

12. RESEARCH AND DEVELOPMENT

Environmentally speaking, our Sustainability Strategy focuses on lowering CO₂ emissions, conserving resources, and implementing the circular economy. The aim is to bring about climate-neutral steel production by 2050. Life cycle assessments (LCAs), the digital transformation, sustainable products, and expanded material and energy cycles help us achieve our goals regarding resource conservation and the circular economy. This requires intensive research and development (R&D) work.



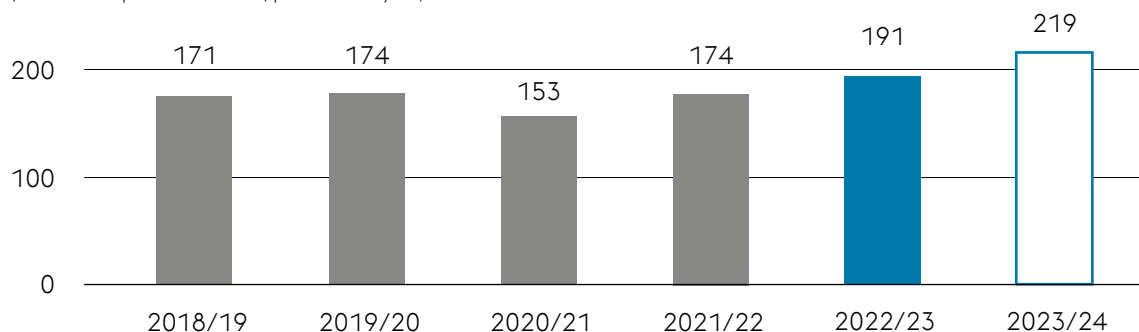
12.1 RESEARCH EXPENDITURES OF THE voestalpine GROUP

voestalpine's corporate strategy focuses on leadership in innovation, technology, and quality. As a result, R&D is key to our business mod-

el. Both the continual increase in related expenditures and the new, record-setting budget also underscore the significance of R&D.

GROSS R&D EXPENDITURES

(Excl. R&D capital investments) per business year, in millions of euros





12.2 PATH TO CLIMATE-NEUTRAL STEEL PRODUCTION

A key goal of voestalpine's decarbonization strategy is to avoid generating carbon dioxide from technical processes. Hence the company conducts intensive research on new processes and procedures for achieving sustainable steel production. A new process route for the climate-friendly production of pig iron is being evaluated in collaboration with Primetals Technologies based on the "Hyfor" technology. Hyfor comprises a hydrogen-based process for the direct reduction of fine ores that does not require any agglomeration steps such as sintering or pelleting. Numerous test runs have been carried out successfully in batch operations at the Group's pilot plant in Donawitz, Austria, since the process was launched at the end of calendar year 2021. The next step involves preparing a pilot plant enabling continuous operations at the Group's Linz, Austria, facility, which will incorporate the existing hydrogen electrolyzer facility.

The Sustainable Steelmaking (SuSteel) project entails research on an entirely new technology. Fundamental research conducted in this connection involves examining how steel could be produced directly from iron ore using hydrogen plasma without the intermediate pig iron step.

The development activities at the demonstration facility in Donawitz are proceeding successfully, demonstrating the feasibility of the technology in principle.

As long as carbon is indispensable to the production of high-grade steel, for example, researchers will also continue to work on solutions that make it possible to suitably utilize the carbon dioxide generated in the production process. This is why voestalpine Stahl GmbH is participating in the "Carbon Cycle Economy Demonstration" project of RAG Austria AG, which is being carried out in cooperation with energy producers and research institutes. In part, this project aims to set up a carbon cycle in which CO₂ from different waste gases generated in steelmaking is pumped into natural underground storage facilities together with hydrogen produced sustainably in the Linz-based electrolyzer facility. The methanizing then takes place in these storage facilities. In turn, this sustainably produced methane gas can be extracted as needed and returned to the processes. As a result, the carbon dioxide remains within the cycle and is not emitted.

12.3 PROCESS OPTIMIZATION THROUGH DIGITAL TRANSFORMATION

Algorithms, robots, model-based rules, and state-of-the-art sensor technology combined with artificial intelligence (AI) are already being used or implemented in the Group's production plants. The consistent push toward the digital transformation enables selective collection and

analysis of all relevant data and, ultimately, fully-integrated process routes that can be managed much more efficiently. Downtimes and production stoppages are reduced, operating personnel is supported, and product quality is stable at a high level or even enhanced.

12.4 CIRCULAR ECONOMY — KEY TO SUSTAINABLE PRODUCTION

voestalpine has launched a Group-wide project pertaining to sustainable processes that serves to identify and harness existing potential. Roughly one half of the project volume focuses on the circular economy. Numerous subprojects concern topics such as the processing of dust,

sludge, and slag. The aim is to recover all recyclable material using all available technological means and to bring about the meaningful reuse of residual products—including through other industries.

12.5 R&D FOR SUSTAINABLE PRODUCTS

A wide range of product innovations helps both voestalpine and its customers to achieve their respective sustainability targets. Among other things, our R&D work focuses on products that can be recycled in ever more environmentally friendly, effective, long-lasting, safer, and unproblematic ways. The following voestalpine products thus contribute to sustainable development:

- >> High-quality rails resistant to wear and tear
- >> Intelligent turnouts with diagnostic systems to ensure reliable track system availability
- >> Ultra-high tensile steels for lightweight construction of autobodies
- >> Electrical steel strip for highly efficient electric motors and for generators used in power generation
- >> Components for wind turbines, whether on or offshore
- >> Mounting systems for photovoltaic (PV) modules
- >> Turbines for pumped storage hydroelectric power plants
- >> Seamless tubes for transporting hydrogen
- >> Ultra-pure alloys as pre-material for medical technology
- >> Guard rails, safety belt tensioner tubes, high-tensile sections for driver's cabs, and other products serving to enhance security