



Environmental Protection in the Aurubis Group  
and Updated Aurubis AG Environmental Statement 2019  
Hamburg and Lünen Sites

 **Aurubis**  
Metals for Progress



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Dear readers,

As a production company, Aurubis holds a special responsibility. On the one hand, refining metals can have impacts on the environment. Each day, we intensively work on reducing our emissions further and on utilizing the newest technologies available, thus continuing to shrink our environmental footprint. On the other hand, we lay the foundation for environmentally friendly technologies and renewable energies with our metals. Without us, the energy transition and modern environmental protection simply wouldn't be possible.

We have stepped up to this responsibility for a long time. We can justifiably claim that we are among the companies with the highest environmental standards and the lowest emissions in our industry. And we don't stop there: in the past year, Aurubis presented its Sustainability Strategy until the year 2023, which is part of the corporate strategy. It follows the company's mission of responsibly transforming raw materials into value to provide metals for an innovative world. In addition to the pillars of Economy and People, the Environment is defined as a central element for our future activities. To us, this means treating the environment and limited natural resources with care. We have set ambitious goals to underpin our strategy: for instance, we want to implement energy efficiency projects that reduce CO<sub>2</sub> emissions by more than 100,000 t annually within ten years, based on the reference fiscal year 2012/13. We also intend to reduce specific metal emissions to water by 40 % during this period.

We also think beyond our plant boundaries when it comes to energy-efficient production. The heat that forms in our production processes can't always be used sensibly elsewhere in the plant. To prevent this energy from going to waste, since fall 2018 Aurubis has supplied the Hamburg district HafenCity East with CO<sub>2</sub>-free heat that forms in a sub-process of copper production. This helps us avoid 20,000 t of CO<sub>2</sub> emissions each year. We have been distinguished with national and international prizes for this project.

This environmental report highlights in detail the activities we have undertaken in the past year to protect the environment and conserve natural resources. We hope it's an inspiring read.

Sincerely,



**Dr. Thomas Büniger**  
Chief Operating Officer

# Company Profile and Business Model

## The Aurubis Group

Aurubis AG is a provider of non-ferrous metals that operates worldwide. As an integrated group, we process complex metal concentrates, scrap metals, and metal-bearing recycling materials into metals of the highest purity. In addition to our main metal, copper, our product portfolio also includes gold, silver, lead, nickel, tin, minor metals such as tellurium and selenium, and platinum group metals.

The company's headquarters, which is also home to key production facilities, is located in Hamburg, Germany. Our additional sites are primarily located in Europe, with larger production centers in Germany, Belgium, and Bulgaria. Furthermore, we also have a production site in the US and a global sales and service network. Aurubis has approximately 6,700 employees.

## Business Model and Group Structure

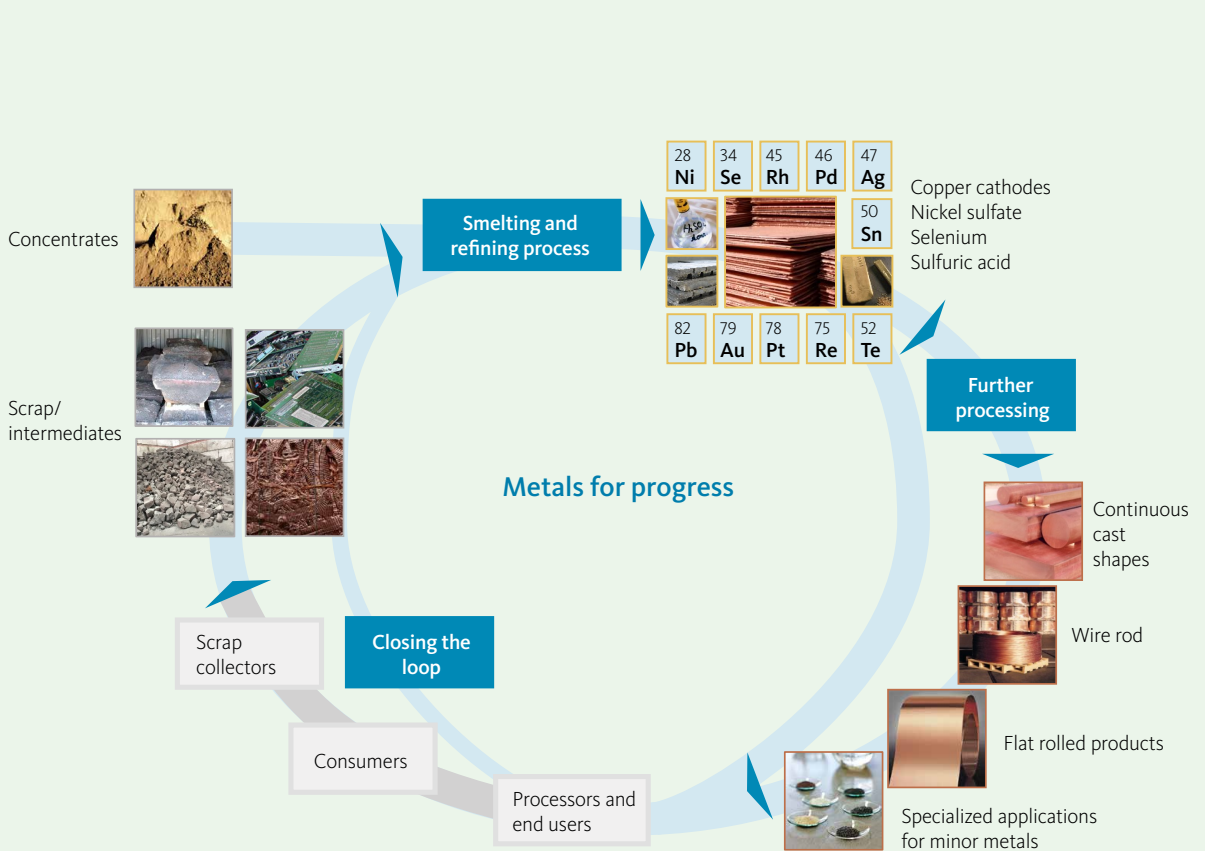
In accordance with our Vision 2025, we are consistently expanding our current business model, which is focused on copper, to encompass a broader multi-metal approach. We are increasingly extracting other metals in addition to copper from systematically purchased raw materials and intermediate products and then processing them into marketable value-added products. Our most important internal project Future Complex Metallurgy embodies our multi-metal approach (see page 28 "Processes at the Hamburg plant").

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

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

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

Fig. 1.1: The life cycle of our products



### Our Group structure

The Aurubis Group's organizational structure is oriented towards its underlying business model. This structure is made up of two operating segments:

Segment Metal Refining & Processing (MRP) processes complex metal concentrates, copper scrap, and metal-bearing recycling materials into metals of the highest quality. From an organizational perspective, MRP includes the Commercial and Operations divisions. The Commercial division combines raw material purchasing and product sales, while the Operations division is responsible for manufacturing all of the base products and metals, as well as processing them further into products such as rod and shapes.

Segment Flat Rolled Products (FRP) processes copper and copper alloys – primarily brass, bronze, and high-performance alloys – into flat rolled products and specialty wire and then markets them. We plan to leave the strip sector and further strengthen our strategic orientation towards multi-metal business. In fiscal year 2017/18, we therefore signed a contract with Wieland-Werke AG to sell Segment FRP. The European Commission blocked the sale in February 2019. We are currently reviewing other strategic alternatives for this business area.

This organizational core is framed by the central functions Corporate Development and Technology, as well as by supporting functions such as Human Resources and Finance & Controlling.

# 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, the following principles were established in our company guidelines:

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

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

# Environmental Protection in the Aurubis Group

## Environmental protection is part of the company strategy

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

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

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

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

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

## Achievements and successes in environmental protection

In 2013, we set environmental targets for the period ending in 2018. We fully achieved these emission reduction targets, exceeding them considerably in some cases.

Dust emissions per ton of copper output in copper production were reduced by 14% compared to 2012 (target: 10%). Similarly, SO<sub>2</sub> emissions in primary copper production were reduced by 13% in the same period under review. When compared internationally, Aurubis is a forerunner in reducing specific sulfur dioxide emissions.

We have also made significant improvements in water pollution control. We have reduced metal emissions to water in copper production processes from 2.2 to 1.1 g per ton of copper output since 2012. This is a decline of 52% (target: 10%).





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

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

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

We were only able to achieve these successes with continuous investments: we have invested over € 590 million in measures to improve environmental protection in copper production since 2000.

As an energy-intensive company, Aurubis feels especially committed to climate protection. We therefore invest in energy-efficient plant technologies at all sites, carry out measures to save additional energy, and implement projects such as the use of industrial heat for heating purposes. This long-term involvement has been successful: we have considerably reduced our CO<sub>2</sub> emissions per ton of copper at the sites.

The following are examples of measures that have strongly contributed to ongoing improvements in environmental protection:

- » Our project to utilize industrial heat from the Hamburg plant facilitates an energy-efficient heat supply for the HafenCity East district. At the same time, 12 million m<sup>3</sup> less cooling water and Elbe River water is used each year, as the excess warmth is now used for heating purposes (see page 14 "Energy and climate protection").
- » The rainwater retention facility in Lünen was optimized to further reduce consumption of city water. The treated water is used in the Lünen plant.
- » To reduce fugitive emissions, a new facility for cooling converter slag in pots is being built at the site in Pirdop, Bulgaria. Commissioning is expected in late 2019.

Fig. 1.2: **Our environmental targets until 2023**

**Climate protection**

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

**Nature conservation & biodiversity**

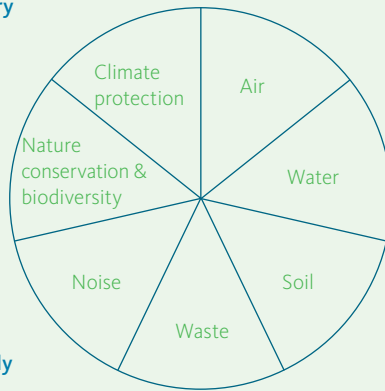
- » **Target: Improvement of nature conservation at the production sites**
- » Example: Participation in the NABU project UnternehmensNatur in Hamburg

**Noise**

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

**Environmental management**

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



**Air**

- » **Target: Reducing dust emissions in copper production by 15 % compared to 2012**
- » Example: Reduction of fugitive emissions

**Water**

- » **Target: Reducing metal emissions to water in copper production by about 40 % compared to 2012**
- » 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

**Waste**

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

**Targets and challenges**

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

**Dialogue with interested parties & commitment**

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

Since 2013 we have participated in the EU projects Organizational Environmental Footprint and Product Environ-

mental Footprint, which seek to achieve an environmental balance in organizations and products. The goal of this collaboration is to develop and test the methods for determining the environmental footprint. On this basis, the European Commission is striving to create a single market for “environmentally friendly products” and “environmentally friendly organizations.” In 2018, the two pilot projects we participated in were successfully concluded when the results were accepted by the official supervisory bodies. We will take part in the next phase of the environmental footprint and contribute our experience in this area.

In addition, we are participating with 22 national and international partners in the European research project FORCE – Cities Cooperating for Circular Economy. The goal of the project is to develop new concepts for waste avoidance and treatment for the material streams for plastics, biomass, used electrical equipment, and wood. As a multi-metal recycler, Aurubis supports the project with its expertise for the purpose of improving the recycling of strategic metals (e.g., copper, gold, silver, and lead)

through the best possible collection and dismantling system for waste electrical and electronic equipment.

In Hamburg, we have been a member of the Environmental Partnership since 2003, and a member of the Partnership for Air Quality and Low-Emission Mobility, which is coordinated by the city of Hamburg. The goal of the latter partnership is to reduce nitrogen dioxide emissions, which are caused by transport in particular. For this purpose, we also participated in the German model project Mobil.Pro. Fit® in collaboration with the environmental organization B.A.U.M. e. V. The goal of the project is to develop a sustainable and climate-friendly mobility concept.

### Environmental management organization

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

With the involvement of employees, plant managers, managing directors, and the Executive Board, uniform environmental protection standards were developed, established with corporate guidelines, and implemented across the Group as part of the environmental management systems

Fig. 1.3: Corporate Environmental Protection organizational chart

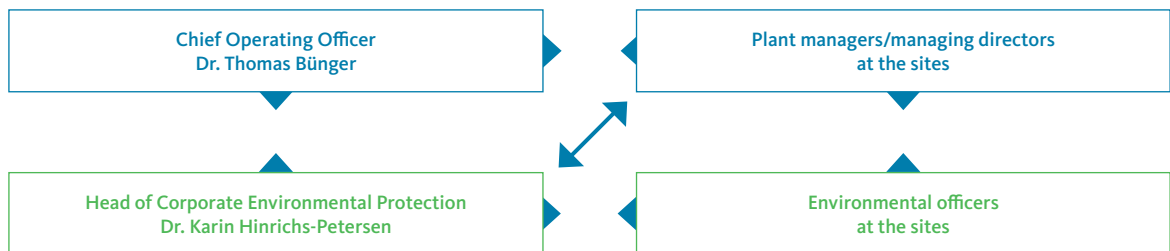
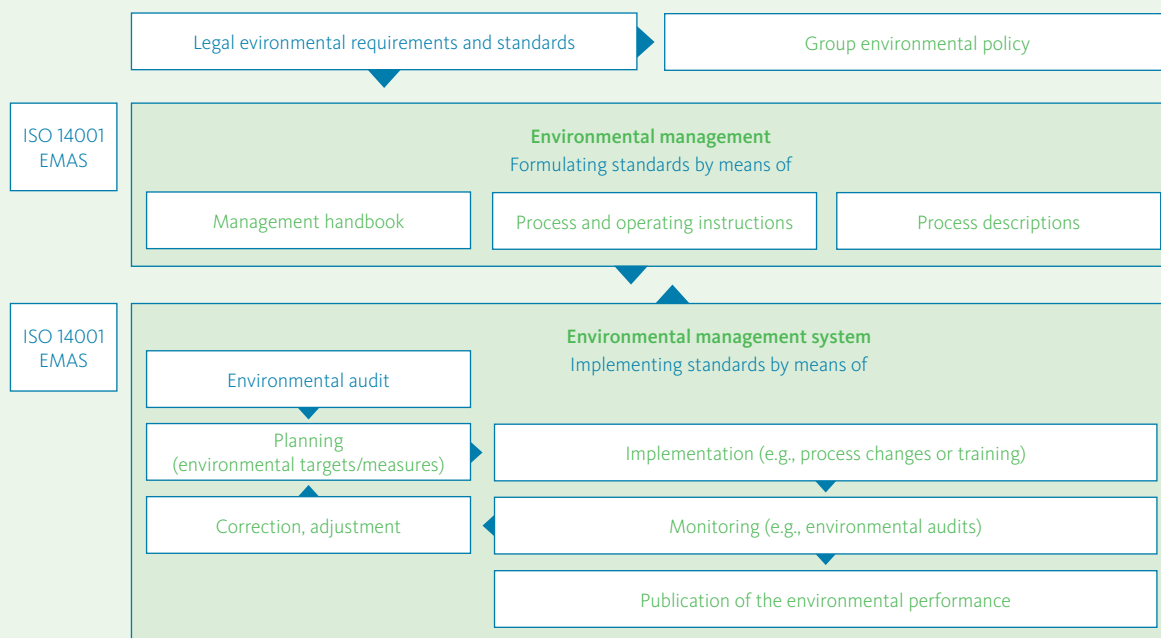


Fig. 1.4: Environmental management in the Aurubis Group



(ISO 14001 or EMAS). The EMAS registration under which this Environmental Statement is being submitted encompasses Aurubis AG and thus 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 support 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 German Federal Immission Control Act, the Closed Cycle and Waste Management Act, the Water Management Act, and the European chemical regulation, REACH. The results of internal and external assessments confirm that the legal regulations were adhered to.

An integrated management system (IMS) was developed for Aurubis AG for the areas of environment, quality, and energy. It was certified in its entirety for the first time in 2017. The IMS utilizes synergies, harmonizes process, and improves environmental, quality, and energy management.

Furthermore, we determine key environmental protection factors, which are uniform within the Group and are reviewed and certified by external auditors annually.

Fig. 1.5: Certifications by site

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

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

**ISO 14001:** standard for environmental management system guidelines

**ISO 50001:** standard for energy management system guidelines

**ISO 9001:** standard for quality management system guidelines

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

**EfbV:** Waste Management Company Ordinance (certificate in DE)

<sup>1</sup> For the sale of iron silicate granules used to produce blasting abrasives

<sup>2</sup> Not majority-owned by Aurubis (50% stake)

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

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

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

environmental protection targets can also be achieved and development opportunities can be utilized.

To prepare ourselves for future developments, we regularly evaluate opportunities and risks that the company faces. When we see opportunities, we use them by implementing projects. One example is the project Future Complex Metallurgy currently underway, which will make an important contribution to the efficient use of resources. Risk management exists to prevent environmental damages, non-compliance, and unexpected costs. Thus, environmental risks are investigated regularly and minimized by establishing precautionary measures.

# Energy and Climate Protection

The individual production steps in the Aurubis value chain are complex and very energy-intensive overall. For us, the effective and efficient use of energy is an issue of ecological and economic responsibility. As a result, all of our sites utilize energy as sparingly as possible. Increasing productivity and efficiency is part of our everyday work at Aurubis. The Energy & Climate Affairs Department oversees the corresponding coordination of the measures across the Group. In order to control energy consumption optimally and identify additional energy savings potential, the main German sites are certified in accordance with DIN EN ISO 50001.

Energy aspects and consumers are determined and assessed to derive a variety of suitable steps that lead to effective energy use and a continuous reduction in energy consumption. Existing measurement systems record energy consumption and verify energy savings.

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



The development and implementation of the Group-wide energy strategy is the central responsibility of the head of Corporate Energy & Climate Affairs, who reports directly to the Executive Board. In addition to large projects to enhance energy efficiency – such as the steam turbines used to produce electricity from process waste heat at the Hamburg, Lünen, and Pirdop sites – energy-conscious conduct and the participation of all employees are called for in particular. In order to raise awareness of these issues among employees, an Energy Day was organized at the Hamburg plant, for example. Moreover, energy training sessions also take place regularly.

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

Energy consumption is the main source of CO<sub>2</sub> emissions in the Aurubis Group. The biggest CO<sub>2</sub> emitters in the Group are the German sites in Hamburg and Lünen. Currently, Aurubis systematically records the direct CO<sub>2</sub> emissions at the sites, as well as the energy-related indirect emissions, for example from purchased electricity.

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

conservation, and energy efficiency optimally across the raw material spectrum.

With the installation of a power-to-X technology – an electric steam boiler – we are participating in the project NEW 4.0 to identify potential for electricity flexibility for our plants. This large-scale project – funded by the German Federal Ministry for Economic Affairs and Energy – brings together more than 50 partners in the German federal states of Hamburg and Schleswig-Holstein. “NEW” stands for “Norddeutsche EnergieWende” (Northern German Energy Revolution) and the “4.0” indicates the threshold to the fourth industrial revolution, i.e., the digitalization of industry, in which the intelligent networking of systems – including with regard to the energy revolution – is playing an increasingly decisive role.



