



SUSTAINABILITY REPORT 2023





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FOREWORD

SUSTAINABILITY CONCERNS US ALL!

Welcome to LOESCHE's third Sustainability Report, proudly published on a voluntary basis. While regulatory authorities have granted us a grace period before mandatory compliance with the Corporate Sustainability Reporting Directive (CSRD), sustainability remains a cornerstone of our corporate philosophy. For years, sustainability has guided the evolution of our products, supported our customers in achieving their goals, and shaped our everyday practices—whether in offices or on construction sites.

Our Sustainability Team, comprised of passionate employees from all departments and the works council, is dedicated to advancing ESG (Environmental, Social, and Governance) initiatives. Together, we are preparing for the complex demands of CSRD compliance by developing robust internal processes and reporting structures. At the same time, we reflect critically on our own actions, taking concrete steps to reduce our ecological and social footprint. For example, we carefully evaluate the necessity of business flights, often opting for virtual meetings as a sustainable alternative. Additionally, we actively promote and support social activities across the company. Read more about this in this report!

Through focused communication and awareness-building, we have sharpened our understanding of ESG and identified areas for meaningful improvement. One key area of focus is gender equality, where we see substantial opportunities for progress within our organization.

Sustainability is not just a concept for us - it's a mindset.

From cycling to work to innovating our products for greater efficiency and resource conservation, we are driven by a shared determination to create positive change. At LOESCHE, we fully embrace our responsibility and approach future challenges with confidence.

Together, we are committed to making a lasting impact!

Dr. Regina Krammer

Sr. Manager for Knowledge Management, Communication & Sustainability
Member of the LOESCHE Works Council



OUR COMPANY

OUR CORE COMPETENCIES

LOESCHE's core competencies revolve around the development and design of customized concepts for dry-grinding plants featuring vertical roller mills. LOESCHE's extensive expertise and product range find applications in diverse industries, encompassing cement, metallurgy, power generation, as well as the mining and minerals sector.

Originating as a mill manufacturer over a century ago, this family-owned company has evolved into a renowned provider of innovative and sustainable solutions. In particular, over the past 25 years, the responsible utilization of resources and the sustainable integration of industrial by-products have assumed paramount significance in the battle against climate change and the reduction of carbon dioxide (CO₂) emissions within the industry.

For LOESCHE, reducing CO₂ emissions and the production of cement composites have ascended in importance. We are actively engaged in extensive research areas related to sustainable building materials. This includes endeavors such as concrete recycling, the utilization of steel slag as a supplementary cementitious material (SCM), and the creation of ultra-fine materials. Collaborating with our subsidiary, Dynamis, we have successfully developed and implemented solutions for the production of calcined clay.

To counteract climate change, all industries, especially the cement industry must go out of its way to drastically reduce their CO₂ footprint. LOESCHE develops technologies that optimize the production process, save energy, and reduce emissions. In the coming years, we will continue to research and develop

technologies and bring innovative concepts to industrial maturity to offer a wide range of sustainable solutions.

To combat climate change, it is imperative that all industries, with a particular focus on the cement sector, take extraordinary measures to significantly slash their CO₂ emissions. LOESCHE is at the forefront of developing technologies that enhance the production process, conserve energy, and minimize emissions. In the years ahead, we remain committed to relentless research and development efforts, culminating in cutting-edge solutions that are ready for widespread industrial adoption. Our goal is to provide an extensive array of sustainable solutions that align with our vision for a greener future.

The concept of enhancing efficiency and minimizing material consumption is a universally welcomed principle across all industries where LOESCHE operates. The company's approach continually advances its positive impact on the environment, extending beyond traditional sectors to encompass fields such as mining, waste management, and the practice of remanufacturing parts to prolong product life cycles.

As part of our unwavering commitment, 2021 marked the inception of our heightened dedication to sustainability. We embarked on the journey of integrating sustainability into our core strategy.

Now, we proudly present our third sustainability report for the year 2023. Our objective is to maintain a steadfast focus on quantifying and managing our influence on the planet and society, all while consistently reporting on our accomplishments and challenges on an annual basis.



LOESCHE expanded its competencies and knowledge through vertical integration and strengthened the worldwide LOESCHE Group. Our most significant additions to the LOESCHE family regarding sustainability and clean processes include:



A TEC is an engineering and technology supply company focused on optimization and efficiency improvement of cement plants. A TEC's expertise lies in pyro process technologies, which include, among other things, the optimization of preheaters and the installation of bypasses.



aixprocess offers industrial process modeling and simulation technologies for various applications, including process design, Computational Fluid Dynamics (CFD) services, computer-aided engineering, virtual reality, Big Data analysis, and real-time process optimization as part of the Internet of Things (IoT) and Industry 4.0.



Dynamis is the youngest member of the LOESCHE family since 2021 and offers innovative technologies that ensure high energy efficiency and sustainable use of resources. Dynamis is known worldwide as a specialist in the field of clay calcination.

OUR DOMAINS

CEMENT

MINING

STEEL

POWER

WASTE

SERVICES

KEY FIGURES

117

YEARS AS A FAMILY-OWNED COMPANY

30

PATENTS

>

750

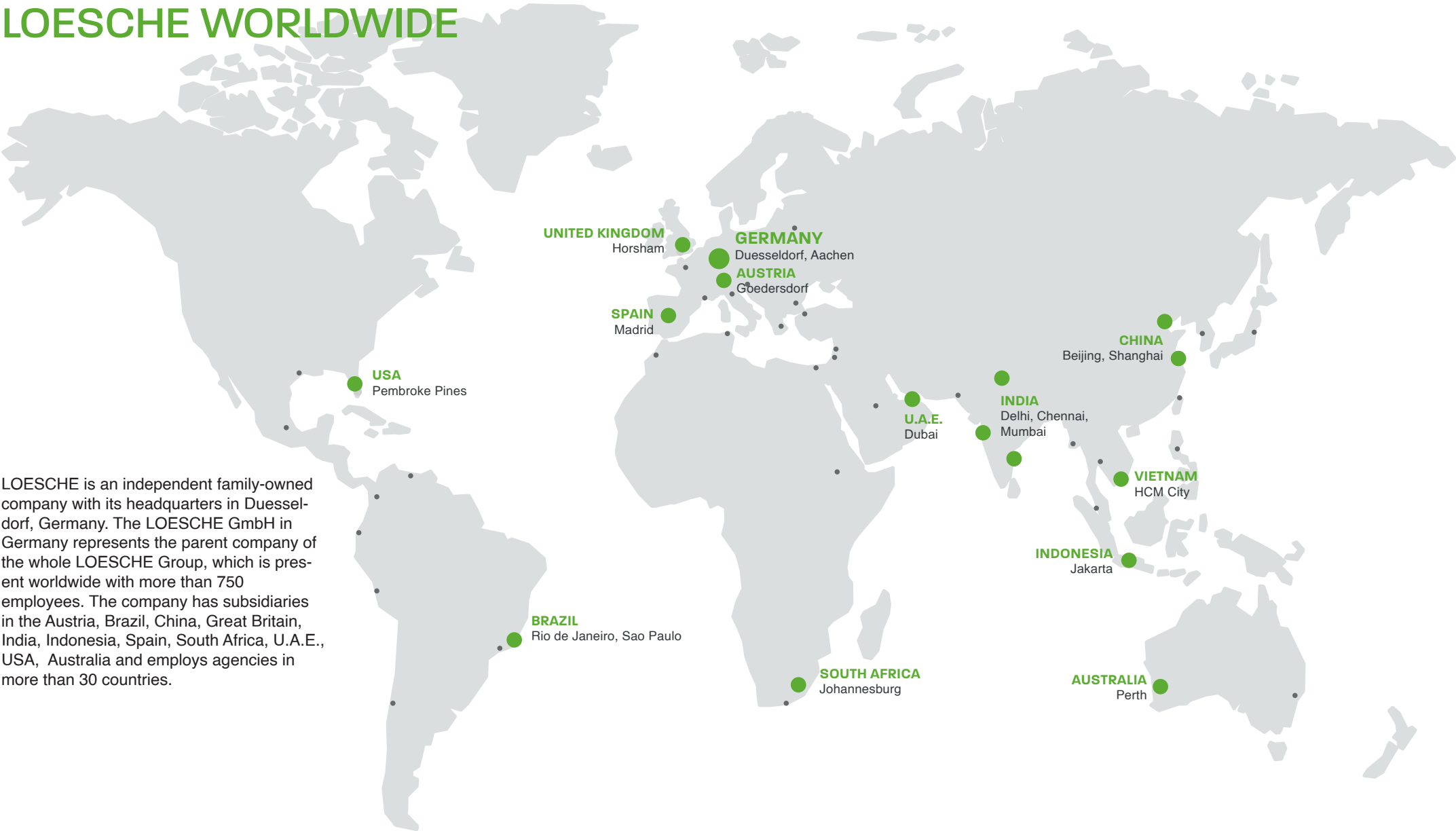
EMPLOYEES WORLDWIDE

16

GROUP MEMBERS GLOBALLY

HEADQUARTERED IN DUESSELDORF

LOESCHE WORLDWIDE



LOESCHE is an independent family-owned company with its headquarters in Duesseldorf, Germany. The LOESCHE GmbH in Germany represents the parent company of the whole LOESCHE Group, which is present worldwide with more than 750 employees. The company has subsidiaries in the Austria, Brazil, China, Great Britain, India, Indonesia, Spain, South Africa, U.A.E., USA, Australia and employs agencies in more than 30 countries.

● LOESCHE offices ● LOESCHE country and region representatives

OUR EMISSIONS

SCOPE 1 AND 2

The climate crisis undeniably stands as the most pressing challenge of our era. Human activities, principally through emissions of greenhouse gases, have unequivocally caused global warming, with global surface temperature reaching 1.1°C above 1850-1900 in 2011-2020. Global greenhouse gas emissions have continued to increase, with unequal historical and ongoing contributions arising from unsustainable energy use, land use and land-use change, lifestyles and patterns of consumption and production across regions, between and within countries, and among individuals (IPCC Climate Change Report 2023). The focus needs to be on reducing global CO₂ levels and transitioning to a net-zero industry. The right decisions today will make the difference for our world tomorrow.

Through continuously investing in and developing innovative solutions, we at LOESCHE strive to do our part in charting the path for a net-zero future.

To commence the journey towards a carbon footprint reduction, we first looked at our own direct and indirect impact. To do so, we identified the CO₂ emission sources we are responsible for within our headquarters and our locations in and around Duesseldorf, namely the **LOESCHE GmbH**. We determined our direct emissions caused by our facilities (scope 1) and our indirect emissions come from our electricity (scope 2). Within the considered locations, most of our operations are office-based. The remaining consumption comes from our Test Center.

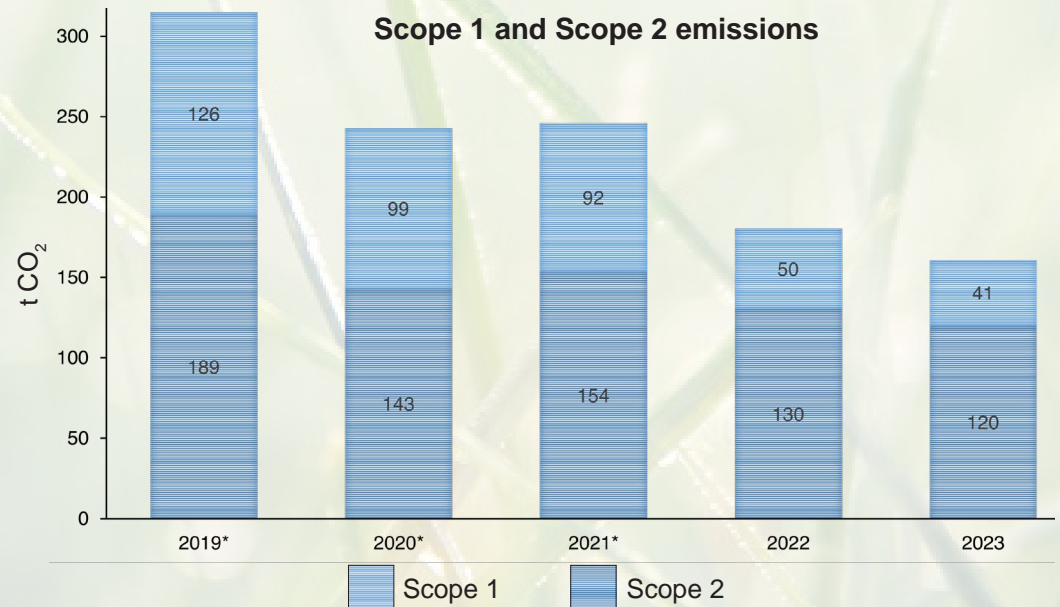
The details of our GHG emissions and their division into scope 1 and 2 can be seen in the table on the right side. To establish a basis that would reflect business as usual, we determined 2019 as our base year for all following CO₂ emission measuring and managing. From here on onwards, we will continue to measure and improve our carbon footprint.

When comparing the tracked emissions per year a clear decline can be noticed. Overall GHG emissions for the LOESCHE GmbH declined by almost 50 % since 2019.

This excellent result is mainly due to the switch to renewable energy by our electricity supplier for our main office headquarters in Duesseldorf. Furthermore, by reducing the room temperature and by carrying out a hydraulic calibration of our heating systems we were able to achieve significant savings in the gas consumption at all our sites.

In order to reduce our electricity consumption, we continuously identify energy consumers and replace them with energy-saving equipment where possible. In 2023, IT equipment in particular was critically reviewed and unnecessary power guzzlers were removed or replaced.

With these measures, we have taken a first step towards zero emissions for our scopes 1 and 2 and will focus on smaller improvements in the future. For this purpose, we have been conducting a comprehensive annual energy audit since 2018, from which several measures for improvement have already been derived.



*revised data compared to Sustainability Report 2021 due to actual data

** IPCC Report, 2022.

OUR EMISSIONS

SCOPE 3

The next step towards understanding the environmental impact of our emissions encompassed assessing all relevant scope 3 emissions along our value chain.

Guided by the GHG Protocol, we started the process of identifying all sources of emissions within the different categories of scope 3. Under considerations such as contribution to the total anticipated scope 3 emissions, risk factors, and opportunities for alternatives the different GHG emission sources are currently being reviewed and calculated.

It is already becoming apparent that our scope 3 emission will extend our emissions of scope 1 and 2 by far. Therefore, it is especially important to precisely understand the emission sources along our value chain and to determine how we at LOESCHE can take action to omit these.

