of copper production sites, including mines, smelters, and refineries. In fiscal year 2019/20, Aurubis Bulgaria was the company's first primary smelter to successfully conclude the multi-stage review process. The Hamburg and Lünen sites also committed to The Copper Mark in July 2021 and started the audit process. With this standard, we want to foster responsibility throughout the value chain, boosting and verifying our own sustainability performance with an external certification from an independent body. Additional sites will follow successively.

In addition to purchasing primary and secondary raw materials, Aurubis procures goods, services, and operating supplies that are required for our production, but that don't go into our sales products (indirect procurement). We select suppliers and service providers according to established supplier assessment processes – for example, by consulting a catalogue of questions about environmental protection, occupational safety, and social issues. It is updated regularly and has to be answered by all new suppliers. Suppliers that do not complete the questionnaire or that provide insufficient answers are not considered in the rest of the tendering procedure. When it comes to purchases with environmental importance made by Aurubis AG, we carry out an authorization process related to the purchases' environmental compatibility. This is used for waste disposal services, for example. We annually review the documents from our suppliers whose work is environmentally relevant to ensure that they are complete. Environmental protection and safety requirements for the product as well as services connected with the product or the supplier are defined and taken into consideration when sourcing investment goods. The criteria include energy consumption, emissions, material input, prescribed disposal methods, the expected life cycle, and whether important test certificates are available – for example, for material quality or employee qualifications.

## Risks and opportunities

### RISK MANAGEMENT IN THE AURUBIS GROUP (RISK MANAGEMENT SYSTEM)

Risk management is a fundamental part of corporate governance at Aurubis. Our objective in risk management is to manage and monitor the risks associated with our business with the help of a risk management system (RMS) suited to our activities. Identifying and observing risk development early on is of major importance. Furthermore, we strive to limit negative effects on earnings caused by risks by implementing appropriate and economically sound countermeasures.

Risk management is an integral component of the centralized and decentralized planning, management, and monitoring processes and covers all of the Aurubis Group's main sites, business sectors, and central functions. The planning and management system, risk reporting, open communication culture, and risk reviews at the sites create risk awareness and transparency with regard to our risk situation. The RMS is documented in a corporate policy.

Risk management officers have been appointed for all sites, business sectors, and central functions, and they form a network within the Group. The Group headquarters manages the network. Corporate Risk Management has regular discussions with the Corporate Environmental Protection, Sustainability, and Corporate Energy & Climate Affairs departments – for example, to report on new legislative proposals, broadly identify risks related to them, and prepare measures to control these risks in good time. These discussions also promote the risk culture and risk awareness in the Aurubis Group.

Standard risk reporting takes place bottom-up each quarter using a uniform, Group-wide reporting format. Within this format, the identified risks and risks beyond a defined threshold are explained and evaluated on the basis of their probability of occurrence and their business significance. Measures to manage them are then outlined. The risks registered with Group headquarters are qualitatively aggregated into significant risk clusters by Corporate Risk Management and reported to the entire Executive Board. The report also establishes the basis for the report to the Audit Committee as well as external risk reporting.

### LOCAL RISK MANAGEMENT AND OPPORTUNITIES

Based on the system described above, every site and every centralized function is required to maintain and carry out “local” risk management. For example, the Corporate Environmental Protection and Energy & Climate Affairs departments have codified their own corporate policies that govern the way they handle risks in their specific areas of responsibility – in alignment with the Corporate Risk Management Policy.

Moreover, the environmental risks for all Group sites are regularly analyzed and assessed by external experts. Measures are developed and stipulated to effectively counter possible risks.

In 2021, these risk analyses were expanded to include the areas of biodiversity, water availability, and nature conservation. Opportunities were systematically analyzed as well. The reports for the Hamburg, Lünen, Pirdop, Olen, Beerse, and Berango sites were completed in April 2021. If they exceed the thresholds mentioned above, key results from these analyses are included in the risk reporting that is submitted to Corporate Risk Management. The risk assessment process will be updated in 2022.

One opportunity is that Aurubis will contribute substantially to achieving the targets of the European Green Deal. We enable a more efficient use of resources and an increase in recycling in particular. At Aurubis, we produce multimetals using environmentally compatible methods and play a role in a circular, climate-friendly economy. With the ongoing integration of the plants in Beerse and Berango, Aurubis is reinforcing its recycling capabilities and opportunities. Recycling is crucial for a sustainable society.

Aurubis has set itself the goal of ensuring carbon-neutral operations well before 2050. In late 2019, we joined the UNGC initiative Business Ambition for 1.5°C, which requires the Group to set science-based emissions reduction targets (Science-Based Targets) and thus to contribute to achieving the 1.5°C objective from the Paris Climate Agreement. Our metals are a key component of modern environmental technologies; without our products, an energy transition wouldn't be possible. Aurubis is also taking advantage of the opportunity to continue developing the best available techniques (BATs). For instance, we are investing in a new ridge turret suction system in our copper smelter in Hamburg to develop innovative, IT-controlled environmental protection technologies and to reduce emissions even further. This project makes us a forerunner that can serve as a role model to other multimetal producers.

### EXPLANATION OF RISKS

The main risks for the risk clusters “Energy and climate,” “Sustainability,” and “Environmental protection,” including the specific measures to control the risks, are explained in the Risk and Opportunity Report of the Annual Report [see Annual Report 2020/21](#). The climate risks in the Annual Report are categorized in physical and transitory risks, in alignment with the definition given by the Task Force on Climate-Related Financial Disclosures (TCFD). In this way, we document that we take climate protection very seriously on the one hand, and, on the other, that we fulfill the heightened interest in information that the readers of the Annual Report have regarding our climate risks.

In addition to the financial risks just described, there are also non-financial risks that are reported separately in the scope of the Non-Financial Report [see Annual Report 2020/21](#). In the process, no non-financial risks were identified that were very likely to cause a serious negative impact on employee and environmental matters, on respect for human rights, on the prevention of corruption and bribery, or on social matters. Nevertheless, it is important to us to handle non-financial risks even if they are evaluated as non-material according to the strict definition of the German Commercial Code (HGB), and we have developed and implemented related management approaches.



## Iron silicate:

### A versatile and sustainable substitute for primary raw materials

For us, practical resource conservation includes using our raw materials as completely as possible and directing them into the value chain. One example is our synthetic minerals consisting of iron silicate that we produce in our metal refining and recycling processes and whose qualities we specifically adjust and monitor for applications in the construction sector in particular.

#### WHAT IS IRON SILICATE?

Iron silicate is an industrially produced mineral comparable to natural stone from quarries, but without the disadvantage of strong interference in nature. Aurubis is a leading global provider of non-ferrous metals and one of the largest copper recyclers worldwide. Iron silicate has different uses, especially in construction as a replacement for primary building materials.

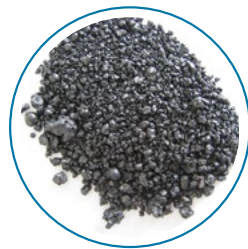
#### WHAT DOES IRON SILICATE CONSIST OF?

As the name suggests, it mainly consists of the mineral iron silicate, as well as silicates of aluminum and calcium. Trace metals are largely included in the silicate phases, which are therefore characterized by high bounding stability and low leachability.

There are three basic products, depending on the process:



Iron silicate stone, with edges up to 450 mm in length, comparable to igneous rock



Iron silicate granulate, similar to e.g. natural volcanic glass



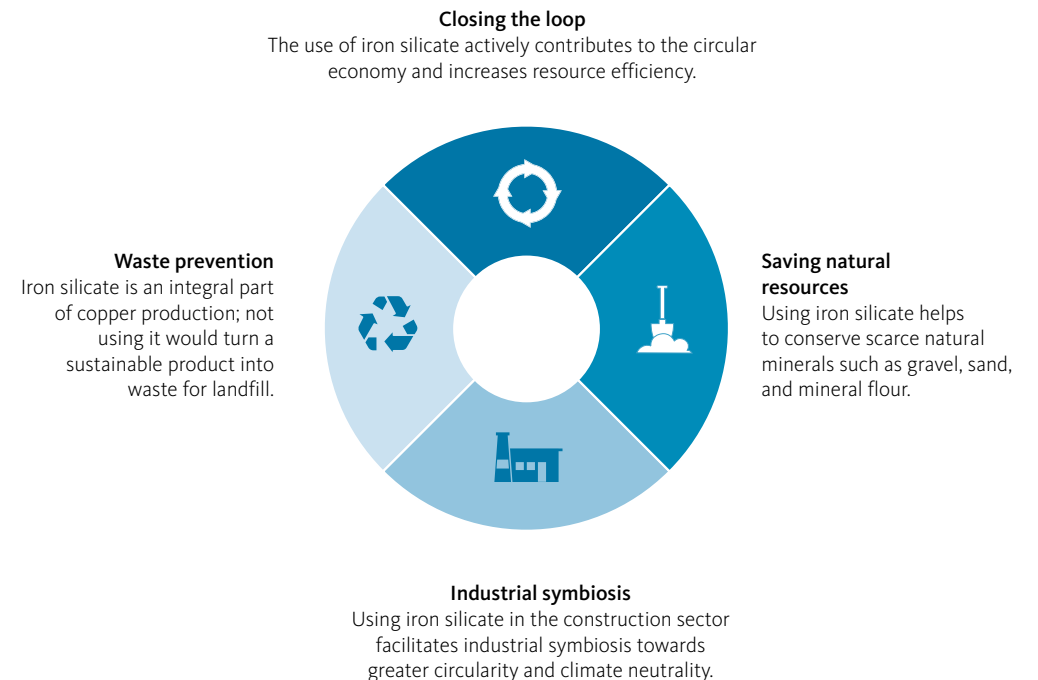
Iron silicate fines, similar to e.g. mineral flour

#### ADVANTAGES OF IRON SILICATE

- » High dry bulk and specific density
- » Ideal volume stability
- » Optimal surface coarseness
- » Very durable
- » Doesn't absorb much water
- » Very hard
- » Dense pore structure
- » Very good frost resistance
- » Cubic grain shape
- » High weather resistance
- » No linear deformations

A long-lasting, sustainable replacement for natural building materials

Fig. 1.10: A heavyweight with considerable potential in the circular economy and climate protection





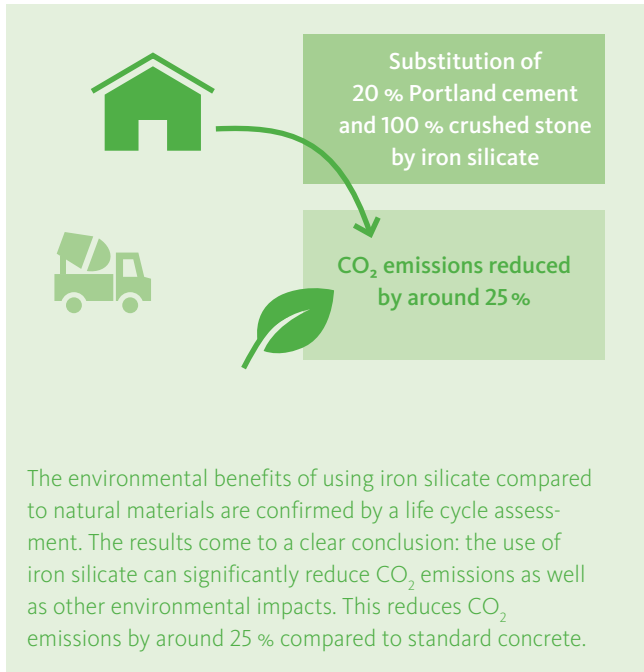
### ACTIVE CLIMATE PROTECTION

Iron silicate can reduce CO<sub>2</sub> by the following volumes per year:

- » 11,400 t of CO<sub>2</sub> when used in road construction by preventing the recovery of aggregate in quarries
- » 170,000 t of CO<sub>2</sub> as a reactive mineral additive in blended cements
- » 116,000 t of CO<sub>2</sub> as a substitute for cement and crushed stone in concrete

Baseline: use of 1 million t of gravel, cement, and concrete. Substitution of 100 % gravel, 100 % crushed stone, and 20 % Portland cement by iron silicate.

Source: life cycle assessment of different substitution scenarios for iron silicate, Quantis, technical report, September 2020/Aurubis calculation



### AURUBIS' COMMITMENT TO INNOVATION FOR LOW-CARBON CONSTRUCTION MATERIALS

We are continuously collaborating with EU innovation and research projects to further investigate the potential offered by iron silicate in new applications and to develop less carbon-intensive construction materials.



**Goal:** Development of a new generation of construction materials and concrete with a low carbon footprint. Application in alkali-activated binders/geopolymers based on iron silicate.

**Financing:** Horizon 2020

**Partners include:** Ghent University, Delft University of Technology, Karlsruhe Institute of Technology, ETH Zurich, and 15 industrial partners



**Goal:** Upscaling project to produce inorganic polymer building materials from iron silicate, using a modular and mobile upscaling unit. This would result in a lower environmental footprint and would make metallurgical industries an important raw material supplier with integrated zero-waste processes.

**Financing:** EIT KIC Raw Materials

**Partners include:** Katholieke Universiteit Leuven, University of Athens, ResourceFull, ZAG



**Goal:** European training network for the valorization of industrial process residues such as cementitious materials and inorganic polymers.

**Financing:** Horizon 2020 MSCA-ETN

**Partners include:** Katholieke Universiteit Leuven, University of Leicester, University of Bonn, TU Bergakademie Freiberg








**Goal:** Development of innovative, recyclable inorganic polymer-based materials, based on slags from non-ferrous metallurgy.

**Financing:** SIM ICON MARES

**Partners include:** Katholieke Universiteit Leuven, VU Brussels, BRRC, Flamac

## WHAT IS IRON SILICATE USED FOR?

Its technical properties enable iron silicate to be deployed in a wide range of applications. Fifty years of practical experience and substantial testing demonstrate that it is safe to use throughout its entire life cycle. Iron silicate is registered in compliance with the EU's REACH regulation and is available at a consistent quality throughout the year.

Area		Purpose	Special advantages
Hydraulic engineering		Protecting embankments and the beds of rivers, canals, and harbor basins against tide and waves.	<ul style="list-style-type: none"> <li>» Thinner stone layers and less excavation work</li> <li>» Stability through high dry bulk density, cubic particle shape, and optimal surface texture</li> </ul>
Road construction		Used as an anti-frost and gravel-bearing layer	<ul style="list-style-type: none"> <li>» Very good load-bearing capacity</li> <li>» Frost resistance</li> <li>» Water permeability</li> </ul>
Cement		As an underlay for paving	<ul style="list-style-type: none"> <li>» Ready-to-use source of iron</li> <li>» Decreases burning temperature and therefore fuel consumption</li> </ul>
Concrete production		Versatile use as a substitute for natural aggregates and Portland cement	<ul style="list-style-type: none"> <li>» Enhances workability in its fresh state, improves mechanical properties, enhances durability</li> <li>» Enables special types of concrete such as radiation protection concrete, heavyweight concrete</li> </ul>
Abrasives		Granulate used for blast cleaning	<ul style="list-style-type: none"> <li>» Provides a perfect grit for blasting steel, stone, and concrete</li> </ul>

In addition to these examples, **iron silicate can also be used in asphalt, ceramics, dry mixtures, coal flotation, soil stabilization,** and many other ways.



## BIODIVERSITY

We are actively involved in creating and maintaining good conditions for species conservation and biodiversity in our plants and their surroundings. After all, we've come to realize that protecting biodiversity is one of the major environmental challenges of our time, and have thus incorporated it as an additional dimension of our sustainable development. It has therefore also been one of our environmental targets for several years now. We plan to further expand and systematically structure our activities in this segment as well as in our biodiversity management.

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 in the Group: 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 Olens 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, a fayalite landfill that was closed at the Pirdop site in late 2018 was ecologically restored. At the Hamburg site, a pilot project to set up a green facade was implemented to promote biodiversity and improve the ambient air.

Options for promoting biodiversity are assessed for every project and building development.

**Fig. 1.11: Conservation areas in close proximity to copper production sites**

	Name	Type	Distance	Direction
Hamburg (DE)	Hamburger Unterelbe	Natura 2000	200–600 m	Southeast
	Holzhafen	Natura 2000	600–1,000 m	East
	Heuckenlock/Schweenssand	Natura 2000	3,600 m	South
Pirdop (BG)	Tsentralen Balkan – bufer (nature conservation area)	Natura 2000	approx. 1,000 m	North
	Tsentralen Balkan – bufer (bird conservation area)	Natura 2000	approx. 1,700 m approx. 2,300 m	North East
	Sredna Gora <sup>1</sup>	Natura 2000	approx. 2,300 m	South
Lünen (DE)	In den Kämpen, Im Mersche und Langerner Hufeisen	Natura 2000	<2,000 m	Northeast
	Lippeaue	Natura 2000	<5,000 m	Northwest
	Lippe-Unna, Hamm, Soest, Warendorf	Natura 2000	<2,500 m	Northwest
Olen (BE)	Valleigebied van de Kleine Nete met brongebieden, moerassen en heiden	Natura 2000	approx. 1,000 m	North
	De Vallei van de Kleine Nete benedenstrooms	VEN <sup>2</sup>	approx. 1,000 m	North
	Het Olens Broek en Langendonk	VEN <sup>2</sup>	approx. 1,000 m	North
Beerse (BE)	Eksterheide	Natura 2000	approx. 500 m	West
	Duivelskuil	Natura 2000	approx. 750 m	Southwest
	De Pomp-Poelberg	Natura 2000	approx. 1,000 m	Northwest
Berango (ES)	Ría de Mundaka-Cabo de Ogoño Marine Area	Natura 2000	approx. 3,500 m	North
	Ría del Barbadún	Natura 2000	approx. 10,000 m	Southwest

<sup>1</sup> The nature conservation area Sredna Gora is home to the Dushantsi Reservoir, which was created at the same time the copper smelter was constructed in the 1950s to supply industrial water to the Pirdop plant and is operated by Aurubis.

<sup>2</sup> VEN: Vlaams Ecologisch Netwerk (Flemish environmental network).

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

### Already small and shrinking: the environmental footprint of Aurubis cathode copper

Metals – and, in particular, copper – are the key to a clean energy transition and thus achieving the EU target of a carbon-neutral continent well before 2050. They play an important role in expanding renewable energies, electrification, and building electric vehicles. Clean energy will only truly be clean once metal production is sustainable across the entire value chain.

As a sustainably oriented multimetal company, Aurubis assumes responsibility for the global challenges of climate change, environmental protection, and resource conservation. We have therefore set ourselves the goal of achieving carbon-neutral production well before 2050. And we're already well on our way: In just six years, we've managed to reduce the carbon footprint of Aurubis' cathode copper by an impressive 25 %. And the footprint of our cathode copper was already 40 % lower than the global average of all copper smelters and refineries.<sup>1</sup>

### Life cycle assessment for Aurubis cathode copper

But CO<sub>2</sub> emissions alone do not provide a full picture of a product's environmental impact, which is why we at Aurubis have determined the environmental profile of our core product, cathode copper, using a life cycle assessment (LCA). This is a recognized method of choice for assessing the environmental impacts of a product throughout its entire life cycle. Using this comprehensive approach, we've taken all of the activities into account, from production of cathode copper to the factory doors ("cradle to gate"). This approach includes copper ore extraction, smelting, refining, transport, energy consumption, and the use of auxiliary materials. The study was conducted in accordance with the ISO 14040 and 14044 standards for life cycle assessments.<sup>2</sup> The calculation includes the production of both primary and secondary raw materials and thus encompasses the weighted average of the cathode copper from across the entire Aurubis Group.

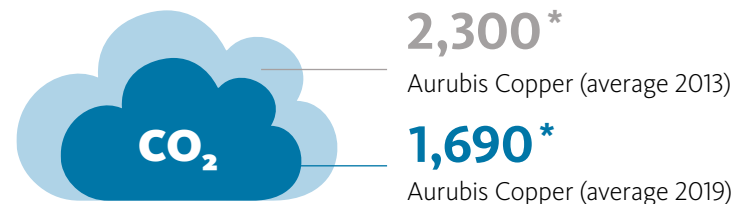
### The result: Our footprint continues to shrink

The results of the update of our earlier life cycle assessment reveal that the environmental footprint of Aurubis cathode copper has continued to decrease drastically in all of the impact categories analyzed. Aurubis therefore makes a real contribution to the global challenge of environmental and climate protection. Important environmental aspects were evaluated on the basis of so-called impact categories, which were selected because they represent a broad spectrum of environmental impacts and can each be determined by a well-established scientific approach.