### Our successes

#### Best Newcomer Germany 2015 and Index Leader MDAX 2016: Aurubis

In 2015 and 2016, Aurubis participated in the Carbon Disclosure Project (CDP) investor initiative. 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. The Sustainability Strategy and the transparent presentation of Aurubis' approach to the opportunities and risks of climate change contributed to the good performance. This distinction includes the copper products that contribute to increasing efficiency in applications, as well as the effective production processes, energy management, and investment in energy and CO<sub>2</sub>

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

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

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

By using waste heat, for instance converting it into electricity and using the residual heat, the recycling center achieves the optimum energy recovery possible. The installation produces about 23 million KWh of electricity (about 14 % of the site's energy needs, or the average energy demand of around 6,500 three-person households). It simultaneously manages to prevent 14,000 t of CO<sub>2</sub>.

The energy efficiency initiative of the German Energy Agency rated the project as exemplary and awarded it the label Best Practice in Energy Efficiency in 2015.





### Our flagship project

The city of Hamburg is striving to reduce its CO<sub>2</sub> emissions by 40 % in 2020 compared to 1990 and by 80 % in 2050, as well as to make its district heating supply more climate-compatible in the medium term. The use and inclusion of industrial heat as part of the future heating concept in Hamburg is a clear objective of the local government's coalition agreement, the local citizens, and the German federal government.

In February 2017, Aurubis AG and enercity Contracting Nord GmbH signed a contract for the use of industrial heat for the energy supply in the Hamburg district HafenCity East in the presence of Hamburg's Environmental Senator Jens Kerstan.



In the contract, the partners agree to use industrial heat from the Aurubis Hamburg plant to provide energy-efficient district heating to HafenCity East. Aurubis achieves this by extracting heat that is formed when sulfur dioxide – a by-product of copper smelting – is converted to sulfuric acid. This industrial waste heat is nearly free of CO<sub>2</sub>, and utilizing it will prevent more than 20,000 t of CO<sub>2</sub> emissions per year.

“We could deliver significantly more district heating for the city of Hamburg and thus cut up to 140,000 t of CO<sub>2</sub> each year,” explained Aurubis Executive Board Chairman Jürgen Schachler. “However, at the moment, the technical, financial, and contractual foundations haven't been established yet. We are very interested in a solution and are intensively working on one.” Schachler added: “It is important to Aurubis and to me personally that we do everything

to ensure that our company works in a way that conserves resources. According to our usual investment criteria, this project wouldn't be cost-effective for us.” Nevertheless, the company has decided to pursue heat extraction, he explained. “However, it would be easier for us, and certainly other industrial companies, to opt for industrial heat extraction if corresponding incentives were established,” the Aurubis CEO continued. “In the scope of emissions trading, we require certificates for each ton of CO<sub>2</sub> that we emit, but we don't receive any compensation when we reduce CO<sub>2</sub> emissions in households in this way.”

The industrial heat project is one of ten case examples for the project “Flagships of Energy-Efficient Waste Heat Use” started by the German Energy Agency (dena).



On September 26, 2018, the project received the German Renewables Award in the category “Project of the Year.” According to the jury of the German Renewables Award, Aurubis AG's winning project in this category makes “a decisive contribution to Hamburg's heat transition.”





On November 26, 2018, the project received the Energy Efficiency Award in the category “Energy Transition 2.0” during the German Energy Agency’s Energy Transition Congress. “The fact that we received another award – especially such a sought-after award – shows once again that we have achieved something very special,” explained Senior Vice President Corporate Energy & Climate Affairs Ulf Gehrckens. “Everyone at Aurubis can be proud of this!” And Project Manager Christian Hein added: “In this category, we were the top applicant of a group of 26 submissions from Germany and abroad. This shows that our industrial heat project stands out at the international level as well.”

The jury explained their decision stating that with the help of industrial heat, the emission level in HafenCity East even falls below the demanding emission threshold stipulated for the heat supply of this new development area. Thorsten Herdan, head of the department “Energy Policy – Heat and Efficiency” of the German Federal Ministry for Economic Affairs and Energy, presented the award.



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

# Our Raw Materials – Responsibility in the Supply Chain

We process copper concentrates that are obtained from ores and are offered by mining companies and trading companies on the global market. Apart from copper concentrates, we also use copper scrap and other metal-bearing recycling materials, as well as bought-in intermediates, as feed material.

It is important to us to carefully select business partners in Germany and abroad. We source our primary and secondary raw materials from a number of suppliers, which protects us from becoming too dependent on individual major suppliers and shields us from regional fluctuations on the global market. For primary raw materials, we value long-term relationships and strategic cooperation with our suppliers. We source most of our secondary raw materials from Germany and other EU countries. Compared to primary raw materials, secondary raw materials are largely purchased on the basis of short-term supply contracts.

Our raw material for primary copper production, copper concentrate, is mainly extracted on site at mines, where ores with about 0.3% to 3% copper content are concentrated to an average copper content of 22–30% to reduce transport volumes. Our primary concentrate suppliers are the mining companies Vale, Teck, Antofagasta, and Newmont Mining.

Responsibility in the supply chain is one of the relevant topics of the Aurubis Sustainability Strategy. In addition to the Group-wide guidelines to avoid raw materials for gold manufacturing from conflict zones (Gold Supply Policy), Aurubis introduced a uniform IT-based screening system for business partners in the supply chain in 2013. The screening system is used to review the identity and integrity of Aurubis AG's business partners before entering into contracts. Business Partner Screening is software-based and relies on multiple steps. The plan is to implement it across the Group. The specifically configured software creates a risk profile after the department making the purchase has entered relevant information. In the

case of increased risk, the Compliance and Sustainability Departments carry out an expanded review according to appropriate criteria, using business and risk databases, among others. Based on the corresponding recommendations, management decides on possible contracts or restrictions. Since close communication with our suppliers is part of our company policy, visits with primarily business objectives take place regularly. At the same time, however, our raw material purchasers also observe the criteria that are relevant for the screening process and the corresponding results.

## Certificate for conflict-free gold

We already gained initial experience with supplier screening for precious metals in 2013. A review of the sources of precious-metal-bearing and particularly gold-bearing raw materials concluded that Aurubis does not extract any conflict-affected gold-bearing raw materials. The screening program was applied as part of the Gold Supply Policy, which was developed in the same year. This policy is oriented to the requirements of the Gold Guidance of the London Bullion Market Association (LBMA) and is based on the OECD Due Diligence Guidance for conflict minerals, as well as the provisions of the UN Global Compact. Since 2013, Aurubis' gold production has been continuously certified as conflict-free according to the LBMA's Gold Guidance standards, and the past fiscal year is no exception.

Business Partner Screening is continuously developed and adjusted to changes in requirements.

# Environmental Protection – Facts and Figures

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

Fig. 1.6: Capital expenditure for environmental protection in Aurubis Group copper production

in € million

» Since 2000, more than € 590 million has been invested in environmental protection measures in copper production.

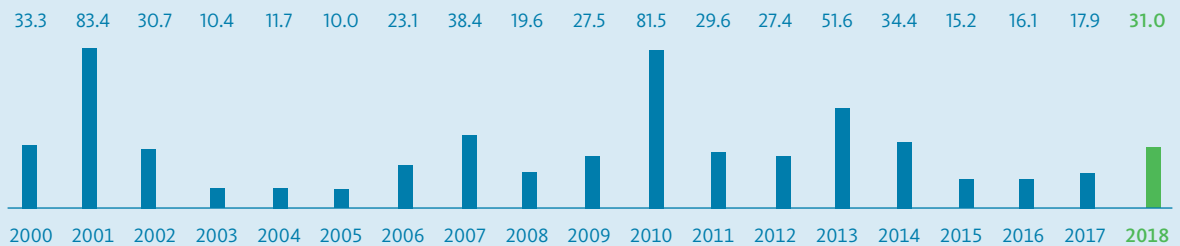


Fig. 1.7: CO<sub>2</sub> emissions from fuels in Aurubis Group copper production

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

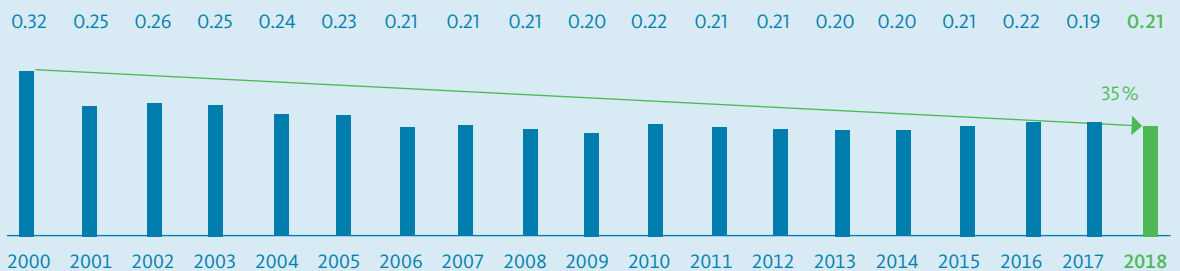
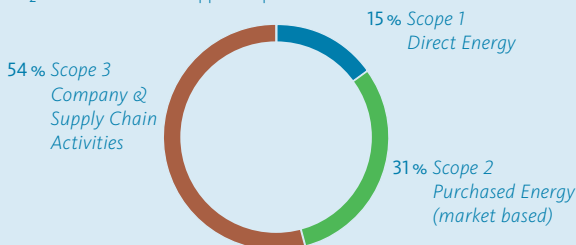


Fig. 1.8: Aurubis Group CO<sub>2</sub> emissions – estimated

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



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

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

Fig. 1.9: Successful reduction of dust emissions in Aurubis Group copper production

Dust emissions in g/t of copper output

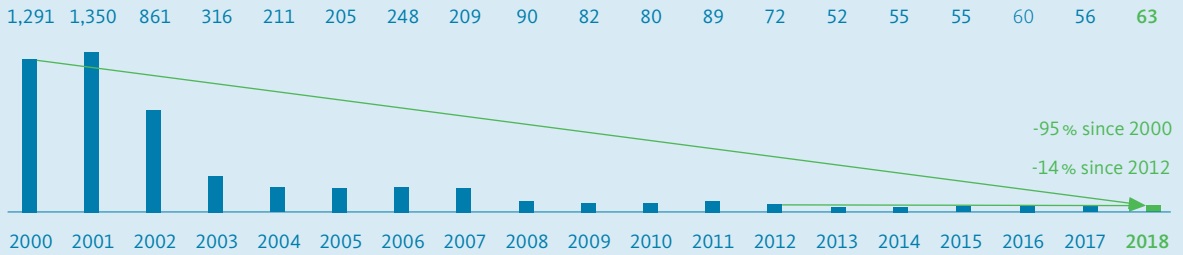
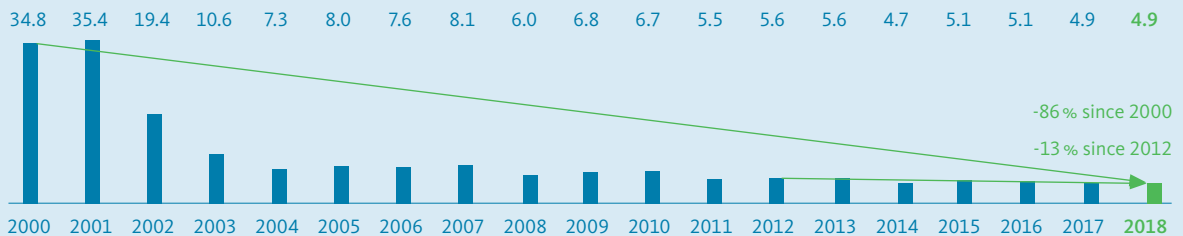


Fig. 1.10: Specific sulfur dioxide emissions in Aurubis Group primary copper production

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



At 0.21 t of CO<sub>2</sub> per ton of copper output, specific emissions from fuels are at a low level. Product-related emissions have been reduced by 35% since 2000 (see Fig. 1.7).

The dust emissions arising during copper production can contain metals and metal compounds. The consistent use of the best available plant techniques has led to a 95% decline in specific dust emissions in primary and secondary copper production since 2000 (see Fig. 1.9).

One of the main focuses in the 1990s was the use of state-of-the-art filter technologies for all directed emission sources, such as chimneys. Today, projects to reduce fugitive emissions have high priority. For example, fugitive emissions can arise around hall openings – such as gates, doors, or ridge turrets – and during material storage and handling. We have already achieved a great deal in reducing directed dust emissions with technical measures and have nearly

exhausted the technical possibilities. Further developments related to non-directed emissions pose additional challenges for the future. It will be necessary to develop innovative technologies and break new technical ground.

Apart from copper, sulfur is one of the main components of the copper concentrates in use. The gaseous sulfur dioxide produced when concentrates are smelted is converted into sulfuric acid in the sulfuric acid plant using the modern double catalysis process. When compared internationally, Aurubis is a forerunner in reducing sulfur dioxide emissions: emissions per ton of copper output have been reduced by 86% since 2000 (see Fig. 1.10).

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

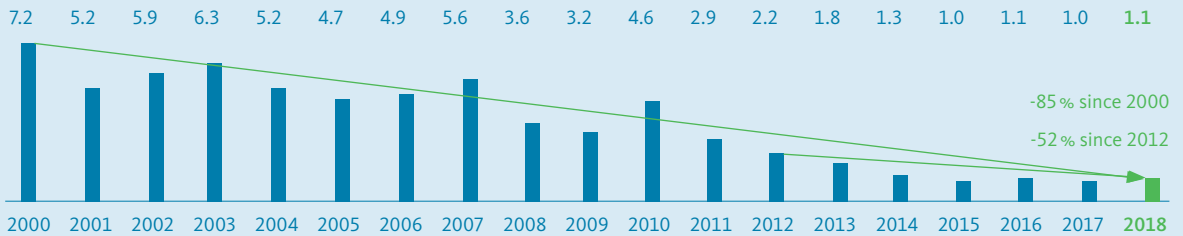
Fig. 1.11: Specific water withdrawal in Aurubis Group copper production

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



Fig. 1.12: Specific metal emissions to water in Aurubis Group copper production

Metal emissions to water in g/t of copper output



resources. We have reduced specific water withdrawal in copper production by a total of 12% since 2000 thanks to more efficient facilities (see Fig. 1.11).

Apart from conserving water, treating wastewater and thus avoiding environmental pollution is one of our fundamental responsibilities in industrial environmental protection since water may contain metals after use. We have reduced metal emissions to water in copper production processes from 7.2 to 1.1 g per t of copper output since 2000. This is a decline of 85% (see Fig. 1.12).

### Biodiversity

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

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

Wherever possible, we maintain or expand green areas on our plant grounds. 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

Fig. 1.13: Conservation areas in close proximity (copper production sites) GRI 304-1

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

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 our plant premises, we choose areas that naturally have limited biodiversity.

Additional measures are currently being devised to protect and reinforce biodiversity. For example, we are planning to ecologically restore a fayalite landfill that was closed at the Pirdop site in late 2018. After we receive the construction permit, we expect to finish the restoration efforts by the end of 2020. In Hamburg, the set-up of a green facade (pilot) is being planned to promote biodiversity and improve the ambient air. The project should be implemented in 2019.

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

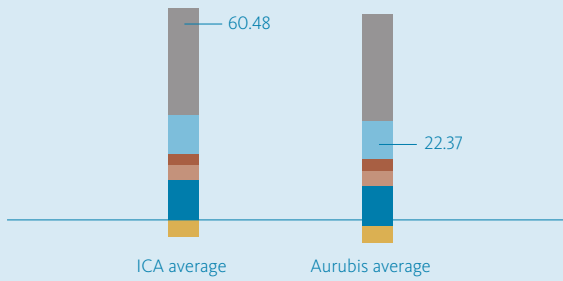
To evaluate our environmental protection performance, we carried out a life cycle assessment for our main product, the copper cathode. When observing the entire life cycle up to the finished cathode, Aurubis production has lower impacts than the global average in all of the environmental categories considered.\*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

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

Fig. 1.14: Life cycle assessment for the copper cathode

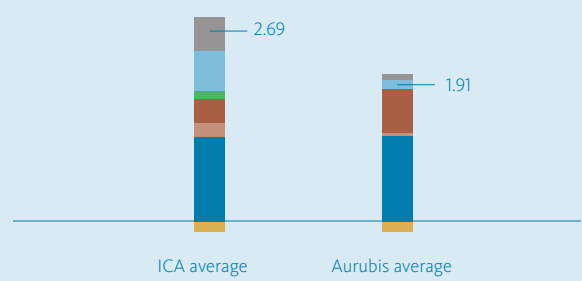
### Acidification potential (AP)

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



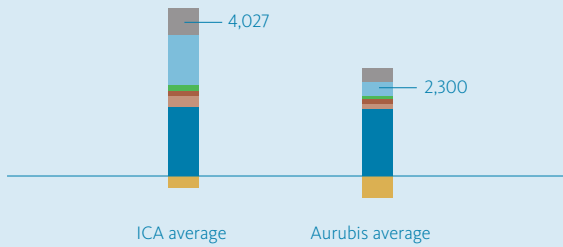
### Eutrophication potential (EP)

kg phosphate eq.



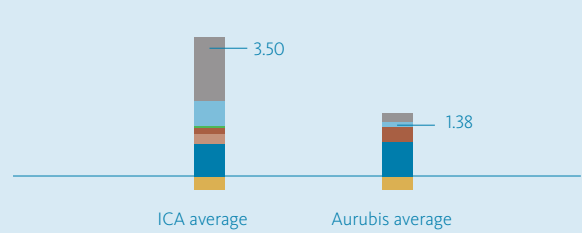
### Global warming potential (GWP)

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



### Photochem. ozone creation potential (POCP)

kg ethene eq.

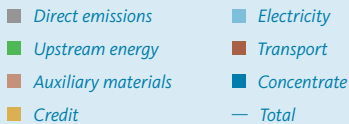
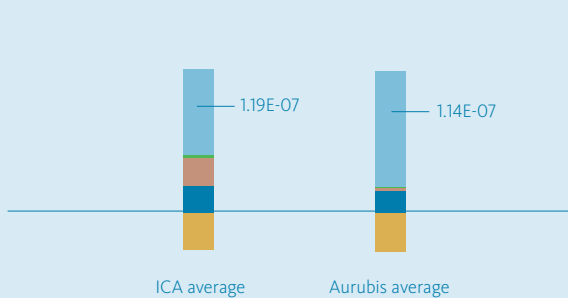


- Direct emissions
- Electricity
- Upstream energy
- Transport
- Auxiliary materials
- Concentrate
- Credit
- Total

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

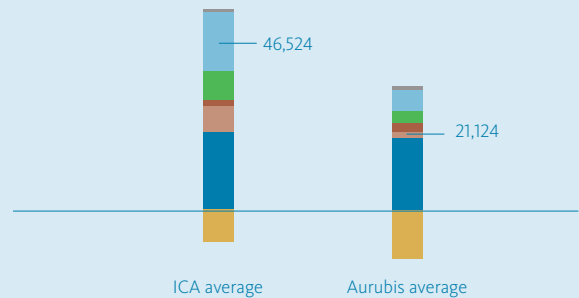
## Ozone layer depletion potential (ODP)

kg R11-eq.