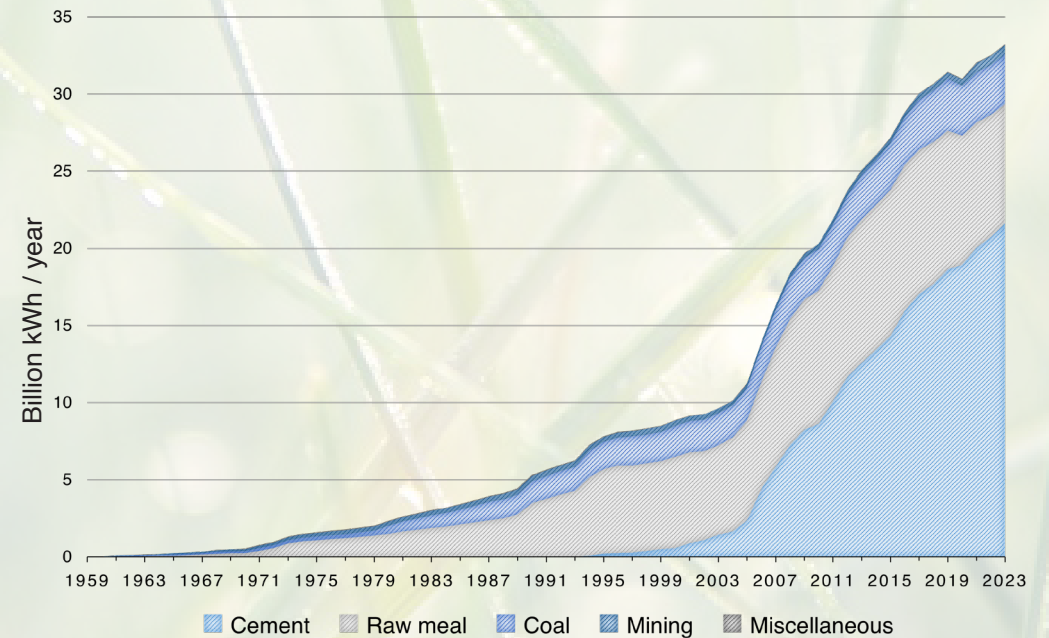
We aim to establish a carbon accounting and reporting approach that will ensure a consistent, comparable, and reliable picture of our CO₂ footprint by beginning of 2025. This will allow us to identify improvement opportunities and will guide us in delivering an effective carbon reduction plan. We will moreover roll out our carbon footprint efforts to the global LOESCHE Group.

The figure to the right shows the historical data of electrical power consumption of LOESCHE mills in kWh / year — split up into our main plant categories.

We observe that there was steady, linear growth in the CO₂ emissions due to the operation of our mills from the 1950s to the early 2000s. During the global boom in the cement industry between 2005 and 2010, cement mills were further established in the market. During this period, the population of LOESCHE mills rose sharply.

Over the last two decades, there has also been a clear trend towards ever larger plants - with drive powers of up to 9.6 MW. Considering a service life of 30 years, the operation of our grinding plants today consumes approx. 35 billion kWh annually, which corresponds to 13 million tons of CO₂ approximately per year.

Electricity consumption of LOESCHE mills over the years



THE AVERAGE LOESCHE GRINDING PLANT CONSUMES ABOUT 4,000 KW, WHICH IS ABOUT AS MUCH ELECTRICAL ENERGY AS AN AVERAGE FOUR-PERSON HOUSEHOLD IN GERMANY CONSUMES IN ONE YEAR.

CEMENT

REDUCING THE CO₂ FOOTPRINT
OF CEMENT

CEMENT

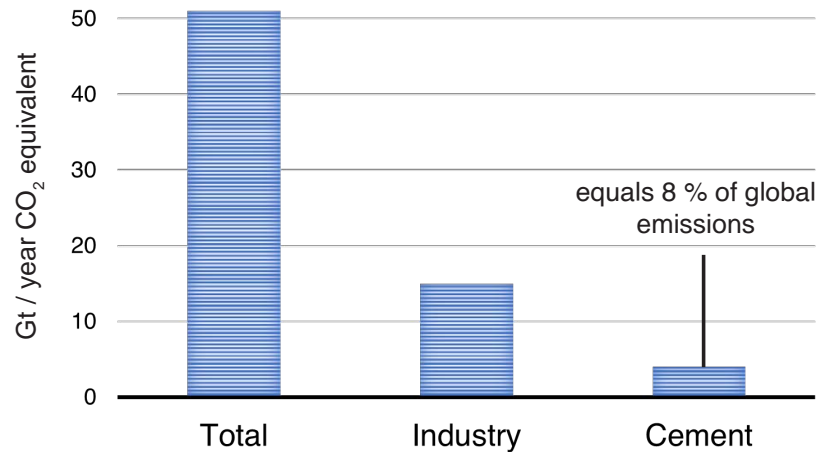
REDUCING THE CO₂ FOOTPRINT

Concrete ranks as the second most consumed product globally, trailing only water in terms of overall usage. Alarming, the cement industry holds the unenviable title of being the largest single emitter of CO₂.

With the growing awareness of the climate change crisis, governments worldwide are intensifying their efforts to curtail CO₂ emissions. This shift is compelling heavy industries to strike a delicate balance between reducing their carbon footprints and maintaining competitiveness. Now, more than ever, there is a pressing demand for a diverse range of technical solutions to serve as the linchpin in the transformation of the carbon-intensive cement industry we currently have into the low-carbon industry that is essential for our future. LOESCHE appreciates that there is no 'magic bullet' and that complex processes require complex solutions. It is of great importance to tackle this challenge from all angles. Every potential gain must be recognized, understood, and exploited in the most effective possible way.

Taking on the task of identifying and analyzing our effect on the environment, LOESCHE makes a clear distinction between its own CO₂ footprint and its potential impact on the CO₂ footprint of the industry.

Cement industry's contribution to global CO₂ emissions*



*Statista (2023) [online]---Cement production worldwide from 1995 to 2022 [online]. Cement production global 2022 | Statista [accessed on: 06 July 2023].



CEMENT

REDUCING THE CO₂ FOOTPRINT

Worldwide, 4.1 billion tons of cement were produced in 2022*. The main component of cement is still Portland cement clinker, which accounts for 72 % of the global average cement**. With approx. 800 kg CO₂ per ton of ground clinker, it is the main contributor to the carbon footprint of cement and thus largely responsible for the cement industry's high share of 7 % of anthropogenic CO₂ emissions.

As already reported in our Sustainability Report 2021, the specific CO₂ emissions of Portland cement are divided among its manufacturing process as follows: 50 % limestone decomposition, 40 % fuel combustion, 10 % provision of electrical energy.

The breakdown shows that the electrically driven grinding processes are of secondary importance for the cement life cycle assessment. LOESCHE Vertical Roller Mills (VRMs) represent a very energy-efficient solution for the grinding tasks in cement production. The continuous replacement of ball mills by VRMs in modern cement plants led to a significant reduction in

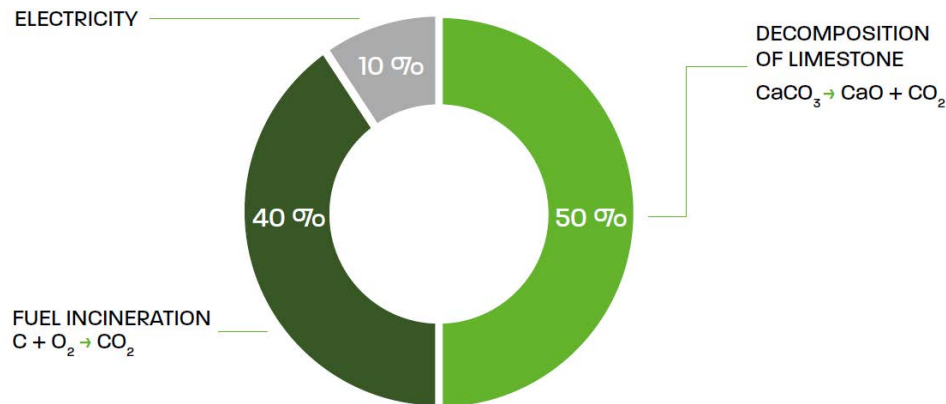
energy usage and CO₂ emissions in the industry in the past two decades. VRMs are recognized as a standard nowadays.

Therefore, there is comparatively very little remaining potential for CO₂ emission reduction when it comes to electrical energy consumption.

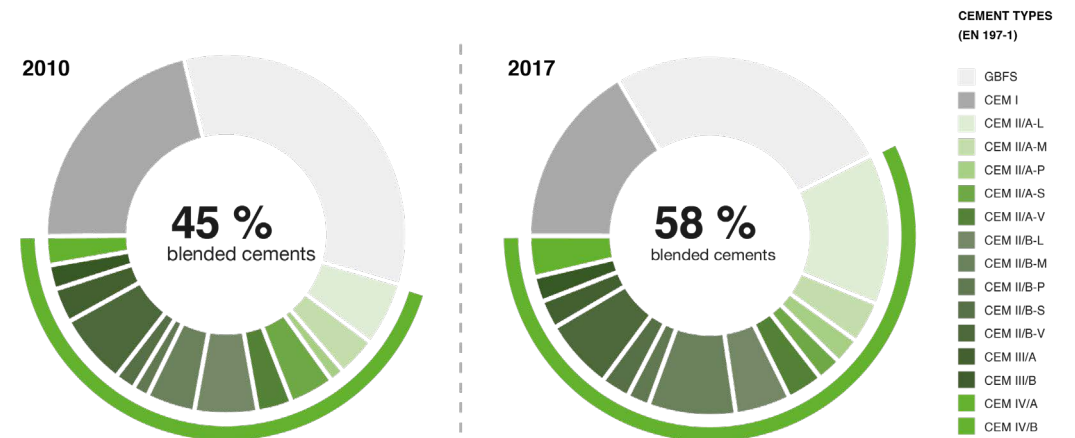
Evidently, to reduce the CO₂ footprint of cement we need to review its most significant emission sources, being the decomposition of limestone and fuel incineration, as seen in the figure below.

The trend towards blended types of cement has been evident for some time. We observe that the traditional supplementary cementitious materials (SCMs), such as granulated blast furnace slag (GBFS) and fly ash (FA), will become decreasingly relevant in the future. This is due to the fact that they will no longer be available in sufficient quantities.

Breakdown of emission sources in the cement production



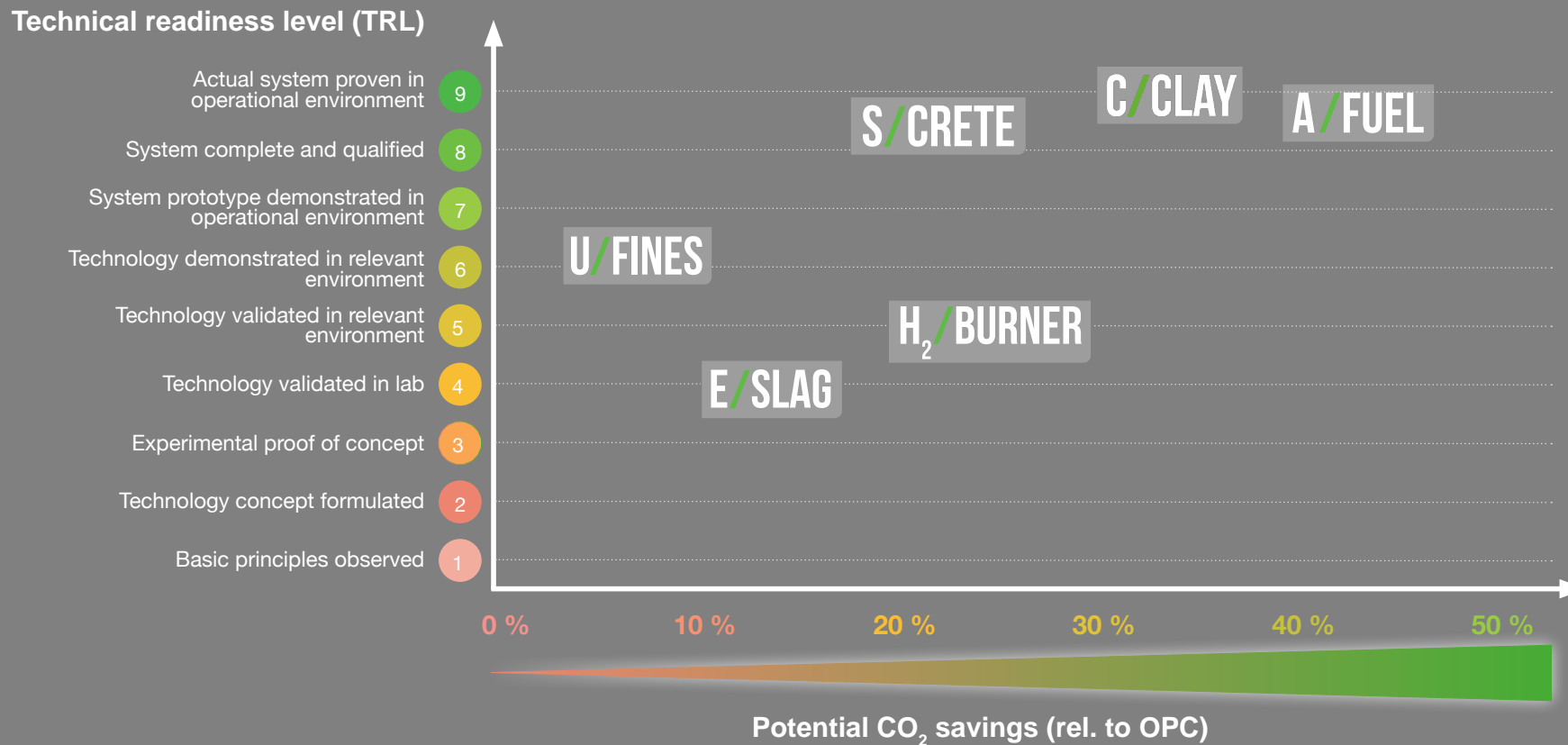
Development of SCMs



*Statista (2023) [online] — Cement production worldwide from 1995 to 2022 [online]. Cement production global 2022 | Statista [accessed on: 06 July 2023].

