MAGAZINE 2017/18

THERE'S MORE TO IT

Aurubis

Metals for Progress

THERE'S MORE TO IT

In a world of constant change, the way
we live is challenged continuously.
Copper has shaped our company's long-
standing tradition and has made Aurubis
a leading specialist internationally.
But there's MORE to it.
There is MORE in our key raw material
copper concentrate, in scrap, and in
industrial residues that we can unlock
through innovative processes.
There is MORE in our partnerships with
mines and recyclers, MORE in our relationships
with the communities we work and live in,
and MORE in our organization and
the way we work together.
In line with our vision and through the measures
encompassed by our strategy,
we will tap this potential. With one goal:
to increase the value of Aurubis.

You can find the full Annual Report at:
annualreport2017-18.aurubis.com

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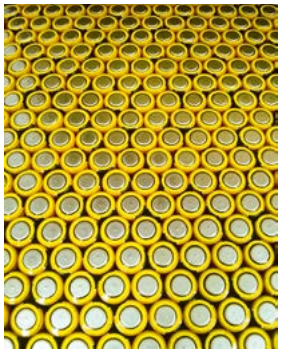
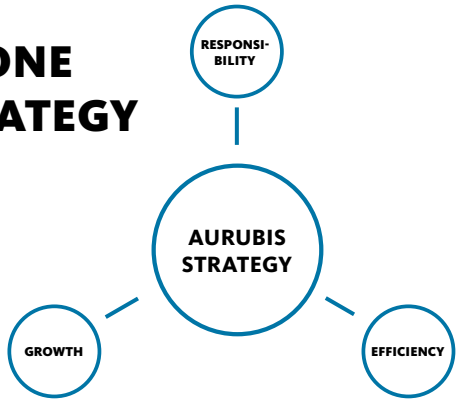




DR. THOMAS BÜNGER

CHIEF OPERATING OFFICER

JÜRGEN SCHACHLER

EXECUTIVE BOARD CHAIRMAN

RAINER VERHOEVEN

CHIEF FINANCIAL OFFICER

CHECKING IN

With our new vision, new strategy, and new way of thinking, there is a lot going on at Aurubis. In the following, the Aurubis Executive Board assesses the current situation and explains where our path is headed.

THE NEW AURUBIS STRATEGY WAS PRESENTED ABOUT ONE YEAR AGO. HOW WOULD YOU EVALUATE IT SO FAR?

JS: Positively, without a doubt. We've initiated many small and large measures for further growth. One of the most visible is our internal project Future Complex Metallurgy, or FCM for short. This project will help us substantially increase the volumes of metal, apart from copper, that we recover, and develop more in the direction of a multi-metal supplier. Our efficiency improvement program is also important to me. It is a program that has been making an impact in the company for a while now. Thanks to forward-looking planning, we already know which initiatives we'll be carrying out in the coming year to generate another € 60 million in project success in 2018/19, of a total of € 200 million. All of the employees in every division and at every site are contributing to this, from production to the administrative departments. We pay attention to this balance.

RV: This success is also reflected in our numbers, with operating earnings up by 10 % in 2017/18. Indeed, this is one of the best results in the company's history. We are thus comfortably within our forecast. It's fair to add that we have benefited from a positive market environment. Moreover, we're virtually debt-free at the moment. This is a good starting point for further growth.

TB: One more point regarding FCM: I'm glad to see how much excitement the employees are bringing to their work and collaboration. An important project like this one has the potential to help individuals surpass themselves. It's no wonder that we're fully on schedule for implementation despite the uncertainties that accompany a huge project like this one. Our sites' good operating performance in fiscal year 2017/18 also clearly indicates that we have a huge level of commitment to our daily work in the entire Group!

Jürgen Schachler's preliminary conclusion on the new company strategy is positive.

IN WHAT AREAS DO YOU WISH YOU WERE FURTHER ALONG?

JS: As a general rule, we don't rush, because we can maneuver from a place of strength thanks to our good market position.

However, in the future we want to shape external growth more than we currently do. Following initial success with the full acquisition of Deutsche Giessdraht in July 2018, our acquisition situation has calmed down somewhat. This doesn't mean that we're not actively reviewing different possibilities at the moment, but that we do this very conscientiously – with the necessary level of prudence. For instance, there could be interesting synergies in multi-metal recycling, where we already have a competitive edge due to our leading technology. The same is true for the sale of our Segment Flat Rolled Products, which will enable us to concentrate more on our metallurgical expertise again.

RV: External growth is an important part of our strategy – but not at all costs, of course. Nevertheless, we will stay on the ball in 2019 because we have the necessary funds and ideas.

A stronger harmonization of software solutions, processes, and approaches is one of Rainer Verhoeven's main interests.

New Executive Board member Dr. Thomas Bünger is convinced of the FCM project's potential.

JS: The topic of leadership culture is also close to my heart. We would like to give our employees the tools to feel more like entrepreneurs within the company. What I mean is, those who have a high level of responsibility for their actions and their work are more willing to deliver a top performance and follow through with their tasks. Moreover, we have to act more strongly as a team in the future, as ONE Aurubis. My guiding motto: Nobody is perfect, but a team can be. We have room to grow in this regard.

TB: In my opinion, there's also still some catching-up to do when it comes to the question-and-answer culture and how we provide good explanations internally about the change processes that come with our new strategy. On the other hand, it is also important for employees to ask these questions. This is the only way that everyone can ensure that the issues relevant to them are addressed and that they can help shape these areas.

WHAT DO YOU EXPECT FROM 2019?

RV: We will continue to pursue our strategic measures with enthusiasm and focus. As Mr. Schachler already mentioned, we will also push forward with improvement projects in the administrative divisions as well. A stronger harmonization of software solutions, processes, and approaches – across all of the key international sites – is one of my main interests. Our research and innovation department is working intensively with digitalization topics. For example, we want to draw even more from our raw materials and continue improving our energy management using models and artificial intelligence.

TB: We will make Aurubis fit for the future with the people who work here. Our environment is changing: Today, about half of the world's copper is produced and processed in China. With innovative process solutions such as FCM, which can be ideally integrated into our existing smelter network and provide us with even more flexibility in raw material sourcing, we will continue to expand our competitive position. In this way, we're developing from a sheer processor into a solution provider, for instance for our mine partners. At the same time, we want to work more intensively with our copper product customers in the future, in areas like recycling and end products.

JS: Our fundamental goal is to build on the previous year's good development in the coming year. We defined a clear objective with our Vision 2025, and we're now on the path to attaining it. It's important to me that we travel this path under the guidance of our sustainability ambitions. These include forward-looking projects such as our Industrial Heat project, which we inaugurated at the end of October. These successes strikingly indicate that we are in a position to unite economic interests with sustainable conduct. We will continue to do so in 2019.

This interview was conducted by Angela Seidler, Vice President Investor Relations & Corporate Communications.

OUR PORTFOLIO:

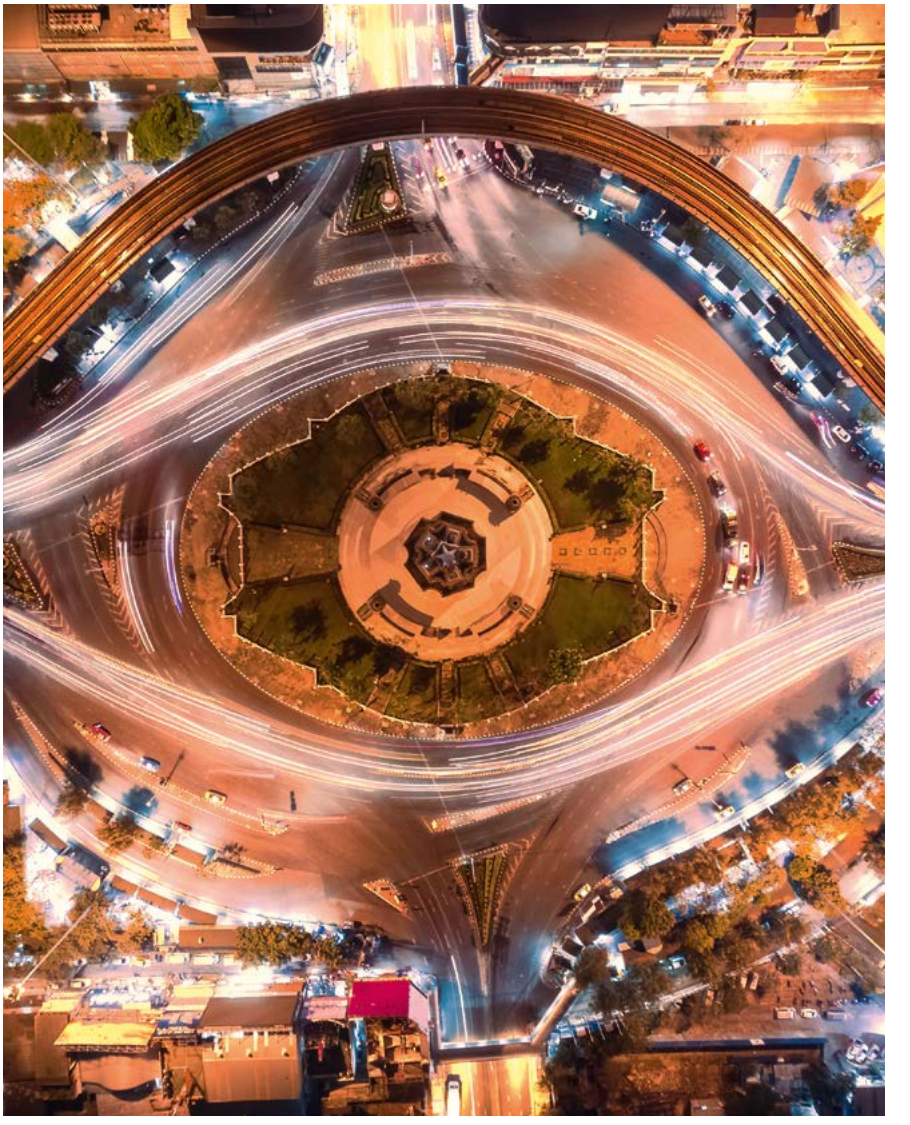
THE NEW VARIETY OF METALS

			28 Ni Nickel	29 Cu Copper					34 Se Selenium
	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver			50 Sn Tin	51 Sb Antimony	52 Te Tellurium
75 Re Rhenium		77 Ir Iridium	78 Pt Platinum	79 Au Gold			82 Pb Lead	83 Bi Bismuth	

While Aurubis tends to be associated with copper only, its processing activities encompass a range of metals. Indeed, the recovery of non-ferrous metals other than copper is becoming an increasingly important area of business – one encapsulated in the term multi-metal.

Many of the metals we produce are essential for megatrends such as digitalization, renewable energies, electric vehicles, and urbanization to become a reality in the first place. At the same time, these areas drive demand for our industrial metals even further. In short: The future is made from metals – in the best case, from ours.