## Primary energy demand, non-renewable sources (net cal. value)

MJ



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

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

The data collected included representative annual data for the year 2013 for all technological routes in the copper production process. The background data was representative for the years 2010-2013. Copper is produced in a pyrometallurgical method at the Aurubis sites in Hamburg, Pirdop, Lünen, and Olen.

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



# At a Glance – Environmental KPIs for the Aurubis Group<sup>2</sup>

	Unit	2014	2015	2016	2017	2018 <sup>3</sup>
<b>Emissions to air</b>						
Dust	t	94	90	93	101	110
NO <sub>x</sub>	t	799	868	870	809	846
SO <sub>2</sub>	t	5,101	4,986	4,648	5,145	4,859
<b>Water consumption</b>						
<b>Water withdrawal</b>	million m <sup>3</sup>	85.2	81.0	77.7	82.6	80.5
Water withdrawal by source						
Surface water	million m <sup>3</sup>	81.6	77.2	74.1	79.0	76.6
Rainwater	million m <sup>3</sup>	0.4	0.4	0.4	0.4	0.4
Groundwater	million m <sup>3</sup>	0.5	0.6	0.6	0.5	0.6
Municipal water	million m <sup>3</sup>	2.5	2.5	2.3	2.1	2.6
Other	million m <sup>3</sup>	0.1	0.2	0.4	0.5	0.3
<b>Total water discharge</b>	million m <sup>3</sup>			72.9	77.1	77.0
<b>Water discharge by destination</b>						
Surface water	million m <sup>3</sup>			71.4	75.8	75.6
Municipal wastewater system	million m <sup>3</sup>			1.4	1.3	1.4
Wastewater to third parties	million m <sup>3</sup>			<0.1	<0.1	<0.1
<b>Waste</b>						
<b>Hazardous waste</b>	t			43,421	53,755	48,548
Landfilling	t			27,430	34,417	34,032
Disposal (thermal)	t			197	139	81
Thermal utilization	t			2,363	2,407	2,109
Recycling	t			9,220	13,063	10,457
Storage	t			3,722	1,264	1,846
Internal utilization/recycling	t			487	2,464	24
<b>Non-hazardous waste</b>	t			44,494	45,350	42,966
Landfilling	t			1,991	1,899	2,134
Disposal (thermal)	t			197	139	428
Thermal utilization	t			499	446	472
Recycling	t			33,916	35,768	32,947
Storage	t			1,265	184	128
Internal utilization/recycling	t			6,626	6,914	6,857
<b>Construction waste</b>	t			51,029	38,826	46,558
<b>Energy &amp; CO<sub>2</sub></b>						
Primary energy consumption	million MWh			1.72	1.66	1.75
Secondary energy consumption <sup>4</sup>	million MWh			1.73	1.88	1.77
Total energy consumption	million MWh			3.45	3.54	3.51
Direct CO <sub>2</sub> emissions <sup>5</sup>	kt CO <sub>2</sub>			508	517	522

<sup>2</sup> These KPIs include all production sites that are majority-owned by Aurubis (>50 %).

<sup>3</sup> Figures for 2018 haven't been verified at all sites yet

<sup>4</sup> Electricity for oxygen generation is only included if operated by Aurubis

<sup>5</sup> In line with the emission trading system excluding vehicles

# Updated Aurubis AG Environmental Statement 2019

Hamburg Site





### The Hamburg plant

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

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

total of 2,487 personnel are employed at the Hamburg site, including around 180 apprentices (as of December 2018).

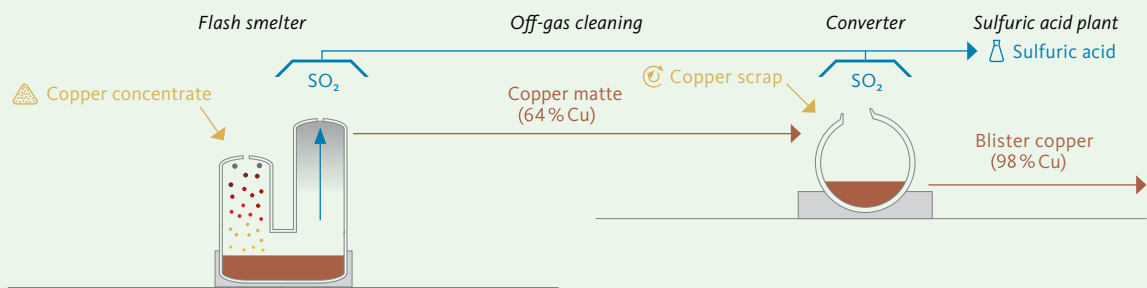
The individual production sectors at Aurubis AG in Hamburg are divided into three plant areas (see Fig. 2.1): Plant North (RWN) is mainly comprised of the administrative building, the workshops, the secondary copper smelter, and precious metal production. Plant South includes the sludge decomposition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

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



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

Fig. 2.2: From copper concentrate to cathode



### Processes at the Hamburg plant

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

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

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

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

Minor metals such as Zn, Ni, Sb, Se, and Te are collected and enriched in a targeted way in the matrix metals copper and lead. In the subsequent pyro- and hydrometallurgical processes of multi-metal recovery, these elements are brought out in metallic form or as metal compounds.

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

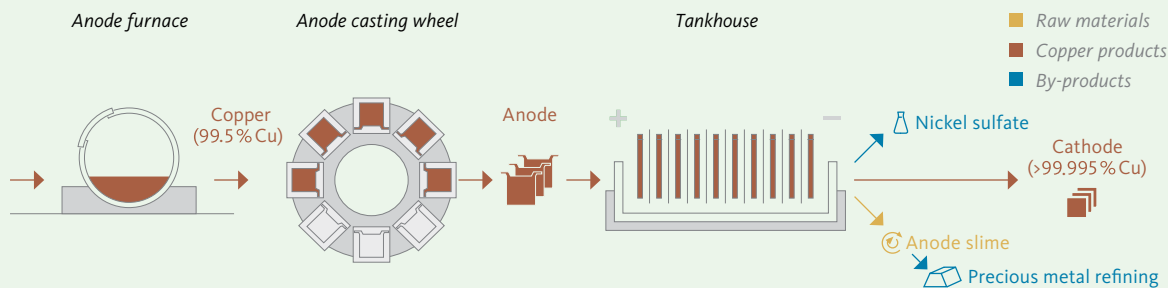
In the precious metal smelter, precious metals (silver, gold, platinum group metals) are separated using hydrometallurgical procedures and then extracted as commercial products.

Aurubis is currently planning the Group's medium-term development with "Vision 2025." Apart from the main metal, copper, additional metals will be recovered in larger quantities in the future. In this context, the permit for a new project for processing primary and secondary raw materials – Future Complex Metallurgy (FCM) – was applied for at the site in 2017 and has already been granted.

To improve and speed up the recovery of valuable metals from the input materials, the current converter in the Plant North smelter will be replaced with a submerged lance furnace with subsequent granulation within the scope of the FCM project.

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

The new FCM facilities should be started up by 2021/2022, according to current plans.



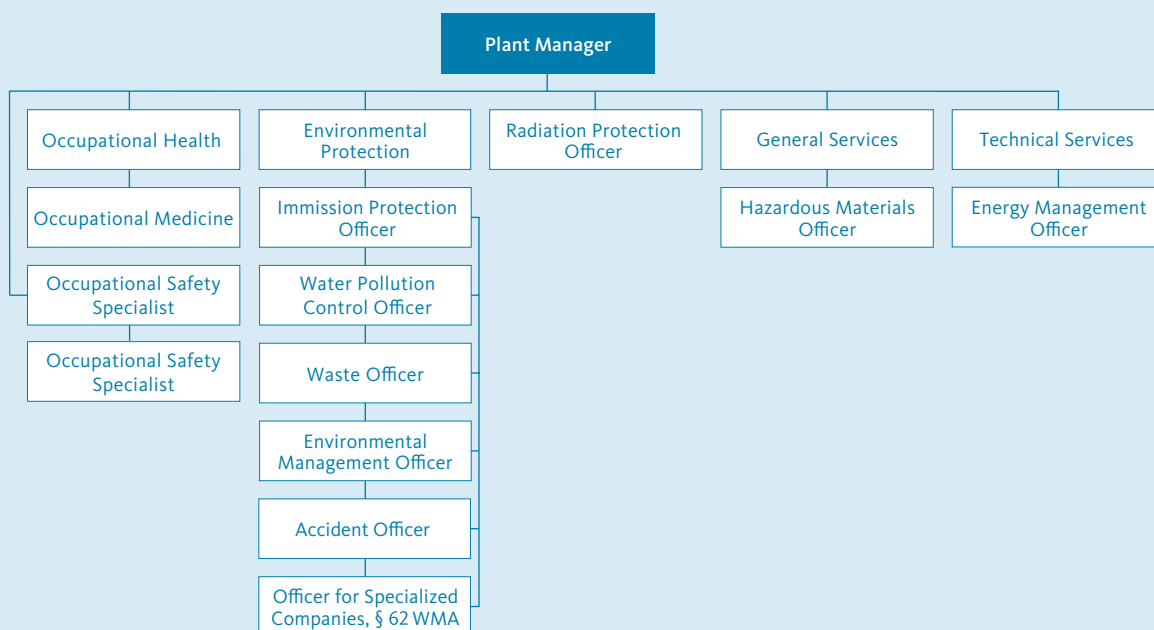
### Environmental protection organization at the Hamburg site

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

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

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

Fig. 2.3: Plant officers at the Hamburg site



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

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

Aurubis has had an environmental management system at the Hamburg site since 2002, which is certified in accordance with DIN EN 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 DIN EN ISO 50001 for the first time in May 2013.

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

### Targets and tasks of the environmental management system

The environmental management system helps us to confidently control production processes. In particular, it defines targets and measures and monitors their implementation. The environmental management system includes the documentation of operational processes, external environmental inspections, internal audits, routine recordings, and site inspections. Situational evaluations form the basis for decisions about the type, extent, suitability, and execution of environmental protection measures.

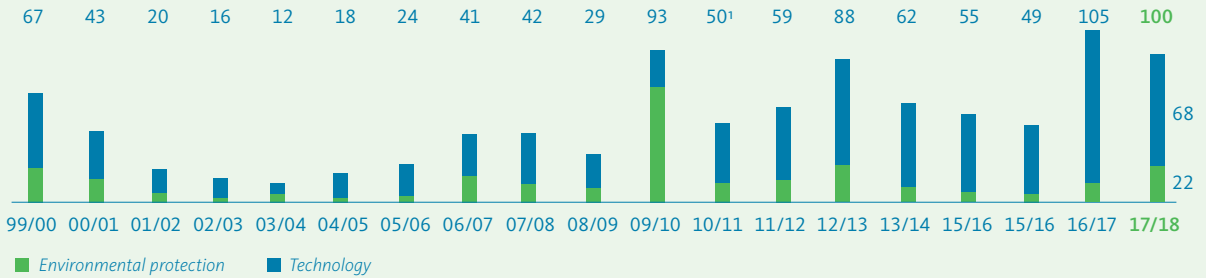
A member of the Environmental Protection Department at the Hamburg site holds the position of Environmental Management Officer. This individual ensures that the requirements for the environmental management system conform to the ISO 14001 and EMAS standards. As part of the environmental management system, 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 an IT-supported derivation of legal obligations that also cover technical inspections of facilities and buildings. The new system can be used to generate facility-specific action recommendations, designate responsibility to individuals, and track implementation.

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

The systems and organization of the IMS are described extensively and understandably in two handbooks available to employees. The general IMS handbook governs procedures that apply to Aurubis AG, the Hamburg and Lünen sites. The integrated management system handbook for the Hamburg plant describes the site-specific procedures. The environmental management system EMAS also helps in the implementation of the Aurubis Group sustainability targets, which were newly defined in 2018, at the Hamburg site ([see www.aurubis.com/sustainabilitystrategy](http://www.aurubis.com/sustainabilitystrategy)).

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

Capital expenditure at the Hamburg site in € million



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

**Monitoring and internal auditing of environmental management**

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

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

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

The status of follow-up measures from the last management reviews, goals and key figures, changes involving the management system, information about the performance and effectiveness of the management system, summaries of the results of internal audits, the status of preventive and corrective measures, risk assessments, and information about resources and potential improvements form the basis of the management review.

**Environmental aspects and performance**

Following fundamental investments in filtering technologies in the 1980s and 1990s, an additional € 265 million has been invested in environmental protection in the Hamburg plant since 2000. With total capital expenditure of more than € 900 million, environmental measures account for 30% of overall capital expenditure on average. Among other things, dust emissions have been reduced by 33 % with these investments. This makes a significant contribution to improving air pollution control in the environment. Investments are being made in the areas of water and noise as well (see Fig. 2.4).

The facilities at Aurubis Hamburg are operated in line with the current state of the art. Through what is known as the Sevilla or BREF process, the BATs (best available techniques) are continuously developed for the non-ferrous industry. The state of the art was updated and the new BAT conclusions were published in 2016. They have to be implemented by 2020. Most of the new requirements are already being observed or exceeded today.

When compared worldwide, Aurubis Hamburg holds a top position in environmental protection. Additional improvements require higher and higher capital expenditure for the same level of reduction and the development of modern technologies. The objective of plant management is to continue improving the plant's environmental performance and the expansion of its top position in environmental protection. Consequently, corresponding environmental protection projects were planned and initiated in 2018 as well.

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





Planner Andreas Heuer and Plant Operator Carsten Holst in front of the fan of the new filter facility for concentrate drying, which was successfully commissioned in 2018.



Filter Specialist Peter Retzlaff and Plant Operator Christian-Ole Möller at the new off-gas hood for the RWN e-furnace ridge turret

### Air – Emissions

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

The permanent 9 t/year reduction that was agreed upon in the sixth emission reduction agreement between the city of Hamburg and Aurubis in 2011 was also confirmed with the 2018 emissions declaration after the associated measures were implemented. The Hamburg site emissions were reduced further in 2018.

The draft of an additional seventh public agreement with the city of Hamburg that establishes further steps to reduce dust emissions is still being discussed. A decision about the follow-up agreement should be made in 2019. Additional investments in air pollution control were made in both primary and secondary copper production in 2018. With the suctioning of the e-furnace ridge turret in secondary copper production and the replacement of the off-gas cleaner with a more efficient filter technology in primary copper production, fugitive emissions in particular were cut further. The capital expenditure came to over € 5 million.

In 2017, the 5S methodology was introduced at the entire Hamburg plant. 5S serves as an instrument to keep workplaces and their environment safe, clean, and well organized, with the goal of optimizing operating procedures and promoting safe, low-emission work. In 2018, an external auditor reviewed the implementation in all production and service areas.

All of the information in this chapter is based on the current Emissions Report, which is issued annually by the immission protection officer. The values outlined on the following pages are made up of a number of individual recordings. Directed emissions are mostly recorded as classified values from continuous measurements taken with a system provided by Durag data systems GmbH. Fugitive emissions from hall ventilation facilities, etc. are determined on a representative basis in recording campaigns carried out by both external recording institutes and the company's own Environmental Monitoring Department and are used to calculate the annual loads. Fugitive emissions due to transshipments in storage areas, etc. are calculated using the corresponding emission factors from the technical literature and from measurements.

Specific dust emissions have been reduced by 83 % since 1990 and by 33 % since 2000 (see Fig. 2.5).

Copper is the main metallic substance in the dust at the Hamburg production site. Specific copper emissions have been reduced by 78 % since 1990 and by 24 % since 2000. This low level was maintained, as the changes compared to the previous year were in the expected range (see Fig. 2.6).

Specific lead emissions have been reduced considerably (by 90%) compared to 1990 and are therefore still at a low emission level. The fluctuations observed are due to the use of various concentrates (see Fig. 2.7).

Arsenic is a natural component of copper concentrates. Specific arsenic emissions have been reduced by 91 % since 1990 and by 45 % since 2000 in various steps of the copper refining process and have been at a low level in the last several years. Emissions were cut further in 2018 compared to the previous year (see Fig. 2.8).