<sup>1</sup> Sources: International Copper Association (ICA), Copper Environmental Profile, Sept. 2017/Aurubis, supported by Quantis. Reference years 2013 and 2019. Currently being updated by the ICA.

<sup>2</sup> ISO 14040:2006 environmental management – life cycle assessment – principles and framework/ISO 14044:2006 environmental management – life cycle assessment – requirements, and instructions.

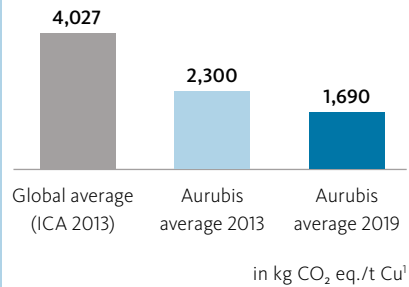
### Carbon footprint of Aurubis cathode copper



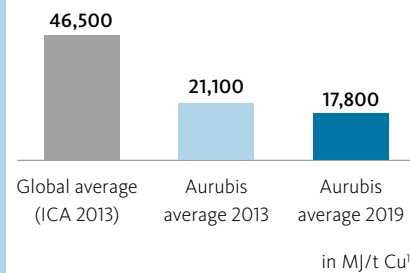
\* CO<sub>2</sub> equivalent per ton of cathode copper in kg

**Carbon Footprint:**

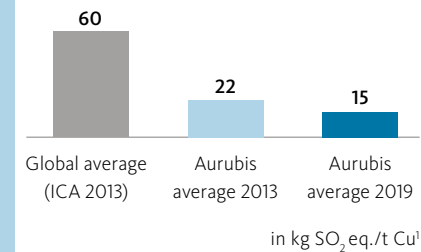
assessing potential impacts  
on climate change / global  
warming

**Primary Energy Demand from non-renewable sources:**

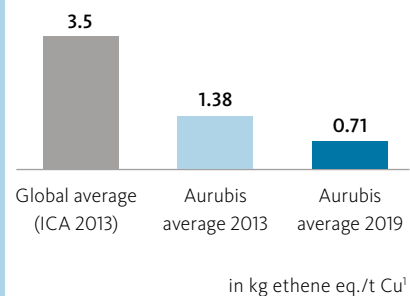
assessing depletion of fossil fuels

**Acidification:**

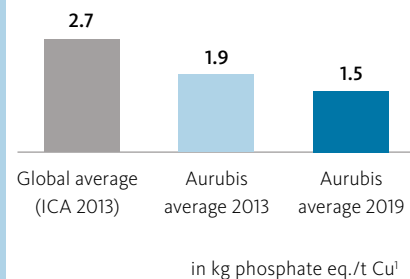
assessing impacts of acidic  
emissions, which cause acid rain,  
for example

**Summer Smog (Photochemical Ozone Creation):**

assessing impacts of emissions  
causing summer smog

**Over-Fertilization (Eutrophication):**

assessing impacts that can cause  
ecological degradation in  
bodies of water, e.g., algal blooms  
and oxygen depletion



**Remark:** The environmental profile of global cathode copper is currently being updated by the International Copper Association (ICA).<sup>2</sup>

Aurubis is participating in this study again, and the profile of Aurubis cathode copper will be updated accordingly. Therefore, a direct comparison of Aurubis' 2019 profile with the ICA's 2013 profile should be avoided at this stage.

<sup>1</sup> The diagrams show the industry's global average results based on data for the reference year 2013 (ICA, left bar), and the average results for Aurubis cathode copper for the reference years 2013 (middle bar) and 2019 (right bar).

<sup>2</sup> The International Copper Association, with its 35 members, is an organization that represents the global copper industry.



**HOW WE DID IT:****IMPROVEMENTS THROUGH CONTINUOUS IMPLEMENTATION OF ENVIRONMENTAL AND CLIMATE PROTECTION MEASURES**

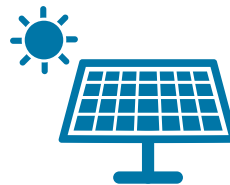
The improvements achieved wouldn't have been possible without extensive investment in environmental measures that fulfill ambitious environmental standards. Aurubis also develops innovative and energy-efficient technologies in environmental protection that often set new benchmarks on a global scale.

**Reducing emissions**

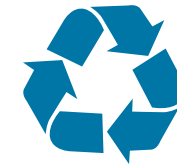
To reduce emissions to air, we have, for example, installed an innovative gas cleaning facility at our primary smelter in Pirdop, Bulgaria. This facility uses a modern process called Sulfacid that's unique not only in Bulgaria, but also the entire copper smelting industry.

**Energy-efficient technologies**

We've also invested in energy-efficient and low-carbon technologies, implemented measures to reduce energy consumption, supported the switch to renewable energies, and thus enabled decarbonization at all of the Aurubis Group sites. For example, we've implemented projects such as the Industrial Heat project at the Hamburg plant, which uses the residual heat of our production processes for district heating. This project makes HafenCity East the first district in the vicinity of our Hamburg plant to be supplied almost exclusively with CO<sub>2</sub>-free industrial heat.

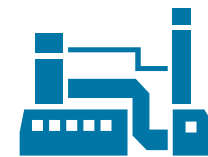
**Expansion of recycling capacities**

Even the expansion of Aurubis' recycling capacities and the acquisition of recycling specialist Metallo helped improve our environmental footprint. With recycling systems in Beerse (Belgium) and Berango (Spain), Aurubis has significantly expanded its reuse of secondary materials, which has reduced the footprint even further in the LCA results.

**Improved recovery of multimetals**

Where possible, Aurubis makes every effort to convert all raw materials into marketable products, which also helps to reduce our overall footprint. Aurubis will expand this strength to further consolidate its position as the most efficient and most sustainable integrated smelter network worldwide. This network also consists of a metallurgical infrastructure that improves multimetal extraction.

With all of the measures adopted, we've managed to reduce the direct emissions of harmful substances such as sulfur dioxide and dust as well as greenhouse gases. We've also expanded our recycling activities and increased the efficiency of metal recovery, which has improved the results of our life cycle assessment.



## Tomorrow Metals by Aurubis: Our sustainability promise to customers

With the name Tomorrow Metals, Aurubis emphasizes the strong Group-wide focus on sustainability. The label stands for Aurubis' pledge to deliver more value while lowering its carbon footprint and imposing the highest standards on energy efficiency and environmental protection.

Michael Hellemann, Head of Commercial at Aurubis, underlines the company's commitment to sustainability: "Our promise encompasses our many efforts to increasingly act and do business sustainably, efforts we have already made in the past and will continue to push forward in the future as well. Those who buy from Aurubis today and in the future can be assured that Aurubis is at the forefront when it comes to sustainability."

Tomorrow Metals by Aurubis consists of more than just a pledge for sustainable and responsible conduct. The label is supported by four pillars that comprise reliable KPIs.

- » Aurubis has invested more than € 730 million in environmental protection measures throughout the Group since 2000, reducing dust emissions to air by 96 % and metal emissions to water by 88 % in copper production across the Group, among other achievements.
- » Aurubis is determined to keep shrinking its carbon footprint, thus contributing to the 1.5°C goal of the Paris Agreement. Compared to 2018, the Group wants to cut its Scope 1 and Scope 2 emissions by 50 % and Scope 3 emissions by 24 % per ton of copper produced by 2030. Aurubis already produces copper with less than half the CO<sub>2</sub> per ton compared to international competitors.

» Currently, Aurubis' copper cathodes contain 45 % recycled material. To further promote the circular economy of metals, the Group will build on its plans to continue expanding its recycling capacities in the future as well – currently, these capacities amount to around one million tons per year.

» When selecting business partners, Aurubis ensures that, among other aspects, sustainability and compliance criteria are reviewed, evaluated continuously, and documented.

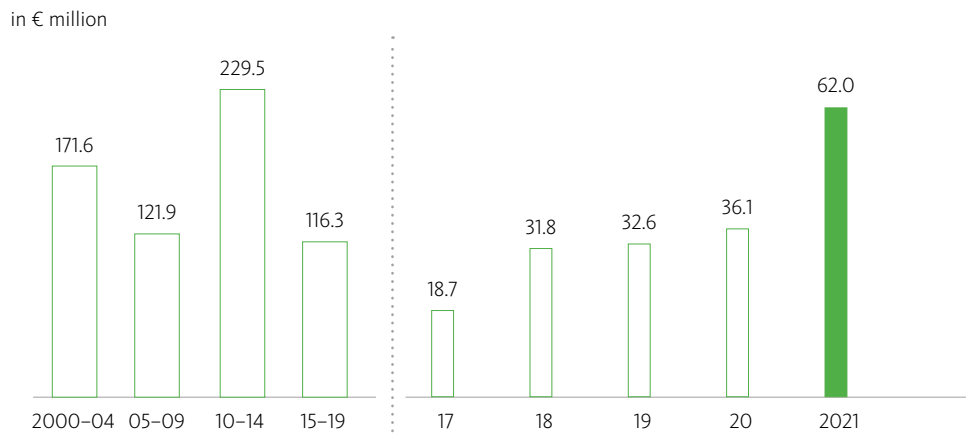


## Environmental protection – facts and figures

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

» We have invested more than € 730 million since 2000 and about € 330 million since 2012 in measures to improve environmental protection throughout the Group.

**Fig. 1.12: Capital expenditure for environmental protection in the Aurubis Group\***

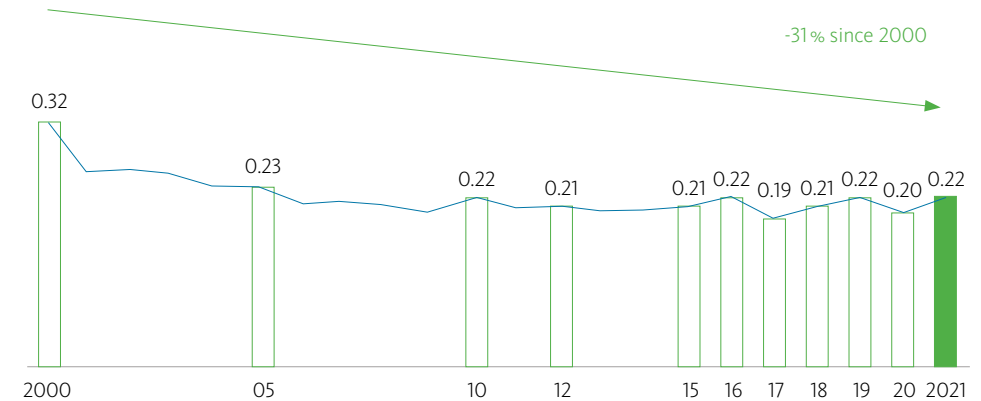


\* Environmental investments of all production sites that are majority-owned by Aurubis (> 50 %); data collected from some of the smaller sites starting in 2013. The Aurubis sites in Beerse and Berango have been included since 2020. The data relates to environmental investments per fiscal year. Single years are provided for readability – for example, 2021 for fiscal year 2020/21.

<sup>1</sup> This report may include slight deviations in the totals due to rounding. Some of the data is preliminary since it hadn't been validated externally as of the editorial deadline.

**Fig. 1.13: CO<sub>2</sub> emissions from fuels in Aurubis Group copper production\***

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

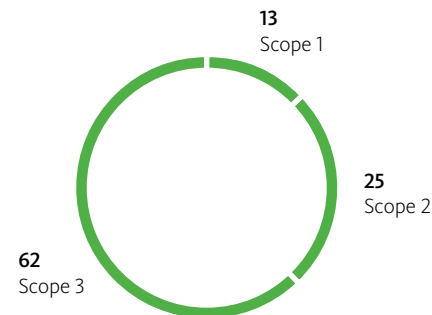


\* The Aurubis sites in Beerse and Berango have been included since 2020.

At 0.22 t of CO<sub>2</sub> per ton of copper output, emissions from fuels were at a low level in 2021. Product-related emissions have been reduced by 31% since 2000.

**Fig. 1.14: Aurubis Group CO<sub>2</sub> emissions – estimated**

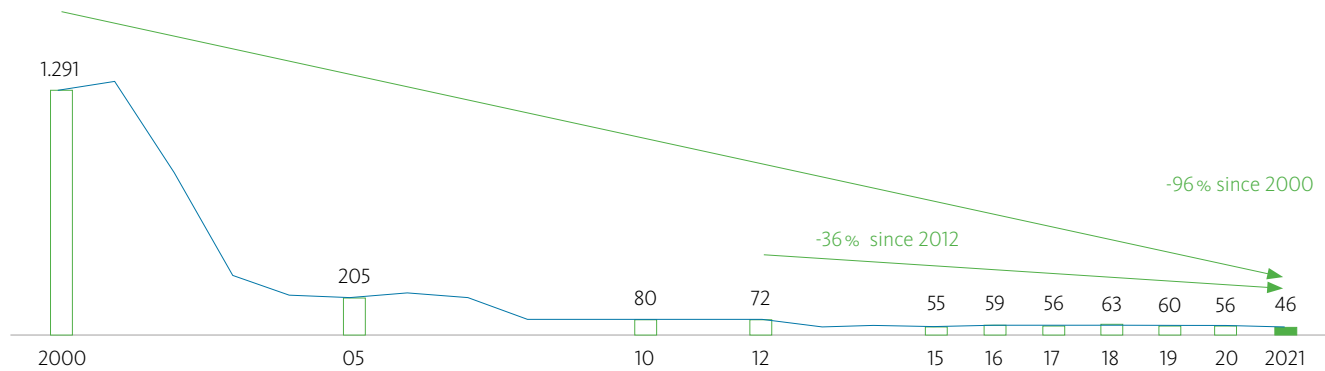
in %



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

**Fig. 1.15: Successful reduction of dust emissions in Aurubis Group copper production\***

Dust emissions in g/t of copper output



\* The Aurubis sites in Beerse and Berango have been included since 2020.

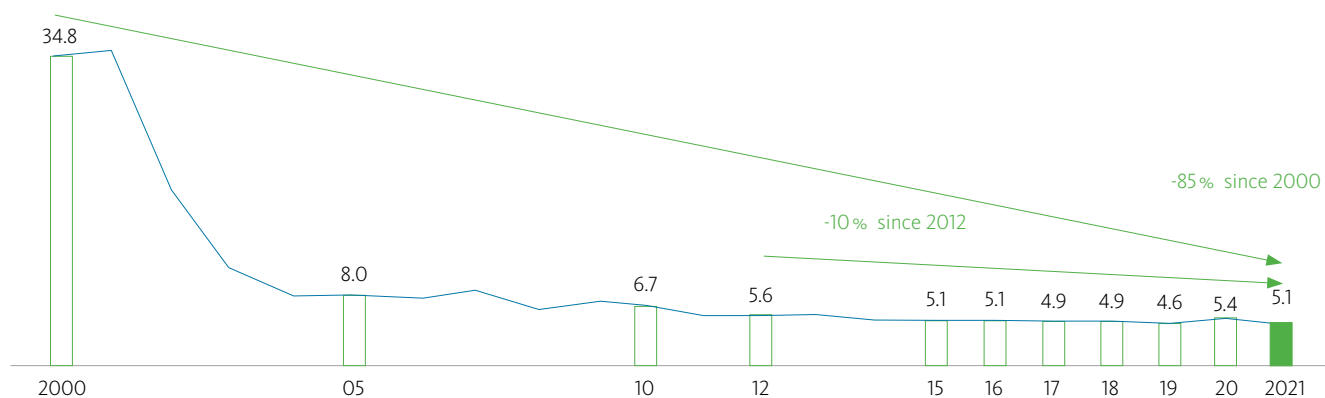
The dust emissions arising during copper production can contain metals and metal compounds. The consistent use of the best available plant techniques has led to a 96 % decline in dust emissions in copper production per ton of copper output since 2000.

Compared to the reference year 2012, dust emissions per ton of copper output were reduced by 36 % [see Fig. 1.15](#).

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.

**Fig. 1.16: Sulfur dioxide emissions in Aurubis Group primary copper production**

SO<sub>2</sub> emissions in kg/t of copper output

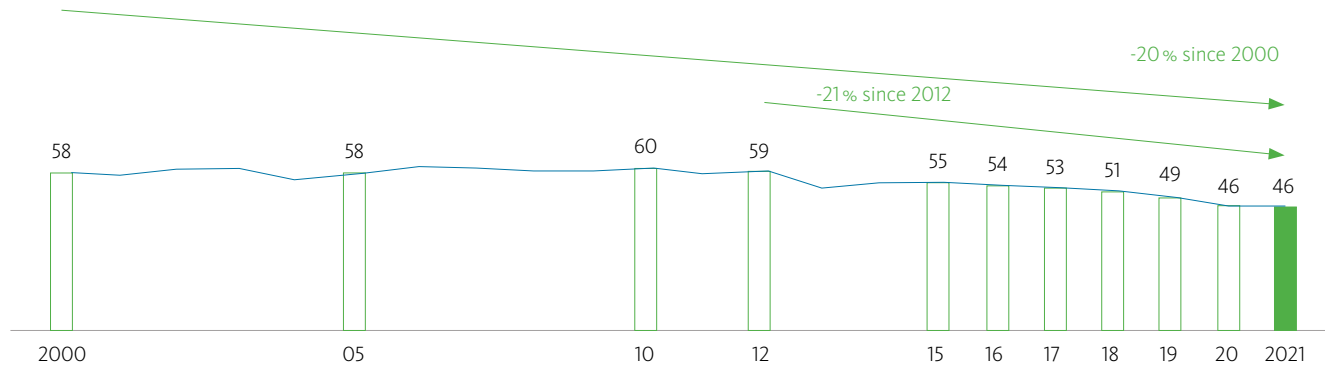


Apart from copper, sulfur is one of the main components of the copper concentrates in use. The gaseous sulfur dioxide produced when concentrates are smelted is converted into sulfuric acid in the sulfuric acid plant using the modern double catalysis process. When compared internationally, Aurubis is a forerunner in reducing sulfur dioxide emissions: Emissions per ton of copper output have been reduced by 85 % since 2000 [see Fig. 1.16](#).



**Fig. 1.17: Water withdrawal in Aurubis Group copper production\***

Water withdrawal in m<sup>3</sup>/t of copper output



\* The Aurubis sites in Beerse and Berango have been included since 2020.

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 water resources.

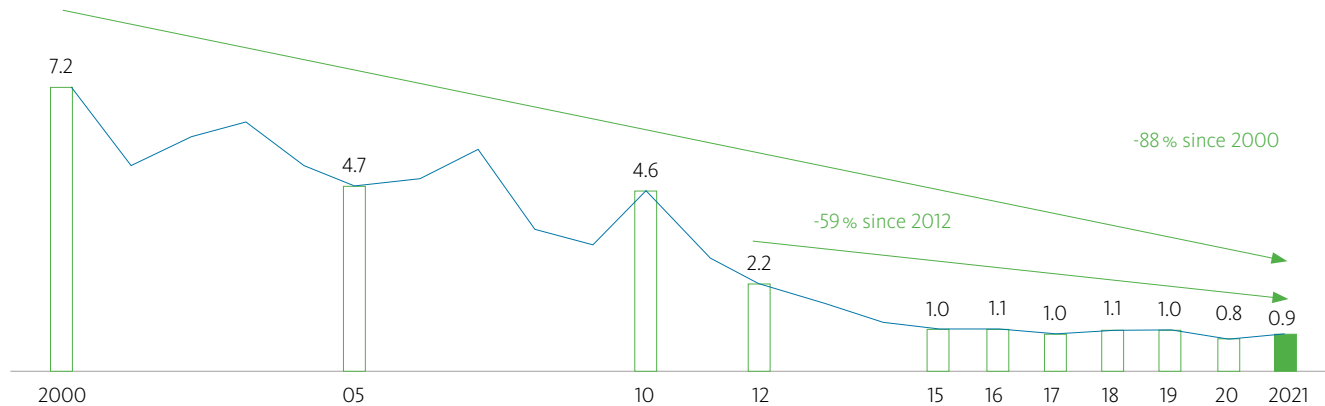
Compared to the reference year 2012, water withdrawal per ton of copper output was reduced by 21 % [see Fig. 1.17](#).