Cu 29



MOMENTUM

COPPER

The basis of our modern world and many forward-looking trends.

Whether transport, energy supply systems, or construction: Many facets of modern life are developing at a fast pace. With its unique properties, copper is and remains the basis for these trends. This allows us to hold a steady course as we move towards the future.

METAL WITH CHARACTER

Apart from its characteristic red color, copper is known for its very high electrical and thermal conductivity. This qualifies the metal for countless uses in energy and telecommunications, as well as in nearly all thermally conductive heat exchangers in air conditioners and radiators. Copper is frequently alloyed with other metals, for example with zinc to form brass or with tin to form bronze. Copper can also be recycled as often as desired without a loss of quality.

ELECTRIC VEHICLES DRIVE COPPER DEMAND

In addition to its use in energy grids, cell phones, and heat pipelines, copper drives future mobility solutions in particular. While a conventional car contains about 25 kg of the metal, electric cars contain over three times that amount. This is similar for electric buses and trucks. But batteries, electric motors, and power electronics are just the start. The necessary charging stations and their cable systems raise demand even further. So it's no wonder that today's global copper demand of about 0.4 million t for electric vehicles alone is expected to increase to nearly 3 million t in 2030.

On top of rising copper demand from electric vehicles, there are also large-scale infrastructure measures such as the "New Silk Road" initiated in China, as well as stable demand from industrialized countries. Global demand for refined copper is expected to increase by around 3 % in 2019 due to these developments.

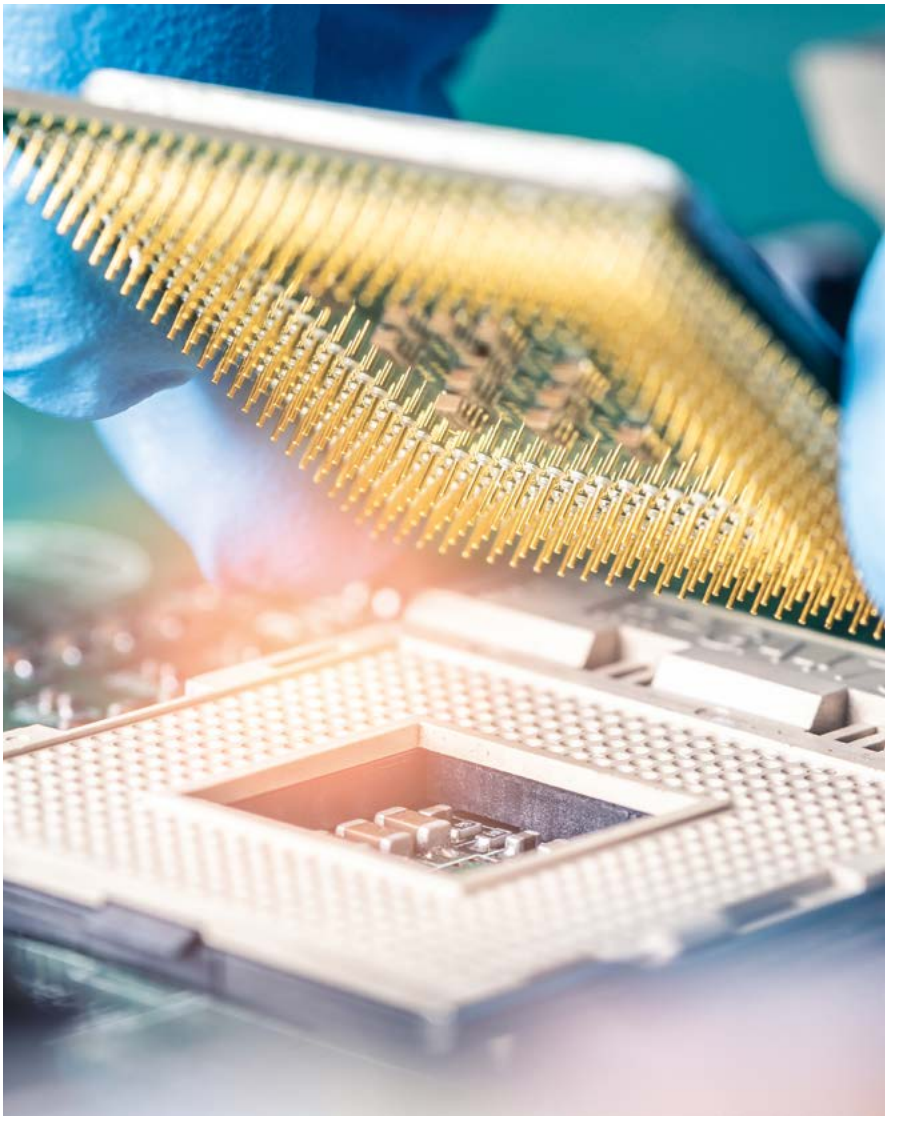
EXCELLENCE IN COPPER

We will benefit from this momentum into the future. Aurubis already fabricates about 1.2 million t of copper cathodes with a purity level of 99.995 %. Thanks to our distinct expertise in recycling, approximately 40 % of these cathodes come from reprocessed copper scrap. And our product range doesn't stop there. In addition to copper cathodes, we offer our customers processed copper in the form of preliminary products such as wire rod, shapes, pre-rolled strip, specialty wire, and alloys. We thus provide a tailored solution for every application. Because progress is based on copper.

19.4

million electric and hybrid cars are projected to be sold in 2025, a market that grows by an average of 24 % each year.

Au 79



CONNECTION

GOLD

is one of the most valuable elements and an important industrial metal.

While gold was once the universal currency for trade and connected thousands of merchants, today it ensures that mountains of data are transferred from one point to the next quickly and securely.

KING OF METALS

With its excellent electrical conductivity and resistance to oxidation, corrosion, and wear, gold displays its strengths everywhere that electric currents or voltage have to be conveyed without losses. It is therefore ideal for high-performance processors, connectors, and electrical resistors.

100 g

of gold are in one ton of old computer circuit boards.

At the same time, gold is a soft metal. It can be easily worked and processed, and its qualities make it highly attractive for many industrial applications. Today, roughly 10 % of all gold resources are found in industrial products such as cell phones and computers. Developments like digitalization and miniaturization increase demand even more.

Apart from its industrial applications, most gold output is used as an investment or is processed to make jewelry. Because the king of metals is so valuable, most of the gold that has ever been produced is thought to still be in circulation. Current global demand for gold is approximately 4,000 t annually. This demand is expected to increase in the coming years, by about 2 % annually.

CERTIFIED SECURITY

We recover gold primarily from copper concentrates and from scrap and industrial residues, mainly e-scrap (including computer circuit boards, cell phones, and electrical devices).

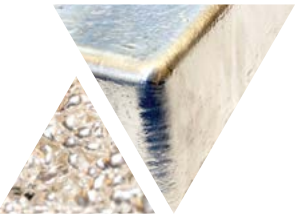
We produce our gold from conflict-free raw materials only. We have been audited accordingly by the London Bullion Market Association (LBMA) for many years and are a certified partner for our customers. Our efforts also qualify us for the smelter and refiner lists of renowned technology companies.

Aurubis produces gold with 99.99 % purity, selling it exclusively to commercial users. Customers in different industries purchase it in the form of granules for electronics and jewelry production, or as bars for the world's safes. Aurubis sold a total of about 48 t of gold in fiscal year 2017/18.

We believe gold has a shining future at Aurubis.

Ag 47

IDENTITY



SILVER
is sold not only as bars, but also as granules. These small pellets can be easily portioned for production.

RFID – these four letters hold great potential for the future. We've all had contact with radio frequency identification devices, for instance in the new personal ID cards. The small chips can be identified without contact, track goods, or open doors. Silver is always part of the equation, as very small silver antennae ensure the necessary transmission range.

THE MOON METAL

Silver has high electrical and thermal conductivity. It is also the whitest metal in general use and reflects 99.5 % of visible light. It is a relatively soft metal at the same time and can therefore be easily shaped. As a result, it is often alloyed with harder metals such as copper. Sterling silver (92.5 % silver and 7.5 % copper) is the standard silver for jewelry.

INDUSTRY 4.0 – IMPOSSIBLE WITHOUT SILVER

Silver is an important catalyst for the future of industry. It is used in new conductor technologies, computers, and household appliances. New markets include wearables, that is, minicomputers worn on the body. The metal is perfect for coating electrical contacts, and the chemical industry needs it as a catalyst for producing antifreeze, polyester, and solvents. Silver is also needed in the growing market of photovoltaics, with one solar cell containing about 120 mg of silver.

Silver is also crucial to Industry 4.0 applications, for instance in automated inventory control systems. Supermarkets of the future, for example, will use RFID systems to identify products in shopping carts, making checkout lines a thing of the past.

7.5 µm

is the thickness of the world's smallest RFID chips. They are referred to as RFID dust or RFID powder.

SILVER AT AURUBIS

Aurubis produces silver at the Hamburg site, recovering it from the anode slime of the copper tankhouse (this process is the same for most metals, with the exception of copper). The recovered silver is then formed into bars or granules with 99.9 % purity. Global silver demand was about 32,000 t in 2017 and is expected to continue growing by approximately 1.5 % in the coming years. Aurubis sold a total of about 877 t of silver in fiscal year 2017/18.

Silver was also key to establishing our identity. The permit that Salomon Beit received from the Hamburg Senate in 1770 to operate a silver separation and smelting furnace laid the foundation for the company that ultimately became Aurubis.

Pb 82

SAFETY

LEAD

is a vital metal for manufacturing starter batteries.

Lead protects and provides a measure of safety in one way or another. Everyone is familiar with the lead aprons used to block x-rays. Protective goggles with lead coating work in a similar way. In construction, lead is used in restoration work to protect roofs and facades. Qualities like good formability and the natural patina it forms, which serves as a type of corrosion protection, qualify the metal for these uses.

LEAD CAUSES THE SPARKS TO FLY

Because of its high density, lead is relatively heavy and is therefore ideal for protecting underwater cables. Thanks to its low melting point, it is often alloyed with tin for soldering technology. Like copper, lead can be almost completely recycled as often as desired without a loss of quality.

By far the most important application for metallic lead is the lead battery, however. About 80 % of the metal's output flows into this area. Compared to other battery technologies, lead batteries are considered very robust and can conduct relatively high voltages. The latter is vital for starter batteries in vehicles.

A RELIABLE WAY TO STORE ENERGY

Global lead consumption rose from 7.3 million t to 11.5 million t between 2004 and 2017. Studies forecast stable demand for the coming years. A key reason for this is that many conventional cars will still be on the roads of tomorrow and will need the reliable technology of lead batteries.

Moreover, the lead battery is set to play an important role in the development of future energy storage solutions for the renewable energies sector, in particular for the photovoltaic industry.