Fig. 2.5: Dust emissions at the Hamburg site

Dust in g/t of copper output

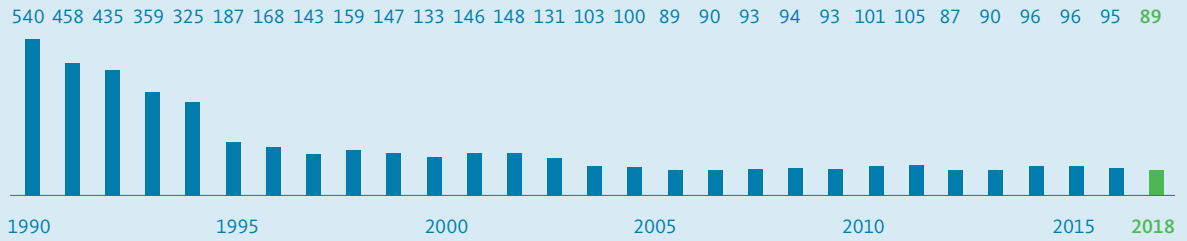


Fig. 2.6: Copper emissions at the Hamburg site

Copper in g/t of copper output

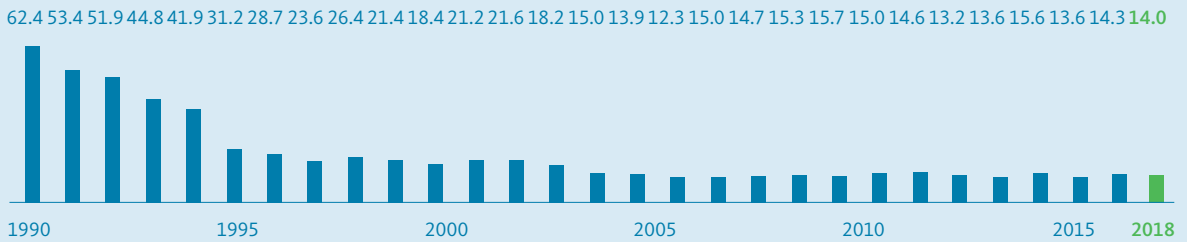


Fig. 2.7: Lead emissions at the Hamburg site

Lead in g/t of copper output

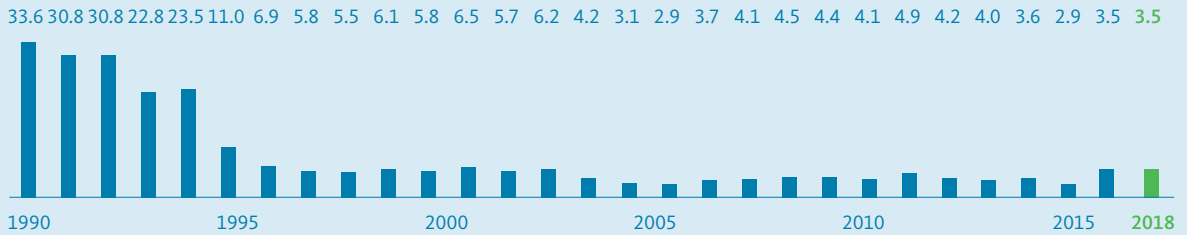


Fig. 2.8: Arsenic emissions at the Hamburg site

Arsenic in g/t of copper output

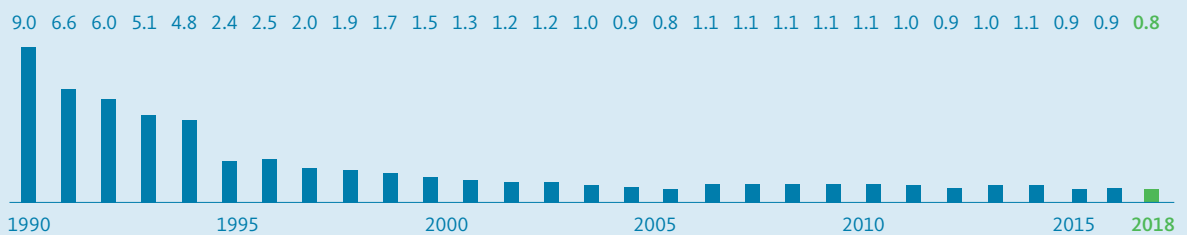
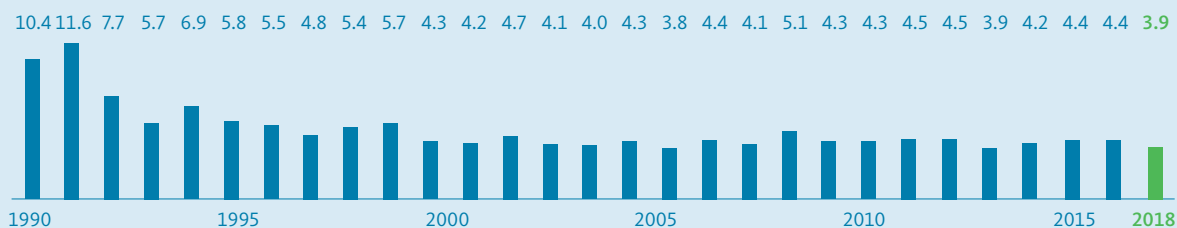


Fig. 2.9: SO<sub>2</sub> emissions at the Hamburg site

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



Apart from copper, sulfur is one of the main components of copper concentrates. The gaseous sulfur dioxide produced when ore is smelted is converted into sulfuric acid in the sulfuric acid plant using the modern double catalysis process. The sulfuric acid is mainly used in the chemical industry. Specific sulfur dioxide emissions have been reduced by 63% since 1990 and tend to vary at a low level (see Fig. 2.9).

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

Aurubis adhered to and fell significantly below the emission limits established in the Technical Instructions on Air Quality Control (TA Luft) and in the relevant permits for sources of collected and fugitive emissions in 2018. The relevant limit values of the TA Luft are featured in chapters 5.2.2, 5.2.4, 5.2.5, 5.2.7, and 5.4.3.3.1 in particular.

### Air – Immissions

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

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

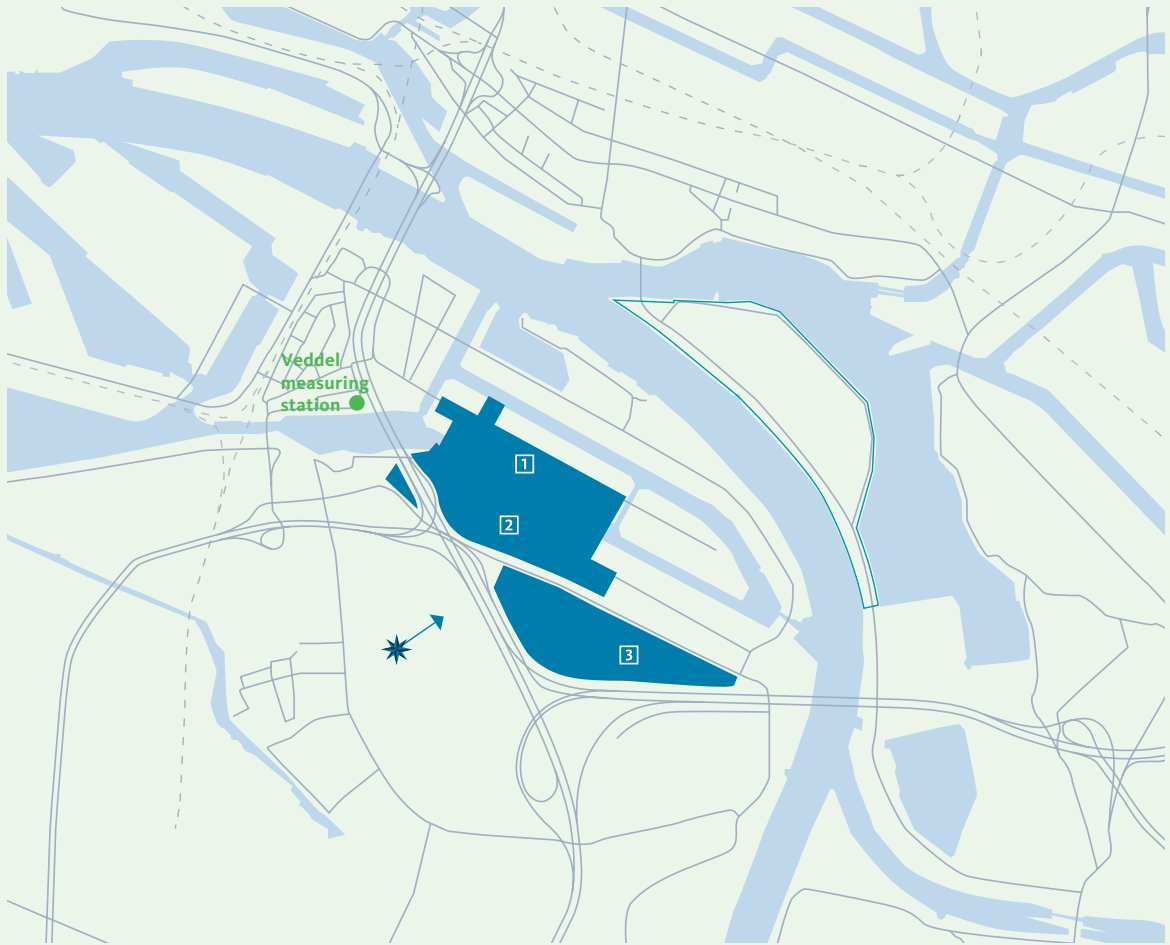
Reflecting the nationwide trend, there were unfavorable circumstances regarding air pollutants in Hamburg in 2018. In 2018, the annual average for arsenic in particulate matter exceeded the target value (6 ng/m<sup>3</sup>) for the first time in 12 years, by 1.8 ng/m<sup>3</sup>, at the ambient air measuring station Veddel only. Despite a similar tendency, all of the other recorded values fell below the limit and target values.


In contrast to limit values, target values according to the definition of the 39th Immission Protection Ordinance are average requirements that should be adhered to where possible and evaluated on a long-term basis. The ambient air at the Veddel measuring station is impacted by the influences of industry, harbor operations, and other factors typical for a large city.

In 2018, Aurubis Hamburg achieved an additional emission reduction. At the same time, 2018 was an unusual year with respect to the weather due to extreme dryness and frequent low-circulation, high-pressure weather patterns. These extraordinary weather conditions had a general negative effect nationwide on the level of particulate matter concentrations in the ambient air and their contents.

Since 2007, the values measured in the environment have fallen below the target of 6 ng/m<sup>3</sup> outlined in the 39th Immission Protection Ordinance in 2013. The fact that the values exceeded the target once in 2018 is due to the extreme weather conditions. The continuous emission reduction program and the six successfully concluded emissions reduction agreements have contributed to this development.

Fig. 2.10: Plant premises at the Hamburg site



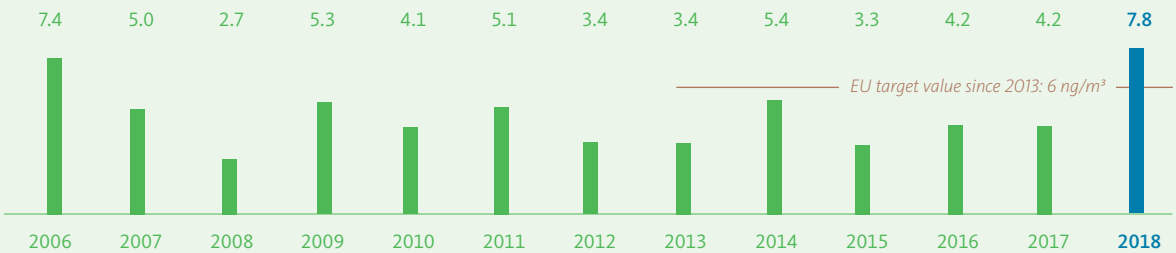
 Prevailing wind direction

**1** Plant North **2** Plant South **3** Plant East

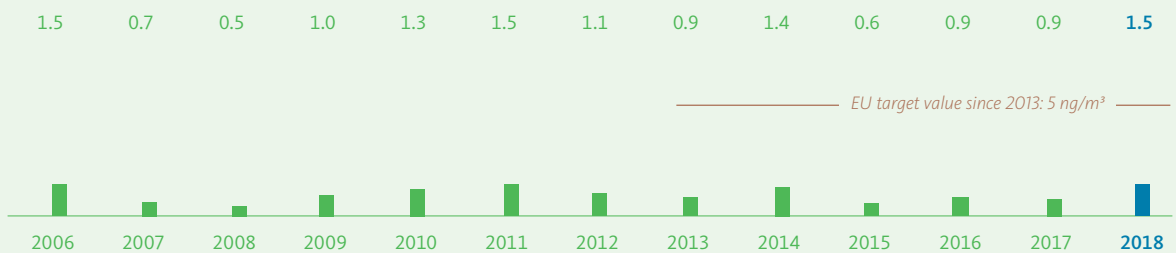
Scale 1: 40.000

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

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



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



The values measured in the environment have fallen well below the target of 5 ng/m<sup>3</sup> outlined in the 39th Immission Protection Ordinance.

1 gram (g) = 1 billion nanograms (ng) <sup>1</sup>Data published by the State Ministry for Urban Development and Environment.

In addition to the improvement measures already planned, Aurubis Hamburg announced an additional comprehensive investment package to the governmental authorities and the public to reduce emissions so that the values sustainably fall below the target value even under extreme weather conditions. The focus of the investments is the ongoing reduction of fugitive emissions from primary copper production.

### 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 together with other wastewater (e.g., from the anode casting machine in the primary smelter) and discharged into the Elbe River. Precipitation is also used as cooling water in some cases. Sanitary wastewater is discharged into the city sewer system.

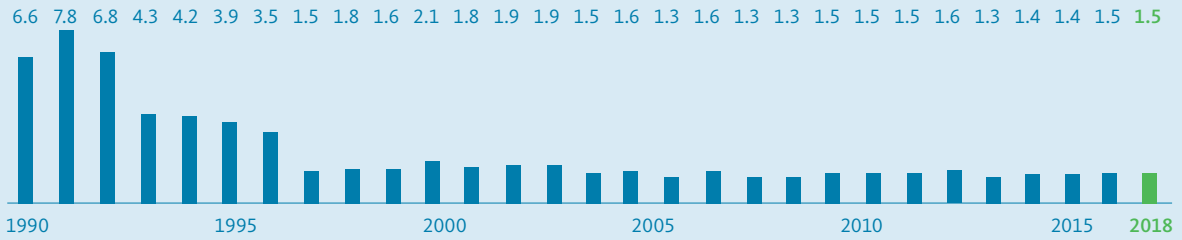
The slightly higher cooling water demand due to the warm summer in 2018 was balanced out to some extent by the recovery of industrial heat starting in late October.

The cooling water discharge fully complied with the strict requirements of the water law permit with regard to the heat content and temperature limit. The oxygen content of the discharges was over the limit value for all of 2018 and was above the concentration in the water withdrawn during the summer months. This is particularly true for critical phases with low oxygen contents in the Elbe River.

Aurubis operates an extensive monitoring network for cooling water discharge. In the process, the heat emissions, discharge temperature, temperature range, and cooling water quantity are measured and recorded at all discharge points. Furthermore, to improve water quality, the oxygen content is increased in the significant discharge areas with targeted turbulence and is measured at the discharge point.

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

Metal emissions in g/t of copper output



On October 29, 2018, the cooling of the contact plant (line 1) was converted by recovering about 20 MW of industrial heat and transferring it to the HafenCity East district. This eliminates the need for the 12 million m<sup>3</sup> of cooling water previously required for circuit cooling each year. At the same time, this heat recovery reduces CO<sub>2</sub> by around 20,000 t per year.

Additional measures to reduce cooling water needs are planned in the scope of the modernization scheduled for secondary copper production (FCM project).

Limit values and requirements for discharges into bodies of water are regulated in the German Wastewater Ordinance (AbwV) and in the water law permit. They are monitored by both internal recordings and unannounced recordings by the relevant authorities. The recorded values clearly fall below the regulated limit values.

In the internal central wastewater treatment plant (ZABA), accumulated process water is cleaned in line with the state of the art. The Hamburg plant has water law permits and observes their requirements.

The proportion of heavy metals discharged by Aurubis in the Elbe's total load is less than 0.1% and is therefore at a low level similar to the previous year. Aurubis has reduced the heavy metal load that is discharged with the wastewater into the Elbe by 77 % since 1990 and by 28% since 2000. Today's average emission value of 1.5 g/t of copper products is evidence of Aurubis' continued top position in environmental protection.

The diagram shows the total metal emissions of all discharge points (see Fig. 2.12). Today, Aurubis already observes the increased requirements stemming from the BAT conclusions, which are supposed to be implemented by 2020.

In 2018, planning started to modernize and improve the cleaning efficiency of the central wastewater treatment plant (ZABA). A hydro-ecological assessment confirmed the compatibility of the project with the targets of the Water Framework Directive. The goal is a reduction in run-off concentrations above BAT level. An accompanying process to amend the existing water law permit began in 2018.

Water treatment management in the operation of the south precipitation treatment plant was improved further in 2018 with respect to higher operating stability during strong rains.

The declining long-term trend for the wastewater load and volume continued for indirect discharge in the city sewer system.

The 42nd German Federal Immission Protection Ordinance on the safe operation of evaporative cooling facilities to prevent the spread of legionella went into effect on August 19, 2017. The new requirements regarding monitoring and modes of operation were passed on to employees in training sessions and were reviewed in 2018 again. An external hygiene audit in accordance with VDI Guideline 2047 Part 2 is planned for 2019.

Peregrine falcon nesting box



## Soil

There are soil impurities typical for industrial areas at the Hamburg plant owing to many years of industrial use. The heavy metal pollution values are so low that no clean-up is required from the authorities' view. The plant premises are mostly paved so that soil impurities cannot mobilize. Furthermore, the groundwater is protected from soil impurities by a water-resistant layer of clay. A sheet pile wall has also been erected in the primary smelter that effectively prevents backwater from flowing beyond the plant premises.

There is an approved report on the initial state of the soil and groundwater pursuant to the Industrial Emissions Directive. The report on the initial state of soil and groundwater for the entire plant property was officially approved on August 21, 2018. The report is connected with routine soil and groundwater monitoring at reference points with the goal of preventatively avoiding negative changes.

The degree of sealing increased further due to different modernization measures for plant infrastructure.

If the site returns to its original state, the baseline report serves as evidence and a standard of comparison and is obligatory for Aurubis in the case of significant facility modifications.

The points of evaluation for the subsequent monitoring program for the soil and groundwater were agreed upon with the responsible monitoring authority. The measures resulting from the inspection program were integrated into the plant monitoring process.

## Soil – Preventative measures

All expert inspections of facilities with substances hazardous to water were free of any relevant deficiencies. Furthermore, adherence to all stipulations from the new, stricter requirements of the law on facilities handling substances hazardous to water was confirmed for all of the facilities inspected. Because of the high water protection standard already achieved, there is no need to retrofit any facilities as a result of the new ordinance.

The next plant inspection by the Technical Control Board (TÜV) under the Water Management Act is planned for 2019.

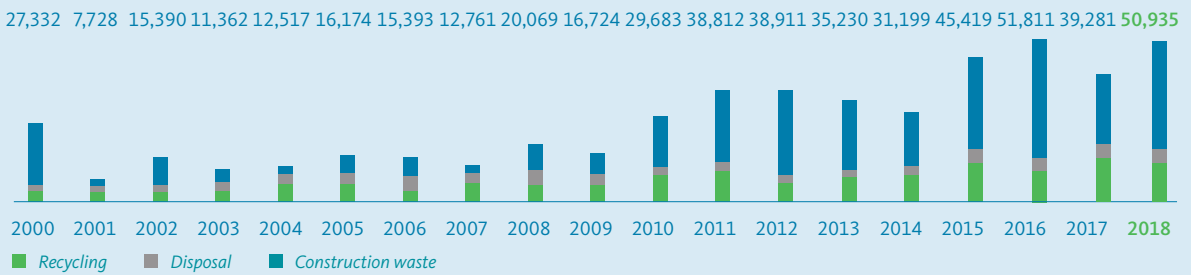
## Noise

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.

After over a decade, there was one noise complaint from the area surrounding the plant in 2018. A cause at Aurubis couldn't be identified even after carrying out several recordings. However, additional preventative measures to reduce noise, especially in the outdoor areas of the plant, were initiated and implemented. The use of a new measurement technology is planned for 2019 to improve noise monitoring.

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

in t per year



### Biodiversity

The Hamburg site is close to nature conservation areas. For example, the nature conservation areas NSG Holzhafen and NSG Auenlandschaft Obere Tideelbe are located just a few kilometers from the plant premises.

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.

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

We 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 water surfaces adjacent to the plant are regularly visited by aquatic birds.

The peregrine falcon that has been at Aurubis for a few years has maintained his territory at Aurubis. The nesting aid installed 50 m high on a chimney is still checked regularly and adjusted to the falcon's needs. The falcon hunts pigeons in the plant as prey. Offspring were observed for the first time in 2018.

### Waste

All in all, 138,543 t of waste were accepted and recycled at the Hamburg site in 2018, of which 15,248 t were classified as hazardous waste. A total of 4,067 t of this came from other countries and was registered.

Overall, 10.1% of the waste accepted was used as a slag former (e.g., spent abrasives, sand, and excavation residues), and 89.9% was used for metal recovery (dust, slimes, slags, and precious metal-bearing sweeps). At about 110,293 t, the use of metal-bearing secondary raw materials decreased slightly compared to the previous year.