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 0.9 g per t of copper output since 2000. This is a decline of 88%.

Compared to the reference year 2012, metal emissions to water per ton of copper output were reduced by 59 % [see Fig. 1.18](#).

**Fig. 1.18: Metal emissions<sup>1</sup> to water in Aurubis Group copper production\***

Metal emissions to water in g/t of copper output



\* The Aurubis sites in Beerse and Berango have been included since 2020.

<sup>1</sup> Figure includes the following metals: Cu, As, Cd, Hg, Pb, Ni, Zn.

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

	Unit	2017	2018	2019	2020	2021
<b>Emissions to air</b>						
Dust	t	97 <sup>2</sup>	103 <sup>2</sup>	93 <sup>2</sup>	102 <sup>2</sup>	86
NO <sub>x</sub>	t	809	842 <sup>2</sup>	769	863	820
SO <sub>2</sub>	t	5,145	4,859	4,154	5,424	5,212
<b>Water consumption</b>						
<b>Total water withdrawal</b>	<b>million m<sup>3</sup></b>	<b>82.6</b>	<b>80.5</b>	<b>71.0</b>	<b>78.3</b>	<b>77.9</b>
<b>Water withdrawal by source</b>						
Surface water	million m <sup>3</sup>	79.0	76.6	67.7	74.6	74.2
Rainwater	million m <sup>3</sup>	0.4	0.4	0.3	0.6	0.6
Groundwater	million m <sup>3</sup>	0.5	0.6	0.5	0.6	0.7
Municipal water	million m <sup>3</sup>	2.1	2.6	2.1	2.2	2.1
Other	million m <sup>3</sup>	0.5	0.3	0.3	0.3	0.4
<b>Total water discharge</b>	<b>million m<sup>3</sup></b>	<b>77.1</b>	<b>77.0</b>	<b>66.1</b>	<b>71.9</b>	<b>70.3</b>
<b>Water discharge by destination</b>						
Surface water	million m <sup>3</sup>	75.8	75.6	64.7	70.5	69.1
Municipal wastewater system	million m <sup>3</sup>	1.3	1.4	1.3	1.3	1.2
Wastewater to third parties	million m <sup>3</sup>	<0.1	<0.1	<0.1	<0.1	<0.1

<sup>1</sup> These KPIs include all production sites that are majority-owned by Aurubis (> 50 %). The Aurubis sites in Beerse and Berango have been included since 2020.

<sup>2</sup> KPI was corrected after the fact.

Some of the data is preliminary since it hadn't been validated externally as of the editorial deadline. The table may include slight deviations in the totals due to rounding.

	Unit	2017	2018	2019	2020	2021
<b>Waste<sup>1</sup></b>						
<b>Hazardous waste</b>	<b>t</b>	<b>51,799</b>	<b>46,886</b>	<b>48,659</b>	<b>50,970<sup>4</sup></b>	<b>50,543</b>
Landfilling	t	34,417	34,032	36,429	36,473 <sup>4</sup>	36,653
Disposal (thermal)	t	139	81	123	370	1,254
Thermal utilization	t	452	447	391	441	445
Recycling	t	13,063	10,457	8,731	11,638 <sup>4</sup>	10,338
Storage	t	1,264	1,846	1,682	1,899	1,417
Internal utilization/recycling	t	2,464	24	1,303	149	436
<b>Non-hazardous waste</b>	<b>t</b>	<b>45,350</b>	<b>43,255</b>	<b>46,992</b>	<b>81,705<sup>4</sup></b>	<b>50,955</b>
Landfilling	t	1,899	2,134	1,739	17,491 <sup>4</sup>	13,410
Disposal (thermal)	t	139	717	682	624	583
Thermal utilization	t	446	472	590	435	950
Recycling	t	35,768	32,947	38,354	57,068 <sup>4</sup>	34,970
Storage	t	184	128	89	133	211
Internal utilization/recycling	t	6,914	6,857	5,537	5,955 <sup>4</sup>	832
<b>Construction waste</b>	<b>t</b>	<b>38,826</b>	<b>46,558</b>	<b>122,503</b>	<b>17,887<sup>4</sup></b>	<b>28,554</b>
<b>Energy and CO<sub>2</sub></b>						
Primary energy consumption <sup>1</sup>	million MWh	1.66	1.75	1.69	1.72	1.85
Secondary energy consumption <sup>2</sup>	million MWh	1.88	1.89	1.78	2.00 <sup>4</sup>	1.94
<b>Total energy consumption</b>	<b>Mio. MWh</b>	<b>3.54</b>	<b>3.64</b>	<b>3.47</b>	<b>3.72<sup>4</sup></b>	<b>3.79</b>
Direct CO <sub>2</sub> emissions <sup>3</sup>	kt CO <sub>2</sub>	517	522	503	540	558

<sup>1</sup> Energy consumption for on-site vehicle traffic included.

<sup>2</sup> Including electricity for oxygen generation.

<sup>3</sup> In line with the emission trading system, excluding CO<sub>2</sub> emissions from vehicles.

<sup>4</sup> KPI was corrected after the fact.



Updated Aurubis AG Environmental Statement 2022

# HAMBURG SITE





## THE HAMBURG PLANT

The largest Aurubis AG production site and the Group headquarters are located on the Elbe island Peute, only about four kilometers, as the crow flies, from Hamburg's city hall. At the Hamburg plant, Aurubis AG 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 2,508 personnel are employed at the Hamburg site, including 186 apprentices (as of February 2022).

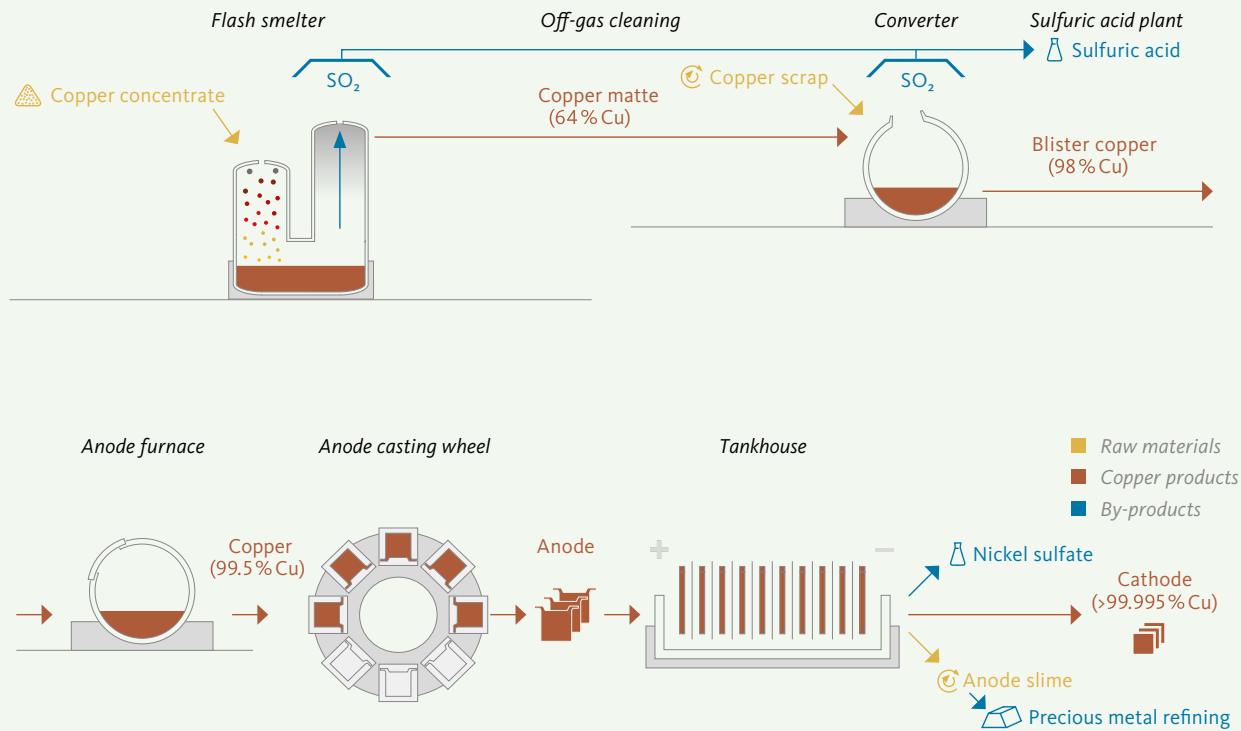
The individual production sectors at Aurubis AG in Hamburg are divided into three plant areas – see Fig. 2.1: Plant North is mainly comprised of the administrative building, the workshops, sampling, the secondary copper smelter, and precious metal production. Plant South includes the sludge decomposition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

Fig. 2.1: The 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) 6 Administrative building

Fig. 2.2: From copper concentrate to cathode



## PROCESSES AT THE HAMBURG PLANT

Copper production is based on the use of primary raw materials (copper concentrates) and secondary raw materials (recycled 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. These products 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) [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 sludge are further treated in an electrothermal process in the secondary copper 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 multimetal 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 sludge 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.

### ENVIRONMENTAL PROTECTION ORGANIZATION AT THE HAMBURG SITE

As the operator of facilities requiring a permit in accordance with Section 52a of the Federal Immission Control Act (BImSchG) and Section 53 of the Circular Economy Act (KrWG), the Aurubis AG Executive Board or an appointed member of the Executive Board is responsible for compliance with environmental protection regulations.

All environmental protection issues are coordinated, organized, and monitored in the Environmental Protection department to support the different business sectors. The department appoints officers for the fields of immission protection, water pollution control, waste, accidents, and harmful substances.

### THE INTEGRATED MANAGEMENT SYSTEM (IMS) FOR OCCUPATIONAL HEALTH AND SAFETY, ENERGY, QUALITY, AND THE ENVIRONMENT

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 AG 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.

The quality management system for the entire Hamburg plant is certified in accordance with the ISO 9001 standard.

Occupational health and safety management was certified pursuant to ISO 45001 as an integral part of the IMS for the first time in 2021.

### TASKS OF THE ENVIRONMENTAL MANAGEMENT SYSTEM

The environmental management system is responsible for maintaining and improving our environmental performance. Targets and measures are defined, and their implementation monitored accordingly. Situational evaluations form the basis for decisions about the type, extent, suitability, and execution of environmental protection measures.

The environmental management officer ensures that the environmental management system fulfills the requirements of the ISO 14001 and EMAS standards. In other words, our environmental management system ensures that the applicable legal requirements are common knowledge and fulfilled with respect to environmental protection. Furthermore, it supports the continuous improvement of our environmental performance with economically reasonable product and process design that takes the environment and occupational safety into account. Targets and measures are defined, and their implementation monitored accordingly. Situational evaluations form the basis for decisions about the type, extent, suitability, and execution of environmental protection measures.

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. Because of the high complexity of the legal standards and requirements that have to be applied, the existing legal register has been supplemented by a web-based EHS software.

The systems and organization of the IMS are described extensively and clearly 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 implement the Aurubis Group's defined sustainability targets at the Hamburg site [see www.aurubis.com/sustainabilitystrategy](https://www.aurubis.com/sustainabilitystrategy).

### MONITORING AND INTERNAL AUDITING OF ENVIRONMENTAL MANAGEMENT

The effectiveness of the integrated management system is reviewed with internal audits pursuant to EMAS regulations, ISO 9001, ISO 14001, ISO 45001, and ISO 50001. Internal audits take place regularly in compliance with the requirements of the standards.

Within the scope of internal audits, 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 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.

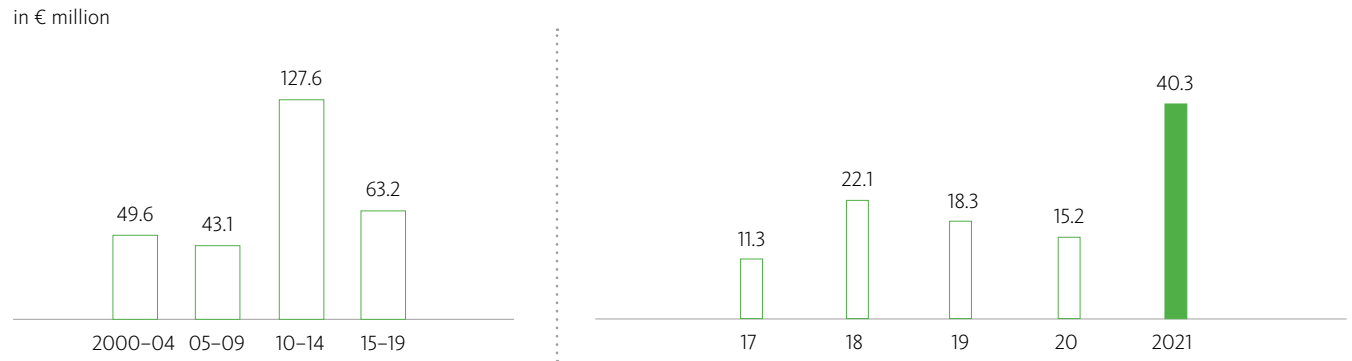
The status of follow-up measures from the last management reviews, goals and key figures, changes involving the management system, information about the performance and effectiveness of the management system, summaries of the results of internal audits, the status of preventive and corrective measures, 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, nearly € 320 million has been invested in environmental protection in the Hamburg plant since 2000. With total capital expenditure of more than € 1.2 billion in the same period, environmental measures account for approximately 26 % of overall capital expenditure on average. Among other things, dust emissions have been reduced by about 43 % 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, however [see Fig. 2.3](#).

When compared worldwide, Aurubis Hamburg holds a top position in environmental protection that extends beyond staying up to date with the state of the art. 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.

**Fig. 2.3: Capital expenditure for environmental protection measures at the Hamburg site\***



\* The data relates to environmental investments per fiscal year. Single years are provided for readability – for example, 2021 for fiscal year 2020/21.



**AIR – EMISSIONS**

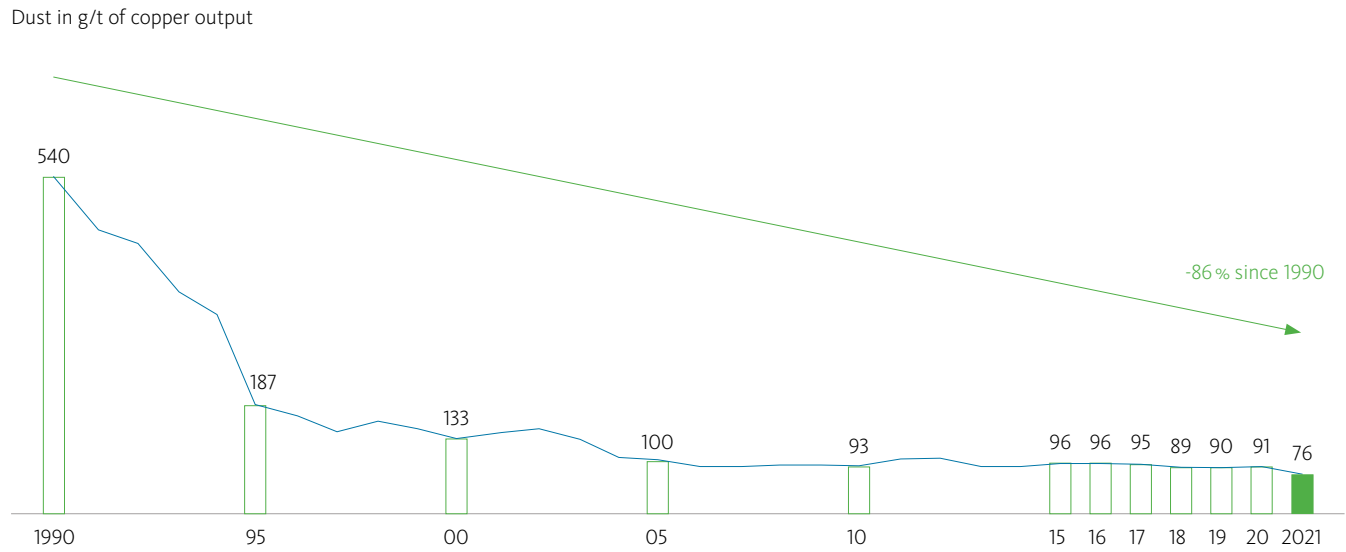
It is crucial for Aurubis AG to develop innovative technologies for air pollution control and to enter new technical territory in the process. Almost 80% of the remaining metal emissions from the Hamburg production site come from fugitive sources, the majority of which stem from hall ventilation facilities.

The Hamburg site emissions were further reduced in 2021. Additional investments in air pollution control were made in both primary and secondary copper production in 2021. The first part of a large-scale investment to continue reducing fugitive dust emissions in primary copper production kicked off in October.

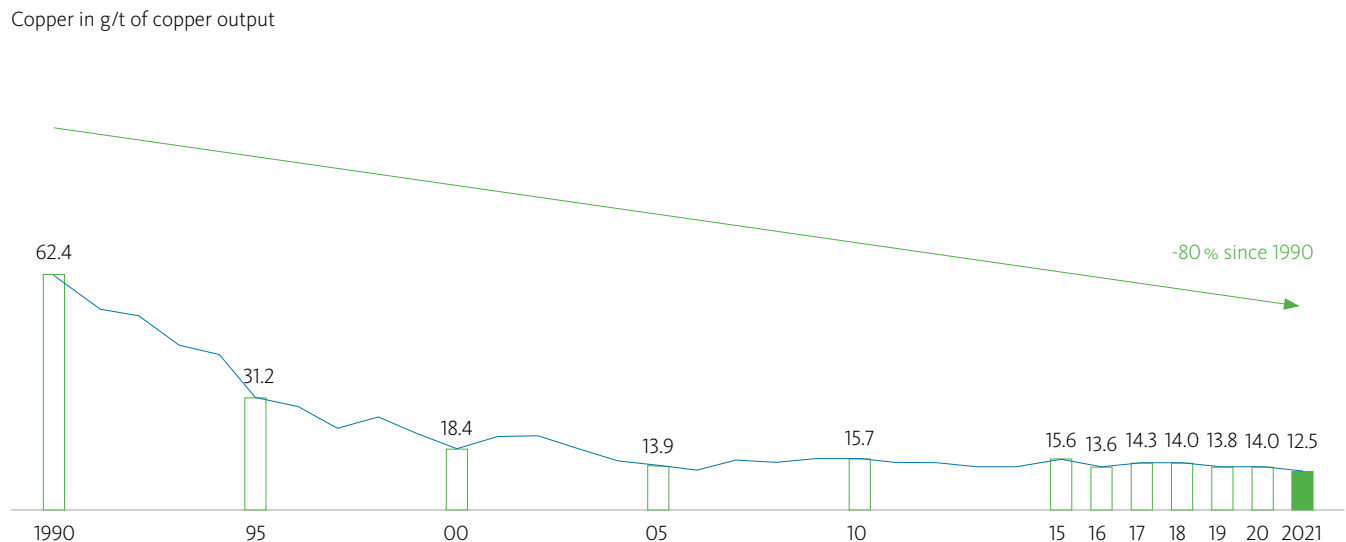
All of the information in this chapter is based on the current Emissions Report, which is issued annually by the immission protection officer. The values outlined on the following pages are made up of a number of individual recordings. Directed emissions are mostly recorded as classified values from 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 fallen by 86 % since 1990 and were reduced by 43 % between 2000 and 2020 [see Fig. 2.4](#).