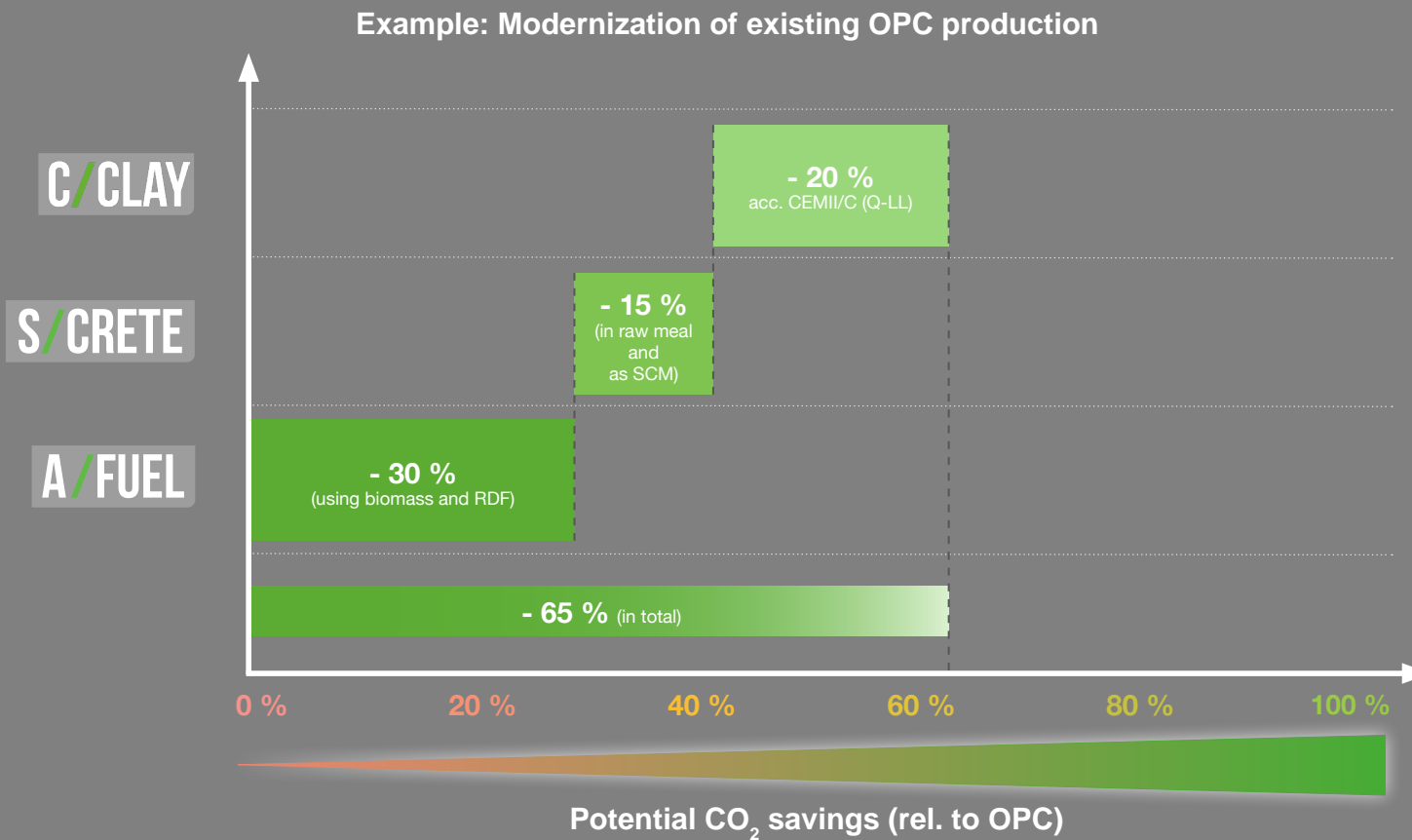
**IEA – International Energy Agency (2023) Cement [online]. <https://www.iea.org/reports/cement> [accessed on: 06 July 2023]

POTENTIAL CO₂ SAVINGS IN CEMENT PRODUCTION



LOESCHE PROVIDES THE TECHNOLOGIES TO REDUCE THE CO₂ FOOTPRINT SIGNIFICANTLY.

POTENTIAL CO₂ SAVINGS IN CEMENT PRODUCTION



LOESCHE COMBINES DIFFERENT GREENKEY SOLUTIONS TO ACHIEVE A SUBSTANTIAL CO₂ REDUCTION.

LOESCHE'S GREENKEY SOLUTIONS

The **GREENKEY SOLUTIONS** include technologies for the provision of clinker substitutes, so-called SCMs (Supplementary Cementitious Materials), for the utilization of waste and biomass as an alternative to fossil fuels, for the use of hydrogen in combustion processes, and for the recycling of concrete and plastic products.

Above all, the replacement of the clinker component, which has a high CO₂ footprint, by SCMs represents a measure that can be implemented quickly to improve the life cycle assessment of cement. These substitutes are chemically reactive secondary products from other industries (granulated blast furnace slag, fly ash, silica fume) or primary products with a significantly lower environmental impact than Portland cement (natural tempered or untempered pozzolans). The partial replacement of clinker by SCMs is already state of the art, but the limits of availability have been reached, so that a further reduction of the clinker content in cement is not possible with the conventional substitutes. Availability is even declining in the case of fly ash and granulated blast furnace slag in view of the reduced use of coal energy and the emerging steel production from direct reduction, respectively.

LOESCHE's GREENKEY SOLUTIONS for providing alternative SCMs are the technologies for the production of calcined clays (**C/CLAY**), for the utilization of steel mill slags (**E/SLAG**), and for the utilization of cement paste meal from concrete recycling (**S/CRETE**). Complementing conventional SCMs as well as inert rock meals and gypsum setting regulator, these materials enable a reduction of the global clinker/cement ratio from the current 72% to 50%, which corresponds to an estimated CO₂ saving of 40 % compared to the footprint of Portland cement. To further reduce CO₂ emissions from cement, LOESCHE offers technologies for the use of green energy from biomass (**A/FUEL**) as well as from green hydrogen (**H₂/BURNER**). In addition, with the GREENKEY SOLUTION **S/CRETE**, the path to a closed loop economy is being taken, in which materially bound CO₂ circulates in the secondary raw material-atmosphere-product triangle and no further CO₂ originating from primary raw materials is released into the atmosphere.

The details of LOESCHE's GREENKEY SOLUTIONS are described on the following pages.

S/CRETE

selective concrete grinding

Breaking down concrete and waste to re-introduce it to the cement process as either raw meal or clinker substitute.

A/FUEL

alternative fuels

Alternative fuels are a key to replace CO₂-intensive fossil fuels.

E/SLAG

enhanced slag reactivity

Recycling excess material from the steel and iron industry, including ultra-fine blast furnace slags and Linz-Donawitz (LD) slags.

C/CLAY

calcined clay and grinding

Widely available and inexpensive, this SCM of the future is one of the keys to the low carbon cement industry of tomorrow.

H₂/BURNER

hydrogen combustion

The transition to carbon neutral fuel sources start with green hydrogen hot gas generators.

U/FINES

ultra-fine grinding

Increase the reactivity of materials in order to subsequently save material and thus resources and CO₂.

C/CLAY

CALCINED CLAY AND GRINDING

In the last two decades, the calcined clay technology evolved from a promising lab-trial method to a high potential contributor to the decarbonation strategy of the cement industry. Beside the technical background that clays can be transformed to reactive SCMs by moderate temperature application without any material related CO₂ release, there are two factors making this technology attractive to get implemented on industrial scale: first, the abundance of clay sources all over the world (in contrast to conventional SCMs) and second, the availability of equipment for an economically feasible production process.



Challenges:



Varying raw materials

composition and constitution of clay vary in a wide range and require individual handling and activation.

Colour control

Acceptance of this new SCM is lowered by its reddish color, which therefore must be prevented by strictly controlling the calciner atmosphere.

Proper grinding

The granulometry of calcined clays must be improved by grinding to achieve optimum cement properties.

Objectives:



Decentralized production

Clays are widely available and can be calcined locally, allowing for reduced transport costs.

Applying proven technology

Handling, calcining and grinding equipment are easily transferable from other industrial processes.

Clinker reduction

Up to 50 % clinker replacement in cement at equal strength compared to OPC results in a CO₂ reduction potential of -40 %.

CALCINED CLAY AND GRINDING



Together with its Group Member Dynamis, LOESCHE provides solutions for every step along the process chain of calcined clay production, always with a focus on selecting the most suitable technique for an optimum performance as SCM.

The engineering competence and services around that technology are summarized in the Greenkey Solution C/CLAY. Customers benefit both from the vast experience within the LOESCHE Group, based on a large number of references and its own testing facilities (see info box), and from the wide range of technical solutions that can be offered. An extract of the individually selectable C/Clay solutions is given below:

- **Flash calciner:**
The low-footprint solution for maximum yield of SCM activity applicable to pre-processed kaolinitic clays
- **Rotary kiln:**
Proven technology with maximum flexibility in terms of raw clay constitution and composition and a minimum of pre-treatment effort
- **Kiln refurbishment:**
Seizing the advantages of a rotary kiln by giving new life to a shut clinker line – the solution for minimized use of resources
- **Quartz separation:**
The upgrade of low-purity clays via selective grinding by LOESCHE creating a high-potential starting material for SCM production.

- **Finish grinding:**
A must-have for releasing the full SCM potential of a calcined clay allowing a reduction of process steps by cement blending via intergrinding
- **D-Gasifier®:**
Gentle firing at moderate temperatures – combustion with Dynamis' gasifier cares for an optimum heat distribution and works with all kinds of fuel, e.g. RDF and biomass.

The range of solutions that can be combined to form customized calcining and grinding plants makes the C/CLAY technology applicable to any type of calcined clay, regardless of the raw material quality and the customer's plant constraints. In this way, LOESCHE is creating the conditions for introducing the technology on a broad scale and thus exploiting its full CO₂ reduction potential on a global scale.

The potential of calcined clays lies not only in their inherent activity as SCM, but also in their synergistic combination with limestone. This effect makes it possible to replace 50 % of the clinker in the so-called LC3 mix with 30 % calcined clay, 15 % limestone and 5 % gypsum without compromising cement performance [LC3]. In this way, 40 % CO₂ and 35 % energy can be saved compared to ordinary Portland cement (OPC).

COLOR CONTROL

Background

Iron in raw clay turns reddish during calcination, which is not very popular on the market.

Technology

Reductive conditions prevent the formation of the red form of iron oxide.

Atmosphere must be controlled during burning and cooling.

Patented solution by DYNAMIS applying its D-Gasifier®

To be tested in pilot scale calciner in the Technical Center



S/CRETE

SELECTIVE CONCRETE GRINDING

To this day, no scalable and affordable technology exists to reach an efficient and CO₂ affecting usage of waste concrete beyond downcycling. Caused by construction, renovation and demolition activities, up to 3 billion tons of concrete waste are produced globally.



Challenges:



340.000 tph

concrete and demolition waste (CDW) is produced worldwide. War and natural disasters also increase these amounts.

Downcycling

CDW is processed only by downcycling for low-quality construction tasks without CO₂ saving effect.

Landfill space

High percentage of CDW has to be landfilled. This severely damages the environment and reduces living space.

Objectives:



Urban mining

The CDW material is quarried, processed and reused on site – even in crowded urban areas.

Upcycling

The old concrete is broken down into its components in a high-quality manner. Hence, the materials are then available for new processes.

Circular economy

Material cycles are closed and transport routes are greatly reduced.

S/CRETE

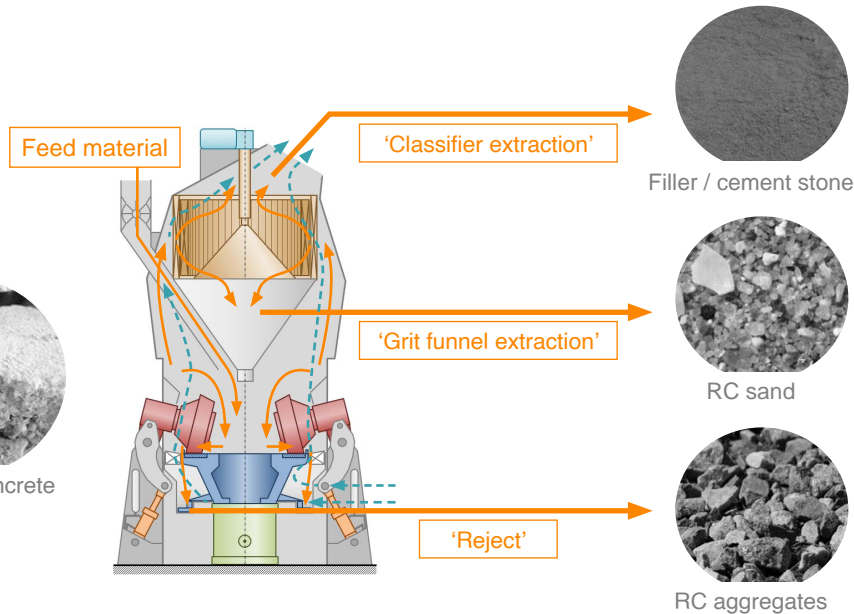
SELECTIVE CONCRETE GRINDING

SOLUTION

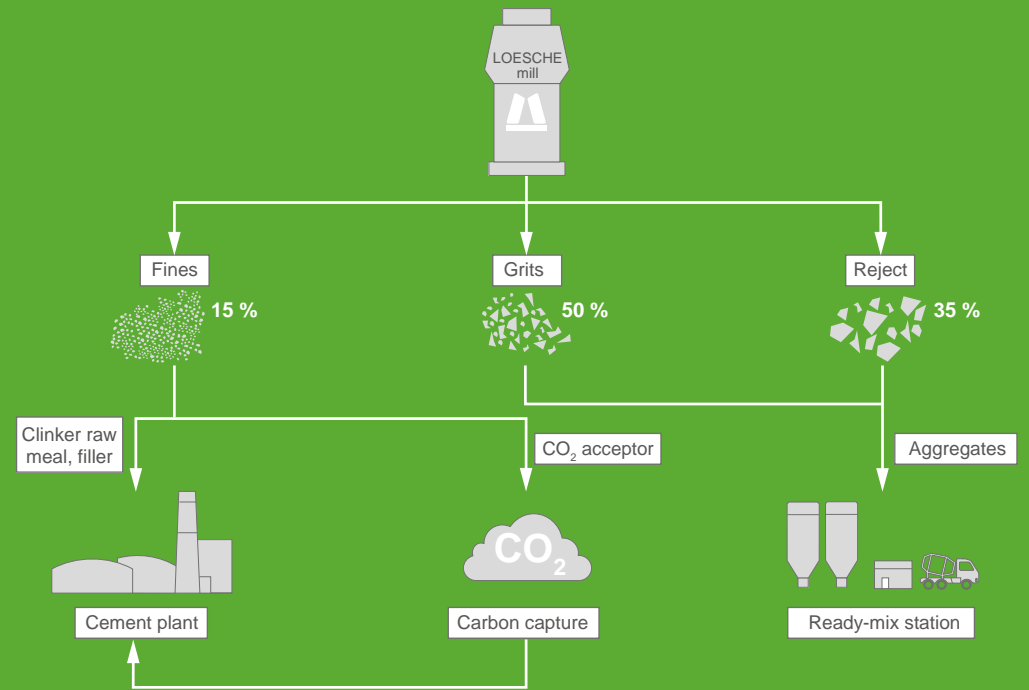
S/CRETE, LOESCHE's approach to recycling concrete waste, aims to completely recycle the old concrete and to comminute it to its initial original materials (gravel, sand, cement stone).

The so-called "selective grinding" plays an important role in this process. By means of attritional grinding at low roller pressures in a vertical roller mill (VRM), it is possible to extract the aforementioned materials on an industrial scale and with a high degree of purity. It is patented and has proven itself in over 100 grinding tests.