LEAD AS THE IDEAL "METAL COLLECTOR"

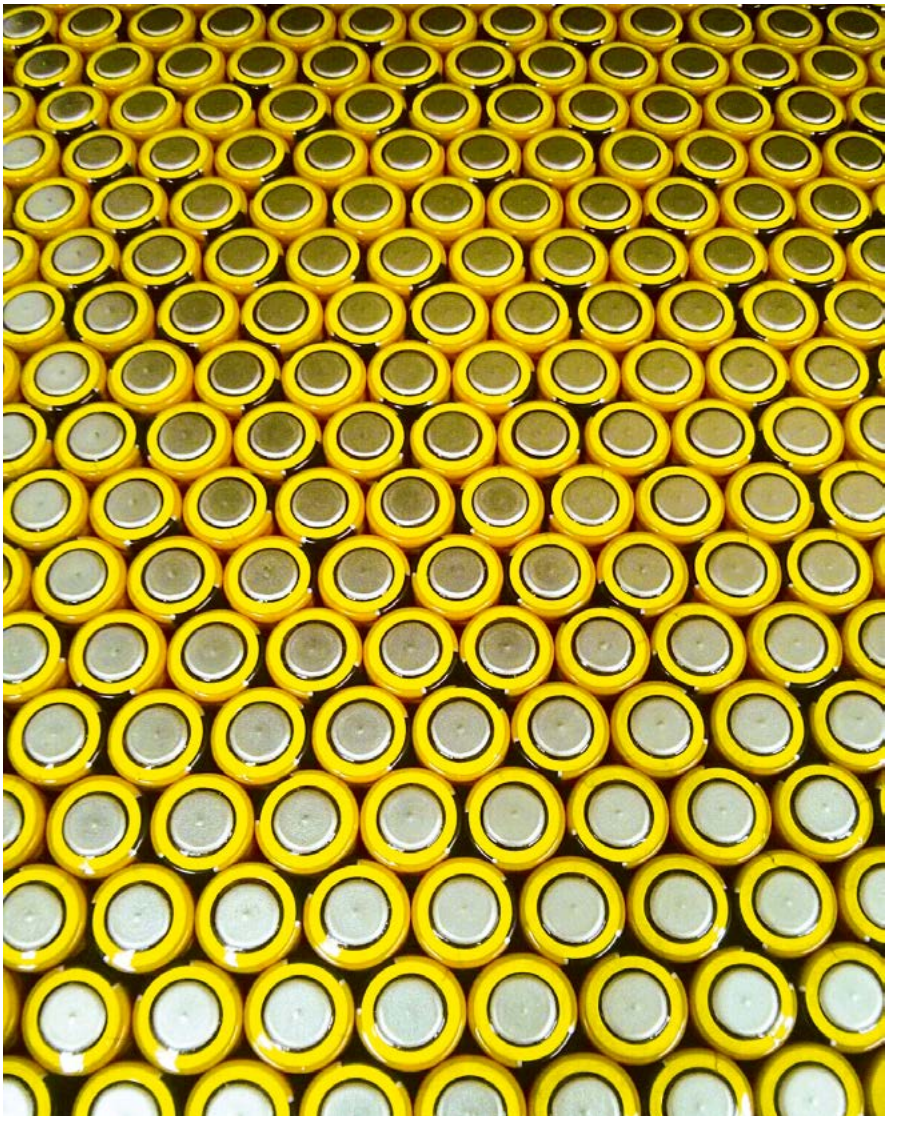
We service this demand at Aurubis by producing high-purity lead, which is 99.985 % pure and is refined from what is referred to as crude lead. We have been audited by the London Bullion Market Association (LBMA) for both lead and gold. Aurubis sold a total of 19,527 t of lead in fiscal year 2017/18.

95 %

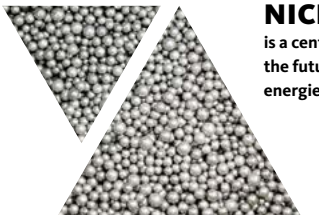
is the recycling rate for rolled lead. Because of its recyclability and its proven lifespan of several centuries, it is a very environmentally sound building material.

Lead is not only produced at Aurubis for its own sake. Just like copper, lead is an ideal "metal collector." In the smelting process, it binds different elements, such as bismuth, antimony, tellurium, silver, and tin, that we can ultimately recover as additional intermediate products. Lead is therefore useful to us on many levels.

Ni 28



ENERGY



NICKEL

is a central success factor for the future trends of renewable energies and electric vehicles.

Energy storage is a game changer for our future – without a storage solution, there will be no energy transition! Nickel and its strengths rise to the challenge.

RESILIENT BY NATURE

Shimmering, silvery-white nickel is a hard, resilient metal. Nevertheless, it can be processed easily and is mostly used in alloys, for example in steel. Thanks to its properties, it protects propellers and pumps against corrosion. As a component in many catalysts, nickel also makes chemical reactions more efficient.

THE CHAMPION OF THE BATTERY AGE

Nickel is crucial in the production of nickel-cadmium (NiCd) batteries and nickel-metal hydride batteries (NiMH), which are ideal for transportable devices due to their low weight.

The energy transition requires additional solutions, however. Ceramic batteries, which store energy at high temperatures, are one of these solutions. Nickel plays an important role in this technology as well, for example in sodium-nickel chloride (NaNiCl) batteries that are also known as ZEBRA (Zero Emission Battery Research Activities) batteries. These are generally used in stationary energy storage, such as energy parks, grids, and self-sustaining buildings, where they enable delayed use of the energy produced.

The significance of nickel is especially apparent in its growth figures. For example, demand for the metal is forecast to increase by an average of 3.5 % per year between 2017 and 2021, and demand for batteries alone is expected to rise by 14 % in the same period.

OUR CONTRIBUTION TO THE ENERGY TRANSITION

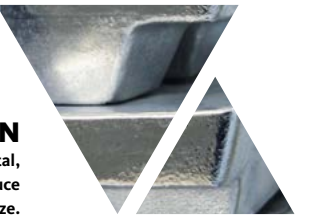
In copper production, the recycling materials and copper concentrate used both contain small amounts of nickel. In the process step that takes place in the copper tankhouse, the nickel remains in the electrolyte, the liquid that flows between anode and cathode. It is continuously removed from the electrolyte as nickel sulfate and then processed into a light green powder through water reduction. In this form, it can't be used directly for applications such as battery manufacture quite yet, but has to be processed further. We are currently working with another company to conduct a feasibility study into producing nickel suitable for batteries. Aurubis sold a total of 3,022 t of nickel in fiscal year 2017/18. Another way we contribute to the energy supply of the future.

12,400

euros was the cost of one ton of nickel on September 30, 2018.

Sn 50

QUALITY



TIN
is an excellent alloy metal, for instance to produce tin plate or bronze.

"Life is too short to drink bad wine," Goethe said. To ensure the quality of those precious drops, bottles of good wine now come with capsules made of tin. The light metal is easily shaped and is ideal for sealing bottles to be nearly airtight. But tin also preserves the quality of cheaper products as well.

TIN IS A FIXTURE IN ALMOST EVERY CUPBOARD

Tin can be easily cut with a knife and rolled into paper-thin foil. Thanks to its good formability and low toxicity, the silvery-white metal is ideal for use in the food sector. About one-third of the global output of corrosion-resistant tin is used to preserve food and drinks. For instance, as an alloy metal, it goes into tin plate for canned goods. Tin is also used to help smooth glass surfaces.

Alloyed with copper, it is vital for the fabrication of (tin) bronze. This has been used in artistic handicrafts for millennia, but also to manufacture turbines and gears.

AN ATTRACTIVE INDUSTRIAL METAL

Tin's low melting point makes it highly attractive to a wide range of industries, in particular to the electronics sector, which accounts for over 50 % of tin currently in use. Here, tin is primarily used for soldering purposes (particularly in soft solders). Tin is also a component of LED flat screens and is used in the chemical industry. Forecasts for the tin market estimate annual volume growth of about 2 % until 2022.

MORE TIN THROUGH RECYCLING

Tin is a minor metal found in our raw materials. We recover it by recycling these materials using resource-efficient, environmentally sound processes in our plant in Lünen (Germany), where we produce tin composite. Our sales of tin amounted to approximately 1,851 t in fiscal year 2017/18. We therefore boost the importance of recycling for the tin supply, as roughly 15 % of tin output comes from secondary sources.

15 %

of the world's tin output comes from recycling.

OUR EXPANDED METAL PORTFOLIO

In addition to our six base metals, we recover further metals from within the categories of platinum group metals and minor metals.

PLATINUM GROUP METALS

Pt 78

PLATINUM

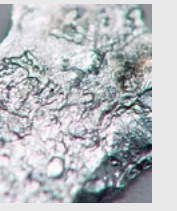
A valuable, shiny, silver-colored precious metal with a high density and formability. Platinum is used in the production of catalysts, jewelry, and fuel cells.

Os 76

OSMIUM

A steel-blue metal with a very high melting point and an extremely high density. Osmium alloys are found in expensive ballpoint pens and medical implants.

Ir 77



IRIDIUM

A very heavy, hard, silvery-white, shiny precious metal with extremely high corrosion resistance. Its alloys are used in surgical instruments and ignition plugs for plane engines.

Ru 44

RUTHENIUM

A hard, brittle, silvery to matte-gray precious metal. It is mainly used in electrical contacts and as a catalyst in chemical processes.

Rh 45

RHODIUM

A silvery, shiny precious metal with high reflectivity. It is frequently used as a catalyst, for instance in vehicles and in the industrial manufacture of basic chemical substances.

Pd 46

PALLADIUM

A silvery, shiny precious metal that is primarily used as a catalyst – in addition to more exotic applications, such as in jewelry or tooth implants.

MINOR METALS

Te 52

TELLURIUM

In its stable form, a brittle metalloid that has a metallic, silvery-white sheen and is not water-soluble. In its pure state, it is used in solar cells, for example.

Re 75

RHENIUM

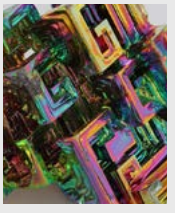
A silvery, shiny, hard metal with a high density. It is included in alloys that are used in aircraft engines and thermal elements, among other things.

Sb 51

ANTIMONY

In its stable form, a brittle, shiny, silver-colored metalloid. It is an important alloying element; for instance, it is alloyed with lead in lead-acid batteries.

Bi 83



BISMUTH

A hard, brittle metal with a crystalline structure. Interferences in a thin oxide layer lead to tempering colors in the metal. Bismuth is used to produce alloys and as a catalyst.

Se 34

SELENIUM

A metalloid with multiple forms. In its most stable form, it is gray and metallic. It is used for electro-optical applications, for example.

WE UTILIZE POTENTIAL

Aurubis is constantly in motion. Currently, for example, we are in the process of implementing a variety of new strategic measures along our value chain. These extend from collaboration with our suppliers, to steps we are taking to help Aurubis produce and work together better and more efficiently, to the way we interact with our customers. We know that Aurubis still has a great deal of untapped potential, and we intend to capitalize on this.

Whether recycling materials or copper concentrate, we see more potential in our raw materials.