**Fig. 2.4: Dust emissions at the Hamburg site**

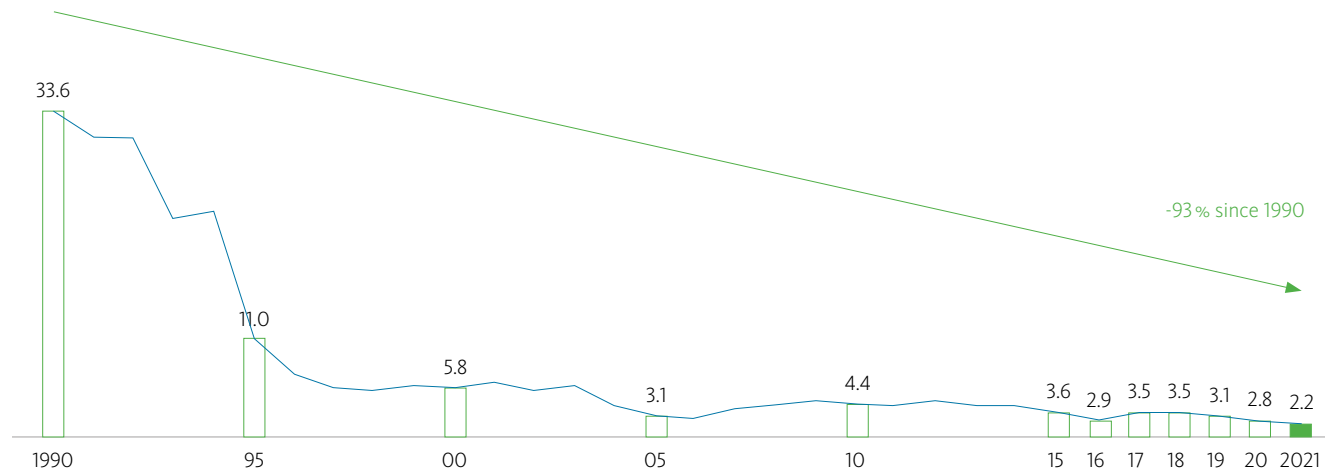


**Fig. 2.5: Copper emissions at the Hamburg site**



**Fig. 2.6: Lead emissions at the Hamburg site**

Lead in g/t of copper output



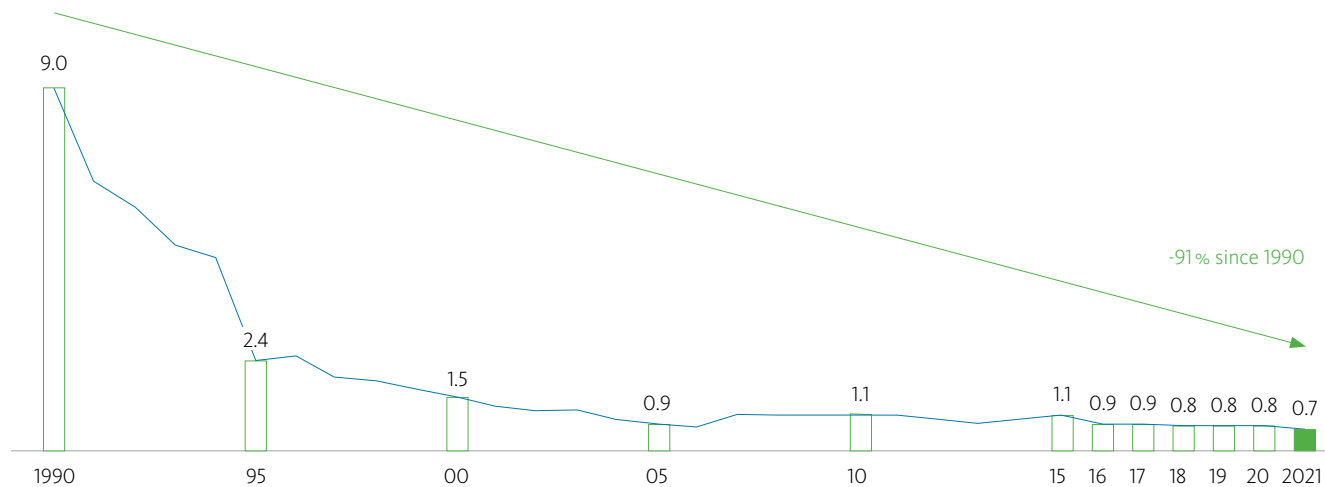
Copper is the main metallic substance in the dust at the Hamburg production site. Specific copper emissions have been reduced by 80 % since 1990 and by 32 % since 2000. The already low level was further reduced when the new emission capture equipment in primary copper production was commissioned, resulting in the changes from the previous year [see Fig. 2.5](#).

Specific lead emissions have been reduced by 93 % compared to 1990 and by 62 % since 2000. The commissioning of the emission capture equipment in primary copper production has had a positive effect here, too, and has resulted in further reduction [see Fig. 2.6](#).

Arsenic is a natural component of copper concentrates. Specific arsenic emissions have been reduced by 92 % since 1990 and 55 % since 2000 in various steps of the copper refining process, further reducing the already low level of emissions here, too [see Fig. 2.7](#).

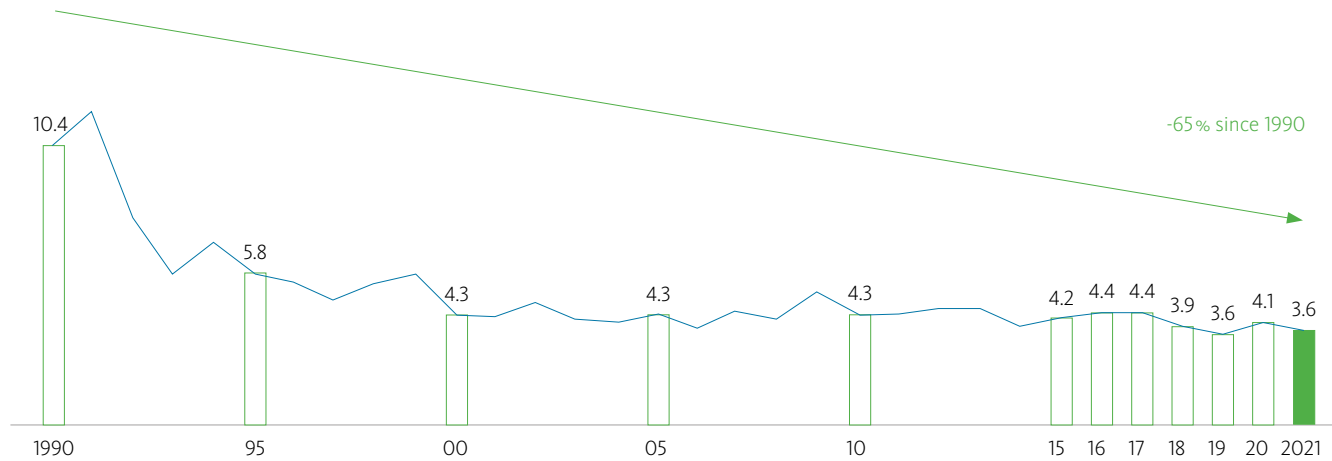
**Fig. 2.7: Arsenic emissions at the Hamburg site**

Arsenic in g/t of copper output



**Fig. 2.8: SO<sub>2</sub> emissions at the Hamburg site**

SO<sub>2</sub> in kg/t of copper output

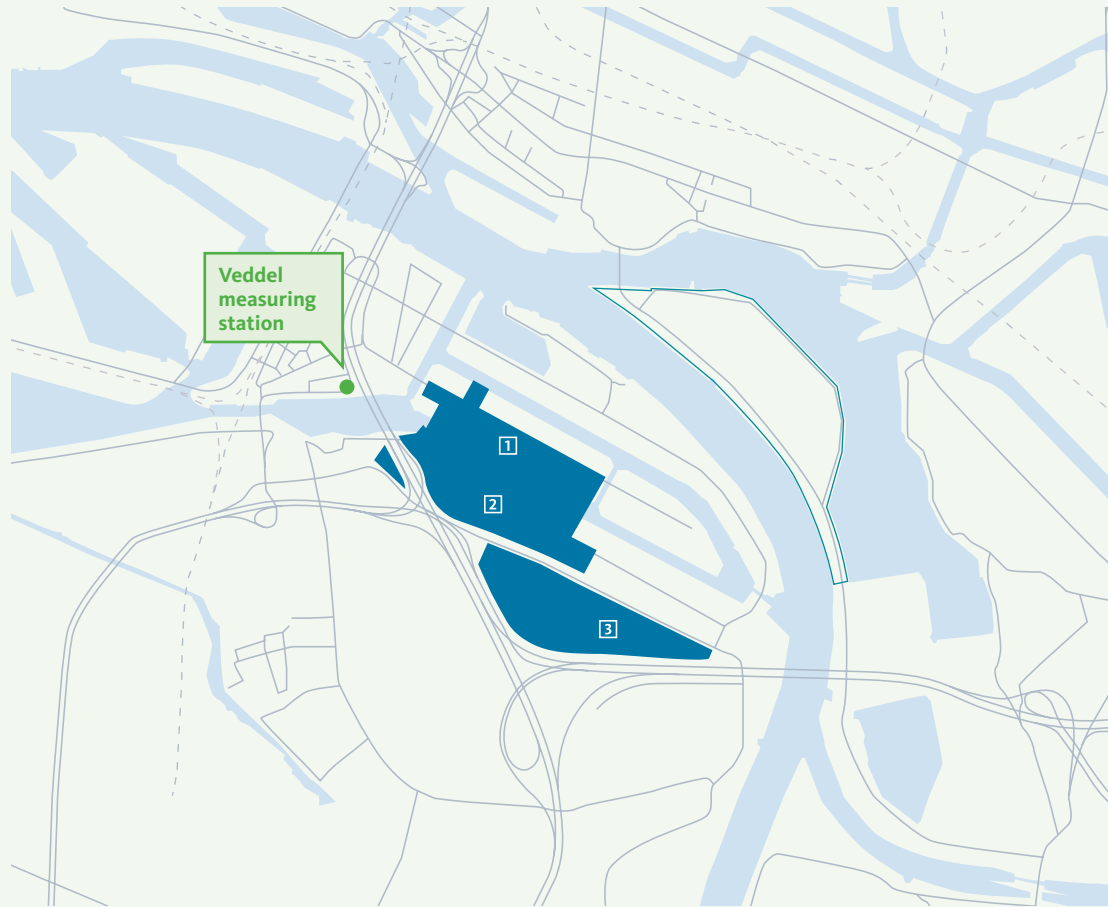


Sulfur is one of the main components of the copper concentrate. The gaseous sulfur dioxide produced when ore is smelted is converted into sulfuric acid in the sulfuric acid plant using the modern double catalysis process. The sulfuric acid is mainly used in the chemical industry. Specific sulfur dioxide emissions have been reduced by 65 % since 1990 and by 16 % since 2000 and are at a low level [see Fig. 2.8](#).

As a primary copper smelter, Aurubis AG's Hamburg site continues to be a forerunner in reducing specific sulfur dioxide emissions.

Aurubis maintained levels well 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 again in 2021. 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.

Fig. 2.9: Location of Veddel measuring station near the Aurubis plant in Hamburg



1 Plant North 2 Plant South 3 Plant East



## AIR – IMMISSIONS

Projects to reduce fugitive emissions have high priority. The success of measures to reduce fugitive emissions is illustrated by the consistently positive results of the suspended particulate recordings taken by the Hamburg environmental authority. 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 AG's Hamburg site for many years.

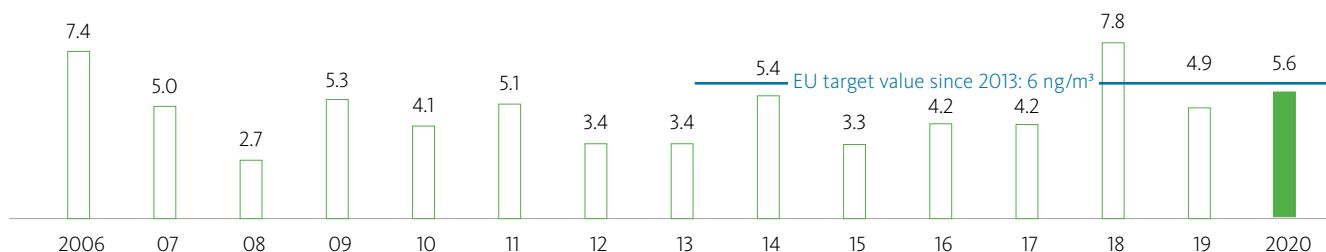
The value measured for arsenic at the Veddel measuring station was well below the target level (a yearly average of 6 ng/m<sup>3</sup>) in 2020.

A project for capturing fugitive emissions from the primary smelter production hall as required kicked off in 2020 to further reduce the site's immissions into the surrounding area. An innovative and highly efficient system will close the roof openings, extract the air, and filter an adjustable amount at a rate of over 1,000,000 m<sup>3</sup>/h. The project has an investment volume of over € 100 million. The first stage was commissioned in October 2021. In addition to equipment to capture emissions on the current ridge turrets (openings in the roof that serve to conduct the heat released in the production process away from the hall), the existing suctioning equipment will be optimized and the flow conditions in the production hall will be improved through an adjusted air intake duct.

After the project concludes, the fugitive emissions from the production hall area will be reduced by about 70 %.

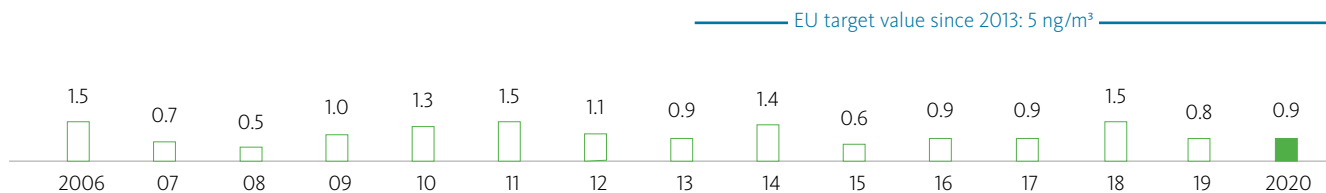
**Fig. 2.10: Low immission values (arsenic) at the Veddel measuring station<sup>1</sup>**

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



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

Cadmium immissions 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. Official results for 2021 aren't available yet.  
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.

The metal loads connected to direct discharge, which are related to production volumes, were 1.4 g/t of copper output, confirming the positive trend from the previous year. This KPI has decreased by nearly 30 % since 2000 due to investments and process improvements. Minimizing the wastewater volume and load is a criterion for implementing projects. The standard achieved today has made it possible to exploit minimization potential to the highest degree possible. The proportion of heavy metals discharged by Aurubis AG's Hamburg plant into the Elbe's total load is currently less than 0.1%.

Process optimization to further reduce the amount of nitrate in the wastewater from the production of precious metals was completed in 2021, ultimately decreasing the load by 75 % compared to 1990.

Additional reductions will require fundamental changes throughout the water management system. We plan to start here and, with the Sustainability Strategy, reduce the metal loads discharged directly with the wastewater by another 25 % throughout the Group by 2030. The Hamburg site will play a key role in achieving this ambitious goal, with the first step planned for 2022.

**INDIRECT DISCHARGE AND POTABLE WATER**

The declining long-term trend for the discharged wastewater load continues for indirect discharge into the city sewer system. 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 %.

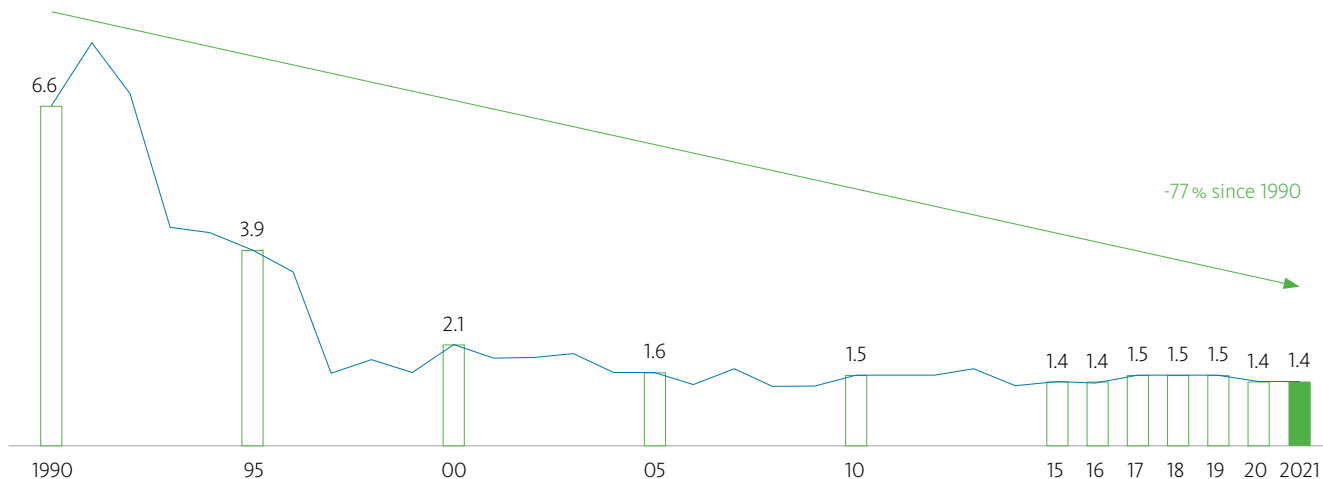
Accounting for 85 %, most of the wastewater is used in production and for measures to reduce dust (sprinklers, misters, cleaning streets and open areas with a sweeper). A total of 15 % is used in kitchens and sanitary installations and is discharged indirectly after use.

The consumption of potable water has declined by over 40 % since 2000. Potable water mostly hasn't been used to produce steam since 2002. Recirculated condensate and, mainly as a supplement, available canal water are used to conserve resources. At just 6 %, the already low percentage of potable water in the boiler feed water produced was maintained in 2021 (309,377 m³). The goal is to limit potable water use to maintenance of the treatment plant.

Consumption was permanently reduced again at the end of 2021 with the commissioning of the ridge turret suction system and the decommissioning of the sprinkler system in primary copper production.

**Fig. 2.12: Metal emissions in water at the Hamburg site since 1990**

Metal emissions in g/t of copper output



## COOLING WATER

In 2021, cooling water was managed without any disruptions or negative impacts on the water balance. All of the limits for discharge temperature, temperature increase, heating of water, and heat input were maintained. Further limiting the volume of cooling water by 2030 is a part of the Sustainability Strategy.

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

## FACILITIES HANDLING SUBSTANCES HAZARDOUS TO WATER

At the Hamburg plant, Aurubis AG 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 (AwSV). During the technical audits carried out in 2021, the TÜV once again didn't find any safety-relevant deficiencies whatsoever. Keeping the plants in proper technical order plays a key role in protecting the soil and groundwater.

The Aurubis plant in Hamburg is a TÜV-certified specialist company in accordance with the Federal Water Act (WHG). TÜV recertified Aurubis as a specialist company under the Federal Water Act (WHG) in 2021.

## 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 at Plant East that effectively prevents backwater from flowing beyond the plant premises. This protective measure is regularly inspected through advisory backwater monitoring to ensure that it is working properly.

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

Soil management in connection with treatment capacities on site limit the volume of soil that accumulates during construction measures, for example, and therefore conserves landfill capacities.

## 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 2021.

## BIODIVERSITY

As an industrial site, Aurubis would like to promote urban biodiversity. We want to leave unpaved areas close to their natural state whenever this is feasible, carrying out the minimum amount of maintenance required. We don't use any chemical pesticides on plants. 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, improving their appearance and also creating new habitats for birds and insects. The Aurubis plant premises are one of 13 Hamburg territories for peregrine falcons. We still maintain the nesting aid at 50 m height, which is occupied by a pair of falcons.

WASTE

A total of 126,422 t of waste was accepted and recycled at the Hamburg site in 2021, of which 4,988 t was classified as hazardous waste. A total of 3,549 t of this came from other countries and was registered.

Overall, 12.9% of the waste accepted was used as a slag former (e.g., spent abrasives, sand, and excavation residues), and 87.1% was used for metal recovery (dust, sludge, slags, and precious metal-bearing sweeps). The same level of secondary raw materials containing metals was used as in the previous year.

In 2021, about 1.48 million t of input materials were processed at the Hamburg site. During processing, 10,966 t of production-related waste accumulated, which was disposed of in an environmentally sound manner (see Fig. 2.13). The conversion of raw materials into products thus remained at a high level. Of the entire volume, 4,840 t was directed to recycling and 6,126 t to external disposal.

This corresponds to a recycling rate of approximately 44%. Most of the waste that is disposed of is sludge from exhaust gas cleaning, as well as washing fluids and emulsions.