Selective grinding in a LOESCHE VRM (patented in 2014)



What to do with the products of concrete recycling?



Above: S/CRETE materials (from left to right): Cement stone, sand, aggregates, crushed concrete.

E/SLAG

ENHANCED SLAG REACTIVITY

E/SLAG is LOESCHE's solution for the utilization of steel slags. By changing their chemical composition, the steel slags become a substitute for energy- and CO₂-intensive Portland cement clinker in binder systems.



Challenges:



200 million tons slag

from steel production are incurring every year. This includes around 140 M tons of slag generated from the basic oxygen furnace (BOF) or the LD converter and 60 M tons of slag from the electric arc furnace (EAF).

Reactivity

Compared to granulated blast furnace slag from pig iron production, untreated LD slag has only a low hardening potential. Therefore, it has not yet been used as a reactive composite material in cement or concrete.

Current usage

Currently, steel slags are mostly downcycled in road construction. A considerable proportion also has to be landfilled.

Objectives:



Utilization

by producing a Portland cement clinker-like material by a thermo-chemical process in which the metal portion is separated from the hardened slag.

Performance

By changing the chemical composition of the melt, alite (the dominating clinker phase) is contained up to 70 wt.% which comes along with a good reactivity.

Circular economy

Using the already existing melting heat to produce a clinker-like material from a waste stream is a sustainable manufacturing process.



E/SLAG

ENHANCED SLAG REACTIVITY

E/SLAG can recover the metal content in slags and generate a hydraulic binder by utilizing the following processes:

Modification

- Application in the liquid slag state
- Controlling the chemistry and the cooling conditions of the melt
- Products:
 - Hydraulic SCM
 - Metal (after selective grinding in VRM)
- Suitable for various LD slags

Metal recovery

- By selective grinding of the slag in a LOESCHE mill
- Products:
 - Metal
 - SCM filler
- Particularly suitable for stainless steel slag

OUTLOOK

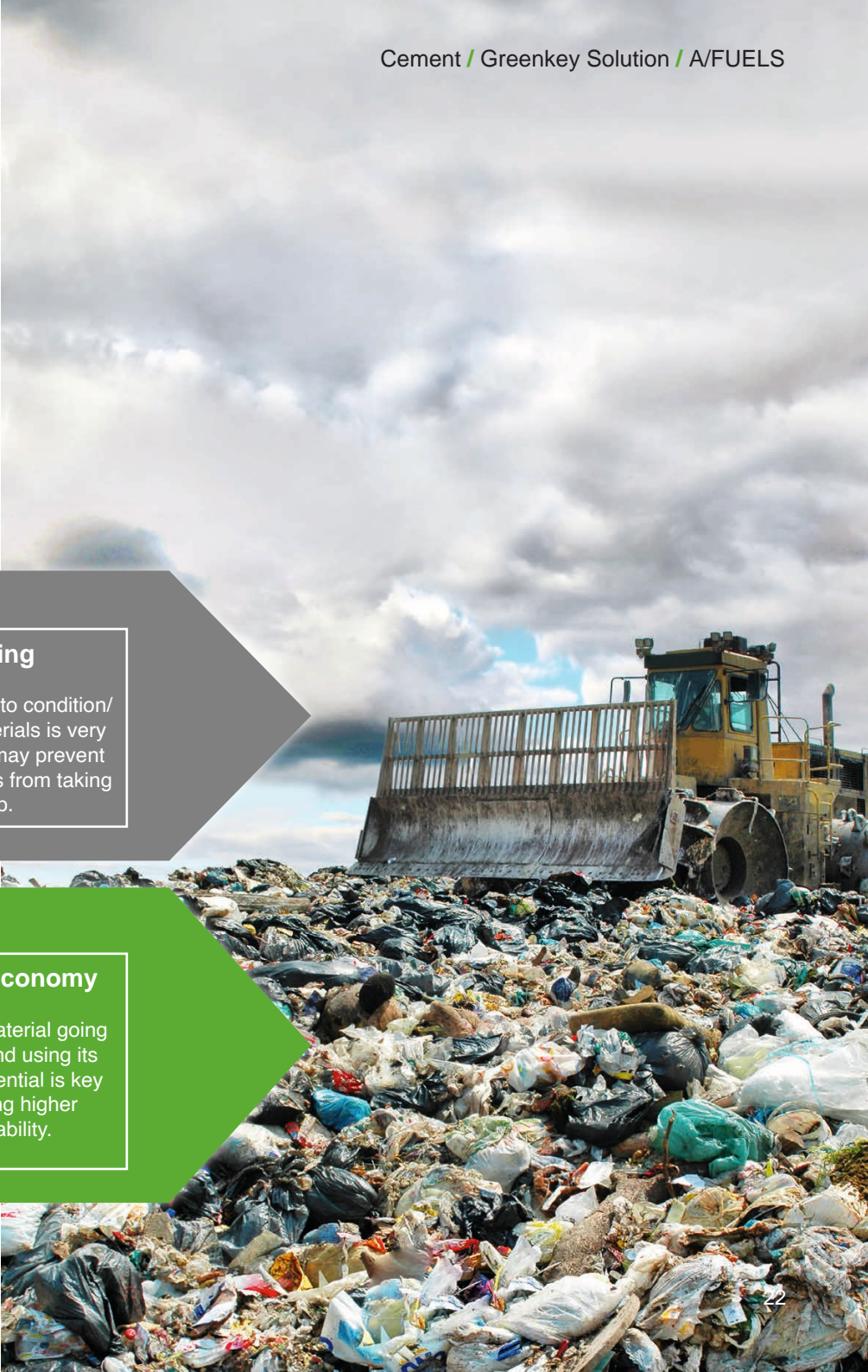
This sustainable process will turn a conventionally downcycled material into two high-value products: Metallic residues as a by-product from the grinding process and hydraulic binder that can replace a remarkable amount of conventional clinker in cement production.

A/FUELS

ALTERNATIVE FUELS

The importance of alternative fuels continues to grow due to ecological constraints, but also current pricing. LOESCHE has been working on this topic since the early 1980s and has had a great tradition ever since. In order to ensure the highest possible CO₂ and fuel savings, various products from the LOESCHE Group can be used depending on the marginal parameters.

Alternative fuels, in conjunction with other sources like biomass, result from waste treatment, aimed at maximizing the inherent calorific value of these materials. The usage of fuels made from waste has two striking environmental benefits: creating an alternative resource to fossil fuels and the reduction of waste being landfilled.



Challenges:



Heterogeneous material

Waste material streams are very heterogenous, requiring high flexibility in the conditioning line in order to obtain the required qualities.

Logistics

Low alternative fuels densities, especially for high-quality requirements, increase transportation and storage costs.

Permitting

Obtaining permits to condition/ utilize waste materials is very challenging and may prevent or delay end-users from taking this step.

Objectives:



Process know-how

Knowing the process requirements and using it to make tailor-made A/FUEL is the key to achieving stable operation and high substitution rates.

Final step at end-user

To decrease transportation costs, the last conditioning step should take place at the end-user. Modular equipment allows flexible solutions.

Circular economy

Minimizing material going to landfills and using its chemical potential is key to achieving higher sustainability.

A/FUELS

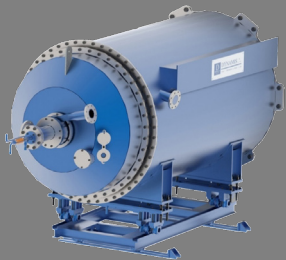
ALTERNATIVE FUELS

A/FUEL helps your business drastically reduce fuel-related carbon emissions by utilizing a TSR (Thermal Substitution Rate) of over 80%. Our technology is biomass proven and ready to use.



D-Gasifier

- Fuels (fine)
- Coal
 - Petcoke
 - Fuel-oils
 - Biomass



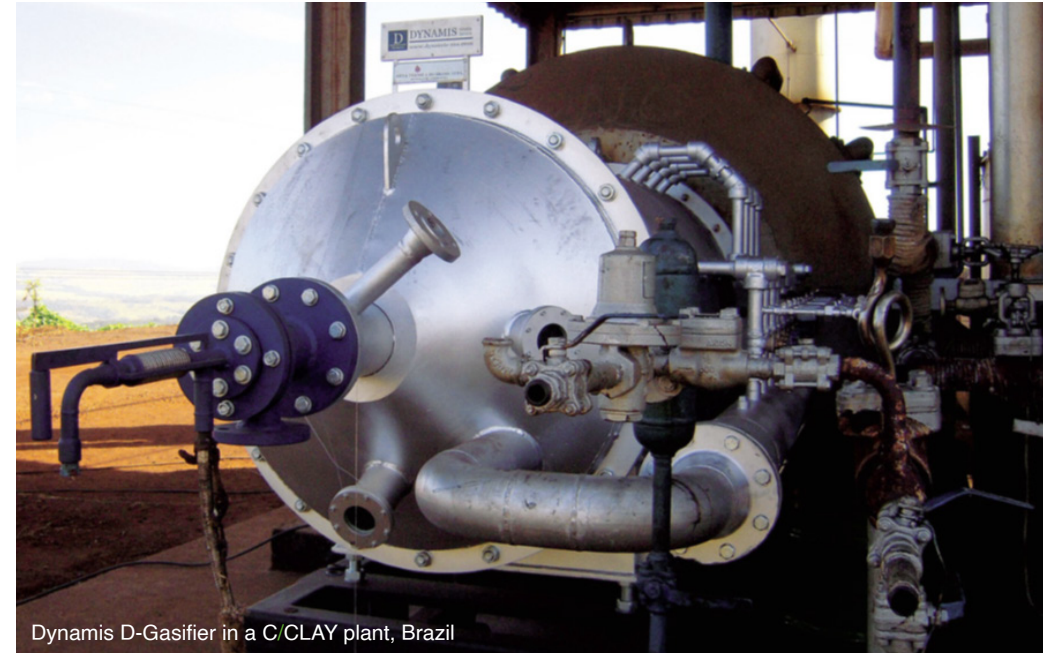
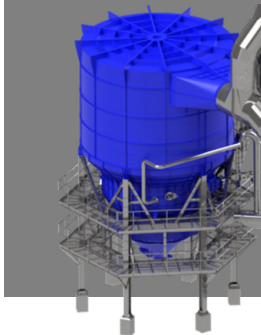
Rocket Mill®

- Shredding of
- Light fraction of MSW
 - Nearly all kinds of plastic incl. GFRP
 - Industrial solid waste (ISW)
 - Biomass incl. wood waste
 - Agricultural waste materials



D-FBED Chamber

Flexibility in operation with multiple fuels (tires, biomass, etc.) and different particle size specifications (coarse material).



Dynamis D-Gasifier in a C/CLAY plant, Brazil



A TEC Rocket Mill® installation for carbon fibre recycling, GERMANY



Dynamis, the youngest member of the LOESCHE Group, provides the combustion technology such as the gasifier for maximum TSR.



A TEC is the specialist for the modernization and optimization of cement plants in the LOESCHE Group.

H₂/BURNER

HYDROGEN COMBUSTION

Hydrogen has considerable potential to dramatically reduce global greenhouse gas emissions. The question is not whether, but when this will be implemented across the board for the many different industrial combustion processes. As part of our product range Greenkey Solutions, we at LOESCHE are also preparing our globally established hot gas generators and the associated burner systems for the partial and complete use of hydrogen.

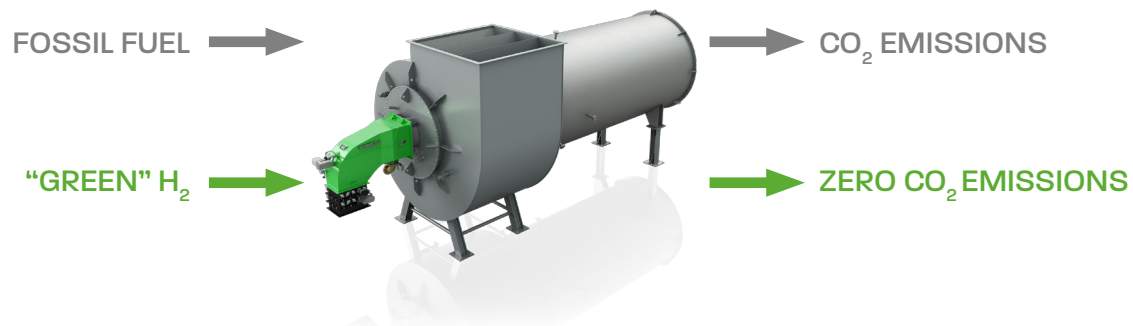
POLITICAL BACKGROUND

The political framework conditions and thus the course for progress have not only been created in Germany and the EU.

The European Commission's large-scale hydrogen strategy launched in 2020 (COM/2020/301) clearly shows that the development of hydrogen is being pursued with great ambition. For this purpose, a 20-point (so called 'key actions') plan was implemented that will have intense impact far beyond the borders of the EU.

An important example is the Global Gateway Investment Package - Africa-EU Green Energy Initiative. The focus of this initiative is on sustainable hydrogen production in Africa and neighbouring EU countries. The intended goal is electrolyser capacities of at least 40 Gigawatt by 2030 that could be used for energy-intensive industries.

As Africa in particular is an important market for LOESCHE's Compact Cement Grinding (CCG) plants, hydrogen-based heating is within reach. The following example shows a comparison of the CO₂ savings that can be achieved with such a medium-sized CCG plant when fossil fuels are substituted with hydrogen produced from renewable sources.



H₂/BURNER

HYDROGEN COMBUSTION



Green hydrogen is the ultimate fuel of the future.



Hydrogen is a **sustainable energy** if it is produced from renewable sources.



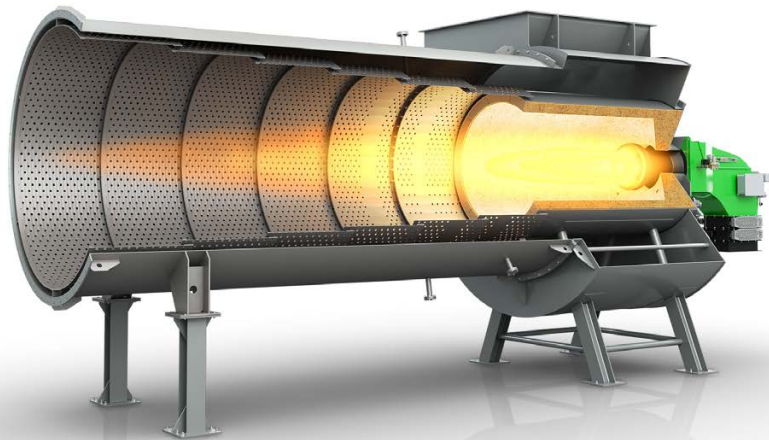
Green hydrogen has almost no **CO₂ emissions** and therefore no special requirements for gas reduction.



Hydrogen can be used in a **variety of ways**, but is currently difficult to obtain.