Jo Rogiers,
Senior Vice President
Technology

INTERNAL GROWTH PROJECT
FUTURE COMPLEX METALLURGY

Creating more value

When meeting Jo Rogiers for the first time, two things are immediately noticeable: his firm handshake and his positive presence. After this first impression, it is obvious that the tall engineer with over 30 years of industry experience knows what he's talking about – whether in Dutch, French, English, or German. Skills that are exceedingly valuable for the tasks that come his way.

FUTURE
COMPLEX
METALLURGY

Future Complex Metallurgy is the largest internal investment project in the history of Aurubis, with an investment volume of about € 320 million.

THE INDUSTRY IS LOOKING FOR AN ANSWER

Normally, mines draw copper ores from the ground and then concentrate them into a defined mixture that they sell as a "standard concentrate" to smelters. Mine-specific ore deposits are increasingly presenting a challenge for operators because some concentrates exhibit higher volumes of additional materials that are more complex to treat. They don't meet the standard anymore and are referred to as complex concentrates. The processing methods of many copper smelters worldwide aren't designed to handle them. Operators thus have the problem that the concentrates, which are highly valuable in some cases, can't be marketed at all or only with a great deal of effort.

AN IDEAL SOLUTION FOR BOTH SIDES

This is where Jo Rogiers comes in. Together with his team, he is implementing one of the biggest growth projects in Aurubis history: Future Complex Metallurgy, or FCM for short. The native Belgian is clearly proud of the in-house development at Aurubis. "With FCM, we will offer our mine and industry partners the possibility to leverage the value potential from complex input materials in the future," he explains. At the same time, this differentiates Aurubis from its competitors. An ideal solution for both partners.

In that sense, the name FCM says it all. Thanks to an innovative metallurgical process, the company will process even more complex input materials in the future. 270,000 t more per year, to be precise. In addition to complex concentrates, these can also include recycling materials, e-scrap, intermediates from copper, zinc, and lead smelters, and metal-bearing slags and materials containing precious metals.

"This allows us to expand not only our raw material portfolio, but also our position in the raw material market," Rogiers states confidently. Because Aurubis can only process the raw materials necessary for FCM to a limited extent in its existing facilities, the expert doesn't see a risk of a cannibalization effect in the Group. FCM will therefore contribute to the strategic target of doubling the volume of directly supplied complex recycling raw materials in the Aurubis Group by 2022/23 compared to 2016/17.

"Due to the increase in valuable complex input materials used, we will also significantly increase the output quantities of other metals. This supports our multi-metal approach," Rogiers asserts. By fiscal year 2022/23, Aurubis plans to increase sales volumes of non-copper metals by 100 % compared to fiscal year 2016/17.

THE BEST OF BOTH WORLDS

The FCM facilities will be constructed at both the Hamburg (Germany) and Olen (Belgium) sites. For Rogiers, the selection of the sites connects the best of both worlds. In Hamburg, he says, the existing sampling division and wastewater treatment can be expanded and upgraded. For the pyrometallurgical aspect, the company will not only use existing facilities but also expand them in some cases, for instance by adding a bath smelting furnace. Furthermore, the Hamburg plant already has the necessary equipment to produce pure sulfuric acid and precious metals.

Facts and figures: Future Complex Metallurgy project

> 180
Jobs
in Hamburg and Olen

+ € 80 million
EBITDA
starting FY 2022/23

2020/21
Production start-up

On the other hand, the employees in Olen have specialized knowledge about the hydrometallurgical aspect and better possibilities to integrate the process into the existing tankhouse. Rogiers looks forward to the more than 180 new colleagues overall, whom Aurubis will hire at both sites in the course of the project.

Aurubis is investing a total of about € 320 million in the planned facilities, about two-thirds in Hamburg and almost one-third in Olen. Production is scheduled to start in 2020/21. Once in operation, the facilities will contribute approximately € 80 million to the operating result (EBITDA) starting in 2022/23. Another benefit of FCM lies in the shorter throughput time for precious metals, which will eliminate production bottlenecks and reduce working capital. A large part of the investment is financed by these savings alone.

There's still quite a lot of work for Rogiers and his team until the scheduled commissioning of the project in 2020/21. However, one thing stands out to him already: "A flagship project like FCM inspires people and brings them together. Regardless of the site where I hold meetings – in FCM, we all speak the same language."

"Due to the increase in valuable complex input materials used, we will also significantly increase the output quantities of other metals. This supports our multi-metal approach."

JO ROGIERS

~ 4 years

Engineering & construction phase

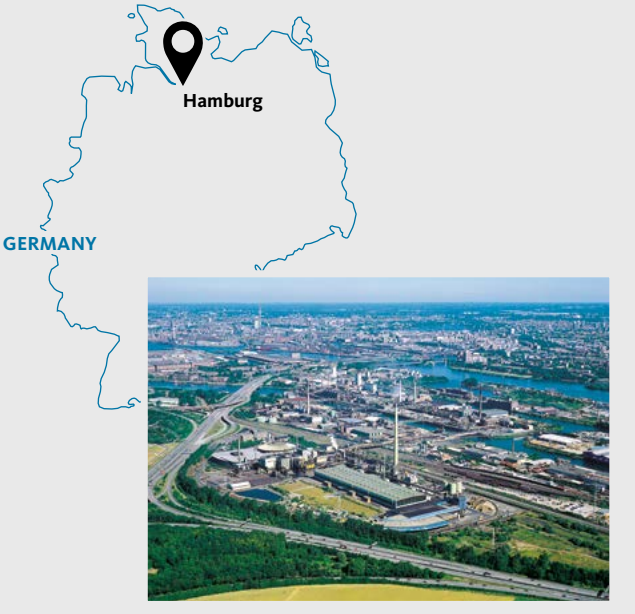
~ € 320 million

Investments

+ 270,000 t

Raw material input

including complex concentrates, recycling materials, and intermediate products



MULTI-METAL RECYCLING AND THE CIRCULAR ECONOMY

Coming full circle

Aurubis processes about 700,000 t of recycling materials every year, and the trend is increasing. The company is the world's largest copper recycler. The input material portfolio is diverse. It extends from production waste such as clean wire scrap, stamping waste, and copper cable, to what are referred to as end-of-life recycling raw materials. These include old gutters, pipes, electronic scrap, and used electrical appliances.

The Aurubis sites in Lünen (Germany) and Olen (Belgium) specialize in recycling these materials. They convert the recycling raw materials, which generally contain copper, into high-purity copper and other valuable metals. Though the primary smelters utilize copper concentrate as their main feed material, they also use copper scrap because it's ideal for process cooling.

Aurubis sources most of its recycling materials from specialized trading companies and businesses focused on collecting and treating such materials. Additionally, more and more copper product customers are becoming direct suppliers as Aurubis takes back production waste from their processing operations. Closing the loop has many other benefits, however.

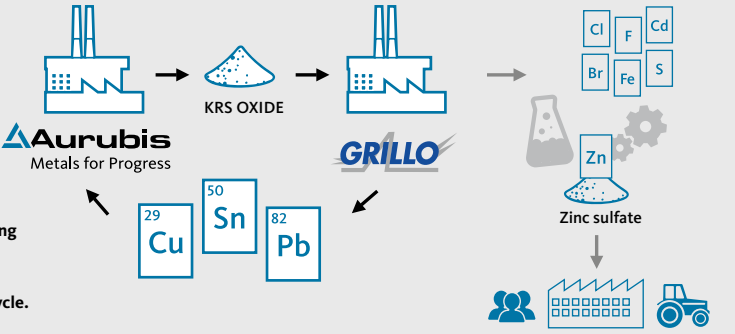
The tonnage of material we recover using closed-loop systems is now in the mid-five-digit range.

Marion Finney,
Executive Director
Customer Scrap Solutions

Interview with Marion Finney

MS. FINNEY, YOU HAVE WORKED WITH THE TOPIC OF RECYCLING IN DIFFERENT POSITIONS FOR OVER 20 YEARS. WHAT MAKES THE CIRCULAR ECONOMY SO EXCITING?

MF: There are a handful of reasons. First, we now recycle so much material that more than every third copper cathode is made completely of recycled material. We do this by flexibly sourcing different recycling raw materials from the value chains of copper and other non-ferrous metals, contributing to a responsible approach to global resources.



Aurubis and Grillo are working together with state-of-the-art technology to achieve a verifiable, closed material cycle.

We of course focus our energy on recycling copper and supplying our facilities. Furthermore, we learn a great deal about product requirements and the recycling materials of the future in our collaboration with our product customers. We stay in continuous dialogue, creating a mutual understanding among different actors in the value chain.

WHAT ARE THESE KINDS OF CYCLES LIKE IN PRACTICE?

MF: A simple example: We offer the customers that we supply with copper products the option to return their production waste to us, most of which contains copper. We monetize this waste by redelivering the copper content in the form of new copper products. A sustainable business concept for both sides! Indeed, the tonnage of material we recover using this method is now in the mid-five-digit range. Our partners include renowned companies like ABB based in Switzerland.

As part of our Sustainability Strategy, we have established the objective of working together with our industrial partners more to develop individual concepts for preventing waste from their production processes or recycling it better. These concepts could be logistical or technical solutions. We are in an ideal position to come up with these kinds of solutions, not least because of our expertise in multi-metal recycling.

CAN YOU BE MORE SPECIFIC?

MF: We will discuss recycling issues with our product customers more intensively in the future. This includes working together on a common understanding of how easily recyclable end products should look. This is referred to as "design for recycling." Both the processing industry and end product manufacturers are exceedingly interested in seeing products at the end of their life cycle being recycled responsibly, in a way that conserves resources. We can even certify this.

DO YOU HAVE AN EXAMPLE OF THE CLOSING-THE-LOOP APPROACH BEYOND COPPER?

MF: Absolutely. There are exciting projects for other metals as well. All of the business and contract concepts we've already described are referred to as closed loops.

One example of a zinc-bearing product comes from our recycling process in Lünen. For our collaboration with Grillo-Werke AG in Duisburg, we even received the Responsible Care prize from the German Chemical Industry Association in 2017.

A zinc-bearing substance we call KRS oxide is formed at our plant and is processed into zinc sulfate at a Grillo plant about 60 km away. The process forms a residue containing copper, tin, and lead that Aurubis takes back. We then use it in our recycling facilities to recover the metals it contains. Thanks to a long-term contract, this collaboration provides a measure of security in both companies' planning process on the one hand and contributes to securing jobs in Lünen and Duisburg on the other. We are thus acting sustainably on multiple levels with this project.

"We unite our expertise with that of our business partners, achieving new, forward-looking solutions and collaboration opportunities in the process."

RESEARCH AND DEVELOPMENT IN THE DIGITAL AGE

Understanding complexity

Our environment is becoming more complex, not least with regard to raw materials, material streams, and electricity demand. In these circumstances, keeping sight of the big picture is an achievement in itself. But only those also able to harness the corresponding developments will be able to create new opportunities from them. Dr. Mario Löbbus is committed to creating order. In addition to material and product research, he forges new paths with his team to bring a semblance of control to this complexity.