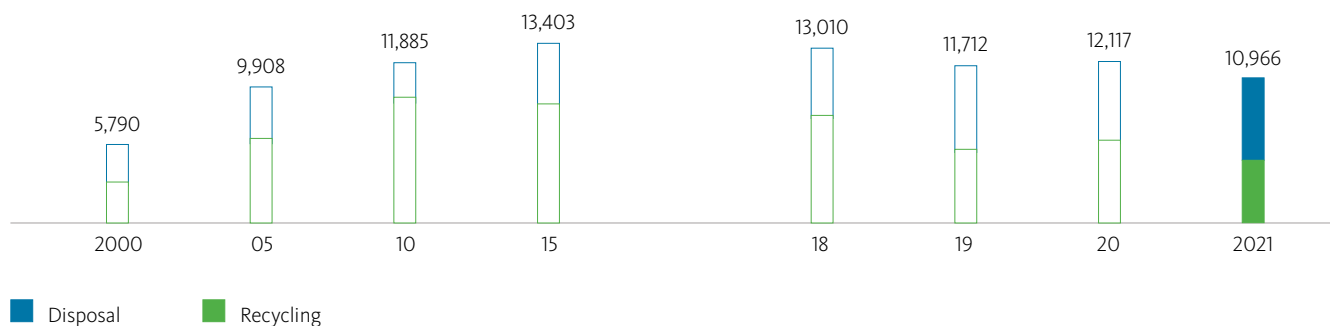
With an output of 489,976 t of refined copper for the year, the specific waste level is 22.38 kg per ton of product (2020: 26.52 kg/t).

A total of 23,640 t of olivine pyroxene rock from the secondary smelter (RWN) and 21,369 t of slag material from the primary smelter (RWO) couldn't be marketed as a product and were taken to landfills. In the process, more than half was recycled for use as landfill construction material.

Due to various construction activities to modernize the site, 10,431 t of construction waste accumulated during the past year. The volume of construction waste declined by approximately 27% compared to the previous year.

Fig. 2.13: Disposal methods for production waste at the Hamburg site

in t per 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 1,250 GWh of energy at the Hamburg site in 2021. With an annual copper output of 489,976 t, this amounts to specific energy consumption of approximately 2.55 MWh/t of copper output, which is lower than in the previous year (2021: 2.68 MWh/t). This includes the electricity used to produce the oxygen necessary for the processes.

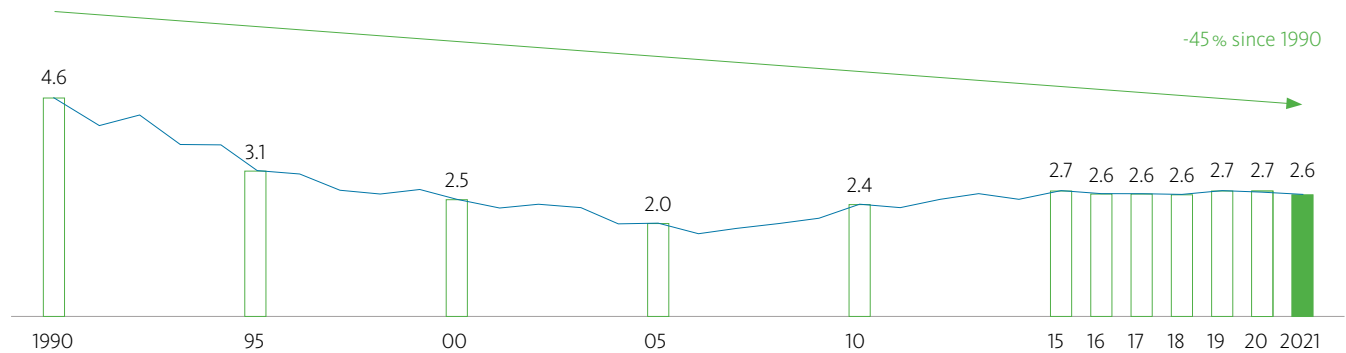
Furthermore, landfill gas was used in the production processes instead of natural gas (2021: 1.6 GWh). Aurubis thus uses 100 % of the landfill gas captured at the former Georgswerder landfill, with the landfill supply continuously declining.

Viewed over the medium term, 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 multimetal recycling and the commissioning of new facilities such as the ridge turret suction system in the secondary smelter. The ridge turret suction system at the primary smelter will also further increase energy requirements in the years to come. In 2021, good and continuous plant capacity and optimization reduced specific energy requirements by approximately 5 % compared to the previous year.

Taking a longer-term view, specific energy consumption has been significantly reduced at the Hamburg production site in the last few decades, falling by 45 % compared to 1990. It has even been possible to reduce fuel-related specific CO<sub>2</sub> output by 69 % since 1990. The reason for this is the significant reduction in the use of particularly CO<sub>2</sub>-intensive fuels, especially coal.

**Fig. 2.14: Energy consumption at the Hamburg site**

in MWh/t of copper output

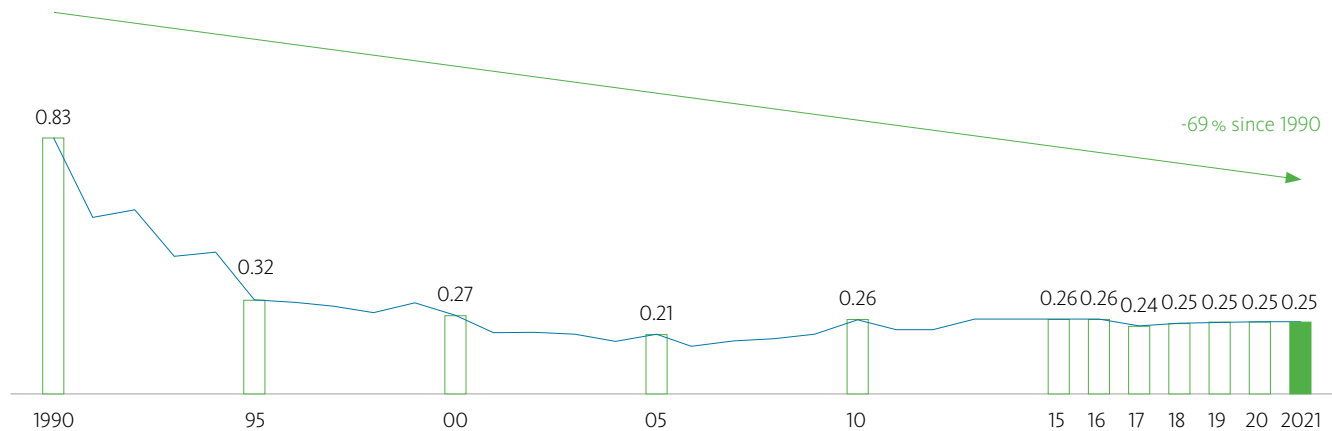


**Fig. 2.15: Breakdown of energy consumption at the Hamburg site**



**Fig. 2.16: CO<sub>2</sub> emissions from fuels at the Hamburg site**

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



With a copper output of 489,976 t in the calendar year, specific CO<sub>2</sub> emissions from fuel amounted to 0.25 t of CO<sub>2</sub>/t of product in 2021 [see Fig. 2.16](#). This corresponds to 124,131 t of CO<sub>2</sub>.

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

- » For natural gas: GasCalc calculation program, Version 2.6, publisher SmartSim GmbH
- » For all other fuels: German Emissions Trading Authority (DEHSt) data, last reviewed in January 2022

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.

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 electric steam boiler that can be hooked up to the grid during 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.

The power-to-steam plant allows us to respond to energy use with greater flexibility. We continuously monitor the economic and political environment of the energy economy and energy supply, which will allow us to respond more quickly and with greater flexibility. A task force is created in special situations like the current war in Ukraine to minimize the impact on our operations.



New power-to-steam facility in the Hamburg plant



## RESIDUAL HEAT USE

Aurubis strives to use process residual heat to the greatest extent possible. It is used to heat buildings, to facilitate the production processes, and to generate electricity. With 87 % of the steam required generated from residual heat, very little was produced from fossil fuels in 2021.

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

The flash smelting furnace'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 7.2 GWh of electricity was produced from residual heat in 2021, or approximately 1% of total electricity consumption.

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 between Aurubis and the energy service provider energyc, 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. Aurubis' production facilities also use up to 40 million kWh. Aurubis and energyc each invested about € 21 million. The project was funded by BMWi.

Fig. 2.17: District heating pipeline route from the Aurubis plant to Hafencity East



The CO<sub>2</sub>-free heat is formed without the use of fossil fuels as a reaction heat released from the sulfuric acid production process. This forward-looking use of residual heat can reduce CO<sub>2</sub> by up to 20,000 t annually. The Elbe River benefits as well, as recovering the heat reduces the consumption of cooling water by about 12 million m<sup>3</sup> per year.

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 was honored as a finalist for the EUSEW Award 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.

Continued: The heat transition is an important part of the energy transition. 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 pipeline has already been dimensioned to accommodate the entire residual heat potential of sulfuric acid production and additional potential sources of residual heat. We could thus provide up to 60 MW or 500 million kWh of industrially generated, carbon-neutral district heating per year to supply the city. The two Industrial Heat projects will be able to reduce CO<sub>2</sub> by a combined 120,000 t per year as of 2025. The associated supply contract was concluded with the municipal supplier of district heating, and construction has kicked off.

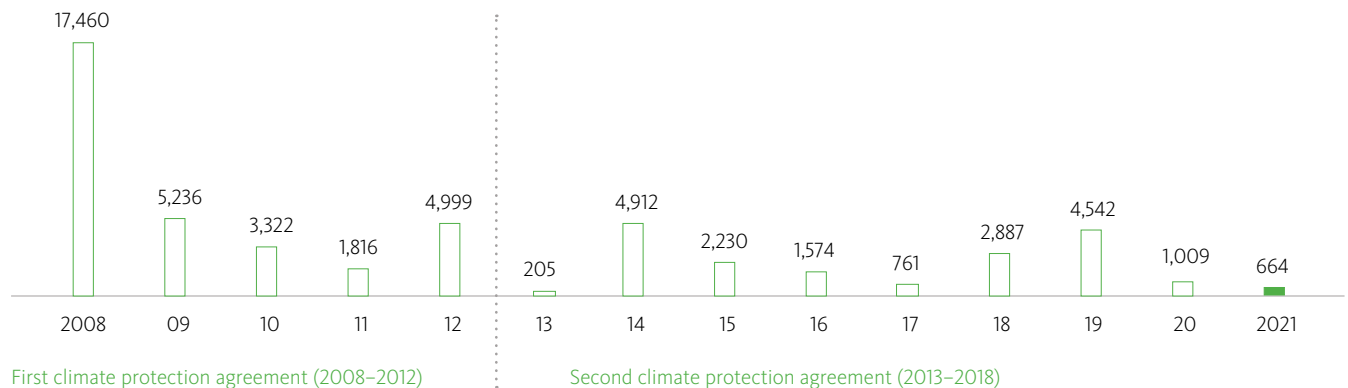
**DIRECT CO<sub>2</sub> EMISSIONS – EMISSIONS TRADING SYSTEM (ETS)**

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

Registered CO<sub>2</sub> emissions amounted to 166,885 t for 2021. Nearly 80 % 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.

**Fig. 2.18: 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 in t of CO<sub>2</sub>/year





## 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 electricity supply contract. Electricity production leads to CO<sub>2</sub> emissions, which are indirect CO<sub>2</sub> emissions for Aurubis, and therefore indirect environmental effects. In 2021, these indirect CO<sub>2</sub> emissions totaled 295,080 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 TO REDUCE CO<sub>2</sub>

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 this 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. 2.18](#).

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

Aurubis reduced CO<sub>2</sub> by roughly 12,569 t by the end of 2018. The city isn't planning an additional follow-up agreement. Nevertheless, additional reduction potential was identified and accompanying measures have been implemented. The site committed itself to implementing energy saving projects between 2019 and 2024 that lead to additional savings of 10,000 t of CO<sub>2</sub> each year, resulting in an additional reduction of 6,214 t of CO<sub>2</sub> per year by the end of 2021.

With the use of residual heat and efficiency improvements, the Hamburg site makes a significant contribution to the corporate goal of reducing CO<sub>2</sub> by 100,000 t annually between 2012 and 2023.

Aurubis participates 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.

Our support of the Science-Based Targets initiative also demonstrates the Group's tireless efforts to reduce greenhouse gases. We're committed to setting science-based CO<sub>2</sub> reduction targets on the basis of the Science-Based Targets initiative and are thus helping to achieve the 1.5°C goal of the Paris Climate Agreement. With the implementation of correspondingly ambitious measures, we want the entire Aurubis Group to become carbon-neutral well before 2050. The aim is to reduce the CO<sub>2</sub> emissions associated with fossil fuels and electricity (Scope 1 + 2) by half throughout the Group by 2030. CO<sub>2</sub> emissions resulting from processes, transport, supply chains, etc. should be reduced by 24 % by 2030 (Scope 3; reference year: 2018).

One of the first important steps was to test the use of hydrogen in primary copper production.

## 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 2021:

- » Lead refinery
- » Chemical plants
- » Hazardous materials storage
- » Rod plant
- » Continuous casting plant
- » Sludge decomposition plant
- » Central wastewater treatment plant

All inspections verified proper operation in accordance with permits.

## HAZARDOUS INCIDENT ORDINANCE

All inspections specifically related to the Hazardous Incident Ordinance were carried out without the identification of any defects.

## INDIRECT ENVIRONMENTAL ASPECTS

Indirect environmental aspects arise first and foremost from the transport of material and from the mines supplying Aurubis with copper concentrate. 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

An internal hazardous goods officer was appointed for the Hamburg site.

In the 2020/21 fiscal year, about 1 million t of outgoing hazardous materials were registered at the Hamburg site of Aurubis AG. Of the total amount of hazardous materials, approximately 70 % are shipped by inland vessel, about 20 % by truck, and 10 % by train.

During the reporting period, there were no reportable incidents in the course of hazardous material transports. Internal monitoring and training were carried out again in 2021 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.

To promote the use of bikes and public transport, a city bike station was set up at the Hovestrasse 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 free bike parking, an option that allows them to travel quickly and conveniently from public transport stations to work.

In order to promote e-mobility, efforts are still being made to set up charging stations at the employee parking lots on the streets Hovestrasse and Muggenburger Hauptdeich. E-mobility for internal plant traffic is also being emphasized.

Due to the voluntary environmental and climate protection measures it implemented in 2021 again, Aurubis Hamburg is still recognized as an active member of the Hamburg UmweltPartnerschaft and is distinguished for its exemplary environmental performance.



## 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.

There were no incidents or other serious disruptions in operations during the reporting period. The routine alarm and danger prevention plan drill was conducted in November 2021, with the participation of the municipal fire department.

The year 2021 was also impacted by the COVID-19 pandemic. Preventing the spread had the highest priority. Plant-specific hygiene concepts, models with staggered shifts, and testing strategies helped maintain safe production operations.

## Environmental Program

The targets set in the context of the Environmental Statement 2021 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 2022. The results are presented in the following Environmental Program.

Target	Planned measures	Degree of implementation/date
<b>Reducing emissions</b>		
Additional improvements to reduce fugitive emissions	Improving suctioning near the source Improving the process for internal cycles Suctioning of the ridge turrets in the primary smelter (RWO) to capture residual fugitive emissions	Suctioning of relevant parts 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; the first stage was commissioned in October 2021
	Constructing an additional closed storage hall in secondary copper production as part of FCM project implementation	Deferred, will be rescheduled
Efficiency improvement in reducing gas emissions	Optimizing wet gas cleaning in hydrometallurgical precious metal recovery to reduce NO <sub>x</sub> emissions	Project deferred – project modification (NO <sub>x</sub> -free) in the pipeline
Improving raw material logistics and sampling, replacement for the former concentrate warehouse 1	Centralizing sampling activities Sampling concentrates and other raw materials	Deferred
<b>Climate protection and energy optimization</b>		
Minimization of energy use for further reduction of CO <sub>2</sub>	Implementing projects to reduce CO <sub>2</sub> by 12,000 t between 2013 and 2018	Stage 1 of the Industrial Heat project also prevented up to 20,000 t of CO <sub>2</sub> a year. Implementation of stage 2 will prevent up to 140,000 t of CO <sub>2</sub> a year  CO <sub>2</sub> was reduced by another 6,214 t annually by the end of 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  Attempts to use hydrogen in the anode furnace (RWO) in 2021 A feasibility study on electrifying the rod plant is currently underway

Target	Planned measures	Degree of implementation/date
<b>Water pollution control</b>		
Continuously optimizing wastewater management	Investigative program to boost efficiency and minimize wastewater in precious metal production's wastewater management	Optimization project completed: reduction of 75 % compared to 2019
Improvement in ZABA (central wastewater treatment facility) cleaning efficiency	Investigation on reducing the halogen concentration	Additional precipitation stage tested; permanent operation planned in 2022
Substitution for potable water	Switching sweeper operation to process water from cooling water withdrawal. Savings of 10,000 to 12,000 m <sup>3</sup> of potable water per year	Extraction point created and commissioned
Reduction in run-off concentrations for metals during the rainwater treatment process at Plant East	Optimization of operating parameters for different operating conditions and adjustment in line with increasing rainfall and fluctuating dry periods; reduction of 10 % in average annual concentrations compared to the yearly average between 2017 and 2021	Development of an optimized operating concept and test phase in 2022



Target	Planned measures	Degree of implementation/date
<b>Partnership for Air Quality and Low-Emission Mobility</b>		
Sustainable, efficient, and climate-friendly mobility	Commissioning a Mobility Group that regularly develops measures	Takes place quarterly
Promoting public transport	Promoting public transport Renting two bike boxes at the train/subway stations Veddel and Elbrücken	Bike boxes were rented (two locations with 20 spaces each), have been in use since October 2019, and are provided to employees free of charge
	Achieving full use of boxes	Capacity currently at 85 %
	Reducing the price of the employer-subsidized public transport ticket	Occurred in 2021
Promoting sustainable mobility	Working towards the setup of a city bike station at the Plant East exit	City bike station for the Plant North exit has already been established (October 2019); talks about establishing a city bike station at the Plant East exit took place with the operator in 2020
	Enabling bike leasing (JobRad) for employees at the Hamburg site	Implemented in 2021
	Offering a car allowance (cash4car) as an alternative to a company car	A new car policy was established and offers cash4car opportunity
	Promoting “smaller” vehicles through an incentive system	Was not implemented
	Reducing the CO <sub>2</sub> limit for the company vehicle fleet	Reduction from 150 to 120 g of CO <sub>2</sub> /km
Promoting e-mobility	Installing charging points (car and e-bike) at the employee parking lots in Plant North and Plant East.	Charging stations were commissioned in employee parking lots at the end of 2021
	Successive replacement of all fuel-driven vehicles within the plant with electric vehicles	Two diesel vehicles were eliminated from the company's internal vehicle fleet in 2021
	Converting forklifts from combustion engine to electric drive	Did not occur in 2021 – planned for 2022

Target	Planned measures	Degree of implementation/date
<b>Promoting biodiversity</b>		
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
	Planting greenery in suitable places on facades	Regular inspection of open areas with regard to vegetation
<b>Plant safety</b>		
Ensuring safety	Drills for the alarm and danger prevention plan	Takes place every three years at the latest, most recently in November 2011. The port authority canceled the flood protection drill planned for all companies at the Port of Hamburg. Preparatory operating measures were carried out for updating the inventory and storage locations of hazardous materials in case of flooding
	Installation of camera surveillance for leak detection at the primary smelter (RWO)	Occurred in 2021
	Installation of an additional alarm system for operational disruptions at the contact acid plant, rod plant, tankhouse, primary smelter (RWO)	Planned for 2022

Target	Planned measures	Degree of implementation/date
<b>Waste management</b>		
Promoting the circular economy	Introducing the collection of an additional material fraction for recycling substances	2021 Expansion throughout the company in 2022
	Optimizing internal disposal logistics by minimizing internal transports	2021
	Additional documentation of plastic pallets and vats for recycling substances	2021
	Installation of a crushing and screening plant for fireproof linings and slag containing metal at the primary smelter (RWO) to promote the internal circular economy	2022
	Assessing the return of used wood pallets for further use	2022
<b>Continuous improvement of the integrated management system</b>		
Further development of an integrated management system (IMS) for the environment, quality, energy, and occupational health and safety	Introduction of general IMS handbook	Up to 2021
	Introduction of Hamburg IMS handbook	Continuous process
	Introductory phase – taking advantage of synergies	
	Start-up of ISO 45001	Audit pursuant to ISO 45001 took place in May 2021
	Continuing the implementation of the Aurubis Operating System (AOS) in the entire Hamburg plant	Ongoing

Target	Planned measures	Degree of implementation/date
<b>Continuous improvement of the integrated management system</b>		
Further implementation of Quentic in the IMS	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:	Complete system integration in environmental law took place in 2020
	» Centrally recording and evaluating environmental law obligations and documents relevant from an environmental law perspective	Currently underway, to be finished by the end of 2021
	» Transferring internal audit management (audit invitations, audit report archiving, monitoring of measures) to Quentic	Implemented in 2021
	» Transferring IMS document management to Quentic	
Informing employees working in all plant areas relevant for environmental protection about current environmentally relevant topics	Annual training for employees in environmentally relevant departments	Repeated annually
	Supplementary introduction of e-learning until 2021 for employees to deepen their knowledge and make participation more flexible	The first e-learning sessions took place in 2021 – implementation of e-learning in five departments by the end of 2021, with more planned for 2022
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 regulatory 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 regulatory management systems	Environmentally relevant conclusions have been documented and measures have been monitored in an IT-supported legal and regulatory management system since 2021
<b>Responsibility in the supply chain</b>		
Key measures regarding responsible supply chains within the context of the Sustainability Strategy 2018–2023 are documented in the separate Non-Financial Report.		