Fossil fuel burners or gasifiers can be **adapted to hydrogen usage**.



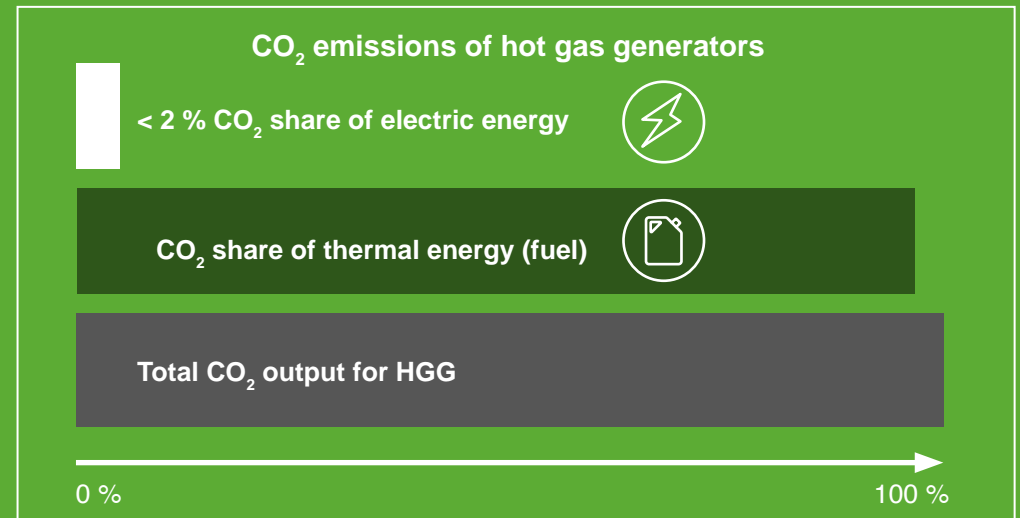
Above: 3D illustration of a modern LOMA heater by LOESCHE

SOLUTION

LOESCHE has already made great progress in the development of the hydrogen burner H₂/BURNER. We will have the capacity to offer our customers innovative combustion concepts based on hydrogen combustion as a component of the established hot gas generators in the near future. On the one hand, already installed HGG plants will be equipped with the newly developed H₂/BURNER systems, in addition to new plant business. On the other hand, LOESCHE is striving to enable the substitution with hydrogen as well as the utilization of pure hydrogen.

ENVIRONMENTAL IMPACT

More than 98 % of GHG emissions emitted from hot gas generators can be allocated to the process of thermal combustion. The remaining < 2 % are caused by the CO₂ share of electrical energy. Using regenerative energy would thus eliminate the CO₂ emissions of the electrical energy part. This change would help realize CO₂ neutrality when considering the balance limits of an entire HGG system.



U/FINES

ULTRA-FINE GRINDING

Virtually any solid material can be processed to achieve ultra-fine fineness, significantly surpassing the standard used in cement production. Ultra-fine materials offer enhanced properties by reactivating the material, making them suitable for a wide range of applications.

A key advantage lies in the improved early strength development, addressing one of the main limitations of alternative supplementary cementitious materials (SCMs) compared to traditional Portland cement.

Challenges:



Low performance

Many SCMs have only poor performance, especially in early strength development.

New SCMs in the market

To reduce the clinker factor a bunch of new SCMs like steel slags will be applied but must be ground to a high fineness.

High energy demand

High finenesses are causing high energy consumption with conventional grinding.

Objectives:



Enhanced reactivity

Due to ultra-fine grinding the activated materials are suitable for many applications

Resources

Even originally unreactive materials can be processed and used in various ways.

Energy savings

The combined grinding and classification process is saving energy and money.

U/FINES

ULTRA-FINE GRINDING

LOESCHE provides compact systems that seamlessly integrate grinding and classification processes, delivering efficient and effective solutions for ultra-fine material production. These systems are designed to meet the highest performance standards while supporting innovative material applications.



In principle, every solid material can be processed ultra-fine.



Ultra-fine materials have a beneficial performance, e.g. reactivity.



Ultrafine materials have a large surface area (>10,000 Blaine) and therefore need to be treated specially.



Special equipment is needed due to special behavior during process.



Utilization of low-value materials is possible.

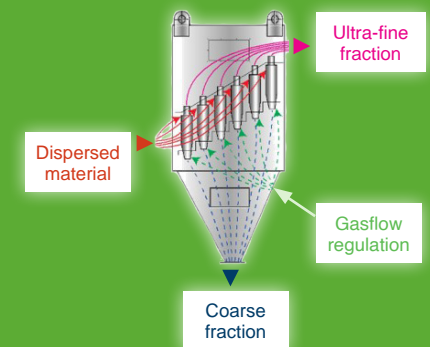


Above: The heart of the process - the multicyclone battery.

EXAMPLE PLANT DESIGN

Key data

- Processing GGBFS
- Input 3,5 t/h @ ~ 4.000 cm²/g
- Output 0,45 t/h fines @ ~ 9.000 cm²/g = 12,9 % = 3.000 t/a
- Output 3,05 t/h coarse @ ~ 3.250 cm²/g



CARBON CAPTURE



CARBON CAPTURE, UTILIZATION & STORAGE (CCUS)

OUR APPROACH



A TEC Group, a member of the LOESCHE Group, is focusing since many decades on cement pyroprocessing and has a long track record of more than 500 successful projects which were focusing on energy efficiency, increase of alternative fuels to highest levels and emission reduction. By leveraging the expertise

of A TEC and its Loesche Group partners aixprocess and Dynamis, A TEC provides tailored solutions for making existing and new cement pyroprocessing lines ready for high efficiency CCUS.

MAKING THE PYROPROCESS CCUS READY

Here you will find an overview of typical services and system/project areas that we support, among others:

Process audits

Process and plant audits settle the baseline for any future optimization or re-configuration approach. Typical focus can be:

- **False air & reduction of gas volume:** False air identification and root cause analysis can save immediately energy, improves efficiency and reduces fuel use.
- **Process optimization for efficiency:** Key process optimizations focus on improving combustion and reducing fuel consumption, setting the stage for successful CCUS integration.

Overall heat & mass balances

- **Future heat integration:** We will review the heat integration and distribution to ensure optimal energy use across the plant. This includes identification of the correct heat source for each direct and indirect process for clinker production, e.g. for raw material drying as well as ensuring future heat recovery systems are aligned with CO₂ capture requirements.
- **Avoiding CO₂ emission points:** Integrating side processes, such as CI and Alkali by-pass systems, fuel and raw material drying and clay calcination to the main clinker production to have one single CO₂ collection point with well known parameters.

Pyroprocess adaptation

- **Preheater and calciner adaptations:** Adaption of the process for the future operation range, like gas amount and composition or to integrate calcination systems for a wide range of alternative fuels.
- **Oxyfuel:** Partly or full Oxyfuel process modification, with or without recirculation.
- **Process reconfiguration:** Certain configurations (e.g., raw mill modifications, oxyfuel combustion) may be required to support new combustion characteristics and CO₂ capture technologies.

CO₂ enrichment by O₂ utilization (Oxyfuel)

CFD optimization for high O₂ atmosphere: Computational Fluid Dynamics (CFD) design validation is essential for optimizing oxygen-enriched combustion system. aixprocess GmbH, a LOESCHE Group Member, brings expertise in CFD to ensure optimal gas flow, calcination equilibrium, sinter zone properties, and combustion behavior within the changed atmosphere by using oxygen.

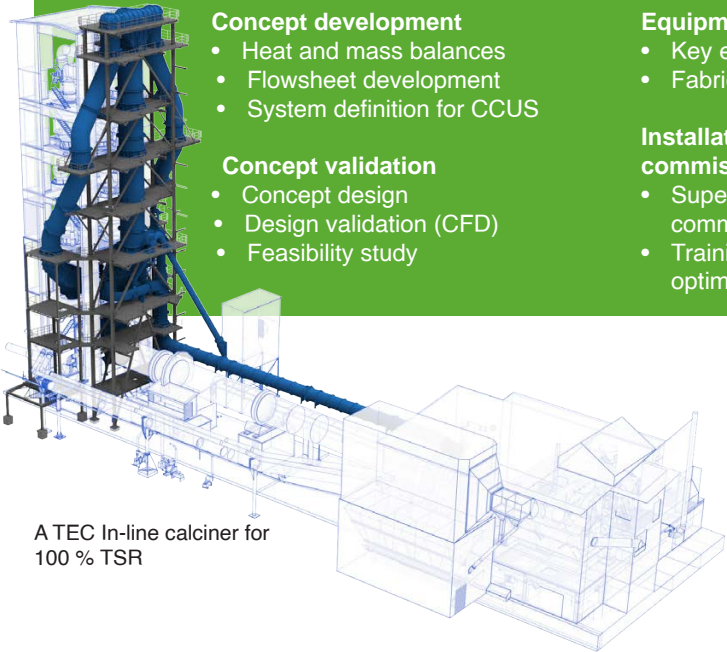
CARBON CAPTURE, UTILIZATION & STORAGE (CCUS)

OUR APPROACH

Possible services and step-wise approach to support the pyroprocess development for CCUS readiness

A TEC offers a structured, step-by-step approach for cement plant owners and operators to make their pyroprocess ready for CCUS technologies. This process ensures that each stage is supported by expert guidance.

<p>Baseline checks</p> <ul style="list-style-type: none"> • Plant assessment • Plant audit • False air and bottleneck assessment 	<p>Engineering</p> <ul style="list-style-type: none"> • Basic engineering • Detail engineering • Functional planning
<p>Concept development</p> <ul style="list-style-type: none"> • Heat and mass balances • Flowsheet development • System definition for CCUS 	<p>Equipment supply</p> <ul style="list-style-type: none"> • Key equipment supply • Fabrication and supply
<p>Concept validation</p> <ul style="list-style-type: none"> • Concept design • Design validation (CFD) • Feasibility study 	<p>Installation and commissioning</p> <ul style="list-style-type: none"> • Supervision and commissioning • Training optimization



A TEC In-line calciner for 100 % TSR



Kiln line incl. five stage preheater, calciner and CI-bypass by A TEC

MINING



MINING

CHALLENGE

The mining industry has a significant environmental impact. In addition to land consumption, an ongoing demand for energy, water, and other consumables require a lot of resources within the process.

Many of the things we face and use on a daily basis, such as general consumables, technological devices, transport and even our infrastructure rely heavily on metals and the mining industry. Combined with a growing world population and increasing economic development, the demand for metals is on the rise.

Metals such as copper, nickel, or cobalt prove to be essential components for a global transition towards green energy, further putting pressure on the market (see figure below). And as the world is working on moving towards the Paris Agreements reduction targets of 1.5° Celsius, it will require the industry to more than double the supply for copper and quadruple the supply for nickel over the next 30 years.

Mining and processing continues to emit great numbers of greenhouse gas emissions into the atmosphere.

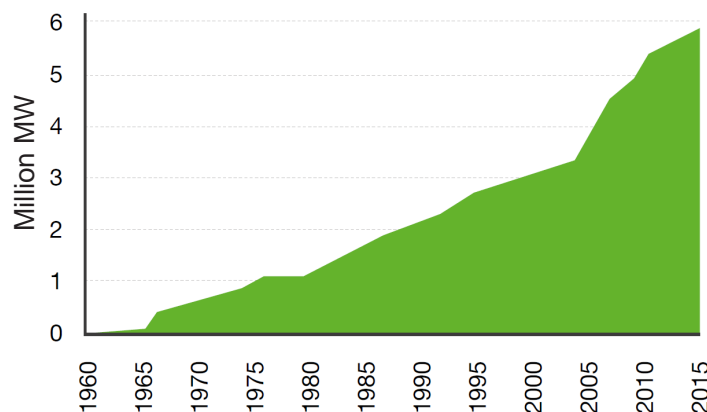
A significant amount here is attributed to the comminution process, as it consumes around 50-55 % of the overall processing energy*.

The most dominant comminution circuits in the ore industry combine semi-autogenous grinding (SAG) and ball milling. It is estimated that the electricity consumption for autogenous grinding (AG) ball mill circuits is 116.5 TWh per year. An additional 14.95 megatons of waste are caused by the usage of grinding balls.

Decreasing grades of the valuable minerals in the ore deposits and the need for finer grinding, due to more complex ores will further increase the energy requirement of the ore industry in the next years. The more efficient LOESCHE VRM technology offers a sustainable alternative which can help to reduce the future energy and water demand at higher overall metal recovery and hence production.

Many companies join the global move towards net-zero as they commit to achieving significant reductions in their carbon footprint. Reduction goals of 30 - 40 % for the next 10 - 15 years are common and many companies aim to achieve carbon neutrality in their scope 3 emissions by 2050, some even by 2040.

Cumulative installed power of AG/SAG mills



Non-ferrous metals**

Ratio of four base metals Al, Cu, Zn, Pb to all other non-ferrous metals

99.0 % - 1.0 %

Growth rate of base ore production 2000/2022 (2018/2022)

119.3 % (6.5 %)

Growth rate of nickel production 2000/2022 (2018/2022)

188.0 % (26.6 %)

Iron and ferro-alloy metals

Ratio of iron ore to all other ferro-alloy metals

97.0 % - 3.0 %

Growth rate of iron ore production 2000/2021 (2017/2021)

169.9 % (7.3 %)***

The LOESCHE VRM is an important technology to reduce the comminution energy requirement of the ore industry.

* Helping to reduce mining industry carbon emissions: A step-by-step guide to sizing and selection of energy efficient high pressure grinding rolls circuits. S. Morrell, Minerals Engineering, 179, 2022.

**World Mining Data 2024, Volume 39.

*** World Mining Data 2023, Volume 38.

MINING

SOLUTION

Conventional comminution technologies are proven and reliable but offer little process flexibility. Moreover, current technologies are reaching their peak efficiency. More efficient, sustainable technologies such as the LOESCHE Vertical Roller Mill (VRM) are needed.

LOESCHE VRMs are state-of-the-art technology in the cement, steel, power, and minerals industry. These mill types have proven themselves successful through reducing operating expenses by decreasing energy, water, and grinding media costs, advanced process flexibility, high and stable product quality, reduced process steps, online process control, high reliability, and maintenance friendliness.

Especially in ore processing, the LOESCHE technology promises significant sustainability features:

1

Energy and water savings

Up to **40 % energy** and **24 % water** can be saved in iron ore processing.

Up to maximum **35 % energy** and **2-5 % water** can be saved in base and precious metals processing.

2

Increased metal output

Grinding the ore in a grinding bed, between the grinding rollers, and the grinding table results in a more efficient preparation of the valuable minerals for the downstream sorting processes. Hence the recovery of valuable minerals increases, and more metal can be produced from the same amount of run of mine ore.

3

Operable with renewable energy

The LOESCHE dry grinding process can be powered with renewable energies. The grinding circuit capacity can be adjusted to the available energy, fluctuating with sun and wind power. The process can be stopped and restarted within minutes if required, providing significantly greater flexibility in comparison to wet grinding circuits.