ON THE LOOKOUT FOR THE OPTIMUM

Managing one or two smelters might be a straightforward endeavor, but Aurubis has grown in the past few decades to encompass four smelters in different regions of Europe. Aurubis has two primary copper smelters that primarily process concentrates and two secondary copper smelters specialized in processing different recycling materials. They all come with unique challenges. "Our plant network has grown into an interlinked structure," Mario Löbbus points out. "We have to learn how to handle this complexity."

Aurubis pursues several goals at once when it comes to managing its facilities, including shaping the material flow to maximize capacity utilization. This means recovering as much copper and other metals as possible with the existing equipment, among other things. Furthermore, the company is working on improving its ability to process the rising volume of complex raw materials. The objective is to generate the

Dr. Mario Löbbus,
Head of Research,
Development & Innovation

Computer algorithms assist in looking for patterns in Aurubis' production data that help us understand the metallurgical processes better.

greatest possible value from the input materials while also optimizing inventory management and improving operating capital. Mario Löbbus sums it up as follows: "In the end, all of our activities aim to draw the optimum out of our existing smelter network."

A MODEL THAT CAN BE USED AGAIN AND AGAIN

In many manufacturing industries, homogenous input materials are turned into finished products comprising multiple individual elements. In copper production, however, things are the other way around, with the input materials (copper concentrate or recycling materials) comprising numerous elements and the final product, only one: high-purity copper. And with Aurubis' multi-metal approach, the variety of input materials will increase in the future.

In its recycling activities, the company took the first steps to deciphering the complexity of its raw materials many years ago. Aurubis has thus developed a leading position in recycling in the past several years. Today, the company continues to develop its capabilities with respect to the recycling materials of the future. The idea has always been to better understand the different components in the recycling materials, whether copper scrap, electronic scrap, or metal-bearing industrial slag.

The experience gathered from the value-oriented, holistic approach that has been established in the meantime will continue to gain importance with the growth project FCM.

A PIONEERING ROLE IN THE METAL INDUSTRY

As with recycling, Aurubis starts its planning process involving copper concentrates before the raw materials are even purchased. The company incorporates modeling and advanced analytics technologies into planning models. Supply chain models can support decisions along the entire value chain: from the raw material to the cathode to the product. Similar systems are already being used successfully in the chemical industry. In copper production, however, Aurubis assumes a pioneering role with its developments.

Mathematical methods can help derive recommendations for production based on the composition of the different raw materials, technical restrictions, commercial conditions, and current market circumstances. Aurubis therefore enhances the value drawn from a number of different concentrates.

> "We are working on a fully digital value chain that spans raw material purchasing, product delivery, strategic planning, and daily implementation."

This works because the company, as a custom smelter, has the option of varying its input mix. "We mix concentrates with specific compositions from different mines and adjust them to the demands of our production process," Mario Löbbus says. "This allows us to produce a larger volume of in-demand metals at a specific time. In doing so, the diversity of our smelters in the Group network is a huge advantage for us."

DATA MINING IN SMELTERS

To further optimize the input mix and facility management, Mario Löbbus and his team want to make process monitoring and the company's collected data easier to use than before. To that end, more and more sensors are being installed in and on the equipment to take continuous measurements. This, together with the

observations and recordings of production employees and information from the Supply Chain Management division, leads to an extensive data pool. Computer algorithms assist in looking for patterns in this data that help us understand the metallurgical processes better, which contributes to the development of new processes and technologies, such as our FCM project.

Aurubis hopes to derive possible optimization potential and guidance for making decisions from this data and to use it for both strategic planning and operative purposes. "Models and artificial intelligence are limited by the quantity and quality of the data given to help them learn," according to Mario Löbbus. "Data isn't always knowledge. This benefit transfer always requires the interplay between data analysts and metallurgists, technicians, and financial experts."

INTELLIGENT ENERGY DISTRIBUTION

An initial project in energy management at the Hamburg site illustrates how this approach can provide concrete benefits in practice. Artificial intelligence is supposed to improve predictions about when Aurubis and its various production facilities draw a particularly high or low amount of energy from the public energy grid. In the future, preemptive interventions should help prevent peak loads in production scheduling. With active management and planning, the company would also like to reduce the impacts of such interventions on its own production. The next step is for the model to react to energy price fluctuations that come at short notice.

PREDICTIVE MAINTENANCE

Apart from the optimizations already described, one of the highest priorities of a company like Aurubis that relies heavily on its equipment is to avoid production disruptions. The department under Mario Löbbus is researching this area as well, which goes by the term predictive maintenance. For a smelter, an unscheduled disruption in the smelting process generally leads to metal losses. Valuable components such as precious metals remain in the slag and can't be recovered in any meaningful way.
"A scheduled facility shutdown is therefore always better than an unscheduled one," explained Mario Löbbus. "The earlier we identify a weak spot, the more options we have to take action." What sounds futuristic today could be reality in just a few years.

"Predictive maintenance is an exciting approach," Mario Löbbus says. "However, it is just as important that we continue working on maximizing metal recovery and the availability of the facilities. When it comes to metal, we have to be the best."

The top submerged lance furnace for the FCM project is equipped with sensors that record pressure, vibration, temperature, and oscillation, providing a continuous report on the furnace's condition.

EFFICIENCY IMPROVEMENT PROGRAM AND AURUBIS OPERATING SYSTEM

How can we make something good even better?

Dr. Mehdi Al-Radhi, Senior Vice President Transformation & Business Improvement

Aurubis is in the middle of implementing the largest efficiency improvement program in the company's history. Dr. Mehdi Al-Radhi discusses the challenges and the specifics of the program and explains how he turns losses into successes.

MR. AL-RADHI, YOU STARTED AS A CONSULTANT AND THEN BECAME HEAD OF THE EFFICIENCY IMPROVEMENT PROGRAM AT AURUBIS. DRAWING ON YOUR 25 YEARS OF INDUSTRY EXPERIENCE, WHAT CHALLENGES DOES THIS TYPE OF PROGRAM HOLD?

MAR: The crux is that it has to enable both short-term and medium-term success while also making a sustainable impact. This requires management that clearly takes on responsibility for the program and, at the same time, is capable of making employees excited about the coming changes. When a company like Aurubis is successful and achieves healthy results, this strength also translates into the risk of becoming too comfortable. Everyone is familiar with this effect in their personal lives. Questioning the status quo and leaving our comfort zones – this is a huge challenge. This is exactly what our efficiency improvement program addresses so that Aurubis doesn't just maintain its leading market positions, but continues to expand them.

WHAT MAKES AURUBIS' EFFICIENCY IMPROVEMENT PROGRAM SPECIAL, IN YOUR OPINION?

MAR: To state it simply, we're tackling the relevant issues from two sides – from above and below. To determine the company's individual potential for improvement, Aurubis underwent a diagnostic phase in the entire Group from mid- to late 2016. On this basis, we defined the financial target of gradually generating total project success of € 200 million between 2016/17 and 2019/20, compared with the base year 2014/15.

The Executive Board has initiated and driven a number of smaller and larger measures that contribute to this success. In addition to this top-down program, we have taken a great deal of time to implement a second optimization program, our Aurubis Operating System, or AOS for short.

WHERE DO YOU STAND IN 2017/18 IN TERMS OF IMPLEMENTATION?

MAR: With our top-down program, we have achieved a total of more than € 60 million in project success in this fiscal year and the previous fiscal year combined. We're therefore fully on schedule. Thanks to foresight in our planning process, we know precisely what improvements we will introduce next year.

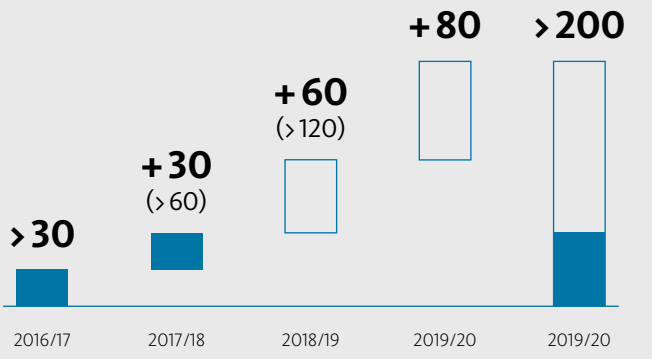
AND WHAT WILL THOSE BE?

MAR: We'll be standardizing processes more strongly than before, for example, and initiating established methods within the entire Group to learn from each other even better. To us, process optimization means that we avoid bottlenecks or redundant work, among other disruptions. Moreover, we want to make the shift handovers as smooth as possible. As a company highly dependent on its equipment, we are focused on continuously improving our maintenance measures. At the same time, we are automating routine tasks and working on harmonizing IT infrastructure across the Group.

A LOT OF PROJECTS ARE UNDERWAY AT THE SAME TIME! HOW DO YOU HANDLE EVERYTHING AT ONCE?

MAR: We have put a high priority on establishing an internal organization that supports this change process. We now have 15 internal consultants overseeing the different projects and assisting our colleagues on site. They provide support across all aspects of a specific measure, from the initial idea through to the launch phase. After all, people often underestimate how crucial the implementation phase is. This mistake doesn't happen to us.

Project target of € 30 million for fiscal year 2017/18 achieved.
in € million, base year 2014/15



> "With our efficiency improvement program, we have achieved a total of more than € 60 million in project success in this fiscal year and the previous fiscal year combined."
>
> **DR. MEHDI AL-RADHI**

Moreover, to maximize the success of our projects, we use a special controlling system that allows us to track project implementation almost in real time. More important than sheer numbers, though, is that we remain in continuous dialogue with the highest level of management about the change process, and that we make immediate adjustments when necessary.

One further distinguishing feature of our program is that it doesn't involve any staff cuts! Aurubis is in growth mode, after all.

WILL AOS ALSO CONTRIBUTE TO INCREASING REVENUES?

MAR: Absolutely. AOS is our system for continuous improvement, tailored to Aurubis' specific needs. It was introduced in 2017 with the goal of ensuring ongoing improvements in results, even after we have fully implemented the € 200 million planned for the efficiency improvement program.

With AOS, we are thoroughly analyzing our company to uncover operating losses in order to eliminate them. To that end, we are empowering employees, across all divisions and hierarchies in the organization, to take on an added measure of responsibility for their own conduct and activities. This includes a distinctive error and feedback culture, which is particularly important when it comes to the topic of accident prevention, one of our highest priorities. We want to improve a little more each day.

From a financial standpoint, we plan to at least balance out the inflation trend in the medium term through AOS. Only the combination of the two programs will make our success sustainable.

AOS HAS BEEN INTRODUCED AT DIFFERENT PRODUCTION SITES SINCE 2017. HOW HAS YOUR INITIAL EXPERIENCE BEEN?