## Key figures for Aurubis AG, Hamburg site, in calendar year 2021

Developments in KPIs are explained in the text

Input	Unit	2019	2020	2021
<b>Raw materials</b>				
Copper concentrates	t	1,037,382	1,299,405	1,229,523
Copper scrap/refining material	t	48,897	46,796	47,603
Other Cu-bearing raw materials	t	146,718	112,491	132,982
Precious metal-bearing raw materials	t	12,251	12,631	13,545
Lead concentrate, scrap, and waste	t	20,575	30,788	28,958
Other waste for recycling	t	4,005	7,052	6,062
<b>Total TC/RC-bearing raw materials</b>	<b>t</b>	<b>1,269,827</b>	<b>1,509,162</b>	<b>1,458,673</b>
<b>Operating supplies and materials</b>				
Sand and additives incl. cyclone sand	t	122,033	124,589	126,704
Iron as an additive	t	13,162	14,096	6,179
<b>Total input materials</b>	<b>t</b>	<b>1,405,022</b>	<b>1,529,066</b>	<b>1,478,803</b>
<b>Input material per t of copper</b>	<b>t/t Cu</b>	<b>3.2</b>	<b>3.3</b>	<b>3.0</b>
<b>Energy</b>				
Electricity consumption	MWh	520,765	567,563	680,010
Additional electricity consumed to produce oxygen (informative) <sup>1</sup>	MWh	125,441	131,208	10,205
Natural gas	MWh	465,037	440,856	472,628
Coke	MWh	43,912	69,967	71,717
Other energy sources	MWh	15,982	15,385	15,866
<b>Total energy consumption</b>	<b>MWh</b>	<b>1,171,143</b>	<b>1,224,980</b>	<b>1,250,426</b>
<b>Energy consumption per t of copper</b>	<b>MWh/t Cu</b>	<b>2.7</b>	<b>2.7</b>	<b>2.5</b>

<sup>1</sup> The air compressors used to produce oxygen have been operated internally since 2021.

Input	Unit	2019	2020	2021
<b>Water withdrawal<sup>1</sup></b>				
River water	m <sup>3</sup>	56,896,000	62,672,000	63,331,000
Potable water	m <sup>3</sup>	362,000	373,000	359,000
Precipitation	m <sup>3</sup>	348,000	365,000	378,000
<b>Total water withdrawal</b>	<b>m<sup>3</sup></b>	<b>57,606,000</b>	<b>63,410,000</b>	<b>64,067,000</b>
<b>Water consumption (withdrawal) per t of copper</b>	<b>m<sup>3</sup>/t Cu</b>	<b>131</b>	<b>139</b>	<b>131</b>
<b>Area used at the Hamburg site</b>				
Total plant area	m <sup>2</sup>	871,000	871,000	874,000
Buildings and paved area	m <sup>2</sup>	766,000 (equivalent tot 88%)	773,000 (equivalent to 89%)	758,000 (equivalent to 87%)

<sup>1</sup> Figures rounded to the nearest 1,000.

Output	Unit	2019	2020	2021
<b>Products</b>				
Copper output	t	440,896	456,830	489,976
Sulfuric acid products as H <sub>2</sub> SO <sub>4</sub> (from exhaust gas cleaning, standardized to 100% acid)	t	922,260	982,392	994,880
Iron silicate stone (incl. granules)	t	689,790	767,611	781,326
Silver, gold, and PGMs	t	1,357	1,476	1,099
Nickel sulfate	t	2,432	3,794	3,117
Other metal compounds	t	1,009	963	437
Lead	t	11,415	11,268	11,886
<b>Total products</b>	<b>t</b>	<b>2,069,159</b>	<b>2,224,334</b>	<b>2,282,837</b>
<b>Waste</b>				
Recycling	t	5,319	6,085	4,840
Disposal	t	6,393	6,032	6,126
<b>Total recycling and disposal</b>	<b>t</b>	<b>11,712</b>	<b>12,117</b>	<b>10,966</b>
of which hazardous waste	t	8,648	9,115	8,183
<b>Waste per t of copper output</b>	<b>kg/t Cu</b>	<b>27</b>	<b>27</b>	<b>22</b>
<b>Waste per t of input material<sup>1</sup></b>	<b>kg/t</b>	<b>86</b>	<b>17</b>	<b>14</b>
Construction waste (informative)	t	109,513	14,203	10,431
<b>Total waste</b>	<b>t</b>	<b>121,225</b>	<b>26,320</b>	<b>21,397</b>
<b>Conversion into products</b>		<b>99.2 %</b>	<b>99,2 %</b>	<b>99.3 %</b>

<sup>1</sup> Including construction waste.

Output	Unit	2019	2020	2021
<b>Emissions</b>				
Dust <sup>1,2</sup>	t	40	41	37
Dust per t of copper	g/t Cu	90	91	76
SO <sub>2</sub>	t	1,591	1,871	1,780
NO <sub>x</sub> per t of copper	g/t Cu	425	424	383
Direct CO <sub>2</sub> emissions (ETS, excluding diesel)	t	156,601	164,051	163,347
of which CO <sub>2</sub> from fuels	t	112,244	115,999	124,131
CO <sub>2</sub> from fuels per t of copper	t/t Cu	0.25	0.25	0.25
Direct CO <sub>2</sub> emissions (diesel for vehicles)	t	3,565	3,513	3,539
Indirect CO <sub>2</sub> emissions from electricity consumption (incl. oxygen production) <sup>3</sup>	t	480,312	519,731	512,292
<b>Water discharge</b>				
Metal discharge in water	kg	678	637	689
Metal discharge in water per t of copper	g/t Cu	1.5	1.4	1.4
Direct discharge	m <sup>3</sup>	54,941,141	60,402,855	59,136,370
Indirect discharge	m <sup>3</sup>	51,220	42,403	37,851
<b>Total water discharge</b>	<b>m<sup>3</sup></b>	<b>54,992,361</b>	<b>60,445,258</b>	<b>59,174,221</b>
<b>Water discharge per t of copper</b>	<b>m<sup>3</sup>/t Cu</b>	<b>125</b>	<b>132</b>	<b>121</b>

<sup>1</sup> For dust content (metals), see the information provided in the "Air – Emissions" section.

<sup>2</sup> Figure also includes dust from fugitive sources.

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



Updated Aurubis AG Environmental Statement 2022

# LÜNEN SITE

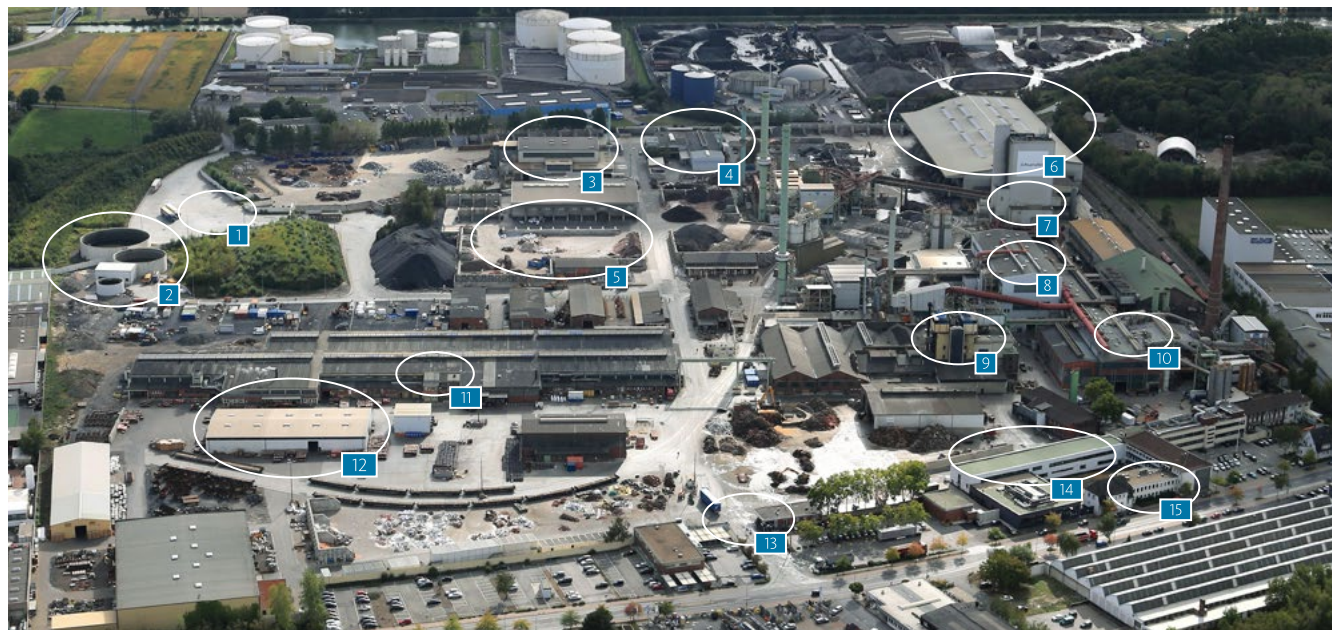


## The Lünen plant

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 World War II, the production facilities were continuously expanded and steadily modernized. After the then-Norddeutsche Affinerie AG acquired the majority of Hüttenwerke Kayser AG 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 one of the world's leading secondary copper smelters.

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

## 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, sludges, 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 input 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 top-blown rotary converter (TBRC) in mid-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 in the copper tankhouse. Zinc-bearing KRS oxide, iron silicate sand (slag granules), a lead-tin alloy, nickel and copper sulfate, and anode sludge are produced as by-products of "multi-metal recycling." The anode sludge is processed into gold and silver metal as well as a PGM1 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. No process-related waste accumulates.

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

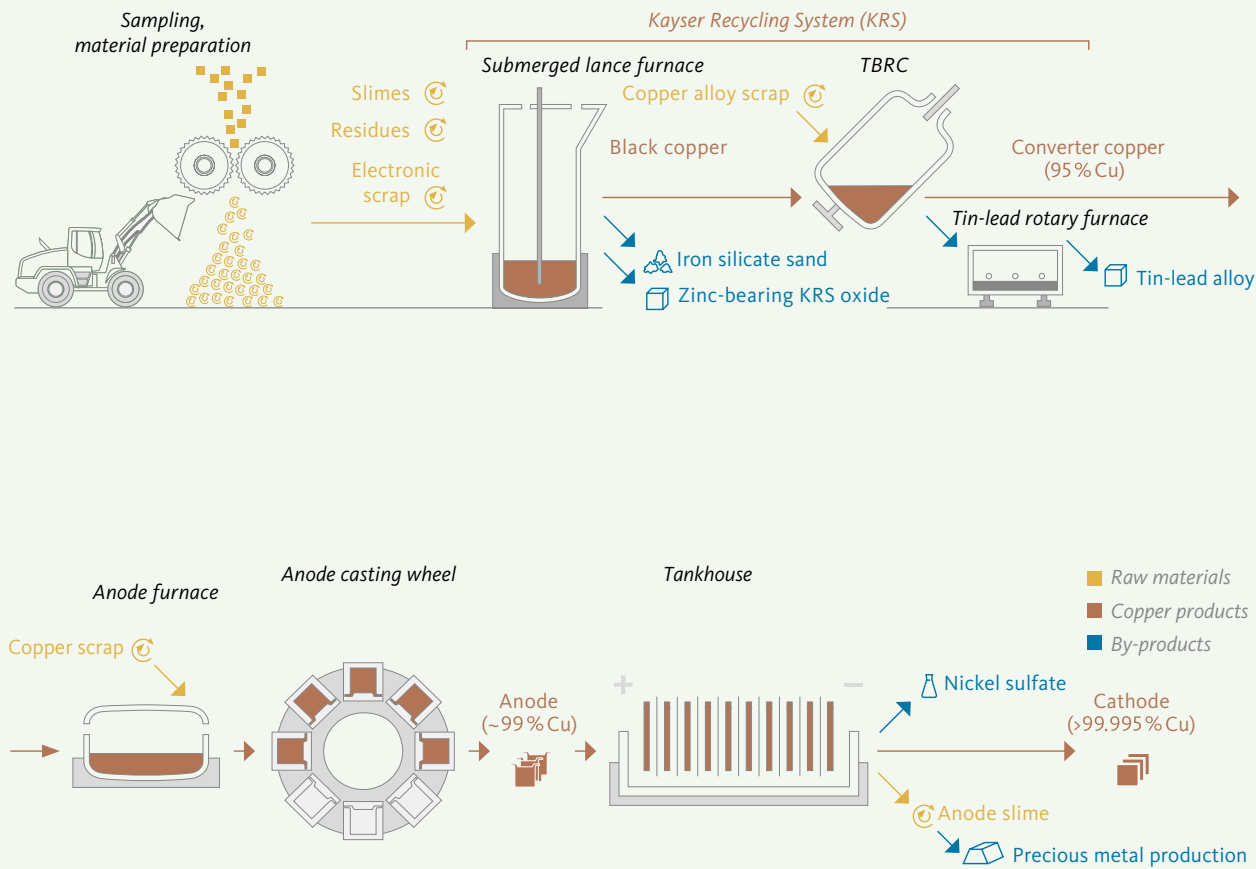
The Lünen site has an environmental management system that has been certified in accordance with ISO 14001 and EMAS since 1997. It is incorporated into an IMS (integrated management system) that also includes quality management pursuant to ISO 9001 and the certified energy management system pursuant to ISO 50001. An occupational safety management system was also certified in accordance with the ISO 45001 standard and integrated into the IMS in 2021.

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

<sup>1</sup> PGM = PGM = platinum group metal.



Abb. 3.2: Multimetall-Recycling am Standort Lünen Fig. 3.2: Multimetal recycling at the Lünen site



The IMS continues to fulfill the requirements of the Ordinance on Specialized Waste Management Companies (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 material preparation (MV-ZS) plant has also been a certified primary treatment facility in accordance with the ElektroG. Since December 2018, the Lünen plant has also been 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 the EMAS Regulation 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 requirements for the integrated management system are being successfully implemented.

### TARGETS AND TASKS OF THE ENVIRONMENTAL MANAGEMENT SYSTEM

The production processes are securely managed through 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 pursuant to 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 comparative assessment 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 measures that were initiated. In the process, the environmental protection officer always attempts to directly contact those who submitted the complaints.

### ENVIRONMENTAL MANAGEMENT ORGANIZATION

As the operator of facilities requiring a permit in accordance with Section 52a of the Federal Immission Control Act (BImSchG) and Section 53 of the Circular Economy Act (KrWG), 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 officer functions at the Lünen site for

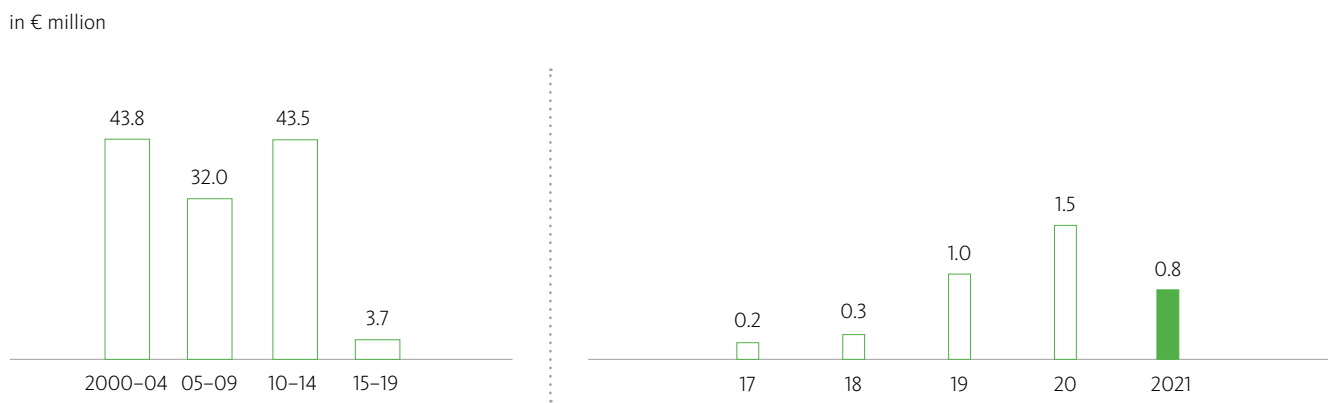
- » Immission protection and accident prevention
- » Waste management
- » Radiation protection
- » Specialist company under the Federal Water Act (WHG)
- » Occupational safety

are carried out by employees of the plant.

The role of hazardous goods officer is filled by an employee with a corporate function who works 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 classification, labeling, and packaging (CLP) is still carried out centrally for all of Aurubis AG by the corporate departments.

Fig. 3.3: Capital expenditure for environmental protection measures at the Lünen site\*



\* The data relates to environmental investments per fiscal year. Single years are provided for readability – for example, 2021 for fiscal year 2020/21.

## ENVIRONMENTAL ASPECTS AND PERFORMANCE

Investments in environmental protection still 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 input 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 € 125 million has been invested in environmental protection from 2000 to 2021 [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. Aurubis will continue to invest in modernizing the facilities and possibly building new facilities in the coming years.

## 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 exhaust 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 much 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.

According to the measurements, the permit limits are observed and, in some cases, by a large margin. The same applies to additional substances listed in the permits such as  $\text{NO}_x$ , HCl, and HF.

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.

Emission measurements using drones at the Lünen plant





The dust emissions in 2021 were again at about the same low level of the past several years; in particular, metal loads as a component of the total dust volume continued to decrease significantly.

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 raw materials, and the miniaturization of technical devices has also resulted in an increase in the number of processing steps. This leads to lower copper output, but more by-products per ton of material input.

The Lünen plant's KPIs will therefore be expanded in the future to optimally depict the shift in the plant's strategy towards increasingly complex input materials. These alternative KPIs also include minor metal production via the value generated by all metal fractions. The figures relating to copper production will be maintained for the time being for comparison with the past.

As another consequence of these process adjustments at the Lünen plant, the processed external bleed was included in the raw material streams, as 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 supplied to other Aurubis sites and no longer directly processed into cathodes in Lünen.

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.

In 2020, an innovative method for recording fugitive emissions using drones was used for the first time in close collaboration with the University of Düsseldorf. Drones with installed dust measuring devices fly around the plant and provide live evaluation data on the existing dust pollution. This method enables precise measurement of the current fugitive emissions. This helped identify potential emission sources in the anode furnace area, which are being closed in the next several months. For instance, the dust tightness of a separate boiler building in the anode furnace area was improved, and a roof section in the anode furnace casting area was equipped with a water sprinkler for dust abatement.