4

Advanced process flexibility

Dry-ground ore can then be stored in silos equivalent to power accumulators. When excessive renewable energy is available, the mill capacity can be fully used to fill the product silos. If less energy is available, the pre-ground product stored in silos can compensate for the lower throughput of the grinding circuit.

5

Reduced consumables and CO₂ footprint

Through the usage of PRONAMIC® Spare and Wear Parts, a potential material saving of 90 % is possible compared to the conventional alternatives such as forged steel balls from SAG and ball mills.

ENVIRONMENTAL IMPACT

Looking ahead, we are striving to take our ambitions a step further. With water scarcity being another topic of materiality to the industry, we're setting out to continue our technologies regarding process grinding.

Especially in the iron ore industry, the world's largest ore market, the topic of complete dry processing has been of relevance in recent years. The field shows great potential to benefit from installing LOESCHE VRMs, encompassing an enormous chance to increase sustainability within the industry.

The dry grinding process in the LOESCHE mill enables dry magnetite pre-separation of coarse iron ore fractions with a gangue rejection of 20 - 40 % weight mass. Ongoing improvements and new developments in fine dry magnetic separation technologies will further increase the percentage of iron ore to be treated completely dry. Consequently, noticeable savings within water, energy, and grinding media can be achieved. Additionally, tailings dams can be reduced in size and potential environmental and social hazards minimized.

LOESCHE installed its first reference grinding plant to process nickel-copper ore in 2023.

MINING

OUR NEW LOCATION DOWN UNDER

LOESCHE Australia, the youngest subsidiary of LOESCHE GmbH, Germany, was established 2023 and is based in Perth, Western Australia, focused on delivering innovative VRM grinding plant solutions to the mining and cement industries. With a strong foundation in providing high-quality spare and wear parts, modification and services to established customers in the cement sector, our goal is to expand our market for VRM and build a robust presence in the dynamic mining market.

MISSION

Our mission is to leverage industry expertise, advanced technology, and a customer-centric approach to drive growth in both the mining and cement industries in Australia and New Zealand. By offering tailored VRM solutions that improve efficiency, reduce wear, and increase sustainability, we've become a trusted partner for our customers and contribute to the long-term success of the industries we serve.

Key differentiators

- **Expertise in cement:** A strong foundation and established track record in the cement industry.
- **Innovation:** Cutting-edge VRM technology and engineering solutions to enhance productivity and reduce operational costs.
- **Customer-centric approach:** A commitment to understanding and meeting the unique needs of our clients.
- **Local presence:** Strong presence in Australia, providing tailored support to local mining and cement operations.
- **Sustainability focus:** Incorporating environmentally sustainable practices into our operations and solutions.



STEEL

STEEL

GREEN STEEL WITH LOESCHE

CHALLENGE

The production of pig iron, the basic material for steel production, represents a decisive step in the metallurgical industry. For a long time, the blast furnace process was considered the standard here. However, in recent decades the direct reduction process has firmly established its place as an innovative alternative. The blast furnace process has the disadvantage of being extremely energy-intensive and polluting. Unlike the blast furnace process, the current direct reduction process is based on the reduction of iron ore without the use of carbon. Instead, natural gas or hydrogen is used as a reducing agent. The reduction of the iron ore takes place under high temperatures, resulting in metallic iron. This can either be further processed as sponge iron (DRI) directly in the electric arc

furnace into crude steel or processed into briquettes (HBI) for transportation.

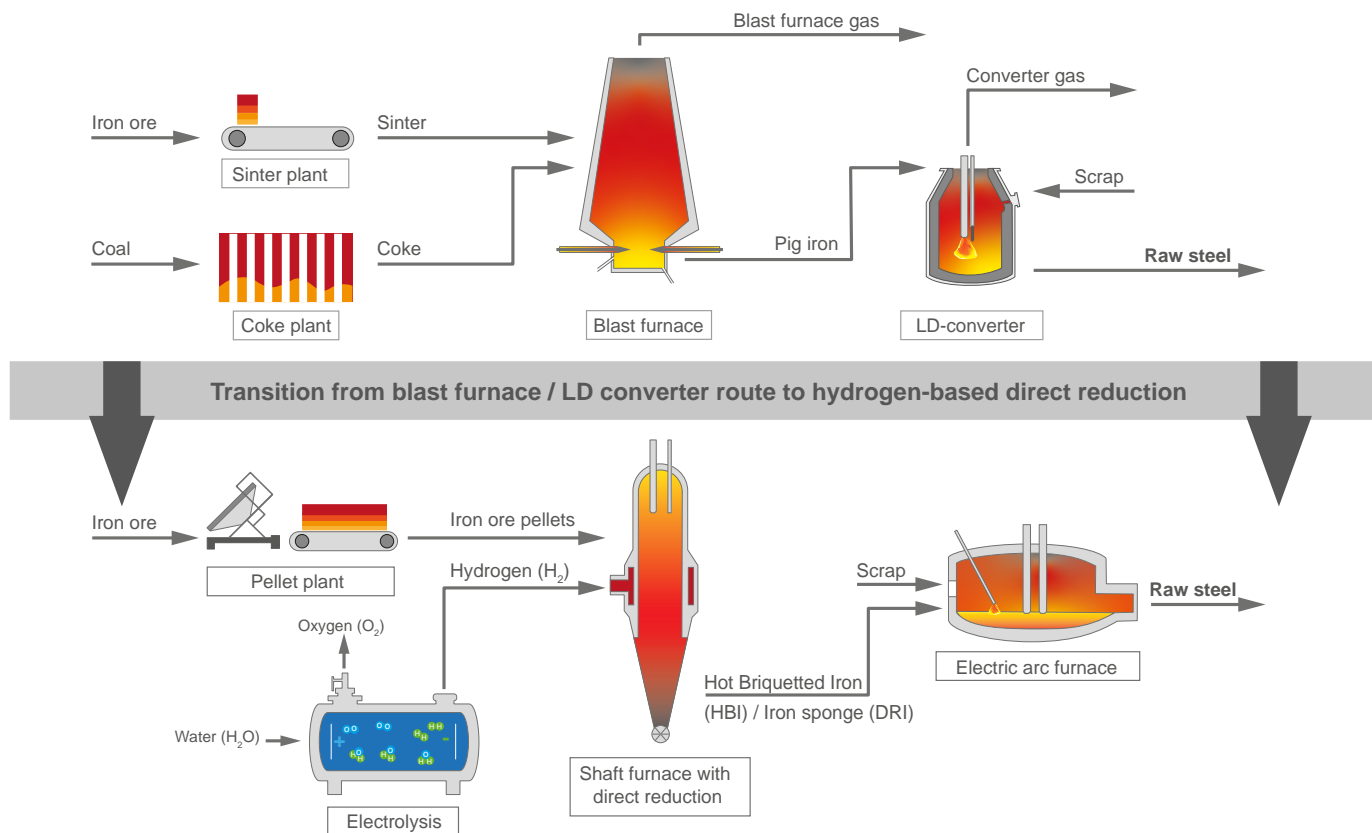
The direct reduction process is more energy-efficient and environmentally friendly than the blast furnace process because, when operated with green hydrogen, it produces no CO₂ emissions, but it requires high-quality iron ore with over 67 % Fe content.

In order to upgrade low-grade ores, it is necessary to crush them and separate them from foreign materials. The crushing of ores represents a fundamental step to reduce the particle size and thus enable efficient separation of valuable materials. This process is traditionally carried out in mills, where the ores are mixed with water to form a suspension.

This suspension, also known as 'slurry', provides a uniform distribution of ore particles, facilitating the separation of valuable materials.

Separation of iron minerals and non-valuable materials is a complex process that requires a variety of techniques. One commonly used method is magnetic separation, which uses the magnetic properties of the iron mineral to separate it from other materials. In addition, separation techniques such as gravity separation and flotation are used to achieve an effective separation.

Against the background of the declining supply of high quality lump ores, the processing of low-grade ores represents a growing challenge. This is where the LOESCHE vertical mill with its dry processing technology comes into play.



STEEL

GREEN STEEL WITH LOESCHE

SOLUTION

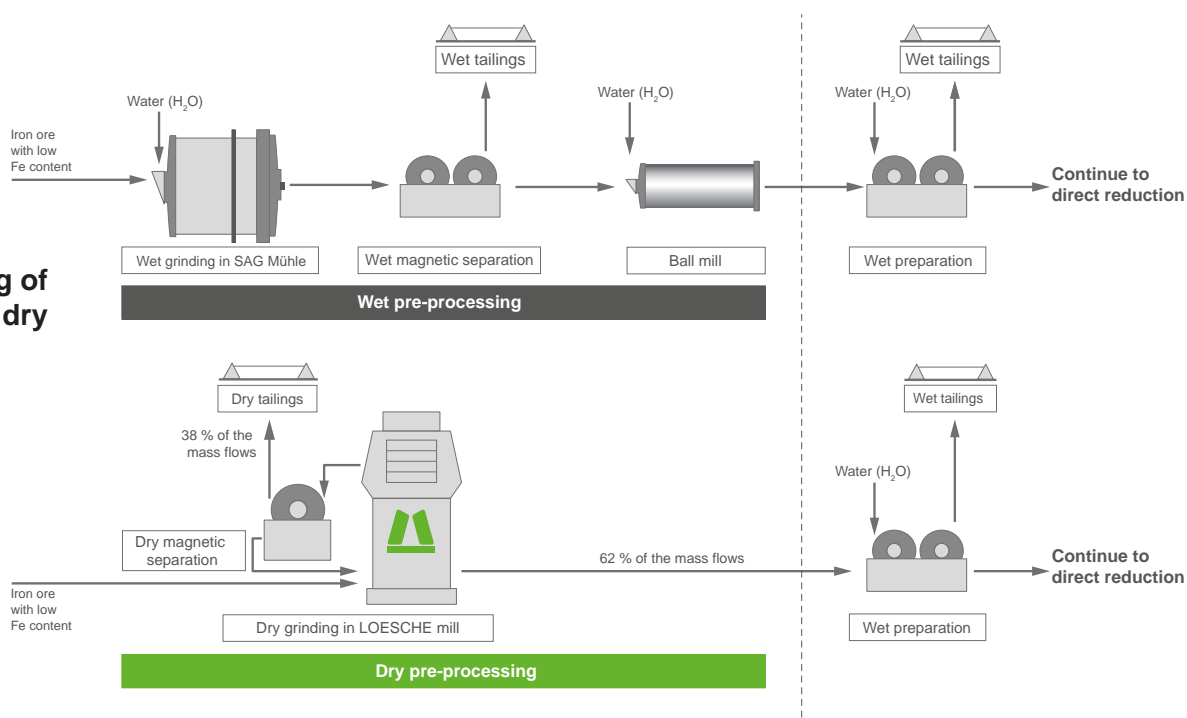
The LOESCHE vertical mill has already revolutionized cement production in recent decades. It has displaced the energetically inefficient ball mills in cement grinding and established itself as the leading technology.

With its single-stage, more efficient, dry grinding, the LOESCHE vertical mill offers numerous advantages over conventional technologies, including up to approx. 40 % energy and 25 % water savings. This helps relieve the already strained water supply in mining countries such as Australia, Peru and Chile. In contrast to conventional, wet comminution processes, LOESCHE vertical roller mills, in remote areas without connection to the power grid, can be operated self-sufficiently with renewable energies.

The advantages of the LOESCHE vertical roller mill in the ore processing are:

- dry grinding process
- compact design and small footprint
- high throughput rates
- high flexibility and fast adaptation to changes in the feed material
- less resource consumption than conventional reprocessing
- higher ore content due to improved concentration
- proven LOESCHE technology with more than 2,300 mills in operation worldwide
- high energy savings.

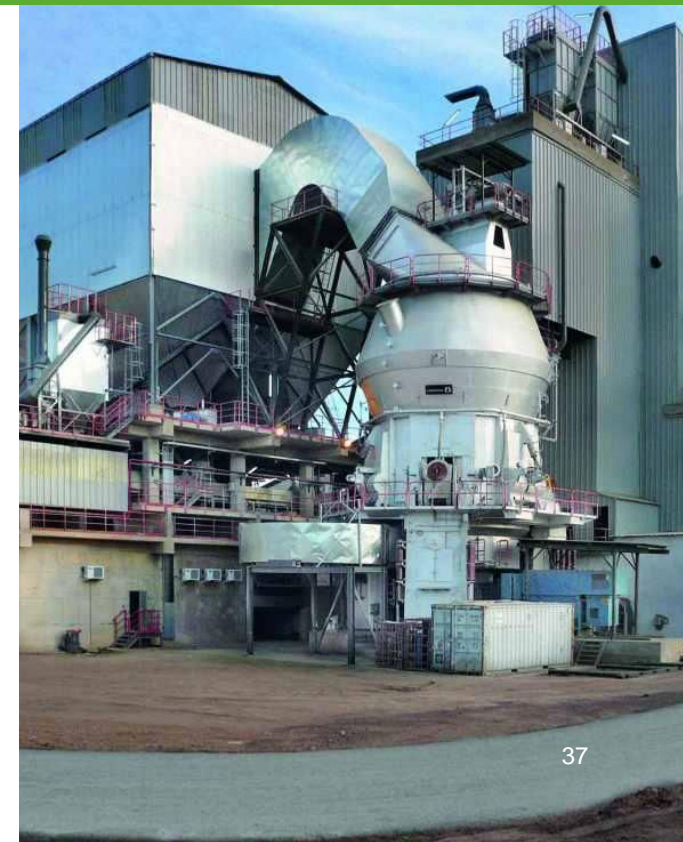
Pre-processing of iron ore: wet versus dry



ENVIRONMENTAL IMPACT

Dry processing in the LOESCHE vertical mill makes it possible to compact the residues from liquid processing, facilitating and supporting the dry storage of tailings. This represents a critical measure to significantly minimize the risk of tailings dam collapses, similar to the tragic incidents in Brazilian mining areas in 2015 and 2019.

LOESCHE's process has clear advantages over conventional processing methods. With the vertical mill and associated dry grinding, LOESCHE has the potential to shape ore grinding in a revolutionary way. This innovative technology paves the way for realization of the vision of emission-free pig iron production.



SERVICES

LOESCHE offers a holistic service concept to its customers: starting from supervision services during installation and commissioning, followed by expert audits, supply of basic spare and wear parts, up to operation and maintenance services for entire plants. Like other fields of our business activity, the service is based on a global network of experts located in LOESCHE's subsidiaries around the world.

There are also dedicated service hubs like the LOESCHE Middle East FZE, serving as spare part hub in the region, or LOESCHE Bahrain, which employs multinational experts and coordinates their calls to our global operations.

Established in 2017, LOESCHE's own product group for wear parts and welding services, PRONAMIC® has become a fast-growing and very successful complement to our product portfolio.