MAR: It's been very good so far! I've observed that AOS motivates colleagues to work on solutions actively and independently, to communicate with each other more, and not just to follow standard processes.

From that perspective, AOS is changing the way we work together in the Group.

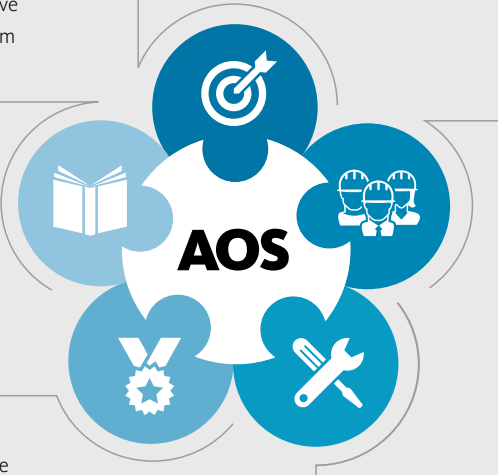
By forming working groups made up of experienced employees on-site and internal consultants, we also benefit from knowledge transfer.

We carry out Pareto and source analyses with the collected data at different levels to identify the biggest sources of loss in detail. We systematically work to stem these negative influences until production is stable again.

Personally, I'm so confident about this program that I really look forward to implementing it not as a consultant, but as a full-fledged Aurubis employee.

Aurubis Operating System (AOS) – production sector example

Management system to achieve continuous and sustainable process improvement.
In addition to this example for the production sector, AOS is adjusted and applied in the supporting administrative functions (transversals).



Focus Improvement

We are creating loss-free production and drawing the best out of our facilities and processes by concentrating on areas with high optimization potential in accordance with the Pareto principle.

Training & Education

All of our employees receive the necessary qualifications so that we can achieve high flexibility and avoid losses from qualification gaps.

Independent Production Teams

We want to produce in the safest and best facilities. Each employee assumes responsibility for products, production equipment, and the production environment.

Progressive Quality

We want to continue improving the management and monitoring of technical processes and facilities in our production sector to ensure a smooth production process with optimal effort.

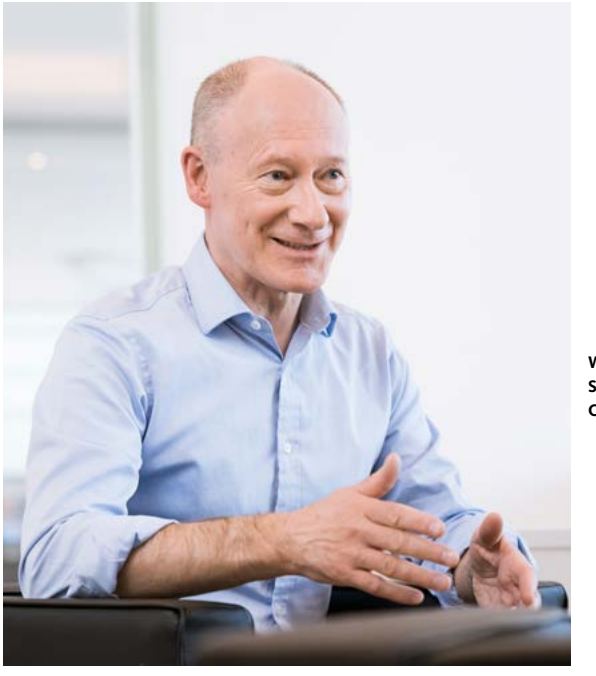
Maintenance Program

Ensuring, with cost awareness, disruption-free operation as a first-choice technical partner. We want to continue developing towards scheduled, predictive maintenance in the future.

EXTERNAL GROWTH OPPORTUNITIES

The multi-metal approach gives us options

At Aurubis, we have our sights set on further – internal and external – growth. Not only are we pursuing internal growth through our FCM project, we are also looking intensively at ways of further driving external growth. With sensible acquisitions, we want to reinforce our business model from the outside as well. A prime example is the acquisition of the 40 % share of Deutsche Giessdraht (Emmerich) previously held by Codelco Kupferhandel GmbH. This strengthens our market position and creates additional synergies.



William Scotting, Senior Vice President Corporate Development

MR. SCOTTING, WHERE DO YOU SEE THE MOST ATTRACTIVE GROWTH OPPORTUNITIES FOR AURUBIS?

WS: We are gradually developing from a copper producer into a multi-metal processor. This offers a variety of possibilities for internal and external growth alike. With our main metal, copper, we are already positioned in areas of future growth. For example, electric vehicles, digitalization, and urbanization are just three of the big trends from which we will benefit to an even greater extent as time goes on. Furthermore, increasingly complex raw materials should allow us to provide solutions to our business partners and extract more valuable elements in the future. This opens up new opportunities for us.

IN WHAT AREAS COULD GROWTH THROUGH PARTNERSHIPS OR ACQUISITIONS BE CONSIDERED?

WS: There are a number of opportunities along our flow sheet to add value in a sensible way. We see interesting options in multi-metal recycling in particular, especially given the rising interest in matters of sustainability. As the world's largest recycler, we already have a great deal of internal expertise and a leading market position that we would like to expand.

WHAT ARE YOUR ACQUISITION CRITERIA?

WS: Aurubis has its roots in Hamburg, and we maintain a pragmatic, Hanseatic approach in M&A topics as well. As such, we want each of our acquisitions to create value, enhance our sustainability, and contribute to our multi-metal strategy. We should also understand the risks involved and how to mitigate these. Geopolitically, this means that we favor regions that are fundamentally politically stable. Aurubis thinks in the long term and therefore needs the security to be able to plan. A stable energy supply is highly relevant to us in this regard. Last but not least, there's the question of logistics: We consider companies that could be easily integrated into our existing network of Group companies to be especially interesting.

IS AURUBIS CAPABLE OF INTEGRATING LARGER COMPANIES AS WELL?

WS: I think that taking a look at our plant in Bulgaria clearly answers this question. Acquired in 2008, the smelter is now one of the most modern in Europe. Thanks to the latest capacity optimization, Pirdop now even has a higher concentrate throughput than the parent plant in Hamburg. At the same time, our Bulgarian plant is one of the most environmentally friendly in the world, and it fulfills our high profitability requirements, making it a real M&A success story. It illustrates well that we can transfer our expertise and our skills within the Group, enabling organic growth. Together with additional acquisitions that we've made in the past, such as the recycling specialist Hüttenwerke Kayser in Lünen, our plants in Olen and Avellino, and the very recent acquisition of Deutsche Giessdraht, we have created a highly efficient and integrated setup in the Group.

SO WHAT TRANSACTION SIZES ARE FEASIBLE?

WS: As a virtually debt-free company, we could incur debt up to three times our EBITDA, generally speaking, without violating any bank restrictions. This gives us a comfortable scope. However, we are more likely to make smaller to medium-sized acquisitions, as opposed to a large transaction. Whether this is successful or not depends on many factors, not least the appraisal of the object of purchase in question. Another very important factor for the success of an M&A transaction is that the parties involved are committed to forging reliable, long-term partnerships. And this is certainly true of Aurubis.

WILL YOU BE DEVELOPING INTO MORE OF A SOLUTION PROVIDER IN THE FUTURE?

WS: Absolutely. With FCM, we are already breaking new ground and clearly positioning ourselves as a preferred partner for our mine suppliers, recycling material suppliers, and industrial suppliers when it comes to complex input materials. There is still a lot more potential in these partnerships, especially when we're talking about metallurgy and processing issues, areas where we can contribute our know-how. Incidentally, this also increases the likelihood of successful financing of a mine. When it comes to solutions on the recycling side, our partnerships to close the material cycle come to mind in particular. In this way, we enable valuable natural resources to be used over and over again. And that's good for all of us in the end.

The Deutsche Giessdraht GmbH plant in Emmerich am Rhein.

Full acquisition of Deutsche Giessdraht GmbH

In 2018, we acquired the remaining shares of Deutsche Giessdraht GmbH from Codelco Kupferhandel GmbH. The acquisition is part of our strategic reorientation and aligns with our intention to position our products in industries of the future. With this step, we are adjusting our rod capacity to our rising production of copper cathodes, the preliminary product for rod. Together with the other rod plants, we are also enhancing our delivery reliability. Our product dg-RheinRod™ is a rod brand that fulfills the highest standards of drawability and surface quality.

Ulf Gehrckens,
Senior Vice President
Corporate Energy & Climate Affairs

ENERGY EFFICIENCY AND CLIMATE PROTECTION

No copper without energy – no energy without copper

Producing pure metals requires energy. In some cases, energy is already in our raw materials, for example, as sulfur in copper concentrate. The rest has to come from elsewhere. But energy isn't free; it usually has to be produced at the expense of other raw materials, which often leads to CO_2 emissions.

As an energy-intensive company, we are aware of our responsibility to handle valuable resources with special care. At the same time, the metals Aurubis produces make environmental developments like electric vehicles and electricity from renewables possible in the first place. Metals therefore make a considerable contribution to technologies that improve the CO_2 balance.

MR. GEHRCKENS, WHAT ARE THE BIGGEST CHALLENGES AT AURUBIS WHEN IT COMES TO THE TOPIC OF ENERGY?

UG: Without a doubt, legal regulations are often at the top of the agenda. The list of issues is broad and extends from CO_2 cost relief and the renewable energy levy to grid charges. As a production company located in Europe and the US and employing almost 6,700 people, we follow the discussions on energy and climate issues. We track them at the political level in both Berlin and Brussels.

FROM AN ENERGY POLICY PERSPECTIVE, IS IT BENEFICIAL THAT YOU ARE SO STRONGLY REPRESENTED IN EUROPE?

UG: We don't think about the situation in that way. We produce in Europe first and foremost. Our key sales markets are here and we are committed to this location!

Nevertheless, our main product – copper cathodes – is a globally traded commodity, the price of which is fixed on the metal exchanges. This price is guided by the law of supply and demand. This means that we can't pass on higher energy costs that might be specific to the region to our customers through the product price. If our production costs in Germany increase disproportionately due to artificially established levies related to the energy transition, this weakens our competitive position compared to the rest of the world. We have to deal with this.

AND HOW?

UG: We want to steadily become more energy-efficient while maintaining high environmental protection standards, which

is why we invest in large and small energy efficiency and environmental protection projects.

Aurubis' smelters are among the cleanest in the world, with the lowest emissions to the environment compared to our competitors. That doesn't just happen. We have invested over € 560 million in environmental protection since 2000. Moreover, we use modern, energy-efficient plant technology at all of our production sites and across all of our business processes.

Wherever possible, we also establish energy cycles to boost our efficiency. For instance, at the Lünen site we introduced a highly efficient process to generate electricity from waste heat and to use it for internal process heat.

The truth is, though, the more steps that have already been taken in energy efficiency, the more challenging it is to achieve additional optimizations.

DO YOU ALSO USE ELECTRICITY FROM RENEWABLE ENERGIES?