In the 2018 calendar year, a total of 50,935 t of waste were generated and directed to waste management at the Hamburg site (see Fig. 2.13). Of this amount, 16,564 t were classified as hazardous waste. The proportion of construction waste in the total waste volume rose to 74 % in 2018 due to higher levels of construction and demolition work (2017: 61 %). A total of 13,010 t of waste arose from production processes, of which 5,105 t were directed to waste disposal and 7,905 t to external recycling. This corresponds to a recycling rate of 61%.

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

With an annual copper output of 473,367 t, the specific waste level (excluding construction waste) is 27 kg/t of product (2017: 33 kg/t).

A total of 43,897 t of olivine pyroxene rock from the secondary smelter (RWN) and 24,321 t of slag material from the primary smelter (RWO) were not marketed as substitute construction material and were taken to landfills. In the process, large pieces were recycled for use as landfill construction material.

Fig. 2.14a: Specific energy consumption at the Hamburg site

in MWh/t of copper output

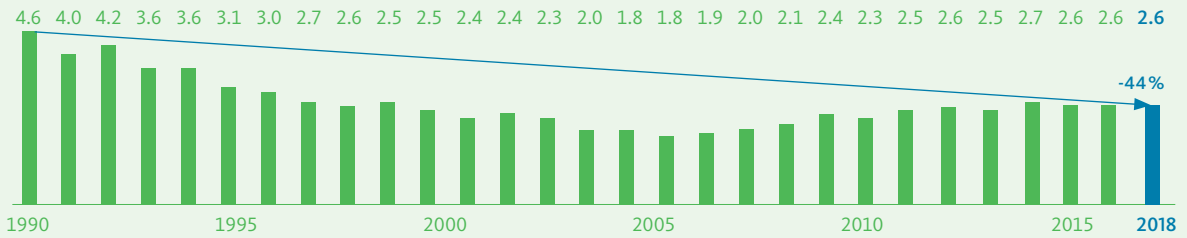
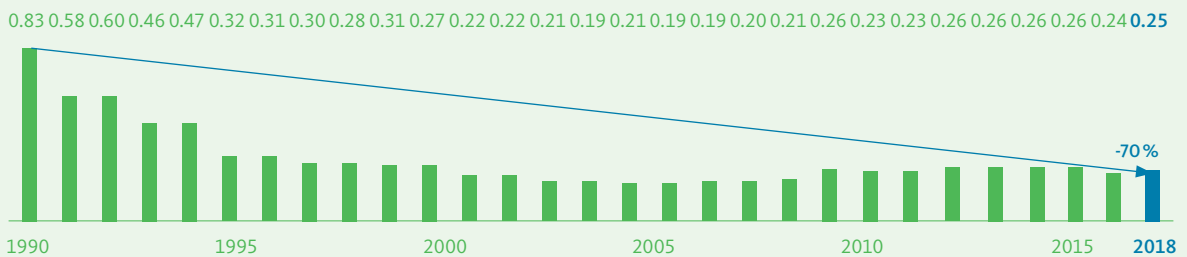


Fig. 2.14b: Specific CO<sub>2</sub> emissions from fuels at the Hamburg site

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



### 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 1,224 GWh of energy at the Hamburg site in 2018. With an annual copper output of 473,367 t, this amounts to specific energy consumption of 2.6 MWh/t of copper output and is therefore at the same level as the previous years. This includes the electricity used to produce the oxygen necessary for the process.

Furthermore, landfill gas was used in the production processes instead of natural gas (2018: 2.9 GWh). Aurubis thus uses 100 % of the landfill gas collected in the former Georgswerder landfill.

Specific energy consumption has stagnated at the Hamburg site in the past several years despite the energy efficiency measures that have been implemented. An

important reason for this is the higher level of multi-metal recycling in the meantime and the commissioning of new facilities, such as the ridge turret suction system in the secondary smelter.

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

To adjust to the German energy transition and increase consumption flexibility, concepts to use electricity preferentially in phases with a surplus are being developed. In this regard, an electrode steam boiler with a capacity of 10 MW has been installed.



The intermediate absorber weighing 250 t is lifted to its final location on the Aurubis plant premises. Virtually CO<sub>2</sub>-free heat develops in this cylindrical container and will be used to heat the new HafenCity East district.



With an output of 473,367 t of copper in the calendar year, specific CO<sub>2</sub> emissions from fuel amounted to 0.25 CO<sub>2</sub>/t of product (see Fig. 2.14a and 2.14b). This corresponds to 116,767 t of CO<sub>2</sub>.

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

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

- » for natural gas: GasCalc calculation program, version 2.3.2, distributed by e.on Ruhrgas AG
- » for all other fuels: German Emission Trading Office data, last reviewed on March 30, 2017.

### Waste heat use

Aurubis strives to use process waste heat to the greatest possible extent. It is used to heat buildings, to facilitate the production processes, and to generate electricity. In 2018, 80% of the steam needed was produced from waste heat and only 20% was produced from fossil fuels. This was half the amount of the previous year.

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

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

Several steam turbines have been installed at the Hamburg site as an effective energy-saving measure. The 60 bar steam is first depressurized to 20 bar in the Interplant turbine, which was commissioned in 2014. The 20 bar steam serves as process steam for various procedures in the plant. The remaining steam volume is depressurized to 3 bar in the first stage of another steam turbine in the thermal power plant. This steam is then available as process and heating steam in the plant and administrative buildings. A total of 6.7 GWh of electricity was produced from waste heat in 2018, or 1% of total electricity consumption (2017: 1.2%). The reason for the slight decline in electricity produced from waste heat was a plant shut-down in 2018, as well as the breakdown of a turbine.

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

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

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

The joint project was distinguished as a flagship project and project of the year by the German Federal Network Agency.

The heat shift is an important part of the energy shift. This is especially true for a metropolis like Hamburg, which has about 900,000 apartments. The energy needed for providing heating, warm water, and lighting to the city's buildings

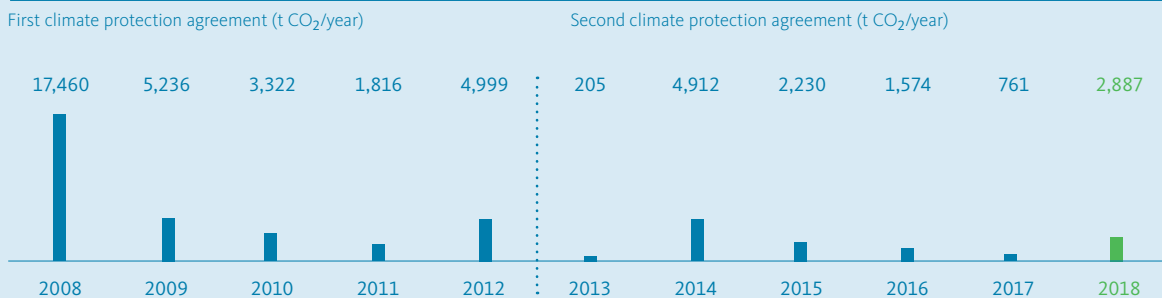
makes up 40% of the total energy demand and is therefore significantly higher than the energy demand in the transport and industry sectors. Today, the heat supply in Hamburg is dominated by decentralized, gas-fueled heating systems and by a large central district heating network whose thermal output is based on conventional large-sale 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.

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

Fig. 2.15: District heating pipeline route from the Aurubis plant to HafenCity East



Fig. 2.16: Annual CO<sub>2</sub> reduction at the Hamburg site in the context of the Hamburg Climate Protection Concept



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

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

The reported CO<sub>2</sub> emissions were 165,029 t for 2018. Direct CO<sub>2</sub> emissions have thus been at a relatively constant level since monitoring started in 2005 (average for 2005–2017: 169,000 t). More than 70 % were caused by the fuels used, mainly natural gas, while the remainder was caused by the carbon contained in the raw materials, recycling materials, and additives.

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

Copper production is an energy-intensive process, so a reliable electricity supply is very important. Aurubis therefore has a long-term cost-based electricity supply contract with the coal power plant Moorburg (a so-called virtual power plant slice). This is one of the most state-of-the-art and efficient power plants of its kind. Electricity production in this power plant nevertheless leads to CO<sub>2</sub> emissions, which are indirect CO<sub>2</sub> emissions for Aurubis, and therefore indirect environmental effects. In 2018, these indirect CO<sub>2</sub> emissions totaled 290,814 t (pursuant to ETS reporting).

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

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

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

Aurubis AG was one of the first Hamburg companies to participate in the Climate Protection Concept and implemented a number of projects between 2007 and 2012 that cut CO<sub>2</sub> by 32,000 t each year (see Fig. 2.16).

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

Aurubis achieved a roughly 12,569 t reduction in CO<sub>2</sub> by the end of 2018. Additional reduction potential was identified and relevant measures are being planned and implemented in 2019.

At least another 20,000 t of CO<sub>2</sub> reductions will be achieved as a result of the decision to use hot water extraction to supply heat to the new urban district under construction, HafenCity East.

Fig. 2.17: Origin of copper concentrates for the Hamburg site

in percent, fiscal year 2017/18



### 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 2018:

- » Primary smelter (RWO)
- » Tankhouse, Plant East
- » Contact acid plant, Plant East
- » Top-blown rotary converter south
- » Precious metal smelter
- » Lead refinery
- » Selenium facility
- » Central wastewater treatment plant
- » Continuous casting plant
- » Rod plant

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

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

### Indirect environmental aspects

Indirect environmental impacts are not directly caused by our production processes on site and therefore can't be directly influenced by Aurubis. They arise first and foremost from the transport of material and from the mines supplying Aurubis with copper concentrates. We cannot directly influence transports of hazardous materials that we have commissioned, either.

We obtain most of the copper concentrates from South America (75%); 12% comes from North America, 6% from the European Union, and small quantities from other countries. The concentrates are transported almost exclusively by sea in bulk carriers via Brunsbüttel. Special ships suitable for inland waterways are used to deliver the concentrate mixtures. They drop off their cargo in the Müggenburg Canal with a crane. In the 2017/18 fiscal year, about 1.2 million t of copper concentrates were delivered to our plant in this way.

### Transporting hazardous materials

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

In the 2017/18 fiscal year, 1,214,998 t of outgoing hazardous materials were registered at the Hamburg site of Aurubis AG. Of the total amount of hazardous materials, approximately 54% are shipped by inland vessel, 32% by truck, and 14% by train.

During the reporting period, there were no reportable incidents in the course of hazardous material transports. Monitoring and training were carried out again in 2018 in order to maintain this high safety standard.

The commissioning of the individuals responsible under hazardous materials law was reviewed in 2018 and adjusted to company requirements.

### 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 NOx (nitrous gases), resulting from individual transport.

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

The construction of a city bike station at the plant entrance on Hovestrass, which is scheduled for 2019, will promote bike use for employees in their daily commutes between home and work. The station will connect the plant to Hamburg's city-wide bike borrowing system. Furthermore, there are plans to build bike parking areas with locks at the nearby train and subway stations.

In order to promote e-mobility, efforts are being made to set up charging stations at the employee parking lots on Hovestrass and the Muggenburg Hauptdeich. E-mobility for internal plant traffic is also being emphasized. Recently two hybrid vehicles were acquired to be used in the vehicle pool. For internal transportation, diesel vehicles were replaced with purely electric vans. In January 2018, eleven clean vehicles were in use in the plant.

### Emergency measures and crisis management

Because of the type and quantity of materials handled, the Hamburg production site is subject to the expanded obligations of the German Accident Regulation. The safety report for the operating area was adjusted to the requirements of the Hazardous Incident Ordinance amended in 2017 and is regularly reviewed and updated according to legal requirements.

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

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

The brochure "Safety for Our Neighbors," which was released in February 2013 to inform the public, was expanded and updated in 2017 in cooperation with the Hamburg Chamber of Commerce and 64 local companies that are also subject to the Hazardous Incident Ordinance. The Hamburg Chamber of Commerce published the brochure online in 2018. The additional distribution of a brochure to neighbors within 500 m of the plant is planned for the first quarter of 2019.

Emergency plans are in place for emergency situations and accidents. Moreover, we have developed an alarm and danger prevention plan in coordination with the responsible authorities, which describes emergency measures for our plant premises. The individual plant divisions also have alarm and danger prevention plans.



The safety report and the alarm and danger prevention plan were updated in 2018 and sent to the relevant governmental authority. Our Plant Fire Department works around the clock in Hamburg and carries out emergency drills with different plant divisions regularly.

Employees are on call for each plant division and for all of the relevant departments as well. An engineer on duty coordinates required measures as necessary.

### Accident prevention

A separate crisis room has been in place in the Plant Fire Department since January 1, 2017. Fictional scenarios can be planned and executed here in staff exercises with the employees responsible. A staff exercise was carried out in 2018.

The Plant Fire Department carried out a number of drills in 2018, for instance to test the alarm and danger prevention plan, to test flood protection, and to train employees. The Fire Department added to and expanded their equipment.

A significant part of incident prevention is regularly carrying out safety hazard analyses. These were also carried out in 2018 and additional preventive measures were initiated as needed.

The hazardous materials section of the Plant Fire Department, which was first created in 2016, has supervised more than 100 hazardous materials situations, such as the filling of tank wagons, the loading of general cargo in containers, as well as preparatory measures for the transportation of hazardous materials in the facilities of Aurubis AG at the Hamburg site. For this purpose, four employees received qualifications through training as hazardous materials officers.

Aurubis Hamburg is still a member of the nationwide transport, accident, and information assistance program TUIS. TUIS, a network of the German chemical industry, supports emergency response personnel across Germany in the case of transport accidents involving chemicals, but also production and warehouse accidents.



## **Environmental Program**

The targets set in the context of the Environmental Statement 2018 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 2019. The results are presented in the following Environmental Program.

## Strengthening environmental awareness

Target	Planned measure	Degree of implementation/date
14-day information session for the plant management team on environmental protection as part of regular communication	Routine discussions and review of measures with plant management and the department or production managers	Weekly as part of regular operative communication or as needed, ongoing
Training employees working in all plant areas relevant for environmental protection	Annual training sessions for employees in the primary smelter, secondary smelter, lead plant, precious metal recovery, casting lines, rod plant, ELWO, acid plant, and logistics	Implemented in 2018 Repeated annually
Information and training sessions for department and plant managers on environmentally relevant topics	<p>Conducting environmental quality circles; information session on the legal situation and the correct implementation of regulations; clarifying the consequences of non-compliance</p> <p>Expanding the legal register by implementing an IT-supported legal and regulatory management system to ensure lawful plant operation as regulations become increasingly complex</p>	<p>Training sessions were successfully carried out again; they will continue in 2018 as part of general continuing education on an ongoing basis</p> <p>Introduced for the legal areas in FM and OHS. Complete system integration in environmental law scheduled for 2019</p>
Plant tours by employees in the Environmental Protection Department	<p>Monitoring plant operations with regard to environmental effects and compliance of Environmental Protection Department with regulations</p> <p>Process improvement by introducing IT-supported implementation controlling as part of AOS</p>	<p>Information provided to the plant and division management in short reports including implementation controlling</p> <p>2018</p>
Strengthening environmental awareness	All employees should be reached through regular training sessions, the distribution of the Environmental Report, and important information on the intranet, i.rubis (e.g., Environmental Policy, IMS handbook with the relevant process instructions).	Completion of the Environmental Report including Environmental Statement ready for printing by August 2018

## Reducing dust emissions

Public contract with the city of Hamburg for the time frame 2011-2016

Target	Planned measure	Degree of implementation/date
Reducing dust emissions by 9 t each year	Various measures from the contract under public law, time frame 2011-2016 – see the chapter Environmental Protection – Facts and Figures	Verification with the Emissions Declaration in 2018 again
Follow-up targets after successfully entering into the 6th agreement:	Improvement of the flow situation in the primary smelter converter hall  Source extraction for skip loading of ladle linings	Planning started in 2018, to be considered in follow-up agreement

Public contract with the city of Hamburg for a time frame starting in 2019

Target	Planned measure	Degree of implementation/date
Additional improvements to reduce fugitive emissions	Suctioning of the ridge turrets in the primary smelter (RWO)	Suctioning of the relevant part of the ridge turrets in the RWO in connection with a flow improvement in the converter hall and improvement measures in the existing auxiliary hood filter system; permit has been issued; commissioning scheduled for 2020, additional stages until 2023
	Program for cleaning surfaces and roofs	Additional vacuums and sweeping machines purchased in 2018
	Improvement of filters	Improvement in filters' cleaning efficiency by using new filter materials and filter fixtures in the following areas:  Examples: Primary smelter concentrate dryer, implemented 2018 EBA RWN Rod plant Continuous casting plant Lead refinery  Permits have been issued Commissioning planned starting 2019

Target	Planned measure	Degree of implementation/date
	Introduction of 5S beyond individual plants/ departments	Plant-wide implementation of 5S successfully audited in 2018
	Suctioning of Plant North DR e-furnace	Commissioning in 2018
	Constructing an additional closed storage hall in secondary copper production as part of FCM project implementation	Permit has been issued, commissioning in 2021
	Reducing fugitive emissions by improving handling of spent potlining in the primary smelter	Commissioning planned for 2023
Efficiency enhancement in reducing gaseous emissions	Optimizing wet gas cleaning in hydrometallurgical precious metal recovery to reduce NO <sub>x</sub> emissions	Implementation by 2020 planned

The above, or equally effective, measures should be established in the continuation of the public contract to reduce emissions in 2019. The coordination talks with the governmental authorities started in 2017. Permits under the German Federal Immission Protection Ordinance have been issued for individual measures. The goal is to reduce dust emissions by more than 5 t per year by 2022.