Note on the selection of the 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. 3.4: Dust emissions at the Lünen site**

Dust in g/t of input material

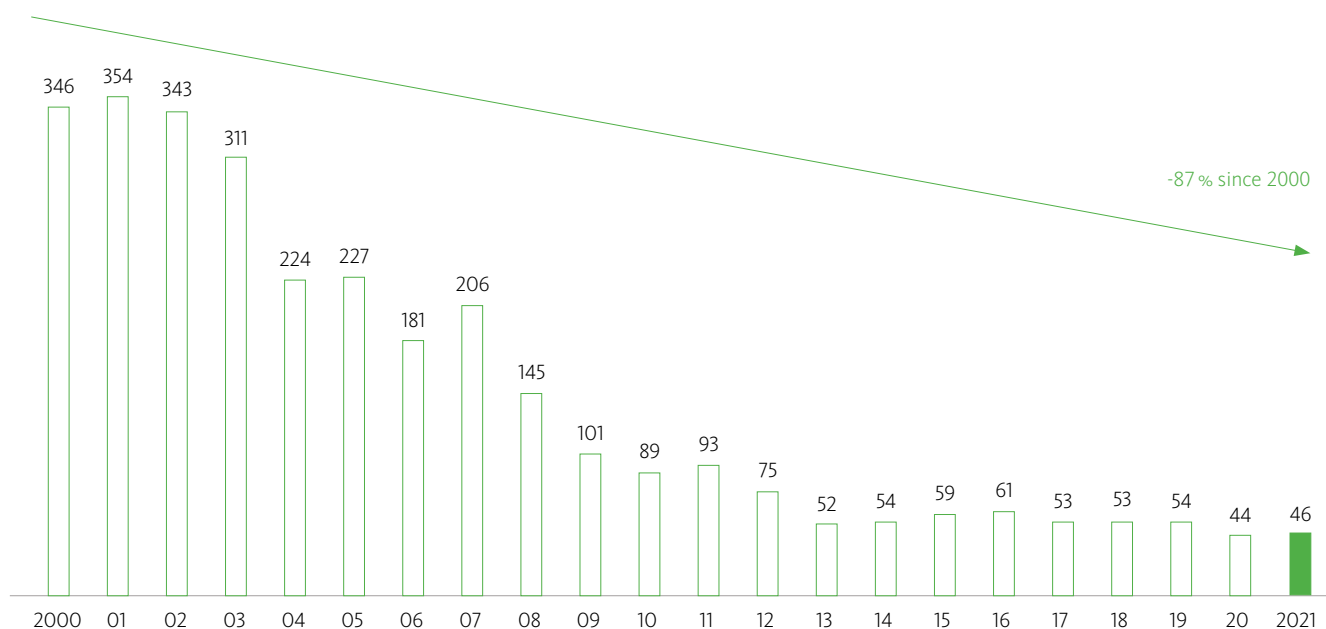


Fig. 3.5: Copper emissions at the Lünen site

Copper in g/t of input material

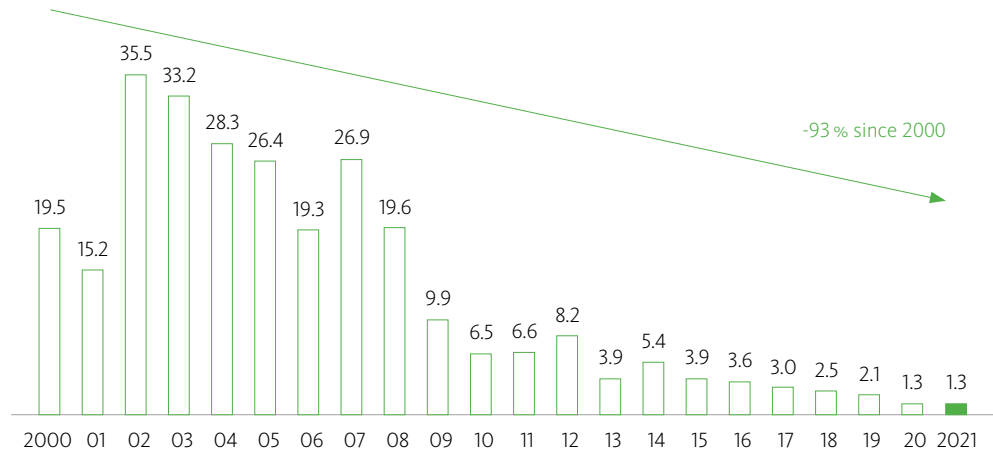


Fig. 3.6: Lead emissions at the Lünen site

Lead in g/t of input material

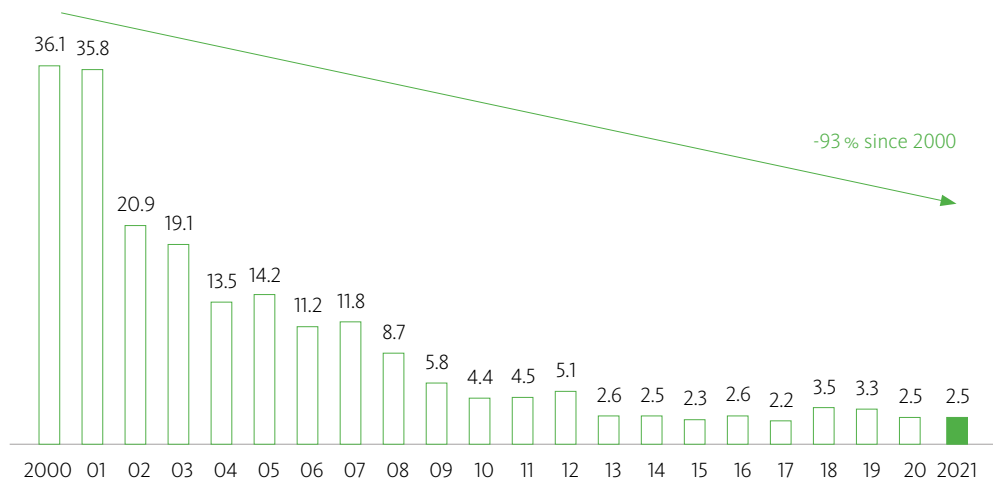
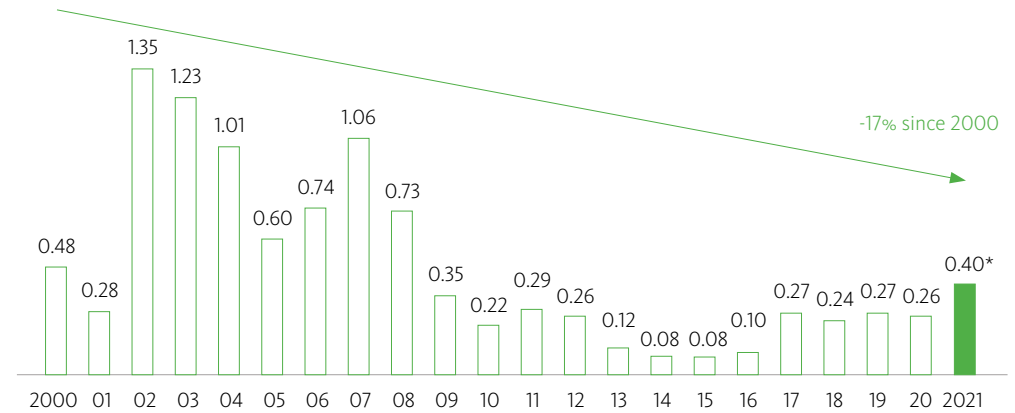


Fig. 3.7: Arsenic emissions at the Lünen site

Arsenic in g/t of input material



\* The increase was ultimately the result of a new one-time emission measurement at the TBRC source, which is projected for the annual emissions. As a result, the emissions reported do not necessarily represent a real increase in emissions.

Note on the selection of the 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.

## AIR – IMMISSIONS

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

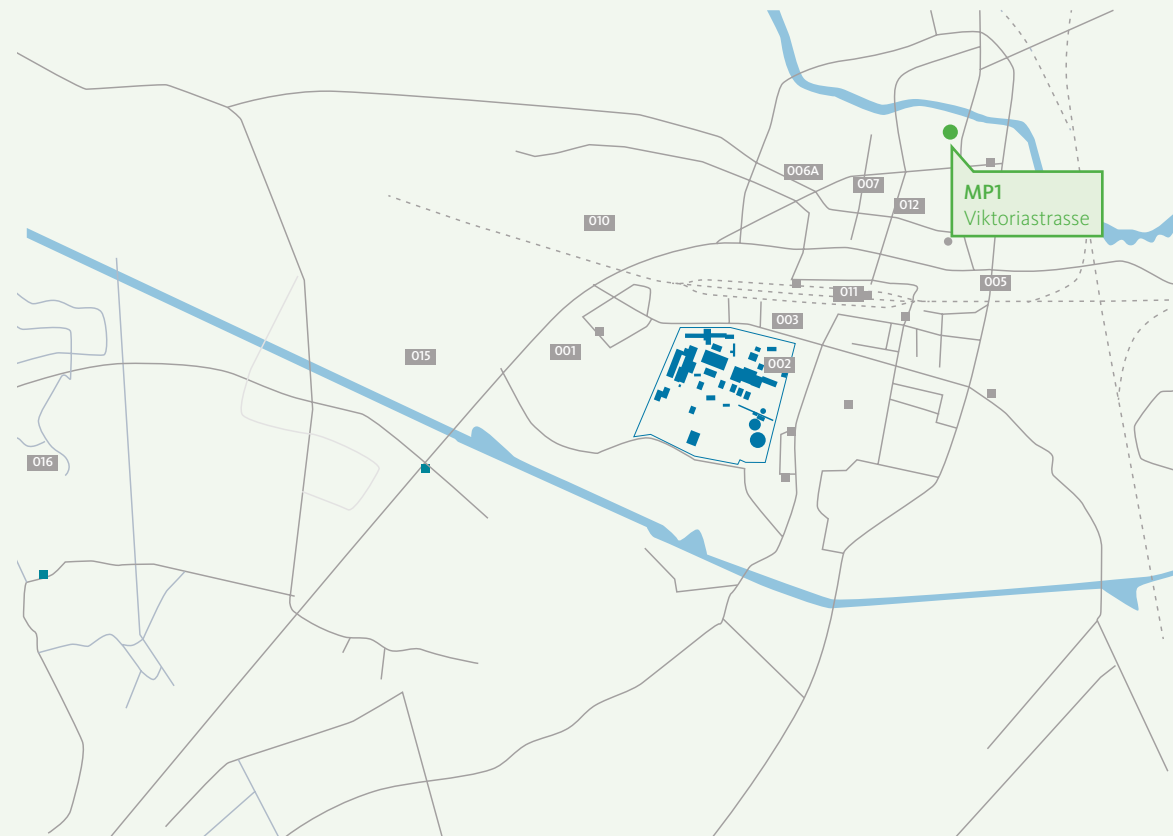
In the last ten years, there has been a significant reduction in dust emissions, primarily in dust components. Although individual deposition values of the TA Luft regulation are still being exceeded, the deposition involves a complex situation and not immissions that can be directly assigned to an individual emitter. With regard to the immission situation in the Kupferstrasse industrial area, Aurubis is in close, ongoing dialogue with the relevant governmental authorities and the other companies on site to identify and implement suitable reduction 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.

The LANUV measuring program, which investigated leafy vegetables from small gardens in Lünen near the plant, was discontinued in 2020, as the measurement values had stabilized at a low level.

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



“Bergerhoff” measurement points in Lünen

Buchenberg  
Kleine Bergstrasse  
Bergstrasse 48  
Bebelstrasse/Süggelbach

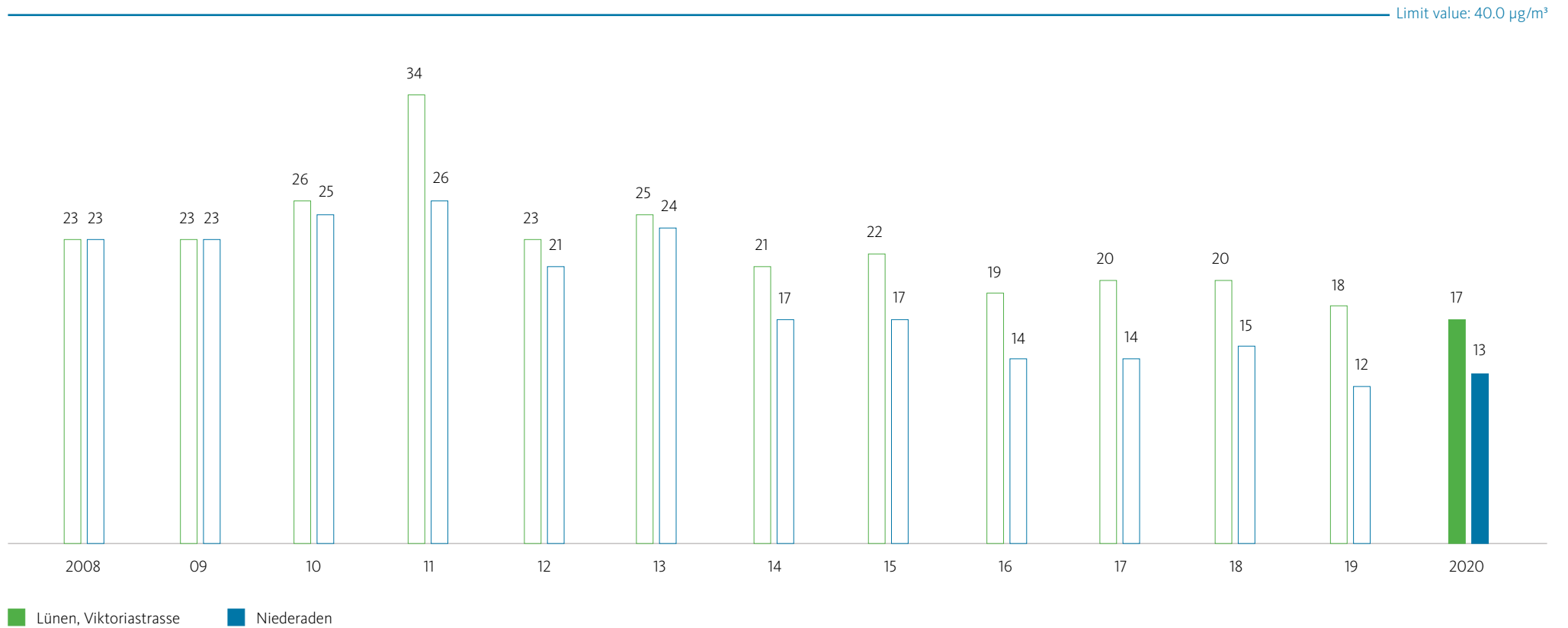
006A Rail line/mosque  
007 Lünen South freight yard  
009A B 236/Lippebrücke  
010 Im Wiesengrund  
011 Builders’ association/building yard

012 Rail line/Kantstrasse  
015 Im Engelbrauck/north side  
016 Im Siepen  
Aurubis plant building

Source: LANUV

Fig. 3.9: Immissions of particulate matter (PM10) compared to the plant's calculated immission maximum<sup>1</sup>

Comparison of dust immissions in  $\mu\text{g}/\text{m}^3$  at the Lünen site, Viktoriastrasse, and Niederaden



<sup>1</sup> Official results for 2021 aren't available yet.

Fig. 3.10: Lead<sup>1</sup>

Lead immissions in  $\mu\text{g}/\text{m}^3$

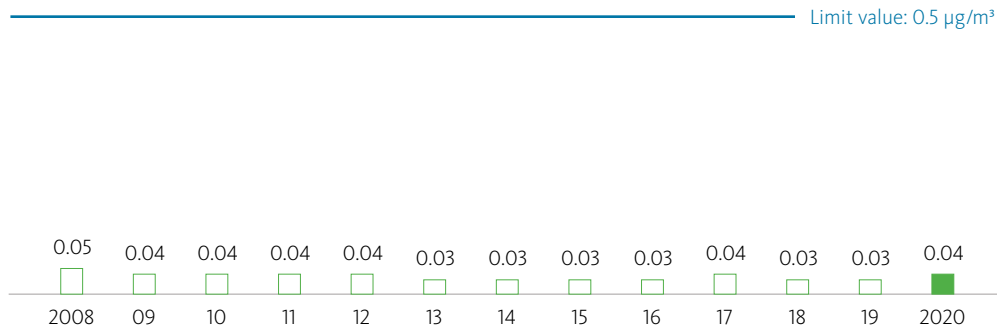


Fig. 3.11: Cadmium<sup>1</sup>

Cadmium immissions in  $\text{ng}/\text{m}^3$

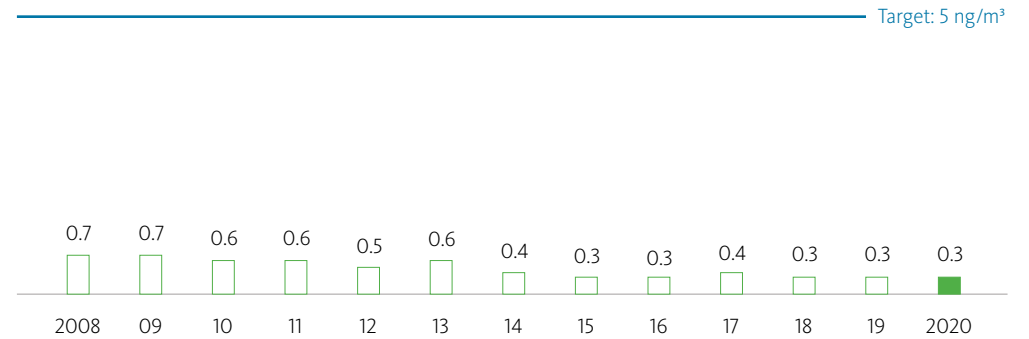


Fig. 3.12: Arsenic<sup>1</sup>

Arsenic immissions in  $\text{ng}/\text{m}^3$

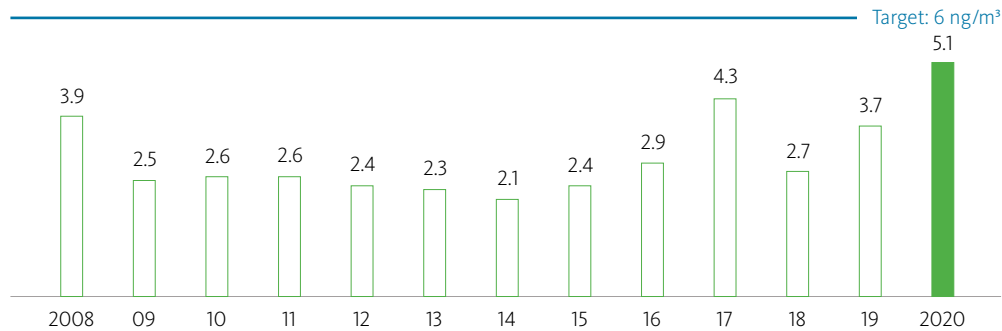
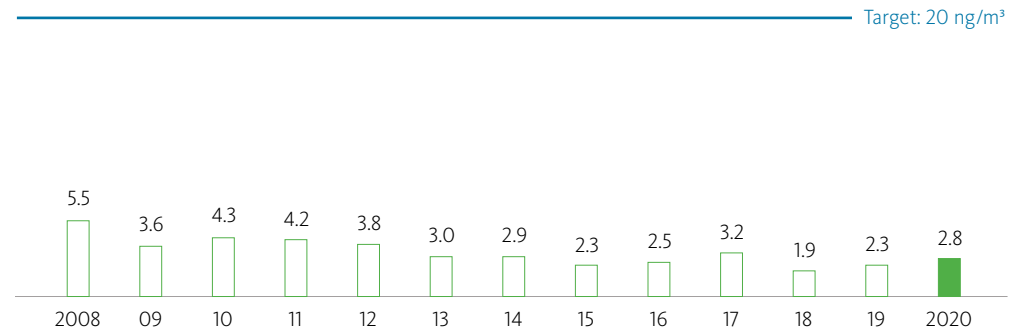


Fig. 3.13: Nickel<sup>1</sup>

Nickel immissions in  $\text{ng}/\text{m}^3$

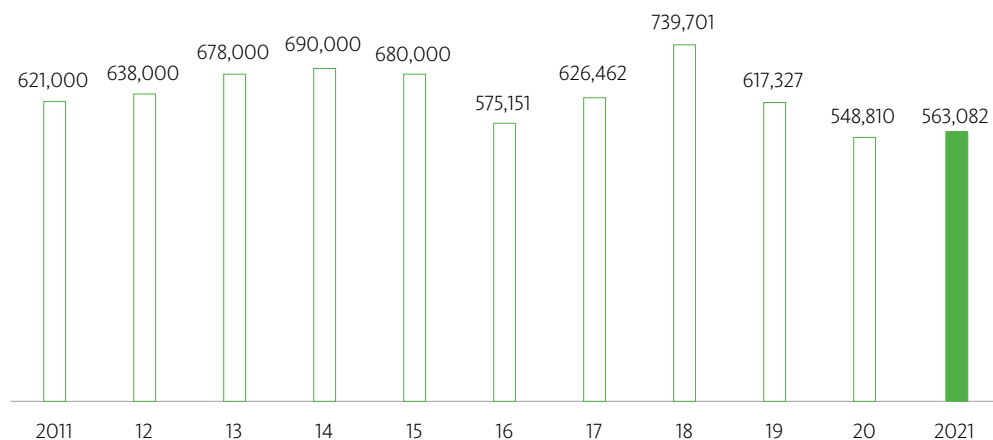


<sup>1</sup> Official results for 2021 aren't available yet.