UG: Generally speaking, we'd like to. Unfortunately, we are faced with the challenge that the use of these energies is affected by fluctuations in the energy supply. Our production processes require a constant energy supply, due in part to our energy efficiency measures.

We are working on initiatives to utilize renewable energies, however. One of these is the NEW 4.0 project. The idea of this nationwide project in Germany is to make the electricity feed-in from renewables more flexible so as to be able to react to fluctuating availability.

We're planning an electrode steam boiler for this purpose, which will help us draw crucial steam from electricity, reducing our gas consumption and thus improving our CO_2 balance. We will enhance our flexibility with respect to input materials at the same time.

ARE THERE AREAS WHERE AURUBIS IS AN ENERGY PRODUCER?

UG: We are taking a close look at all types of waste heat from our processes. Many of them are already used to supply heat and process steam, and in some cases to produce electricity internally. In Hamburg, we obtain 87 % of our process steam needs from waste heat. But we see more potential in this area.

We sometimes produce excess energy that we can't use effectively ourselves. One example is the Industrial Heat project, which is close to my heart. This project involves extracting heat that we otherwise wouldn't be able to fully use and making it available to the community.

We therefore prevent 20,000 t of CO_2 per year. For a comparison, this is equivalent to the emissions of about 10,000 mid-range cars driving 12,000 km per year. And we have the potential to extract three times that amount of heat. By replacing other energy sources, we could prevent a total of 140,000 t of CO_2 emissions each year. This is equivalent to the level that Hamburg industry established as a reduction target in a voluntary agreement. To leverage this potential, it would be helpful if carbon certificates were allocated under the EU emissions trading system for these kinds of CO_2 reductions that are achieved outside of the plant.

Facts about the Industrial Heat project

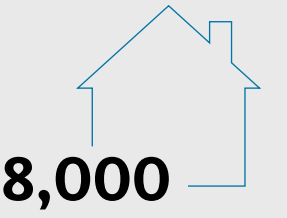
Long pipelines

The pipeline connection from the heat source to HafenCity East is about 3.7 km long.

Hamburg's Köhlbrand Bridge is nearly the same length.

Providing heat

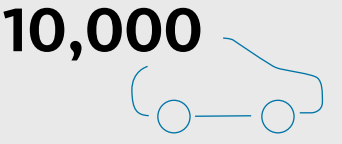
The heat volume of 160 million kWh can supply a total of 8,000 four-person households for about a year.



The total available potential could cover 25,000 households.

Protecting the climate

The Industrial Heat project prevents 20,000 t of CO_2. This is equivalent to the emissions of 10,000 mid-range cars driving 12,000 km per year.

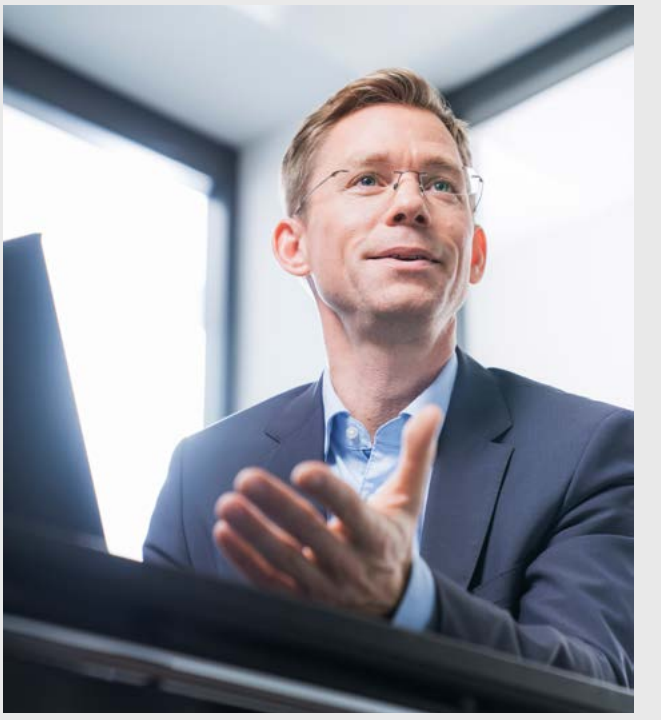


If the full potential is utilized, CO_2 emissions could even be reduced by about 140,000 t.

Conserving water

The adjustment to the acid cooling facility saves 12 million m³ of cooling water and Elbe River water annually.

This is equivalent to the volume of around 4,800 Olympic-size swimming pools.



Christian Hein,
Director Corporate Energy & Climate Affairs and Manager of the Industrial Heat Project

MR. HEIN, WHAT DO YOU FIND EXCITING ABOUT THE INDUSTRIAL HEAT PROJECT?

CH: The great thing is that everyone benefits from it. The residents of HafenCity East are supplied with sustainable heat, the city receives a contribution to its climate goals, and we direct our excess process heat to a meaningful purpose.

We are also a business, of course. The investment of roughly € 20 million has to pay off accordingly – and it does.

HOW DOES THE HEAT GET TO HAFENCITY?

CH: It is formed in a sub-process of copper production: The sulfur in the copper concentrates is processed as sulfur dioxide and then converted into sulfuric acid in what we refer to as the contact acid plant. We transfer the heat formed in an exothermic chemical reaction from our plant in Hamburg to the energy service company enercity via a new, nearly 4-km-long pipeline. In turn, this company supplies HafenCity East with the heat.

AND HOW EXACTLY DOES THIS PREVENT CO_2?

CH: From the start, the Industrial Heat that forms is nearly free of CO_2. We can use about 25 % of the heat for internal purposes. About half of the more than 20,000 t of CO_2 per year is prevented because we use less natural gas to produce steam. The other half comes from beyond the plant boundaries, specifically from the supply of external heat that replaces the conventional fuels used to generate district heating. On top of this, we save 12 million m³ of cooling water from the Elbe River each year.

WHAT MAKES THE PROJECT SPECIAL FROM A TECHNICAL PERSPECTIVE?

CH: Usually, industrial heat is kept at its original temperature and processed via heat exchangers. We go one step further: Our sulfuric acid process is adjusted to run at a much higher temperature – 117 °C instead of 65 °C, making the heat ideal for internal and external heating purposes. All without the use of fossil fuels and thus without CO_2 emissions.

HOW WAS THE PROJECT RECEIVED OUTSIDE OF THE COMPANY?

CH: It was remarkable. In its size and complexity, the Industrial Heat project is unique in Germany. This is evident in the interest shown by those inside and outside of Aurubis.

The German Energy Agency, dena, awarded the project two prizes: one for being one of ten examples of Flagships of Energy-Efficient Waste Heat Use, as well as the Energy Efficiency Award in the category Energy Transition 2.0. The Hamburg Renewable Energies Cluster also gave the project the German Renewables Award in the category Project of the Year 2018. For me personally, the Industrial Heat example is the ideal symbiosis of ecological responsibility and entrepreneurship – to the benefit of many.

SUSTAINABLE INVOLVEMENT

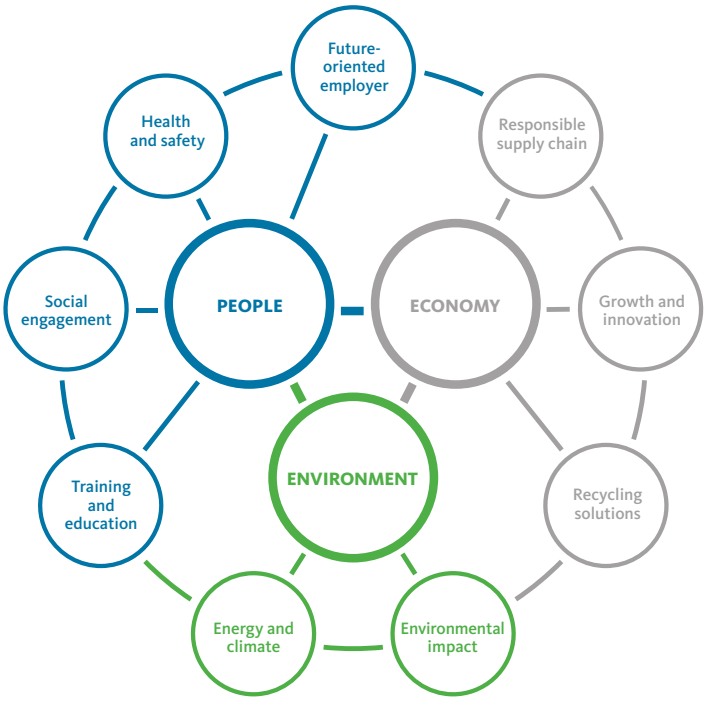
For Aurubis, business success and responsible conduct go hand in hand

Kirsten Kück,
Sustainability Manager

Hamburg Central Station, 6:30 a.m. Kirsten Kück, Sustainability Manager at Aurubis, waits for her train. She is on her way to a meeting with industry representatives. The topic of today's discussion: sustainably sourcing and responsibly processing raw materials. She looks forward to the meeting despite the early start because these talks demonstrate the rising interest among a variety of business partners in the many facets of Aurubis' sustainability activities. Apart from associations, NGOs, and the media, this dialogue increasingly involves investors, customers, and suppliers as well. It's clear to the Sustainability Manager that a company like Aurubis has stronger competitive advantages when it acts responsibly and is known for this. Kirsten Kück has a lot to talk about.

OUR STRATEGY FOR MORE SUSTAINABILITY

Aurubis revised its Sustainability Strategy in 2018 and established new targets to be achieved by 2023. The Sustainability Strategy is part of the Aurubis corporate strategy. It comprises the three areas of people, the environment, and the economy. These are then broken down into different sub-topics based on focus. The targets vary extensively, from increasing input of complex secondary raw materials to enhancing energy efficiency and reducing CO_2 emissions, as well as



The Sustainability Strategy is broken down into different sub-topics in the three focus areas of people, the environment, and the economy.

developing closed-loop systems. Nine targets were defined in total, which are in turn broken down into 27 measures. Aurubis' objective with the targets is to expand its position as one of the world's most environmentally friendly and energy-efficient copper smelters.

The topic of responsible sourcing is especially close to the Sustainability Manager's heart. She knows that responsibility doesn't end at the plant gates. If a company wants to be seen as a good neighbor or a reliable partner, it has to do its part. At Aurubis, this means continuing to manage its supply chains responsibly, together with the entire sector. It's possible to implement uniformly high standards in social and environmental issues and anti-corruption in the entire supply chain, but only with a joint effort.

The Aurubis mission "Responsibly transforming raw materials into value to provide metals for an innovative world" was the basis for the new Sustainability Strategy. Aurubis is keen on highlighting its sustainability activities, especially as an energy-intensive company in the basic materials industry. The Group will continue to source raw materials from around the globe, both primary materials from mines and secondary materials from a wide range of recycling sources. Within the scope of the current Group strategy, Aurubis hopes to expand its multi-metal recycling in particular – for an even greater contribution to the circular economy.