## Climate protection

Target	Planned measure	Degree of implementation/date
Participation in the Hamburg Senate's Climate Protection Concept  Voluntary pledge among Hamburg industrial companies	Implementing projects to cut 12,000 t of CO <sub>2</sub> from 2013 to 2018	Through individual measures, a reduction of 12,569 t of CO <sub>2</sub> per year was achieved  Furthermore, the industrial heat project created the conditions for recurring CO <sub>2</sub> savings of 20,000 t per year.
Participating in the second round of the IVH Energy Efficiency Network	Voluntary savings potential of 75,000 t of CO <sub>2</sub> among the 15 participating companies	Runtime 2019-2021

## Energy optimization

Target	Planned measure	Degree of implementation/date
Heat extraction for internal use and for district heating in the HafenCity East neighborhood – reducing heat discharge in the Elbe River	Conversion of Line 1 for the extraction of 90 °C hot water; construction of the heat line up to the transfer point on the plant boundary. Review of additional potential for the extraction and delivery of waste heat from lines 2 and 3 to the city of Hamburg's district heating grid	The necessary permits were issued in 2017. Heat recovery was commissioned in fall 2018. The heating of the tankhouse cells in the Plant East tankhouse, as well as the heating of the copper sulfate crystallization facility, will be implemented internally in 2019.  Discussions with the city of Hamburg on further arrangements for waste heat recovery and heat extraction for district heating, which began in 2017, will continue.
Additional measures for waste heat use	Constructing a waste heat boiler in the course of building the new submerged lance furnace in the FCM project as a condition for later use	Permit under the German Federal Immission Protection Ordinance was issued in 2017, implementation by 2022 planned
Measures to adjust to the energy turnaround in Germany	Planning the installation of an electrode steam boiler as an alternative to the gas-fired standby boiler to adjust to more flexible consumption in the scope of the project NEW 4.0	Planning to start in 2018

## Water pollution control

Target	Planned measure	Degree of implementation/date
Further developing the monitoring system for cooling water discharges	Improving the monitoring tool by setting up a classification analysis for relevant parameters.	Measurement program has been in place since March 2011; continuation in 2014. Requirements of the thermal load plan have been implemented since 2013. Water law permit was issued in 2015
- Max. heating of water by 3 K	Measurements of heat-relevant parameters, including a data analysis unit (classification unit) to record and assess the heat-relevant data (discharge quantity, temperature increase, discharge temperature, volume measurement, heat input, and oxygen content or oxygen saturation for the discharge point Norderelbe and two points in the Muggen-burg Canal) as an hourly average or six-hour moving average	Installation of measuring buoys in the Elbe and Muggen-burg Canal in 2016 to monitor temperature increases in the bodies of water
- Max. discharge temperature 33 °C		
- Min. concentration of 6 mg/l O <sub>2</sub> in discharged cooling water		
Reduction of heat input via cooling water by 18 MW	Commissioning of waste heat recovery from the KAWO acid coolers	Commissioning in 2018
Further continuous reduction of heat input via cooling water	Constructing cooling towers as part of the implementation of FCM (replacement for the existing converter) and the modernization of WuK South. The existing once-through cooling systems will therefore also be replaced	Commissioning planned for 2021
	Replacing the once-through cooling system of the cracking plant with cooling towers	Commissioning planned for 2020
Continuously optimizing wastewater management	Increasing the level of detail of the operating source register as the basis for demand-based focus optimization	Rod plant pilot planned for 2019
Improvement in ZABA cleaning efficiency	Continuous 2-line design; increase in dwell times for metal precipitation and sedimentation; expansion of hydraulic throughput area	Expert verification stating that the project is compatible with bodies of water and fulfills the standards of the Water Framework Directive was issued in 2018. License and permit procedure planned for 2019, commissioning in 2021

## Partnership for Air Quality and Low-Emission Mobility – Participation in Mobil.Pro.Fit

Target	Planned measure	Degree of implementation/date
Sustainable, efficient, and climate-friendly mobility	Mobil.Pro.Fit program: development of mobility management (focuses: business trips, vehicle fleet, and the improvement of employee mobility in particular)	Participation in the second round of Mobil.Pro.Fit in 2016 Changes to the company car regulations planned for 2019
Mobil.Pro.Fit Coordination of action plan with plant management – certification in Q2 2017.	Developing a concept for e-bike/personalized bike leasing  Reviewing the feasibility of a better public transportation connection (additional Hamburg bus routes or shuttle service to Veddel train station)  Construction of a bike compartment at the Veddel train station and the new Elbbrücken subway stop	Development of mobility management with the Mobil.Pro.Fit action plan certified in 2017  Implementing a car policy by 2019  Start of an evaluation phase in December 2016 with an improved public transportation connection during all shift changes and on the weekend. Optimized public transport schedule since 2018  Planning and discussions with the city's transport operators took place in 2018, set-up planned for 2019
Promoting e-mobility	Installing charging points (car & e-bike) at the employee parking lots in Plant North and Plant East.  Successive replacement of all fuel-driven vehicles within the plant with electric vehicles	Start of infrastructure construction planned for 2019 First cars and vans acquired in 2016 – extension and continuation of the pilot phase in 2017, additional electric vehicles to be purchased for the plant when replacements are needed starting 2018
Promoting bike use for employee mobility	Building a city bike station on Hovestrasse	Discussions with the operating company are underway. Implementation planned for 2019



## Promoting biodiversity

Target	Planned measure	Degree of implementation/date
Promoting biodiversity at the Hamburg plant	Sowing butterfly meadows, planting native bushes, installing insect hotels	Plant inspection with NABU in 2016; implementation of recommendations in 2017
		Repeat inspection of open areas with regard to vegetation (e.g., wildflowers)
	Planting greenery in suitable places on facades	Pilot in the inner courtyard of Hovestrasse 50 scheduled for 2018, postponed to 2019
	Planting trees as part of construction of new IAZ	2019

## Safety aspects/plant security

Target	Planned measure	Degree of implementation/date
Support in the case of transport and warehouse accidents with chemicals in public spaces	Participation of the Plant Fire Department in the TUIS system	Initial deployments have been taking place since 2015. Additional technical equipment for accepting hazardous materials was provided in 2017
Ensuring security	Drills for the alarm and danger prevention plan	Conducted annually, most recently in Nov. 2016
		2017 drill to train the company staff for crisis situations, using the example of a tank wagon leak on the plant premises

## Continuous improvement of environmental management system

Target	Planned measure	Degree of implementation/date
Introducing an integrated management system (IMS) for Aurubis AG for the environment, quality, and energy	Introduction of general IMS handbook Introduction of Hamburg IMS handbook Introductory phase – taking advantage of synergies Revising the documents	General IMS handbook & Hamburg handbook adopted (2016)  Reorganization, consolidation, and revision of process instructions for the environment, quality, and energy  Certification of IMS by TÜV Nord in May 2017  New process instructions went into effect in 2017
	Introducing the Aurubis Operating System (AOS). A supporting tool is being implemented that contributes to continuous improvement of production processes with respect to efficiency, environmental protection, and occupational safety	Pilot projects started in 2017, continuous development
Ensuring compliance	Further development of the annotated legal catalogue, including subsequent actions and follow-up on implementation	Continuously, implementation started in 2017, initial training dates will be scheduled in 2018  Continuously, implementation of new legal requirements in 2017 (e.g., StörfallV, AwSV, 42nd BImSchV)

## Business Partner Screening

Target	Planned measure	Degree of implementation/date
Reinforcing a sustainable approach to raw materials	Developing and implementing a Business Partner Screening process; screening all suppliers and customers under aspects of sustainability, compliance, and tax law, possibly including an in-depth review regarding sustainability and therefore environmental aspects	Concept developed in 2013 and introduced in 2015; developed continuously

**Key figures for Aurubis AG, Hamburg site,  
in the 2018 calendar year**

<b>Input</b>	<b>2018</b>	<b>2017</b>
<b>Raw materials</b>		
Copper concentrates	1,191,475 t	1,287,268 t
Copper scrap/refining material	54,933 t	49,125 t
Other Cu-bearing raw materials	140,365 t	112,897 t
Precious metal-bearing raw materials	28,446 t	27,347 t
Lead concentrate, scrap, and waste	25,013 t	26,438 t
Waste for recycling	1,179 t	823 t
<b>Total TC/RC-earning raw materials</b>	<b>1,441,411 t</b>	<b>1,503,897 t</b>
<b>Operating supplies and materials</b>		
Sand and additives including cyclone sand	176,865 t	182,957 t
Iron as an additive	15,626 t	13,586 t
<b>Total input materials</b>	<b>1,633,902 t</b>	<b>1,700,440 t</b>
<b>Input material per t copper</b>	<b>3.5 t/t Cu</b>	<b>3.7 t/t Cu</b>
<b>Energy</b>		
Electricity consumption	552,307 MWh	549,957 MWh
Additional electricity consumed to produce oxygen (informative)	127,278 <sup>6</sup> MWh	119,594 MWh
Natural gas	480,771 MWh	439,834 MWh
Coke	47,857 MWh	49,513 MWh
Other energy sources	16,269 MWh	17,205 MWh
<b>Total energy consumption</b>	<b>1,224,482 MWh</b>	<b>1,176,104 MWh</b>
<b>Energy consumption per t copper</b>	<b>2.6 MWh/t Cu</b>	<b>2.6 MWh/t Cu</b>
<b>Water withdrawal/uptake</b>		
River water	64,033,000 m <sup>3</sup>	67,277,000 m <sup>3</sup>
Potable water	340,000 <sup>7</sup> m <sup>3</sup>	332,000 m <sup>3</sup>
Precipitation	319,000 m <sup>3</sup>	514,000 m <sup>3</sup>
<b>Total water uptake</b>	<b>64,951,000 m<sup>3</sup></b>	<b>68,123,000 m<sup>3</sup></b>
<b>Water consumption per t copper</b>	<b>137 m<sup>3</sup>/t Cu</b>	<b>150 m<sup>3</sup>/t Cu</b>
<b>Area used at the Hamburg site</b>		
Total plant area	871,000 m <sup>2</sup>	871,000 m <sup>2</sup>
Buildings and paved area	766,000 m <sup>2</sup> (equivalent to 88%)	766,000 m <sup>2</sup> (equivalent to 88%)

<sup>6</sup> The compressors used to produce oxygen haven't been operated internally since 2018, but they are still monitored.

<sup>7</sup> The figure provided is the actual consumption of potable water for production purposes and sanitary facilities.

Output	2018	2017
<b>Products</b>		
Copper	473,367 t	455,406 t
Sulfuric acid products as H <sub>2</sub> SO <sub>4</sub> (from exhaust gas cleaning, standardized to 100 % acid)	989,091 t	1,074,468 t
Iron silicate stone (including granules)	717,375 t	786,787 t
Silver, gold, and PGMs	1,273 t	1,866 t
Nickel sulfate	2,041 t	3,087 t
Other metal compounds	932 t	1,044 t
Lead	11,891 t	11,349 t
<b>Total products</b>	<b>2,195,970 t</b>	<b>2,332,962 t</b>
<b>Waste</b>		
Recycling	7,905 t	10,294 t
Disposal	5,105 t	4,960 t
<b>Total recycling &amp; disposal</b>	<b>13,010 t</b>	<b>15,254 t</b>
of which hazardous waste	9,590 t	11,652 t
<b>Waste per t copper output</b>	<b>27 kg/t Cu</b>	<b>33 kg/t Cu</b>
<b>Waste per t input material</b>	<b>8 kg/t</b>	<b>9 kg/t</b>
Construction waste (informative)	37,925 t	24,027 t
<b>Total waste</b>	<b>50,935 t</b>	<b>39,281 t</b>
<b>Conversion into products</b>	<b>99.2%</b>	<b>99.1%</b>
<b>Emissions</b>		
Dust	42 t	43 t
Dust per t copper	89 g/t Cu	95 g/t Cu
SO <sub>2</sub>	1,830 t	2,046 t
NO <sub>x</sub> per t copper	450 g/t Cu	564 g/t Cu
Direct CO <sub>2</sub> emissions (ETS, excluding diesel)	165,029 t	166,732 t
of which CO <sub>2</sub> from fuels	116,767 t	109,721 t
CO <sub>2</sub> from fuels per t Cu	0.25 t/t Cu	0.24 t/t Cu
Direct CO <sub>2</sub> emissions (diesel for vehicles)	4,433 t	3,865 t
Indirect CO <sub>2</sub> emissions from electricity consumption (ETS)	290,814 t	288,816 t
Metal discharge in water	718 kg	684 kg
Metal discharge in water per t Cu	1.5 g/t Cu	1.5 g/t Cu
<b>Water discharge</b>		
Direct discharge	63,676,000 m <sup>3</sup>	65,364,198 m <sup>3</sup>
Indirect discharge	42,000 m <sup>3</sup>	50,288 m <sup>3</sup>
<b>Total water discharge</b>	<b>63,718,000 m<sup>3</sup></b>	<b>65,414,486 m<sup>3</sup></b>
<b>Water discharge per t copper</b>	<b>135 m<sup>3</sup>/t Cu</b>	<b>144 m<sup>3</sup>/t Cu</b>

# Updated Aurubis AG Environmental Statement 2019

Lünen Site





### The Lünen plant

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

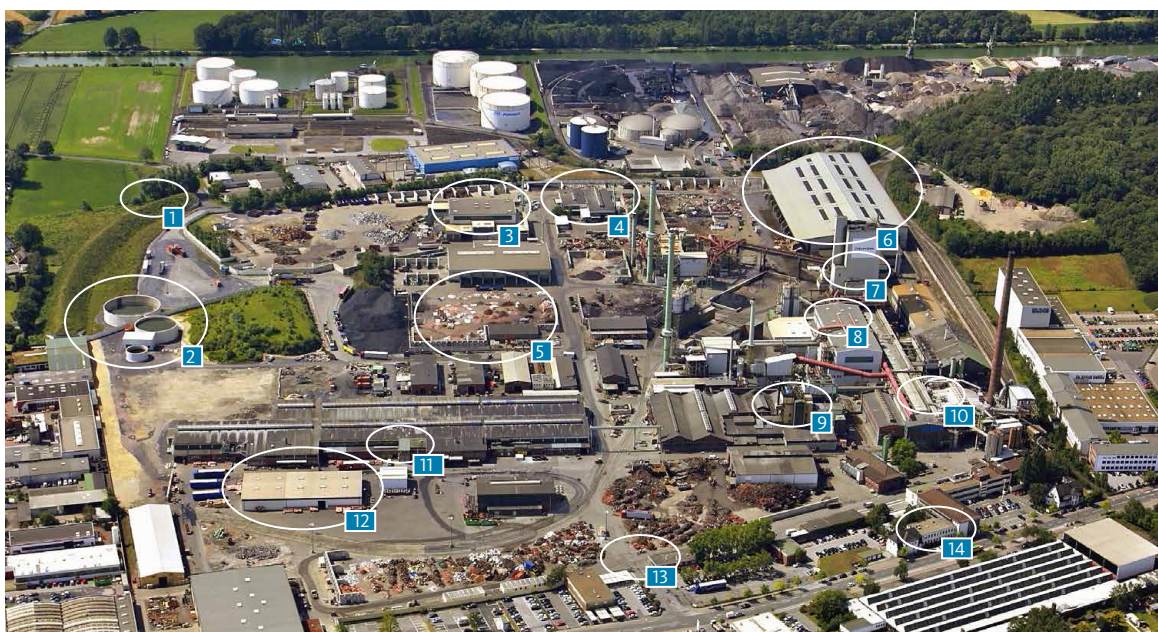
The plant was built and commissioned on undeveloped land between the Cologne-Minden railway and the Datteln-Hamm Canal in 1916 as a branch plant of Hüttenwerke Kayser AG in Berlin. After the loss of the Berlin plants and reconstruction after the end of World War II, the production facilities were continuously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

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

### The processes at the Lünen plant

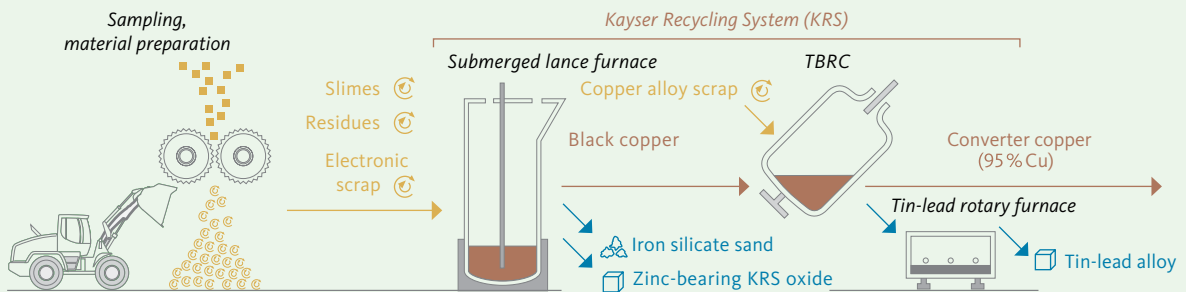
Lünen's smelting and refining processes involve recycling raw materials almost exclusively. These include traditional recycling raw materials such as copper scrap and alloy scrap, slimes, and residues, as well as high quantities of complex materials and other processing products from e-scrap, old cars,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

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 Administrative building

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



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. Additional anode quantities from other Aurubis sites are also processed in the copper tankhouse (see Fig. 3.2).

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

There are about 600 employees at the Lünen site, around 40 of whom are apprentices.

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

An environmental management system exists at the Lünen site as well. It has been certified in accordance with ISO 14001 and EMAS since 1997 and is incorporated in an IMS (integrated management system) in connection with quality management pursuant to ISO 9001. Since 2013, the IMS has also included a certified energy management system pursuant to DIN EN ISO 50001.

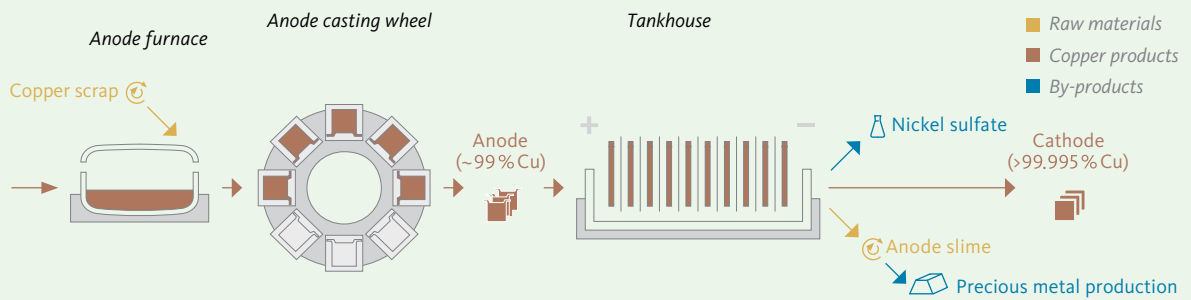
Therefore, the management system and handbook and their process and work instructions are related not only to environmentally relevant issues, including accident prevention and health protection, but also to quality assurance and energy management measures.

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

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

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





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

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

### Targets and tasks of the environmental management system

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

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

issues are planned, managed, monitored, and continuously improved with due regard to legal requirements.

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

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

### Environmental management organization

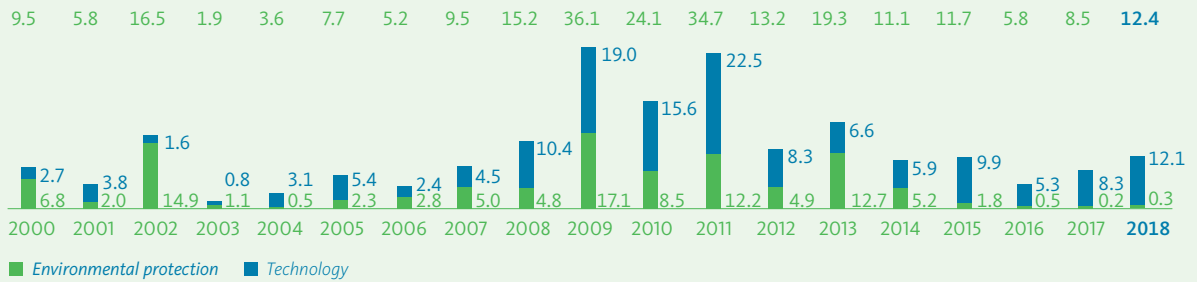
As the operator of facilities requiring a permit in accordance with Section 52a of the Federal Immission Protection Law and Section 53 of the Recycling Management Law, the Aurubis AG Executive Board or an appointed member of the Executive Board is responsible for observing environmental protection and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

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

- » Immission protection and accident prevention
- » Waste management
- » Radiation protection
- » Specialist company under the WHG

Fig. 3.3: Dust in g/t of copper output at the Lünen site

in € million/fiscal year



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

The officer function for REACH and CLP (Classification, Labeling, and Packaging) is still carried out centrally for all of Aurubis AG from Hamburg.