PARTS & SERVICES

CIRCULARITY IN SPARE & WEAR PARTS



LOESCHE is an original equipment manufacturer and therefore supplies spare and replacement parts for the after-sales support. LOESCHE may also supply parts for non-LOESCHE mills upon request.

The wear parts are most relevant to the sustainability theme as:

They are essential for the protection of the mill, extending its useful life and ensuring that the sub-assemblies are not affected.

They are consumable items which must be replaced or refurbished periodically. The management of the wear parts therefore is central to the sustainability issue.



The grinding parts are a special subset of the wear parts as they carry out the intensive grinding function of the mill. They are in direct contact with the abrasive media and therefore there is a proportional loss of material during grinding.

The management of the grinding parts has a direct impact on sustainability as:

The grinding parts are subjected to the most intense wear.

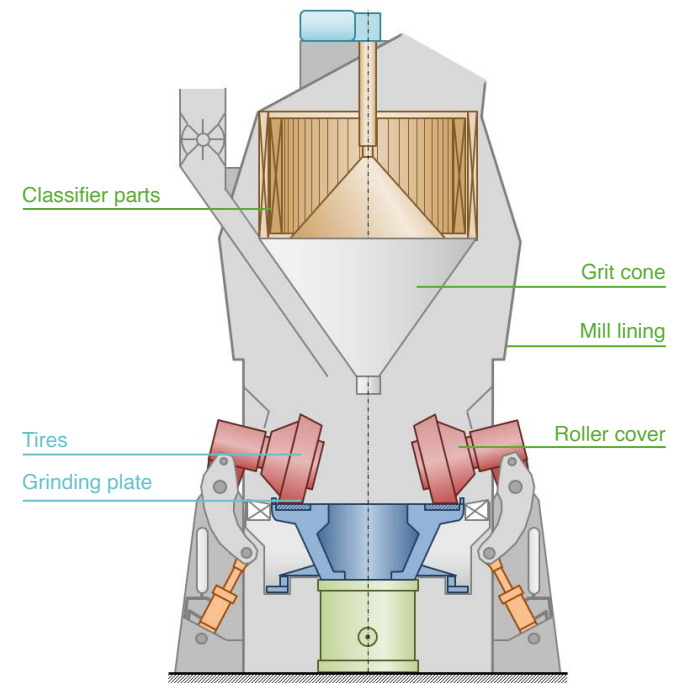
Product quality is important to avoid premature failure and achieve adequate service life, reducing consumption of replacement parts.

The grinding efficiency degrades with wear, which impacts on the production rate and will increase specific power consumption.

The following convention is useful for reference.

Wear parts: The family of parts whose aspect and shape change over time, e.g. due to wear. Wear is a result of several mechanisms including abrasion and erosion. For convenience, this term is used for all mill parts except the grinding parts.

Grinding parts: An important sub-set of wear parts, including specifically the tires and grinding plates. The grinding parts are in direct contact with the media under pressure and are subject to the most demanding intensity of wear in the mill. The grinding parts may directly influence the mill efficiency since they define the bed shape.



Distinction between wear parts and grinding parts

The 2017 created PRONAMIC® brand focuses on wear parts. In Europe, around 160 million tons of the steel produced every year are made with large amounts of steel scrap. With around 100 million tons of scrap steel recycled each year, more than half (56 %) of EU steel is made from scrap.

The PRONAMIC® Grinding Parts aims to accelerate steel sustainability in the industry as wear parts offer full recyclability.

PRONAMIC® Grinding Parts also transcend the current benchmark for recycling in comparison to current European steel production as they are complemented by PRONAMIC® Services to allow for continuous replenishment of the material worn in service. This effectively eliminates the scrapping of parts. PRONAMIC® can be restored indefinitely, whereby only the worn mass is replenished, without limitation to the number of times.

Reduction of material usage: The service life is extended through an efficient design that uses a tough core and highly abrasion-resistant layers, which outlasts the traditional abrasion-resistant white iron castings.

Reusability: Parts are reused indefinitely as they can be refurbished in-situ or in the workshop; the ability to refurbish in-situ avoids necessary transportation of heavy parts.

Repairability: PRONAMIC® Parts that are unintentionally damaged can be repaired quickly in-situ or in the workshop; the repairs can be carried out close to the installation, avoiding unnecessary transportation of heavy parts.

Recyclability and the ability to be remanufactured and redistributed, in any state of wear. The energy spent on recycling by means of welding is only a fraction of that spent on casting a novel item.

PRONAMIC® Parts are advantageous in comparison with abrasion-resistant white iron parts. They last longer, they are tough and can be repaired locally, for example, in case of unforeseen stoppages. PRONAMIC® resolves the inherent deficiencies of abrasion-resistant white iron's brittleness, which may lead to serious structural damages, and impossibility to repair or recycle due to the poor weldability under normal conditions. Brittleness and the impossibility to repair were always a concern, potentially limiting the mean time between failures.

PRONAMIC® Parts are designed to be topped-up regularly during operation, preserving efficiency. This is described under PRONAMIC® Services.

PRONAMIC® Parts are manufactured using simple and well-established industrial processes. They are a result of the re-engineering of the traditional hard casting, using instead a tough structural core that is overlaid by noble materials with enhanced abrasion resistance.

Further advantages include:



Reduction in machining, time and cost.



Reduction in number of casting patterns and related inventory control.



Reduction in transportation because most processes are carried out in a single LOESCHE location.



Enhanced quality control because the material is easily inspected with non-destructive techniques.

The ability to carry out most manufacturing operations in one location moreover contributes towards reducing the environmental impact associated with transportation.

PRONAMIC® SERVICES



LOESCHE pairs the supply of PRONAMIC® Parts with PRONAMIC® Services, which can be repeated as many times as needed. The service packages are flexible and can be carried out either in-situ or in local workshops.

Whether on-site or in the workshop, the refurbishment involves much less energy than the manufacture of new parts. For instance, the grinding parts are refurbished before the wear reaches 10 % of the total mass, after which the grinding efficiency may degrade significantly. The top-up is carried out by means of welding, which can be compared to a small-scale casting process. In this manner, the energy needed to cast the other 90 % of the mass is saved. The above is an over-simplification of the true savings because refurbishment welding avoids the entire process chain of casting a novel item, including heavy machining operations, transportation of heavy items, planning, etc.

The benefits from unlimited refurbishments were made possible by the adoption of the weldable, structural core used by the PRONAMIC® Parts. The mean time between failures for the new parts is in principle significantly enhanced in comparison with the abrasion-resistant white irons and the metal-matrix composites.

The choice between site or workshop services is flexible and depends on preference and situation. Site Services are normally most efficient for large components as they (a) eliminate the need to disassemble the old parts, (b) re-assemble new parts, (c) transport the heavy parts, (d) avoid the health and safety concerns in handling large and heavy items, etc. For this purpose, LOESCHE developed the PRONAMIC® Welding Equipment, which is modular, portable and incorporates drive systems for tires and grinding plate in-situ.



EXPERT AUDITS

In the course of a LOESCHE Mechanical Audit, an engineer determines the mechanical condition of the plant. A particular focus is placed on the wear condition of the equipment and the spare parts inventory.

The LOESCHE Technical Audit is the comprehensive audit package for the grinding plant.

An experienced LOESCHE engineer will perform the audit at your plant. During the audit we will collect data about capacity, product quality, energy consumption and raw material usage. In this way, we collect all important information about the mechanical condition of the mill and the current process data such as gas flow, process temperature, and product quality, because various influences can lead to a reduction in plant efficiency.

The LOESCHE expert audits provide customers with adequate support in overcoming challenges such as wear, machine availability, product quality, environmental regulations and requirements for energy savings or new emission standards.

OUR TEST CENTER

The 'Technikum', our TEST Center at the core of our innovation

Based in Neuss, Germany, our Test Center is at the heart of our research and development efforts. As LOESCHE mills and technologies are processing industrial and natural raw materials, testing, and analyzing the original material is essential for finding the right solution for each application.

The Test Center offers outstanding capabilities with three industrial halls and several laboratory rooms. Everything from material receiving, storing, and preparation (crushers, mixers, dryers) to processing (mills, classifiers, filters, sorting equipment) and to analyzing (fineness, moisture, chemical composition) can be realized.

OUR TEST CENTER

The four fully automated pilot-scale grinding plants are the heart of the Test Center. The plants work and operate exactly as LOESCHE's industrial plants, providing various opportunities. As they are equipped for testing purposes, the grinding plants offer even more processing flexibility and data recording possibilities than their big brothers and sisters.

Furthermore, with the OGP mobile, LOESCHE's mobile Ore Grinding Plant, even a small, containerized test center on wheels is available for our clients at any location in the world. The Test Center and the OGP are operated by a dedicated team of test engineers, laboratory technicians, and mechanics.

On the one hand, the daily business for the team consists of so-called standard grinding tests. These are carried out for material characterization and grindability determination of customer materials. The generated values are used for individual mill and machine layouts for various applications.

The flexibility of the laboratory mills in our Test Center allows us to test further possible applications of the LOESCHE mill. Combined with cyclones, an ultra-fine product can be screened out to meet the demand for cement for special purposes. Here, the LOESCHE team can try new processing routes and technologies, test and improve new designs or think outside the box with the material at hand.

The Test Center plays a vital role. Innovation is an integral core value of LOESCHE, and as such, the Test Center continues to accelerate innovative and sustainable engineering for our company.

RESEARCH IN 2023

Out of the 250 grinding tests that took place in our Test Center in 2023, more than 40 % were regarding R&D purposes, including not only the established GREENKEY Solutions C/CLAY, S/CRETE and E/SLAG but also alternative fuels.

High requirements and new material properties bring more challenges, such as careful handling, special equipment modifications and comprehensive analyses, to which the Test Center team is dedicated.

In addition to grinding tests with material provided by customers, the Test Center is always striving to optimize the LOESCHE mill and the grinding process. New geometries of grinding parts for cement have been tested, as well as new wear parts made of a wide variety of wear-resistant materials.

We operated the previously commissioned grit recirculation with various types of iron ore and different setups of the magnetic separation. The grit recirculation is equipped with a magnetic drum that can separate the coarse material coming out of the mill into magnetic material, which is returned to the mill to be ground to final product size, and non-magnetic material, which is removed without further grinding to save energy. Beyond that we tested the grit extraction for copper ore. Though magnetic separation is not utilized, the discharge of the coarse particles still results in much higher product output for the same energy input. In addition, the coarse grit without fine particles is exactly the ideal material for the floating process afterwards. The beauty of the entire circulation and separation process is that it does not require water, as it is the case with conventional separators in the ore industry, making it a perfect final part of the LOESCHE VRM process for the mining industry.



OUR SUPPLY CHAINS

Through our international operations, LOESCHE has established a solid global sourcing network over the years. All purchasers in the LOESCHE Group are closely connected and support each other in their daily business with respective locally based suppliers.

Today, LOESCHE Mills Shanghai (LMS) is one of the most important suppliers for the LOESCHE GmbH and the LOESCHE Group. In addition to large welded components such as mills' upper and lower parts, LMS also supplies entire machines such as classifiers for projects worldwide. In addition to LMS, the highest-volume suppliers are predominantly internationally active group companies from which LOESCHE purchases, for example, gearboxes, castings, and rollers.

Joint way to more sustainability

For many years, we have nurtured strong and enduring business relationships with our key suppliers, fostering successful collaborations and joint developments. As the majority of our procurement volume is already sourced from suppliers deeply committed to ambitious sustainability objectives, we eagerly look forward to extending our cooperative efforts in the realm of sustainability.

In the immediate future, LOESCHE will establish its own policies and strategies for promoting more sustainable supply chains, and we will become more mindful of the leverage our procurement volume offers. As an initial and visible step, LOESCHE will voluntarily adhere to the German Supply Chain Act. Over the coming years, we aim to proactively engage with our supply chain partners, collaborating to identify opportunities for enhancing the sustainability of our operations. Notably, our procurement department's experts, specializing in the Supply Chain Act, have been active members of LOESCHE's Sustainability Team, which has been in operation since 2020. This integration ensures seamless support and collaboration between both teams.

Hybrid meeting to save emissions

Supplier visits were a regular practice at LOESCHE until 2019. These visits encompassed both outbound trips to suppliers worldwide and inbound visits from suppliers to LOESCHE for negotiations or new partnerships. However, due to the impact of the pandemic and the subsequent lockdown, virtual meetings gained prominence for these interactions.

From 2020 to 2022, this trend not only persisted but also gained momentum even after the lockdown restrictions were lifted. As a result, pure virtual or hybrid meetings became the preferred choice over traditional in-person gatherings. This shift led to a significant reduction in CO₂ emissions, stemming from decreased travel distances and a decrease in air travel.



PEOPLE

TURN IDEAS INTO TECHNOLOGY. OUR EMPLOYEES, OUR GREATEST ASSET

At LOESCHE, we know that the key to implementing technological ideas lies in the commitment and creativity of our employees. This conviction forms the foundation of our values and our corporate culture.

We value a long-term orientation, a high sense of responsibility towards our employees and their families and a family environment in our company. By promoting cultural diversity, responding to individual needs and encouraging teamwork. We create a workplace where everyone can flourish.

Our employees have the freedom to innovate, make decisions and make a significant contribution to LOESCHE's history. It is through their performance and commitment that we achieve joint success. We maintain an open dialog with our Works Council to ensure employee involvement in key decisions and to create a collaborative and inclusive work environment.

At LOESCHE, we are committed to providing the necessary tools and support to cultivate a positive and collaborative work environment where everyone can thrive.

OCCUPATIONAL HEALTH & SAFETY

Ensuring safety in field operations

We are committed to supporting our customers with the introduction and installation of our products and technologies. Our team members are on site to assist with the handling of heavy machine components and to ensure smooth operation. Together we are responsible for maintaining safe working conditions.

In 2023, we provided for all our technical field engineers:

- Occupational health reviews
- Annual health and safety training
- Safety Certificates for Contractors (SCC)

All LOESCHE field engineers are fully equipped with personal protective equipment (PPE) that meets or exceeds safety requirements. They are also provided with workwear that complies with the latest international standard EN ISO 20471, ensuring visibility and safety in different areas of operation.

The on-site organization for LOESCHE divides into two different levels of responsibility. On the one hand, we have the delegation of supervisors to sites with a 3rd party general contractor. On the other hand, LOESCHE holds full responsibility for all site activities for engineering, procurement, and construction (EPC) projects. In most projects, field staff for supervision is sent by LOESCHE as well.

The one responsible for the site is obligated to:

- prepare a health and safety plan,
- observe and enforce that all rules and regulations are met,
- conduct and document safety instructions and training,
- sanction persons or companies that violate the safety rules.

Occupational Health & Safety

At LOESCHE, the topic of Occupational Health & Safety (OHS) extends beyond construction sites to encompass all employees, including those working in offices or remotely. We are dedicated to ensuring that health and safety measures are implemented effectively across all work environments.