A SHARED UNDERSTANDING

The new Sustainability Strategy is a joint achievement, having been developed by thirty employees from various departments, among them Accounting, different operating divisions, and the Works Council. Kirsten Kück enjoys this integrative aspect of her work. In her opinion, promoting sustainability requires close cooperation across departments. After all, only through teamwork can a shared understanding of what sustainability is be established and advanced.

Aurubis has systematically structured and expanded its sustainability activities in the past several years. Its involvement started with the first Sustainability Strategy in 2013 and continued with the steady expansion of reporting and participation in different rankings and initiatives such as CDP Climate Change, ISS oekom, and EcoVadis.

For Kirsten Kück, the day ends where it started: in Hamburg. The meeting was intense but constructive. Although the day wore her out, she's happy that the topic of sustainability is developing into a recurring point on the agenda in her dialogue with industry partners in Aurubis' value chain.

“Multi-metal recycling makes an important contribution to the circular economy and resource conservation.”

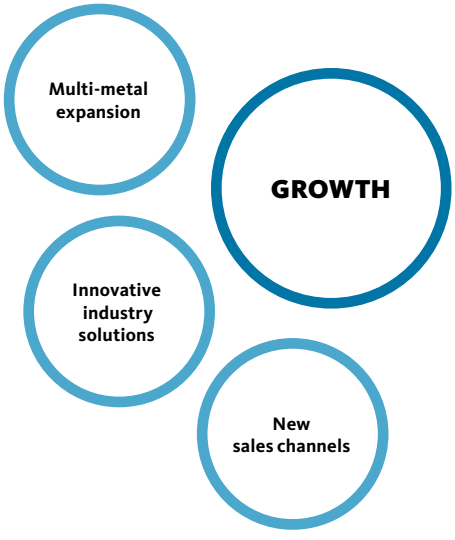
KIRSTEN KÜCK

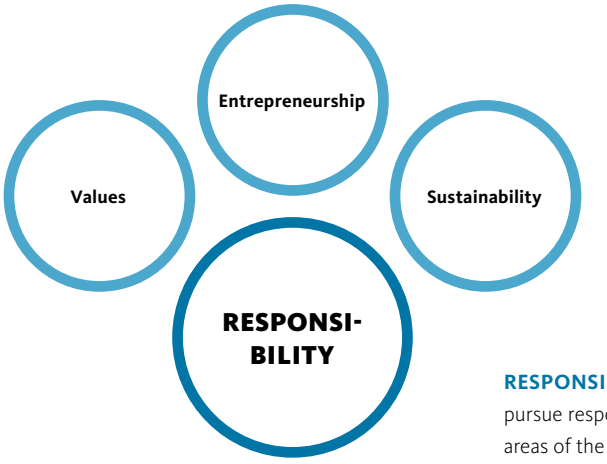
The Aurubis site in Lünen alone processes more than 100,000 t of secondary raw materials from electrical and electronic scrap each year.

ONE STRATEGY

We developed a new strategy as part of our Vision 2025. It comprises three focus areas: Growth, Efficiency, and Responsibility. On the one hand, we want this strategy to strengthen our leading position in the standard copper business through structural optimizations and high cost competitiveness. On the other hand, we want to press ahead with the expansion of the multi-metal business using our well-developed process expertise and metallurgical expertise, as well as innovative industrial solutions.

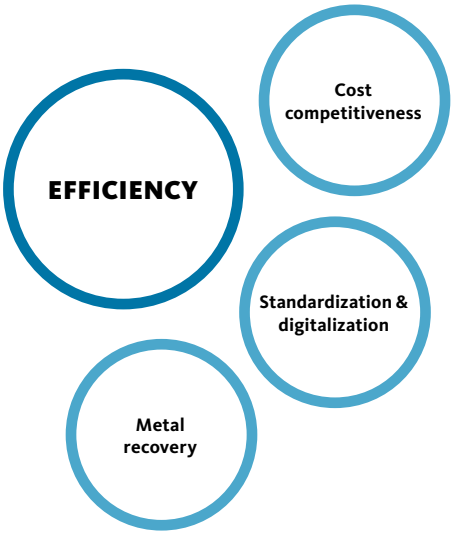
GROWTH We are pursuing the goal of growth, both internal and external. Our important internal growth project Future Complex Metallurgy (FCM) embodies the multi-metal approach. With this and other projects, we would like to increase sales volumes of all non-copper metals and use more complex concentrates. In addition to internal growth, we want to strengthen ourselves with appropriate external acquisitions.





RESPONSIBILITY As part of our Sustainability Strategy, we will pursue responsible targets in order to remain a leader in the three areas of the economy, the environment, and people. We have set new, ambitious sustainability targets for this purpose. We want to remain one of the cleanest copper smelters in the world, with the highest employee safety standards.

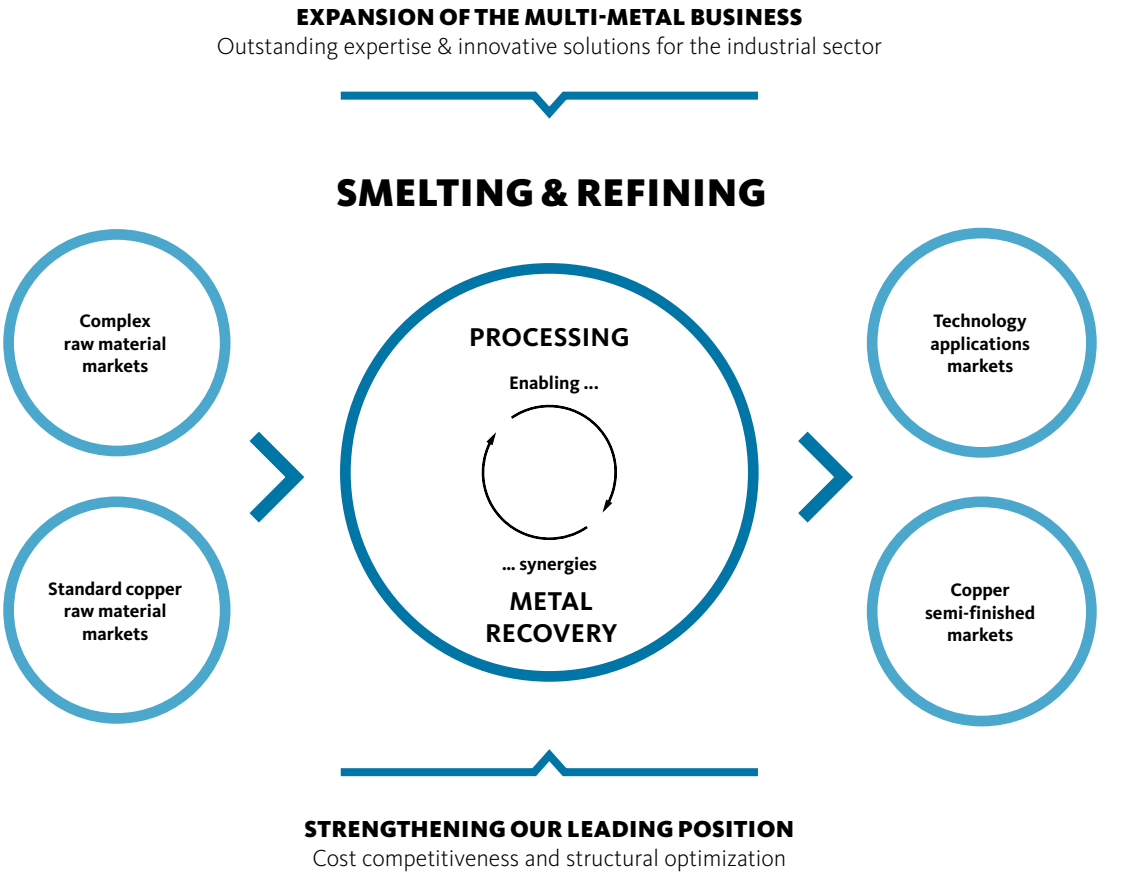
AURUBIS STRATEGY



In the area of **EFFICIENCY**, we focus on the standard copper business in particular. Here, we are focused on standardizing core processes, automating production, and implementing projects in the area of digitalization, among other topics. Taken as a whole, all efficiency measures are expected to yield project success of € 200 million by fiscal year 2019/20 (including Segment Flat Rolled Products). All divisions are contributing to this, from production to corporate divisions.

MORE METALS

We are developing our business model by reinforcing the copper business and expanding multi-metal solutions.



In the future, we intend to extract other metals in addition to copper from systematically purchased raw materials and intermediate products and then process them into marketable value-added products.

A MULTI-METAL FOCUS

As an integrated group, we process complex metal concentrates, scrap metals, and metal-bearing recycling materials into metals of the highest purity. In accordance with our Vision 2025, we will consistently expand our current business model, which is focused on copper, to encompass a broader multi-metal approach in the future.

We intend to extract other metals in addition to copper from systematically purchased raw materials and intermediate products and then process them into marketable value-added products. In addition to our main metal, copper, our metal portfolio also includes gold, silver, lead, nickel, tin,
minor metals such as tellurium and selenium, and platinum group metals.

SUCCESS FACTORS OF OUR EXPANDED BUSINESS MODEL

We process copper concentrates, which are offered by mining companies and trading companies on the global market. Normally, mines draw copper ores from the ground, concentrate them, and sell the result as a "standard concentrate" to smelters. However, ore deposits unique to certain mines are presenting more and more challenges to mine operators. Some copper concentrates exhibit higher volumes of additional materials that are more difficult to treat and are no longer considered standard. These are referred to as complex concentrates.

Apart from copper concentrates, we also use copper scrap and other metal-bearing recycling materials with different compositions, as well as bought-in intermediates, as feed material. Rising complexity plays an important role in this area as well.

Our expanded business model enables us to better exploit the potential in our metals. Copper concentrate is unique in that it has the highest number of valuable

"tramp elements" accompanying it in comparison to other base metals. These elements function as "metal collectors" and therefore hold considerable potential with regard to our multi-metal strategy. We combine this with our extensive expertise in processing and recovering metal from standard and complex concentrates, as well as from a wide range of recycling materials.

Through innovative metallurgical processes like our FCM project, we are in a position to process even complex material combinations of different origins to increase their value. This differentiates us from many other international competitors from the smelter industry. Our standard business based on copper raw materials therefore taps into synergies to recover additional metals of the future while adding value.

Apart from our copper semi-finished product markets, we will supply more of our metals to technology markets in the hopes of benefiting from their growing momentum.

We produced about 774,000 t of copper wire rod in 2017/18, or 8 % more than the year before.

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The language used in this Annual Report is intended to be gender-inclusive.

2.52 million t

CONCENTRATE THROUGHPUT

1.16 million t

COPPER CATHODE OUTPUT

~ 700,000 t

RECYCLING MATERIALS

20,000 t

CO_2 REDUCTION

annually thanks to the Industrial Heat project

€ 329 m

EBT

(operating)

14.8 %

ROCE

(operating)

33

SITES

worldwide

6,673

EMPLOYEES