### Environmental aspects and performance

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

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

Overall, around € 122 million has been invested in environmental protection from 2000 to 2018 (see Fig. 3.3).

### Air – Emissions

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

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

Consequently, the measurements comply with the limit values overall or fall significantly below them in some cases. The same applies to additional substances listed in the permits, such as NOx, HCl, HF, etc.

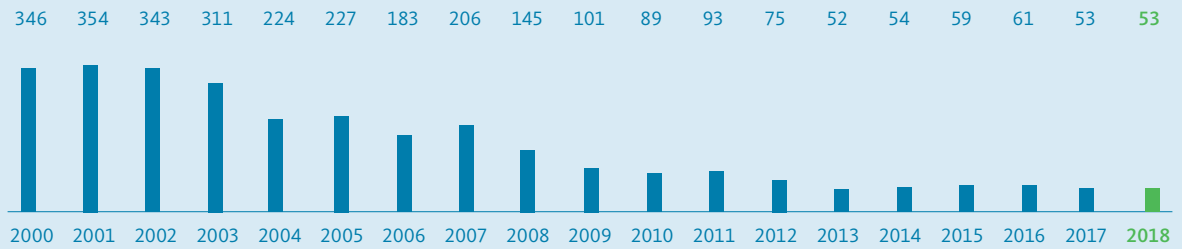
The long-term goal of the Lünen plant is to achieve a continued reduction in emissions despite the input materials, which are becoming ever more complex. Contributing to the difficulty here is that for many areas, the measured values already lie within the margin of error, which can lead to significant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

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

The dust emissions in 2018 were again at about the same low level of the previous year.

Fig. 3.4: Dust emissions at the Lünen site

Dust in g/t of copper output



Higher Pb and As emissions stood out for the first time. These increased emissions can be attributed to one source (the anode furnace casting hall). The exact source within this area is still unclear, however. One possibility could be direct exhaust air streams from the anode furnace during refining processes. Additional measurements will have to be taken here in the next few years to identify and remedy the reason for the increase.

Overall, emissions are still at a very low level. However, shifts are expected for specific emissions in the coming years. This has already been the case for a long time for emissions per ton of copper output because the Lünen plant works with increasingly complex input materials and the miniaturization of technical devices has also resulted in an increase in the number of processing steps. This leads to less copper in exchange for more by-products per ton of material input.

Therefore, in the coming years increasing consideration will need to be given to alternative parameters that describe the more complex processes more reliably. As a first step at the Lünen plant, the processed external bleed was included in the input streams since it constitutes a substantial portion of both plant traffic and the metal freights of wet chemistry.

Initial approaches for an alternative KPI to evaluate energy performance and energy efficiency that includes minor metal production were developed and discussed as part of energy management. An assessment based on the 14040 standards on life cycle assessment seems to make sense.

### Air – Immissions

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

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

In addition, a LANUV measurement station for particulate matter (PM<sub>10</sub>) 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 PM<sub>10</sub> 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.

Fig. 3.5: Copper emissions at the Lünen site

Copper in g/t of input material

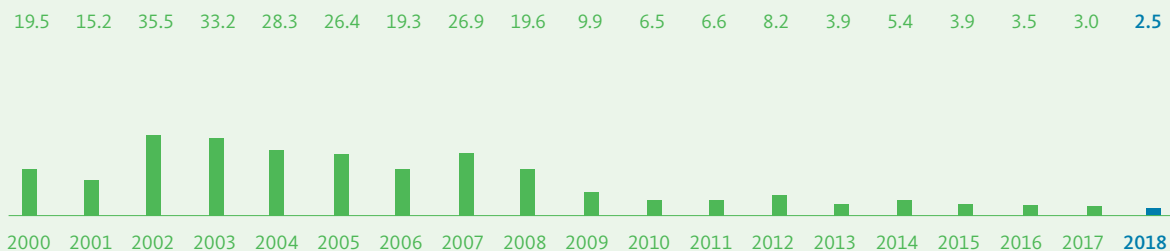


Fig. 3.6: Lead emissions at the Lünen site

Lead in g/t of input material

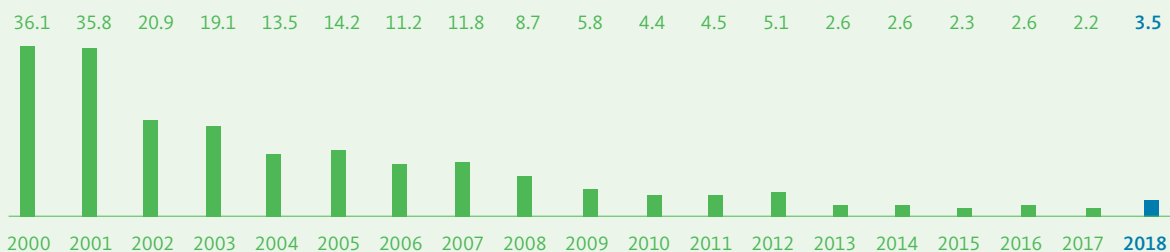
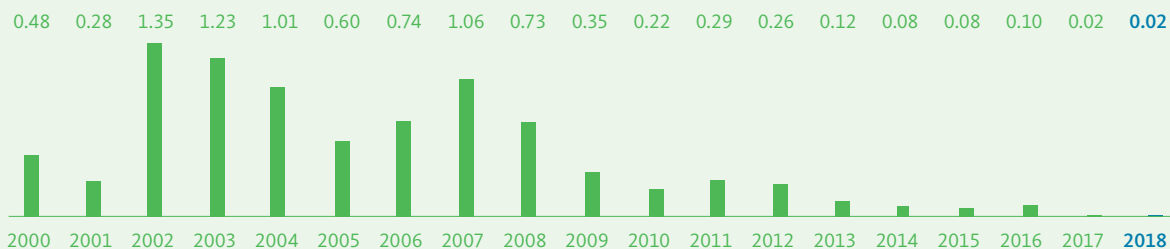


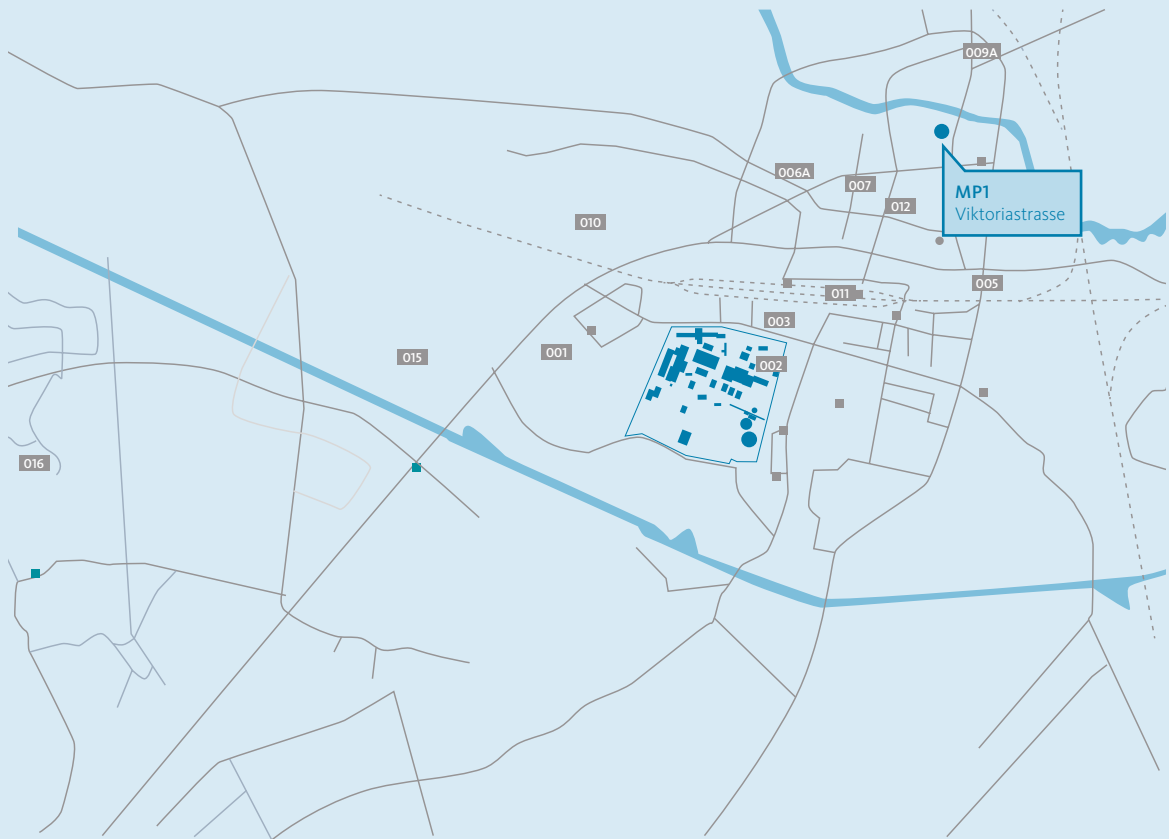
Fig. 3.7: Arsenic emissions at the Lünen site

Arsenic in g/t of input material



Note on the selection of years presented here: Fugitive emissions in particular have been determined or calculated since 2004 in accordance with the methods used at the Hamburg site. The values for 1990, 2002, and 2003 were estimated in a comparable manner, but there are no reliable values for the missing years.

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



*"Bergerhoff" measurement points in Lünen*

- |                             |   |  |
|-----------------------------|---|--|
| 001 Buchenberg              | 006A Rail line/mosque                   | 012 Rail line/Kantstrasse                                  |
| 002 Kleine Bergstrasse      | 007 Lünen South freight yard            | 015 Im Engelbrauck/north side                              |
| 003 Bergstrasse 48          | 009A B 236/Lippebrücke                  | 016 Im Siepen  |
| 005 Bebelstrasse/Süggelbach | 010 Im Wiesengrund                      |  |
|                             | 011 Builders' association/building yard |  |
|                             |   | <span style="color: blue;">■</span> Aurubis plant building |

Source: LANUV

In June 2018, the results of the investigations of leafy vegetables from small gardens in Lünen near the plant were released for 2017. The assessment took place on the basis of Commission Regulation (EC) No 1881/2006 on setting maximum levels for certain contaminants in foodstuffs. This regulation is based on the assumption of regular consumption of the tested foodstuffs, which, due to the actual vegetation period of the leafy greens in question, can't actually be achieved by the harvested plants from the gardens.

At measuring station 11, the limit value for lead for leafy vegetables was exceeded for the first time again in 2017, following a period of no overages in 2016. Compared to 2016, there were higher lead contents at all of the measuring stations.

For arsenic, the values were all below the maximum load, but a contribution to immissions was distinguishable since the values were still higher than the averages in the state of North Rhine-Westphalia.

For copper, nickel, cadmium, and chrome, the report states that a contribution to immissions can't be assumed, as the plants only absorb the substances through the soil.

The recommendation regarding the consumption of the vegetables will be maintained due to the lead contents. The measuring program continued in 2018.

## 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.

In order to mitigate this water consumption, a facility for rainwater retention, preparation, and utilization was commissioned in 2014. In the future, a large part of the internal plant and process water needs within the plant will be covered by collected rainwater.

In 2018, more than 100,000 m<sup>3</sup> of process water was used for internal purposes once again. Overall, the rainwater-use project has significantly surpassed the quantities estimated in the permit. The wastewater discharge is nevertheless still at a high level, even though the established deficiencies have been improved (see Fig. 3.14a). As a result, a revision of the indirect discharger permit has been discussed with the relevant governmental authority recently to adjust the increased water volumes and to include the current technical changes in the plant's internal water management.

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

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

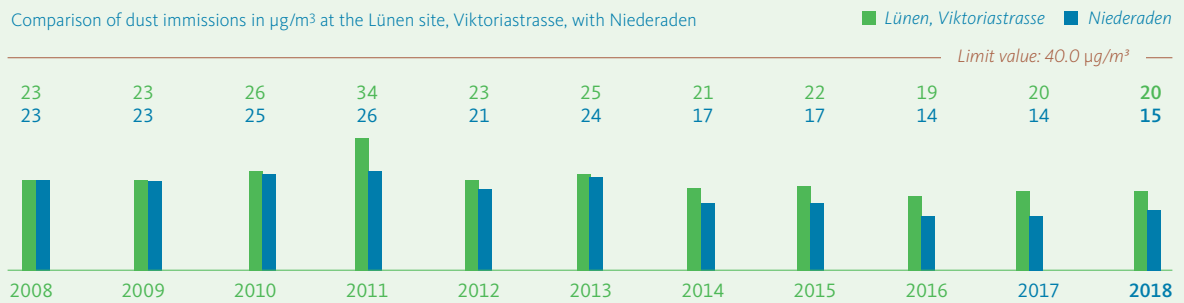


Fig. 3.10: Lead

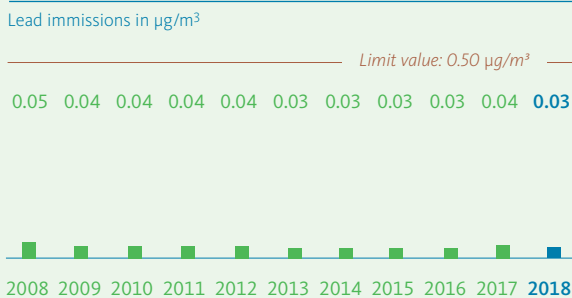


Fig. 3.11: Cadmium

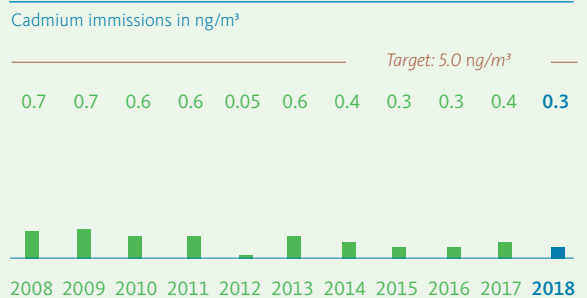


Fig. 3.12: Arsenic

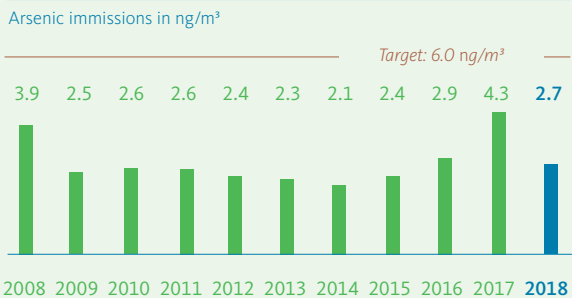
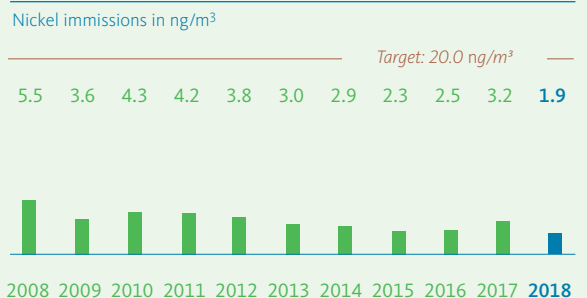


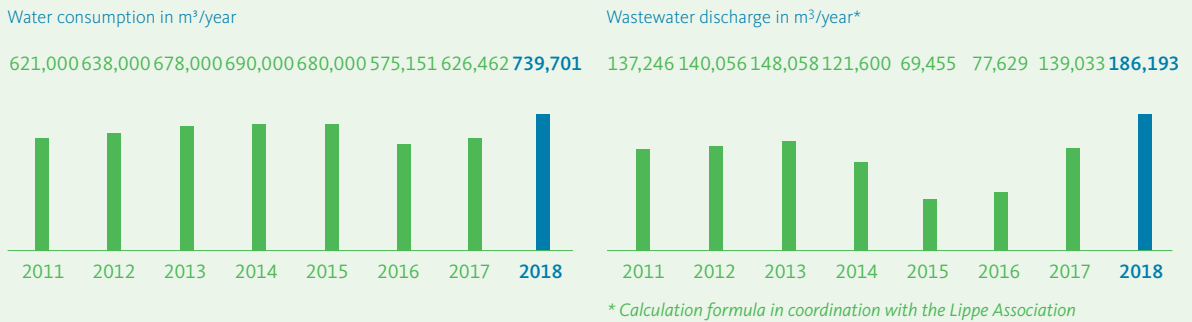
Fig. 3.13: Nickel



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



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



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

The restoration 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.

Furthermore, a groundwater flow model was developed for the site that was welcomed by all participants as a very helpful addition; it has been refined several times since 2016, incorporating additional wishes from the Unna district into the monitoring concept. The draft permit applications were submitted to the Unna district in 2018; at the moment, final revisions are being made that are expected to conclude by summer 2019.

The oil damage restoration taking place near a former oil storage area (the groundwater is locally contaminated with an oil phase), on the other hand, will be established soon and should start in summer 2019.