Our OHS team plays a pivotal role in this effort. Comprising representatives from our Duesseldorf offices, a security engineer, and a medical officer, the team meets regularly to evaluate potential risks, provide guidance, and implement appropriate safety measures. The team's members also represent OHS topics in the company's works council, ensuring that critical issues are addressed and supported at the organizational level.

LOESCHE's OHS initiatives include:

- **Regular health checks:** Employees are offered a range of medical examinations, including general check-ups, blood tests, visual and hearing assessments, and stroke and heart attack prevention screenings. These proactive measures help identify potential health risks early and facilitate preventative action.
- **Occupational health screenings and consultations:** Employees benefit from targeted occupational health assessments and expert advice to address specific needs related to their roles and work conditions.
- **Sports and prevention program:** At LOESCHE, we recognize the vital role of physical activity in promoting health and reducing stress. We provide a range of sports and prevention opportunities. In June 2023, an all-day event held at a nearby fitness studio, offering employees the chance to explore various sports activities. This was followed by a weekly back fitness course that was specially tailored to the needs of our employees. In addition, a fitness trainer has been coming to the office once a week since 2023 to lead an exercise lunch break.

We track all health and safety-related incidents. In 2023, there were only three reportable occupational accident at LOESCHE.

Flexibility through mobile working

The COVID-19 pandemic marked a significant shift in how we work, and at LOESCHE, mobile working has since become a core element of our daily operations. By adopting a flexible approach, employees balance remote work with days in the office, with departmental managers ensuring a fair and practical framework for all team members.

The positive feedback from recent years highlights how mobile working has been well-received across the company. This flexibility has played a key role in enhancing employees' work-life balance, fostering satisfaction and productivity.

To complement the benefits of remote work and preserve a strong sense of community, LOESCHE actively promotes team-building initiatives. Annual summer parties, Christmas celebrations, and Carnival events provide opportunities for colleagues to come together, strengthen relationships, and contribute to a supportive and positive working environment.

By combining flexible work arrangements with a focus on team spirit, LOESCHE continues to create an engaging and inclusive workplace for all employees.



TRAINING & DEVELOPMENT

Knowledge transfer: A core tool in knowledge management

Demographic change presents a significant challenge for LOESCHE. Many of our employees have dedicated decades to the company, amassing invaluable expertise and experience. As members of the baby boomer generation approach or enter retirement, LOESCHE faces the critical task of preserving their knowledge and ensuring its effective transfer to the next generation of employees, minimizing any potential loss.

To address this challenge, LOESCHE introduced the **moderated knowledge transfer** process in 2023. This structured approach ensures that the expertise of departing employees (knowledge providers) is systematically secured and passed on to successors (knowledge takers). Key features of the process include:

- **Trained knowledge transfer moderators:** Specialists from various departments guide the knowledge transfer process, supporting departing employees in documenting their expertise through tools such as knowledge maps and transfer plans.
- **Guidance for successors:** the knowledge transfer moderators assist incoming colleagues in acquiring and applying the transferred knowledge to ensure continuity and smooth transitions.

Participation in the moderated knowledge transfer process is voluntary, with every departing employee offered this opportunity. By implementing this system, LOESCHE is committed to retaining its organizational knowledge and equipping future generations of employees with the tools they need to succeed.



Blended Learning: a cornerstone of employee development

At LOESCHE, training and further education are fundamental to our approach to personnel development. By prioritizing needs-oriented and continuous employee growth, we aim to ensure a long-term, mutually rewarding working relationship. During annual personnel development meetings, employees and their superiors collaboratively define development goals, which are subsequently supported and implemented by HR.

Since the introduction of our first in-house Learning Management System (LMS) in 2008, LOESCHE has embraced a hybrid blended learning approach. This combines in-person seminars with online eLearning courses to provide a flexible and comprehensive learning experience. Our annually updated training catalog offers employees access to both mandatory and optional development opportunities.

Key mandatory training programs cover critical areas such as:

- Data protection
- Information security
- Compliance (including General Equal Treatment Act)
- Occupational health and safety (OHS)

In 2023, the OHS training initiatives focused on essential topics, including workplace health and safety fundamentals, construction site safety, and fire protection. By investing in a robust and integrative learning ecosystem, LOESCHE empowers employees to enhance their skills and knowledge, fostering both personal and organizational growth.

DIVERSITY & INCLUSION



Some of LOESCHE's female employees at the headquarters in Düsseldorf

At LOESCHE, we operate under a strong framework of social, environmental, and ethical standards. We are deeply aware of our duty of care and are committed to respecting and upholding all internationally recognized civil liberties, human rights, and freedoms. Across all countries in which we conduct business, compliance with applicable laws and regulations serves as the foundation of our activities.

We prioritize the rights and well-being of our employees by ensuring humane and ethical working conditions. These conditions align with internationally recognized basic labor standards and the legal frameworks of the regions where we operate. Our commitment includes:

- Preservation of human dignity
- Prevention of child and forced labor
- Promoting anti-discrimination and diversity
- Ensuring equal opportunities in career development
- Respecting the right to freedom of assembly, organization, and collective bargaining

Special attention is given to protecting the rights of vulnerable groups, including children and young people, pregnant women, and individuals with disabilities or reduced mobility. By embedding these principles into our corporate culture, LOESCHE reaffirms its dedication to ethical business practices and the creation of equitable and inclusive working environments globally.

Advancing diversity and gender equality

We acknowledge the need for continued progress in promoting diversity and gender equality within our workforce. Currently, the representation of male, female, and diverse employees does not align with the demographic composition of the German population. Despite the traditionally male-dominated nature of technical professions, the proportion of female and diverse employees at LOESCHE remains an area requiring significant improvement.

Recognizing this challenge, LOESCHE is committed to taking proactive steps to enhance its appeal as an employer for individuals of all genders. Addressing this imbalance is especially crucial in the context of the growing shortage of skilled workers, a challenge of particular importance to an innovation-driven company like LOESCHE.

By fostering a more inclusive and diverse workplace, LOESCHE aims to better reflect societal demographics, strengthen its talent pool, and continue driving innovation through a broader range of perspectives and skills.

GREEN MOBILITY



GREEN MOBILITY

BICYCLE LEASING

Since January 1st, 2022, the leasing of a company bicycles was realized at LOESCHE's headquarters in Duesseldorf.

Available to all employees, the bike leasing service provides an incentive to exchange the car for a more environmentally friendly option to commute. In addition to the positive impact on our climate, cycling proves to be a great opportunity to improve mental and physical well-being.

Bicycles, as well as e-bikes, can be leased through salary conversion, whereby the leasing package includes full-service insurance and a mobility guarantee. In addition, a maintenance package is also included, which is provided by LOESCHE.

In the year 2023, **30 company bicycles** were leased by LOESCHE employees.



Cycling for a good cause

On the initiative of an employee who is a cycling enthusiast, LOESCHE has also been participating as a company team in the Germany-wide 'Stadtradeln' (<https://www.stadtradeln.de>)

campaign for years, which aims to cover as many distances as possible by bike and save CO₂. In 2023, this activity is strongly supported by our General Management.

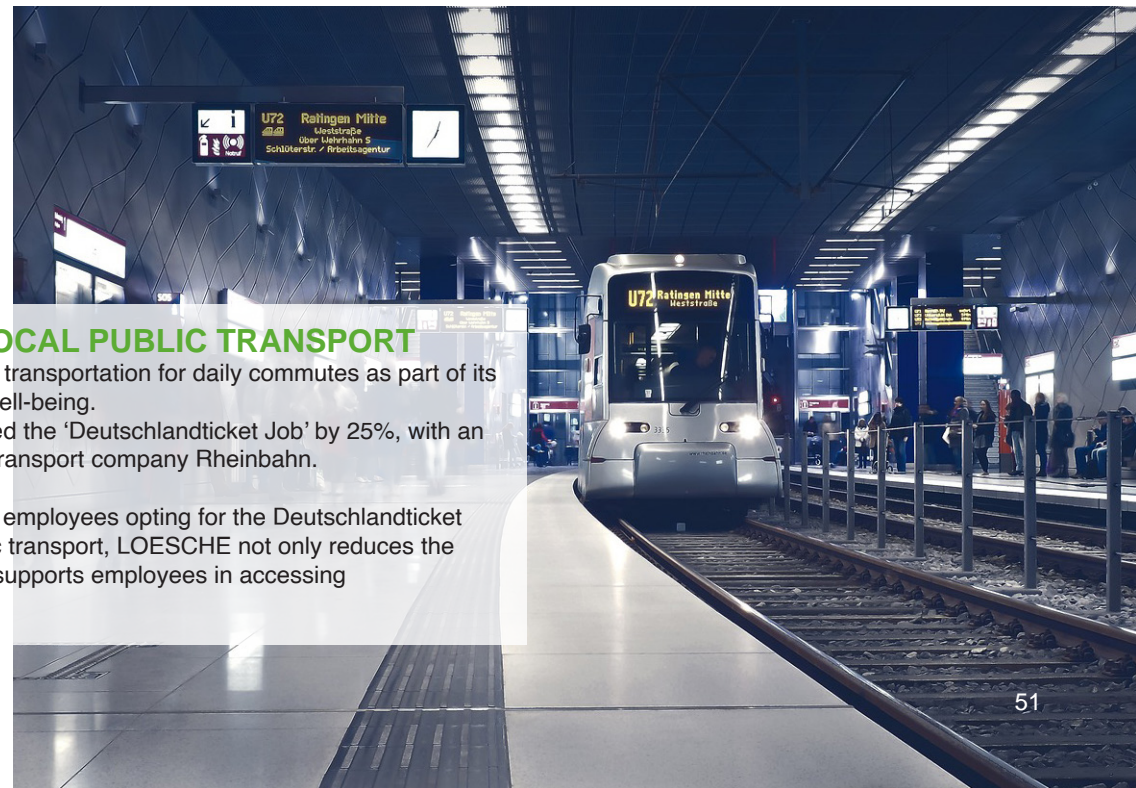


ENCOURAGING THE USE OF LOCAL PUBLIC TRANSPORT

LOESCHE actively supports the use of public transportation for daily commutes as part of its commitment to sustainability and employee well-being.

Since May 1st 2023, LOESCHE has subsidized the 'Deutschlandticket Job' by 25%, with an additional 5% discount provided by the local transport company Rheinbahn.

This initiative has been well-received, with 35 employees opting for the Deutschlandticket Job in 2023. By encouraging the use of public transport, LOESCHE not only reduces the environmental impact of commuting but also supports employees in accessing cost-effective and convenient travel solutions.



COMMUNITY OUTREACH

SOCIAL RESPONSIBILITY DAYS

COOPERATION WITH A LOCAL NON-PROFIT ORGANIZATION

As part of LOESCHE's ESG (Environmental, Social, and Governance) initiatives, LOESCHE management actively supports and promotes the voluntary commitment of its employees, with a focus on social issues and environmental protection.

In response to the war in Ukraine and the resulting refugee crisis, the idea was born in early summer 2022 to launch the first 'LOESCHE Social Responsibility Days', which were dedicated exclusively to helping Ukrainian refugees in Düsseldorf.

These Social Responsibility Days were continued and even expanded in 2023 under the planning and leadership of LOESCHE's internal Communications Manager. Together with the volunteer organization HISPI* (Hilfe bei der sprachlichen Integration) in Düsseldorf, she organized two different action days.

On the first day, LOESCHE volunteers helped the participants of the HISPI language course to sort and secure their German-language documents.

The second day of action was all about manual work. LOESCHE's volunteers painted the classrooms of the HISPI together with some refugees. The paint required for this was donated by the General Management of LOESCHE. The classrooms thus shone in new splendor in time for the HISPI's anniversary celebrations.

The joint work of the LOESCHE volunteers strengthened the team spirit. They did something good together and had a lot of fun at the same time. The contact with refugees gave everyone involved new impressions and caused some of the helpers to learn to appreciate their own life situation anew.

The Social Responsibility Days were well received by LOESCHE employees and were a rewarding experience for everyone involved.

The ongoing connection with the HISPI volunteers goes beyond these action days, and further initiatives have already been strategically outlined for the coming years.



Above: Impressions of LOESCHE's Social Responsibility Days in 2023.

* For more information: www.hispi.de

LONG-TERM PARTNERSHIP FOR A SUSTAINABLE FUTURE

Longterm activities in Madagskar for a sustainable future

LOESCHE has been a committed supporter of the non-profit organization **BioPelletsEnergy gUG** (BPE) for several years. In the past, this collaboration involved mainly technical expertise and material donations.

In 2023, LOESCHE strengthened its partnership with BPE by pledging long-term financial and regular support to BPE. This initiative aims to promote research into biopellets, advance environmental protection and sustainable energy solutions, and train the local population in Madagascar.



Pellets made of grass and other fast-growing plants in Madagaskar.

Who is BioPelletsEnergy?

As a non-profit company based in Duesseldorf and Madagascar, BioPelletsEnergy gUG* (BPE) aims to make energy access sustainable for the poorest inhabitants of developing countries.

We live in times of floods, drought, heat and the clearing of precious forests. In parts of the world, the effects have long been apparent. Without access to electricity, around 3 billion people worldwide cook with fossil fuels. Many of these people sacrifice their daily lives in search of remaining wood to burn directly or use as charcoal. The consequences, such as respiratory diseases, kill 3.8 million of them every year. If there is no wood, cooking is not possible. The result: people starve to death.

BioPelletsEnergy combats deforestation and hunger locally in developing countries. The self-produced BioPellets offer people without access to electricity a sustainable source of energy that not only has a positive impact on environmental protection, but also improves the quality of life and everyday life locally.

BPE started its activities in Madagascar: 90 percent of the original forest area there has already disappeared. The forests have been transformed into fallow land or grasslands.

Together with the local population, the AJPER association and the energy of the sun, they produce pellets from this grass.

The pellets are then made available to the people of Madagascar throughout the country. With the help of stoves made from local raw materials, such as clay, the pellets are charred in an energy-efficient and low-emission way while the food is being prepared. The charring process prevents the CO₂ previously bound in the plants from being completely released. This means that the locals can use the charred pellets as fertilizer for the eroded soil, thus creating an almost autonomous production cycle. Depending on the size of the press, between 125 tons and 2500 tons of CO₂ are saved each year.

Thanks to close cooperation with development aid organizations working in Madagascar and the AJPER student association at the University of Fianarantsoa, BPE has already achieved small successes. A production line for the stoves has already been set up and some energy-efficient models have already been distributed among the population.

* For more information: <https://biopelletsenergy.org/>

IMPRINT

Cautionary note regarding forward looking statements

The statements contained herein may include statements of future expectations and other forward-looking statements that are based on management's current views and assumptions and involve known and unknown risks and uncertainties that could cause actual results, performance or events to differ materially from those expressed or implied in such statements. The company assumes no obligation to update any forward-looking statement.



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