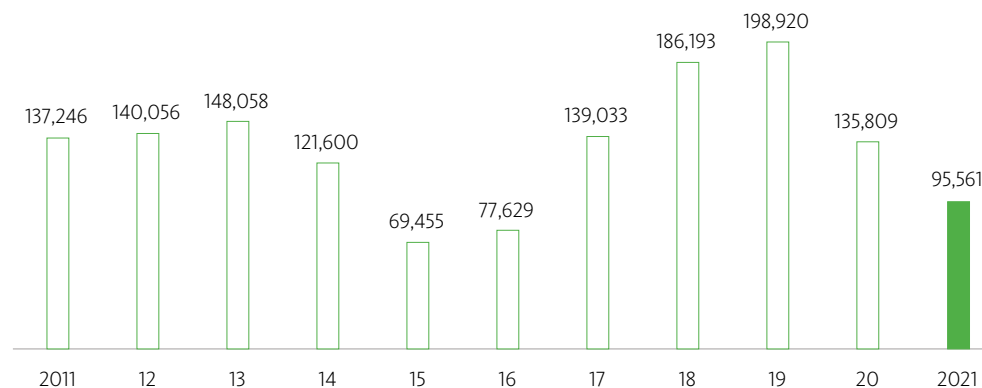


Fig. 3.14: Water consumption and wastewater discharge at the Lünen site

Water consumption in m<sup>3</sup>/year



Wastewater discharge in m<sup>3</sup>/year\*



\* 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.

## 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, and water usage from the public water network has decreased accordingly. In 2021, more than 120,000 m<sup>3</sup> of process water was used for internal purposes. Overall, the rainwater-use project has significantly surpassed the projected quantities. In 2021, wastewater discharge was further reduced by more than 50 % compared to 2019 due to the optimization of water retention and supply [see Fig. 3.14](#). For the coming years, additional optimizations are planned for internal water use such as reviewing the further treatment of internal process water (reverse osmosis, evaporation). The goal is to use water internally to the greatest extent possible and prevent the discharge of process water into the public sewer system.

## 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 and coordinated with the responsible authorities. In late 2014, a remediation agreement was 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.

The oil damage remediation system, the first measure implemented to remediate an oil phase in a former oil storage area, went into regular operation in 2020. This system cleans the extracted groundwater, which is then used as internal process water; the separated oil phase is disposed of externally by the specialized company that operates the system for Aurubis.

For the other remediation measures, the goal is to use the remediated water in a similar way to sensibly combine remediation with further resource conservation.

### 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.

All of the measurements carried out by external experts showed that the reference values relevant for the respective applications were observed at the 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.

Residents on Zum Wäldchen road repeatedly filed noise complaints between May and June 2021. They initially focused on hammering at night in connection with shutdown work, which was brought to a close with the units and third-party companies as quickly as possible. The same residents then reported additional noise to Aurubis – however, no limit violations were measured. No more complaints have been received since June.

In July, residents on Bergstrasse complained of flooding on their properties and in their basements during periods of heavy rainfall. But the reasons for this were presumably the external capacities of the sewer system operator. The plant itself did not discharge any water onto neighboring properties, which the residents were informed of accordingly.

### 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 FFH<sup>1</sup> assessments in order to identify possible impacts on biodiversity. In smaller projects in the plant and in the neighbor-

hood, 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, HOS<sup>2</sup> landfill) and setting up nesting sites on buildings and chimneys.

### 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.

A total of 329 t of hazardous waste accumulated in 2021, mainly spent potlining material. All of this waste was sent for recycling.

<sup>1</sup> Flora Fauna Habitat Directive (EU Habitats Directive)

<sup>2</sup> Blast furnace slag (Herdfenschlacke in German)

Fig. 3.15: Waste generated at the Lünen site

Type of waste in t/year	2015	2016	2017	2018	2019	2020	2021
Non-hazardous waste	4,445	6,664	9,012	5,467	4,842	19,712	4,243
Hazardous waste	264	373	417	362	458	402	329
Construction waste	8,923	4,313	10,940	3,234	9,639	3,015	14,638
<b>Total waste volume, including construction waste</b>	<b>13,632</b>	<b>11,350</b>	<b>20,369</b>	<b>9,063</b>	<b>14,939</b>	<b>23,129</b>	<b>19,210</b>

## 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 and thermal energy for leaching and electrolysis are mainly produced in the waste heat boilers of the KRS sub-merged 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 0.1 bar in the second turbine stage. The German Federal Office for Economic Affairs and Export Control (BAFA) licensed the turbine as a highly efficient new system 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. With around 6.5 GWh of internal power generation in 2021, the turbine capacity was far below the 10 GWh of 2020, which was primarily the result of damage to the waste heat boilers.

Developments and background on the use of primary energy sources:

- » At 505.4 GWh, the plant's total energy demand in 2021 exceeded the 500 GWh threshold again, but was also around 10 GWh below the level of the prior year. The primary influential factors are:
  - Reduction of 10 GWh in demand for power due to ongoing renovation of the tankhouse
  - Reduction of 10 GWh in gas consumption due in large part to the drop in use of auxiliary boilers
- » Continued high input of energy-intensive, complex raw materials such as shredder materials and residues

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 505.4 GWh in 2021, the primary energy input is around 5 % lower than the nine-year average of 529 GWh. Contrary to this trend, direct CO<sub>2</sub> emissions increased again to just over 160,000 t due to a rise in production as a result of improved furnace availability. According to the reporting methods pursuant to DEHSt standards, the organic components in the raw materials still contribute more to the site's CO<sub>2</sub> emissions than the main energy source, SE oil (43 % compared to 39 %).

Energy demand in 2021 reflects the following developments:

1. The fundamentally positive trend in process-related primary energy needs in smelting operations is progressing steadily. Anode output in Lünen was just 177,500 t, approximately 7 % lower than in the period from 2017 to 2020. At 91,100 t, the converter copper output of the KRS system was again much higher than in the previous year.
2. The project to overhaul the tankhouse started in April 2019. The first overhaul stage was completed in early 2020. The second stage should have started directly afterward, but due to a longer tankhouse outage in the Olen plant, a decision was made to run the Lünen tankhouse in full operation for a good six months. This unscheduled mode of operation had a substantial influence on the plant's electricity and heating needs. Renovations resumed again in 2021.

Copper cathode output decreased accordingly, from 172,150 t to 149,853 t. At the same time, 13,100 t of converter copper and 5,500 t of copper anodes, or about 11 % of the copper output (2020: 6 %), was delivered as intermediate products to other Group sites for refining. The goal of the Lünen site is still to push the use of complex raw materials, which require more energy-intensive processing.

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

		2013	2014	2015	2016	2017	2018	2019	2020	2021
Primary energy consumption	MWh	356,061	380,243	404,317	390,734	391,679	360,990	337,970	352,437	352,519
Secondary energy consumption	MWh	155,882	161,997	161,167	155,212	165,117	164,593	155,067	163,553	153,145
Total energy consumption	MWh	511,943	542,240	565,485	545,946	556,796	525,583	493,036	515,990	505,664
Energy consumption per ton of copper output	MWh/t of Cu	2.61	2.81	3.04	3.05	2.89	2.73	2.79	2.83	3.00

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

Fig. 3.17: Breakdown of energy consumption at the Lünen site



Environmental protection facilities are very energy-intensive; Aurubis uses more than 30% of the electricity at the Lünen site for environmental protection measures.

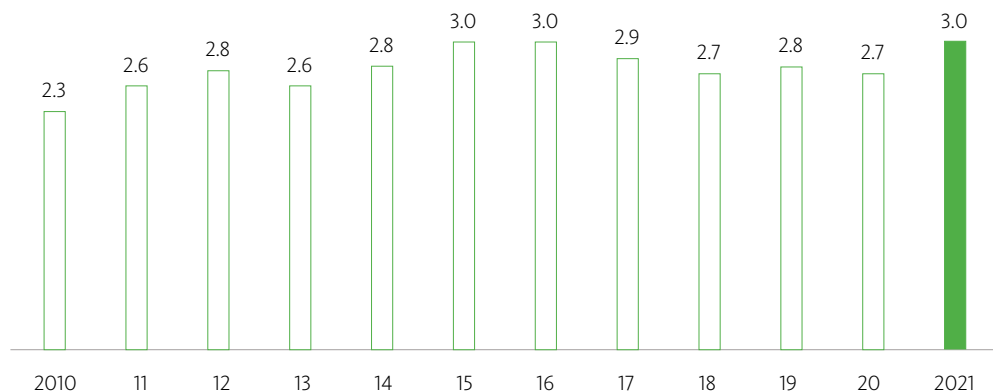
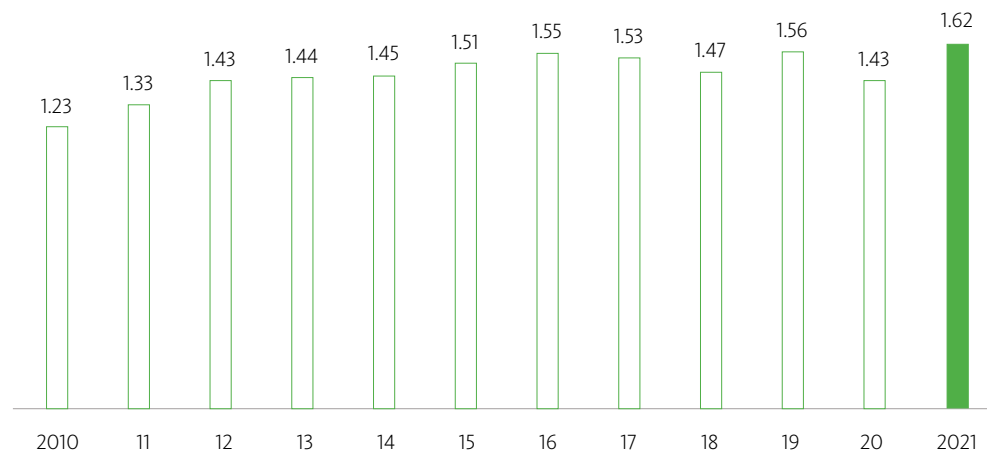
Fig. 3.18: Direct CO<sub>2</sub> emissions at the Lünen site

in t p.a.	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Total CO <sub>2</sub>	172,870	168,297	172,461	174,549	176,067	186,544	169,415	163,572	162,166	164,854
Biogenic CO <sub>2</sub>	0	568	569	0	480	324	300	295	313	379
CO <sub>2</sub> subject to DEV 2020 <sup>2</sup>	172,870	164,995	169,134	171,858	173,202	183,839	166,918	161,113	159,739	162,274

<sup>2</sup> 2020 Data Collection Regulation for the third emissions trading allocation period.

Fig. 3.19: Energy consumption at the Lünen site

in MWh/t of copper output

Fig. 3.20: Direct CO<sub>2</sub> emissions at the Lünen sitein t of CO<sub>2</sub>/t of copper output

### AUDITS AND INSPECTIONS BY GOVERNMENTAL AUTHORITIES

The following environmental inspections were carried out by the relevant governmental authorities in 2021:

- » Incident inspection, district government of Arnsberg, March 2, 2021
- » IED<sup>1</sup> plant inspection, focus on "Anode furnace area: exhaust gas discharge and emissions," district government of Arnsberg, November 4, 2021

The inspections were completed without any deviations. The reports are 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 quantity of anodes delivered to the plant and the cathodes delivered from the plant by train increased significantly.

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 was overhauled in 2020 and, following the incident inspection, was coordinated with the district government of Arnsberg and further expanded in 2021. The hazardous substances register was revised, the location of the materials at the plant more precisely structured, and new incident scenarios added.

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.

<sup>1</sup> Industrial Emissions Directive.



## Environmental Program

The targets set in the context of the Environmental Statement 2021 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 2022. The results are presented in the following Environmental Program.

Target	Planned measures	Degree of implementation/date
<b>Air pollution control</b>		
Reducing fugitive emissions in the anode furnace area	Implementing the measures identified through drone recordings: sealing off boiler house 7, sprinkling water on the roof in the casting area	The measures were implemented and accepted by the authorities in 2021.
Reducing emissions and improving odor immissions in the plant surroundings	New filters in sampling with extraction ring in the sampling hall	The filter will be set up and commissioned in summer 2022.
<b>Water pollution control</b>		
Optimizing wastewater flows	Separately treating sanitation water, improvement in the ratio of used surface water to drained surface water close to 100 %	The previous targets were achieved; an internal concept for water use is currently being developed that is supposed to fully prevent drainage of unused process water.
<b>Waste management/polluted areas</b>		
Renaturation of the internal, defunct blast furnace slag (HOS) landfill	The historical HOS landfill is being dismantled and disposed of externally, eliminating the complex process of securing and cultivating the landfill on the plant premises.	A contract for renaturation and disposal to external landfills has been issued and will be implemented this year.
<b>Energy optimization</b>		
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.
Development of a steam storage facility for optimized use of steam	Steam storage should minimize energy losses and optimize the supply of process steam for the boilers and plants.	The project is in the engineering phase and should be budgeted and tendered this year.

## Key figures for Aurubis AG, Lünen site, in calendar year 2021

Developments in KPIs are explained in the text

Input	Unit	2019	2020	2021
<b>Raw materials</b>				
Recycling raw materials	t	295,343	311,934	330,994
Blister, etc.	t	19,479	12,661	15,938
Copper anodes from other Aurubis sites	t	29,690	22,335	0
Bleed	t	43,000	39,546	45,482
<b>Total raw materials</b>	<b>t</b>	<b>387,512</b>	<b>386.476</b>	<b>392,414</b>
<b>Input material/t of Cu output</b>	<b>t/t Cu</b>	<b>2.20</b>	<b>2.12</b>	<b>2.33</b>
<b>Operating supplies and materials</b>				
Oxygen	million m <sup>3</sup>	39	44	43
Rhine sand	t	20,969	23,820	17,879
Limestone	t	3,493	3,646	2,154
<b>Energy</b>				
External power sources	MWh	151,274	153,478	146,595
Internal power sources	MWh	3,793	10,075	6,549
Natural gas, oil, coal	MWh	337,970	352,437	352,519
<b>Total energy consumption</b>	<b>MWh</b>	<b>493,036</b>	<b>515,990</b>	<b>505,664</b>

Input	Unit	2019	2020	2021
<b>Water withdrawal/uptake</b>				
Potable water	m <sup>3</sup>	617,327	548,810	563,082
Precipitation	m <sup>3</sup>	125,258	126,640	128,636
Other sources (e.g. raw materials)	m <sup>3</sup>	35,833	33,746	39,547
<b>Total water uptake</b>	<b>m<sup>3</sup></b>	<b>592,024</b>	<b>586,051</b>	<b>648,568</b>
<b>Water consumption/t Cu output</b>	<b>m<sup>3</sup>/t Cu</b>	<b>4.4</b>	<b>3.7</b>	<b>4.3</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>	252,784	252,784	252,784
		(equivalent to 80%)	(equivalent to 80%)	(equivalent to 80%)

Output	Unit	2019	2020	2021
<b>Products</b>				
Copper products sold (Kathoden. Anoden u. Blister)	t	176,446	182,424	168,332
KRS oxide	t	20,887	20,327	22,841
Iron silicate sand	t	174,448	177,179	173,904
Other (tin composite, nickel sulfate, etc.)	t	23,048	21,087	23,428
<b>Total products</b>	<b>t</b>	<b>395,190</b>	<b>401,017</b>	<b>388,505</b>
<b>Waste</b>				
Recycling	t	5,300	4,442	4,572
Disposal	t	0	15,672	0
Waste/Cu output	kg/t	30	110	27
Waste/input material	kg/t	14	52	12
Construction waste	t	9,639	3,015	14,638
<b>Total waste</b>	<b>t</b>	<b>14,939</b>	<b>23,129</b>	<b>19,210</b>
<b>Emissions</b>				
CO <sub>2</sub> (direct emissions)/Cu output	t CO <sub>2</sub> /t Cu	0.91	0.89	0.96
Dust/Cu output	g/t	119	93	107
SO <sub>2</sub> /Cu output	kg/t	4.4	5.4	6.5
NO <sub>x</sub> /Cu output	kg/t	1.7	1.8	1.8
<b>Water discharge</b>				
Wastewater (indirect discharge)	m <sup>3</sup>	198,000	135,000	95,000
Water discharge/Cu output	m <sup>3</sup> /t	1.13	0.74	0.57

# URKUNDE



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Register-Nr.: DE-131-00035

Ersteintragung am  
01. November 2005

Diese Urkunde ist gültig bis  
19. Mai 2023.

Diese Organisation wendet zur kontinuierlichen Verbesserung der Umwelleistung ein Umweltmanagementsystem nach der Verordnung (EG) Nr. 1221/2009 und EN ISO 14001:2015 (Abschnitt 4 bis 10) an, veröffentlicht regelmäßig eine Umwelterklärung, lässt das Umweltmanagementsystem und die Umwelterklärung von einem zugelassenen, unabhängigen Umweltgutachter begutachten, ist eingetragen im EMAS-Register ([www.emas-register.de](http://www.emas-register.de)) und deshalb berechtigt das EMAS-Logo zu verwenden.

Hamburg, 10. September 2020  
HANDELSKAMMER HAMBURG



*Prof. Norbert Aust*  
Prof. Norbert Aust  
Präsident

*Dr. Malte Heyne*  
Dr. Malte Heyne  
Hauptgeschäftsführer



## DECLARATION OF VALIDITY

in accordance with the standards of  
**Regulation (EC) No 1221/2009 of 25 November 2009**  
on the voluntary participation by organisations in a Community  
eco-management and audit scheme (EMAS)



The signing environmental verifier Ralph Meß, licensed for the scope "NACE Code 24.44 - production and initial processing of copper", declare to have verified whether the whole organisation as indicated in the environmental statement of the organisation

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with registration number D-131-00035 meets all requirements of Regulation (EC) No 1221/2009 of the European Parliament and of the Council of 25 November 2009 on the voluntary participation by organisations in a Community eco-management and audit scheme (EMAS) as amended by Commission Regulation (EC) No 2017/1505.

**By signing this declaration, I declare that**

- the verification and validation has been carried out in full compliance with the requirements of Regulation (EC) No 1221/2009,
- the outcome of the verification and validation confirms that there is no evidence of non-compliance with applicable legal requirements relating to the environment,
- the data and information of the environmental statement of the sites reflect a reliable, credible and correct image of all the sites' activities, within the scope mentioned in the environmental statement.

This document is not equivalent to EMAS registration. EMAS registration can only be granted by a Competent Body under Regulation (EC) No 1221/2009. This document shall not be used as a stand-alone piece of public communication.

Hannover, 2022-05-15

*Ralph Meß*  
Ralph Meß  
Environmental Verifier  
DE-V-0300

TÜV NORD CERT UMWELTGUTACHTER GmbH Am TÜV 1 30519 Hannover [www.tuev-nord.de](http://www.tuev-nord.de)  
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This report describes calendar year 2021. Current events were included up to the editorial deadline of May 2022.

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

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