Fig. 3.14b: **Layout of the two rainwater retention basins, central pump station, treatment plant, and service water storage tank 1**

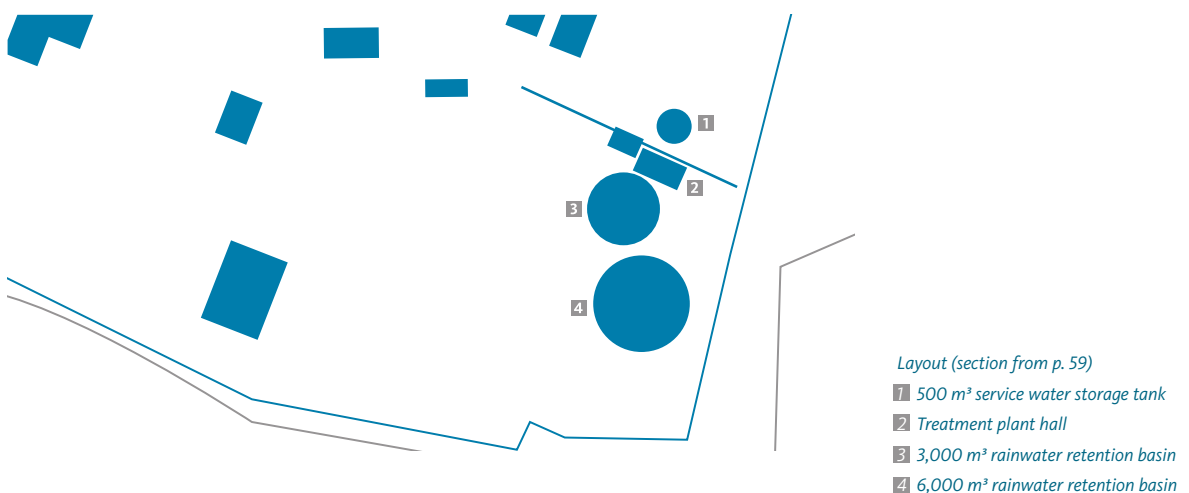


Fig. 3.15: Waste generated at the Lünen site

in t p.a.	2012	2013	2014	2015	2016	2017	2018
Packaging and other waste	1,276	1,338	909	794	910	1,745	1,301
Construction waste	23,740	23,706	9,914	8,925	4,313	10,988	3,235
Spent potlining	264	343	272	201	319	267	286
Sales products from the material preparation plant	5,713	6,683	4,849	3,712	5,808	7,366	4,241
<b>Total</b>	<b>30,993</b>	<b>32,070</b>	<b>15,944</b>	<b>13,632</b>	<b>11,350</b>	<b>20,366</b>	<b>9,064</b>
of which hazardous waste	359	1,513	2,996	276	3,287	367	363

### 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 were carried out at existing facilities as well.

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

The noise complaints due to newly purchased cleaning vehicles declined significantly in 2018 due to the measures that were taken (sound absorbers, refraining from driving through the southern area of the plant early in the morning). In the coming years, planned construction projects such as the training center on the edge of the plant, as well as the heightening of the plant fence on the east side, will further reduce noise immissions in the plant environment.

There was only one odor complaint, in July 2018, from multiple people living near Bergstrasse. This complaint was clarified by directly visiting the area, as the odor came from moist electric scrap heaps. The dispersion of the odor was influenced by an extremely unfavorable weather situation.

### 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, Lippeaue). Respecting and promoting biodiversity is therefore a high priority for us. For example, Aurubis has reviewed larger expansion projects such as the KRS-Plus project with extensive assessments pursuant to the EU Habitats Directive in order to identify possible impacts on biodiversity. In smaller projects in the plant and in the neighborhood, we continue to take active steps to promote and preserve biodiversity, for example by planting greenery on plant surfaces that aren't in use (noise protection wall, landfill for blast furnace slag) and setting up nesting sites on buildings and chimneys.

### Waste

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

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

A total of 363 t of hazardous waste accumulated in 2018. Of this amount, only 1 t of construction waste containing asbestos had to be disposed of.

### New material catalogue for waste acceptance

For better communication with suppliers and to ensure worldwide compliance with the requirements of waste management law, the existing material catalogue of the site has been updated, and its information content was improved.

For this purpose, all of the approved waste codes for the Lünen plant were assigned to the material streams possibly containing waste according to the German Federal Immission Control Act (BImSchG) and the maximum metal content derived from them were determined. The result is a new waste acceptance catalogue that has been published as an official document with a seal by the relevant governmental authority and now is being used by Aurubis for customer information.

### 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 for leaching and electrolysis is mainly produced in the waste heat boilers of the KRS submerged lance furnace and anode furnaces. There are also two auxiliary boilers fueled with light oil or 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 18.6 bar to 5.15 bar in the first turbine stage. Steam is removed for thermal use and the remaining volume is then depressurized to 0.85 bar in the second turbine stage. The German Federal Office of Economics and Export Control (BAFA) licensed the turbine in accordance with Section 5(2) of the German Act on Combined Heat and Power Generation (KWKG). For this project, Aurubis won the German Energy Agency's (dena) award for Best Practice in Energy Efficiency at the end of 2015. Due to unscheduled shutdowns and process adjustments in KRS operation due to the raw materials, only 10.64 GWh of power was generated internally in 2018.

Developments and background on the use of primary energy sources:

- » A high throughput of the metallurgically energy-intensive metal zinc, with an increased yield of the product KRS oxide
- » An up to 60 % higher output volume of minor metal products
- » A considerable increase in the input of energy-intensive, complex raw materials such as shredder materials and residues
- » A decline in usable energy content in electrical and electronic scrap

Furthermore, about 50,000 t of electrolyte from the Olen plant has been treated in the Lünen tankhouse and leaching plant since 2014. This leads to a higher demand for heat (with lower potential for internal electricity generation via the turbine at the same time) and electricity. 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 525 GWh in 2018, the energy input is lower than the seven-year average of 540 GWh

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

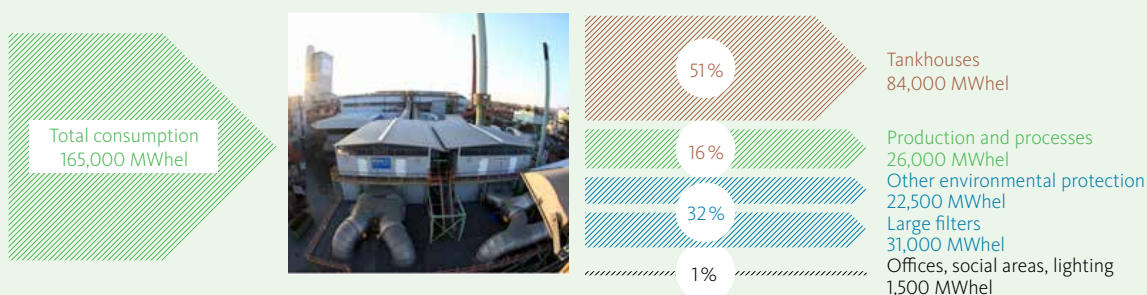
in GWh/year	2012	2013	2014	2015	2016	2017	2018
Heating oil	291	266	266	242	260	257	230
Coal, coke, etc.	6	13	9	27	24	29	23
Natural gas	81	77	105	135	106	105	107
Electricity	154	156	162 <sup>2</sup>	161 <sup>2</sup>	155 <sup>2</sup>	165 <sup>2</sup>	165
Total	532	512	542	565	545	557	525

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

<sup>2</sup> Includes internal electricity production from the steam turbine (2018: 10.6 GWh)

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

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



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

Fig. 3.18: Specific energy demand (total including oil, gas, coal)

in MWh/t of secondary raw material input

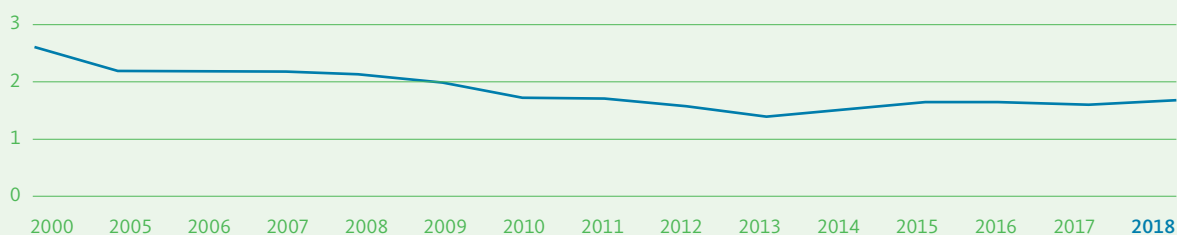


Fig. 3.19: CO<sub>2</sub> emissions at the Lünen site

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

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

Fig. 3.20: Specific energy consumption at the Lünen site

in MWh/t of copper output

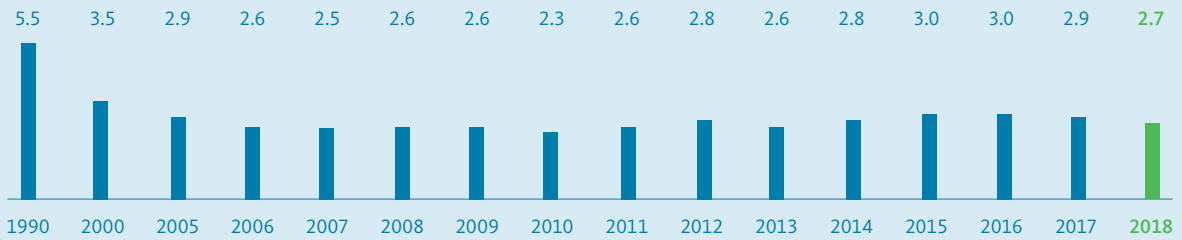
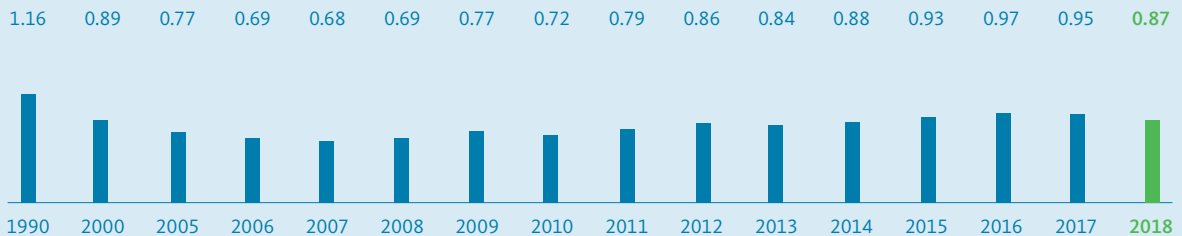


Fig. 3.21: Specific CO<sub>2</sub> emissions at the Lünen site

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



+/- 25 GWh. At the same time, the plant's direct CO<sub>2</sub> emissions fell from 186,500 t (2017) to 170,000 t (2018), or by 8.8 %. Unfortunately, neither development can be directly attributed to energy efficiency measures. Two unplanned KRS shutdowns in September and November had a significant influence and were connected with considerable declines in throughputs of complex recycling materials. The specific energy KPI in relation to the input of recycling raw materials (see Fig. 3.18) very concretely illustrates the multi-metal recycling strategy selected for the Lünen site. With more or less the same cathode copper output, metal is produced from a high and continuously increasing input of recycling materials. The average copper content in the raw materials is decreasing, while the proportion of minor metals such as zinc, tin, nickel, gold, and silver is rising distinctly. The shift in the trend shows that the increasingly complex composition of raw materials is becoming more energy-intensive when it comes to processing.

Due to equipment and market factors, the Lünen plant wasn't able to fully utilize its possibilities for inputting complex raw materials. The copper cathode output stayed at prior-year level thanks to the supply variability in the Aurubis Group and the site's processing flexibility. The development of the total energy input alone doesn't reveal an economic or ecological advantage of either supply structure. The strategic objective of the site and of Aurubis will continue to be to push the use of complex raw materials, some of which are energy-intensive.

The CO<sub>2</sub> emissions were determined in accordance with DEHSt (German Emissions Trading Authority) standards. The increase in the absolute figures is mainly a result of a higher quantity of complex input materials with low copper contents. This trend, which has been observed for some time now, led to an increase of more than 10,000 t in 2011 due to the implementation of the KRS project. The total CO<sub>2</sub> emissions include biogenic emissions and emis-

sions from mobile production equipment, i.e., the diesel consumption of plant vehicles, which are not considered in emissions trading.

According to the reporting methods of the DEHSt, the raw materials contribute more to the site's CO<sub>2</sub> emissions than the main energy source, SE oil (40% compared to 37%).

#### Audits and inspections by governmental authorities

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

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

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

#### Indirect environmental aspects

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

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

#### Emergency measures and crisis management

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

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

There were no incidents or malfunctions with significant environmental effects within the meaning of the Hazardous Incident Ordinance at the Lünen plant during the reporting period. In 2017, the site's safety report was revised and a new notification was submitted to the authorities pursuant to the new standards of the Seveso III directive. Furthermore, the information for the public regarding the Lünen site has been accessible on the Aurubis homepage to every interested citizen since last year.

## **Environmental Program**

The targets set in the context of the Environmental Statement 2018 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 2019. The results are presented in the following Environmental Program.



## Air pollution control

Target	Planned measure	Degree of implementation/date
Closing the KRS roof ventilation	Analysis of the emission effects after closing the smelting operations hall and possibly closing the KRS roof ventilation	The detailed engineering plan indicated additional improvement options that are still being incorporated in the project. A central filter on the roof doesn't seem to be the most efficient solution. Instead, suction processes should be accelerated on all working platforms. However, a complete closure still doesn't appear to be necessary.
Improving odor immissions in the plant surroundings	Measures for ventilating individual production halls as well as additional storage halls in the southern plant area	The measures have been budgeted and will be implemented when there are suitable upcoming renovation or construction measures

## Water pollution control

Target	Planned measure	Degree of implementation/date
Optimizing wastewater flows	Separately treating sanitation water, improving the ratio of used surface water to drained surface water to >60 %	Details are currently being coordinated for environmental remediation with the responsible governmental authorities. The applications for approval should be submitted this year. Improvements to plant technology have been carried out for surface water treatment. New uses for surface water are currently being discussed.

## Energy optimization

Target	Planned measure	Degree of implementation/date
Enhancing energy efficiency	Developing an assessment basis that takes the following aspects into account: <ul style="list-style-type: none"> <li>» Form of energy</li> <li>» Raw material structures</li> <li>» Raw material availability</li> <li>» Raw material composition (complexity)</li> <li>» Price volatility</li> </ul>	The EnPIs have been evaluated as meaningful on the whole. There is no sustainable, norm-based assessment standard for the overall process with regard to energy efficiency
Optimizing the anode smelter cycles and primary smelter cooling cycles	Heat use and water quality (including expansion of process water use) have to be optimized to enhance performance	Concepts are being developed with external support. Projects are taken into account in the investment budget

## Plant safety

Target	Planned measure	Degree of implementation/date
Adaptation of the requirements to the Seveso III Directive	Public disclosure	The documents are available online, development of a new information concept with flyers, visitor orientations to come
	Preparation of a new hazardous substances register	The report pursuant to the new Hazardous Incident Ordinance was submitted to the governmental authorities. The hazardous substances register should be transferred to a more modern software with an SAP interface in order to improve the quality of evaluations

## Environmental management system

Target	Planned measure	Degree of implementation/date
Improved organization	Computerized integrated management system	Document management has been successfully implemented and is currently being used and filled by all plants
	Organization and authorization, assumption of business and operator obligations	The training program for all employees with management responsibility has been introduced as a permanent fixture and supplemented by discussion forums to improve organization
	Earnings improvement projects and project organization	AOS program, Wave measures, supported by trained Aurubis employees (BIGs)

Key figures for Aurubis AG, Lünen site,  
in the 2018 calendar year

Input	2018	2017
<b>Raw materials</b>		
Recycling raw materials	323,519 t	392,420 t
Blister, etc.	19,013 t	15,138 t
Copper anodes from other Aurubis sites	29,438 t	25,404 t
Bleed	27,598 t	
<b>Total raw materials</b>	<b>399,568 t</b>	<b>432,962 t</b>
<b>Input material/t Cu cathodes</b>	<b>1.82 t/t Cu</b>	<b>2.24 t/t Cu</b>
<b>Operating supplies and materials</b>		
Oxygen	38 million m <sup>3</sup>	43 million m <sup>3</sup>
Rhine sand	19,894 t	15,199 t
Limestone	6,671 t	6,814 t
<b>Energy</b>		
External power sources	153,953 MWh	147,351 MWh
Internal power sources	10,641 MWh	17,766 MWh
Natural gas, oil, coal	360,990 MWh	391,679 MWh
<b>Total energy consumption</b>	<b>525,583 MWh</b>	<b>556,796 MWh</b>
<b>Energy consumption/t Cu cathodes</b>	<b>2.73 MWh</b>	<b>2.89 MWh</b>
<b>Water withdrawal/uptake</b>		
Potable water	739,701 m <sup>3</sup>	626,462 m <sup>3</sup>
Precipitation	112,286 m <sup>3</sup>	126,302 m <sup>3</sup>
<b>Total water consumption</b>	<b>711,791 m<sup>3</sup></b>	<b>795,961 m<sup>3</sup></b>
<b>Water consumption/t Cu cathodes</b>	<b>3.7 m<sup>3</sup>/t Cu</b>	<b>4.1 m<sup>3</sup>/t Cu</b>
<b>Area used</b>		
Total plant area (incl. south plant entrance)	316,0000 m <sup>2</sup>	316,000 m <sup>2</sup>
Buildings and paved area	247,0000 m <sup>2</sup> (equivalent to 78%)	247,000 m <sup>2</sup> (equivalent to 78%)

Output	2018	2017
<b>Products</b>		
Copper cathodes	192,323 t	192,516 t
KRS oxide	18,982 t	23,022 t
Iron silicate sand	146,982 t	153,294 t
Other (tin composite, nickel sulfate, etc.)	23,401 t	26,289 t
<b>Total products</b>	<b>381,688 t</b>	<b>395,121 t</b>
<b>Waste</b>		
Recycling	5,829 t	9,378 t
Disposal	0 t	0 t
Waste/t copper output	30.30 kg/t Cu	48.71 kg/t Cu
Waste/t input material	14.59 kg/t	46.16 kg/t
Construction waste	3,234 t	10,988 t
<b>Total waste</b>	<b>9,063 t</b>	<b>20,366 t</b>
<b>Emissions</b>		
CO <sub>2</sub>	0.87 kg/t Cu cathodes	0.95 t/t Cu cathodes
Dust	109 kg/t Cu cathodes	116 g/t Cu cathodes
SO <sub>2</sub>	3.97 kg/t Cu cathodes	5.34 kg/t Cu cathodes
NO <sub>x</sub>	1.35 kg/t Cu cathodes	1.29 kg/t Cu cathodes
<b>Water discharge</b>		
Wastewater (indirect discharge)	186,000 m <sup>3</sup>	139,000 m <sup>3</sup>
Water discharge/t Cu cathodes	0.97 m <sup>3</sup>	0.72 m <sup>3</sup>

# GÜLTIGKEITSERKLÄRUNG

gemäß den Vorgaben der

**Verordnung (EG) Nr. 1221/2009 i.d.F. vom 25.11.2009**  
über die freiwillige Teilnahme von Organisationen an einem Gemeinschaftssystem  
für Umweltmanagement und Umweltbetriebsprüfung (EMAS)



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

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

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

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

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

Hannover, 28.05.2019



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Register-Nr.: DE-131-00035

Ersteintragung am  
01. November 2005

Diese Urkunde ist gültig bis  
19. Mai 2020.

Diese Organisation wendet zur kontinuierlichen Verbesserung der Umwelleistung ein Umweltmanagementsystem nach der EG-Verordnung Nr. 1221/2009 und EN ISO 14001:2004 Abschnitt 4 an, veröffentlicht regelmäßig eine Umwelterklärung, lässt das Umweltmanagementsystem und die Umwelterklärung von einem zugelassenen, unabhängigen Umweltgutachter begutachten, ist eingetragen im EMAS-Register und ist deshalb berechtigt, das EMAS-Zeichen zu verwenden.

Hamburg, 1. August 2017

HANDELSKAMMER HAMBURG



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Tobias Bergmann  
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