6. CLIMATE PROTECTION

The production processes of the steel industry are energy intensive and thus emissions intensive. voestalpine actively engages in research and development projects to reduce CO_2 emissions and to contribute effectively to climate protection. Aside from voestalpine's innovation activities in metallurgy itself, its joint projects with the energy sector are becoming increasingly significant too. The political framework that is decisive to the actual implementation of new decarbonization technologies in the long term must be fleshed out simultaneously at the global, European, and national level.

6.1 THE POLITICAL FRAMEWORK

The continued implementation of the World Climate Agreement; EU requirements regarding energy, climate, research, and trade policies; as well as Austrian projects such as the national hydrogen strategy are the essential parameters of voestalpine's activities.

The company actively supports its core interests, both directly and through advocacy groups. This includes promoting innovations; coordinating EU-wide energy policies (expansion, electricity & natural gas infrastructure); safeguarding fair competition rules; and securing cost reductions in energy-intensive sectors during the transition to new technologies.

Austria held the presidency of the European Council in the second half of 2018. voestalpine participated in a multitude of related events and thus had the opportunity to draw attention to its challenges, approaches to solutions, and ongoing projects aimed at decarbonizing the production of steel in the long term. These activities included the unveiling of the company's hydrogen projects in the Austrian Pavilion at the Conference of Parties (COP 24) in Katowice, Poland; its participation together with K1-MET (a metallurgical competence center) in the "Wind of Change" conference that the EU Commission had organized in Brussels, Belgium, on the issue of energy in future steelmaking; and its participation in the Strategic Energy Technology (SET) Plan conference in Vienna. The high-level conference, "Charge for Change: Innovative Technologies for Energy-Intensive Industries," was held in September 2018 at voestalpine Stahlwelt in Linz as part of an informal meeting of the EU Council of Energy Ministers. During this event, attendees from both the political realm and industry, including then EU Commissioner for Energy and Climate Action, Miguel Arias Cañete, toured the H2FUTURE electrolyzer facility that had been installed at voestalpine's Linz plant.

Numerous renowned industrial companies—including voestalpine's H2FUTURE project partners, VERBUND and Siemens—as well as voestalpine itself signed the European Hydrogen Initiative that the Energy Ministers had adopted. Austria's hydrogen strategy, which is based thereon, is currently being prepared at the national level.

Five of the existent working groups that comprise key stakeholders are looking into technical, regulatory, and economic aspects of the infrastructure required for generating hydrogen with the help of electricity from renewable sources as well as into options for storing hydrogen. The Austrian Federal Ministries for Sustainability and Tourism (BMNT); Traffic, Innovation, and Technology (BMVIT); and Finance (BMF) are coordinating the work. voestalpine chairs the working group on "Hydrogen in Industrial Processes" at the invitation of the BMNT.

6.2 EU EMISSIONS TRADING

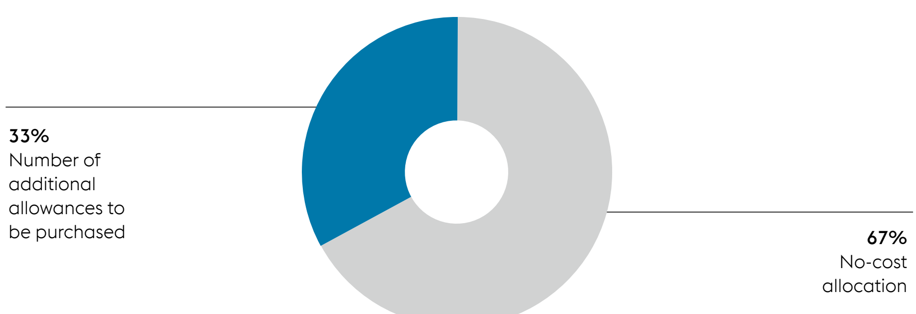
On paper, the Directive on the EU Emissions Trading System (EU ETS) provides for adequate no-cost allocations of allowances for the "best" facilities, i.e., those that are aligned with the benchmarks established by the EU.

This so-called "carbon leakage" protection is intended to prevent the shifting of emissions-intensive industries from the EU to regions where climate protection requirements are weaker. In actual fact, however, the European steel industry must purchase allowances for about one third of its emissions both in the current trading period (up to 2020) and in the subsequent one (up to 2030).

At this time, the voestalpine Group's expense under the EU ETS is about EUR 100 million per year. Assuming that the CO_2 price will stay at least at the current level of about EUR 30 per ton of CO_2 in the long term, voestalpine's total expenditures during the next trading period (2021 – 2030) will exceed EUR 1 billion.

EMISSION TRADING ALLOWANCES: FORECAST FOR voestalpine

Number of additional allowances to be purchased: about 45 million



The considerable expenditures for the EU ETS allowances are not available to research-intensive companies such as voestalpine for investments in low-carbon technologies.

voestalpine thus suggests that the EU ETS expense be refunded in full to such energy-intensive companies for earmarked purposes, i.e., subject to the requirement that the funds be utilized for taking innovative steps in the direction of environment and technology optimization programs aimed at lowering CO_2 emissions. Moreover, the competitive distortions resulting from divergent regulations throughout the EU in connection with the so-called electricity price offsets must be eliminated.

Under applicable EU state aid law, member states may grant offsets out of their proceeds from the national auctioning of ETS allowances to industrial consumers of electricity which, in some countries, account for up to 60% of the proceeds. This serves to offset higher electricity prices resulting from the energy sector's pass-through of the EU ETS expenditures to its customers. In Austria, however, this option has not yet been put into practice. At a CO_2 price of EUR 30, voestalpine's current cost disadvantage relative to its EU competitors is approximately EUR 40 million per annum.

6.3 DECARBONIZATION: voestalpine's OPTIONS AND PROJECTS

Coal and coke—the fossil raw materials on which conventional steelmaking is based—simultaneously are the main source of energy that is converted in the form of process gases into electricity in our own plants. In this way, our integrated steel facilities in Linz and Donawitz generate up to 80% of their electricity needs themselves; in other words, thanks to highly complex internal energy cycles they are largely independent of the external grid.

The energy equivalent for the crude steel production facilities in Linz and Donawitz is about 33 terawatt hours per year, which will have to be replaced by renewable energy from the external grid and/or by hydrogen generated with the help of renewable energy once the conversion to CO_2-minimized technologies has been completed.

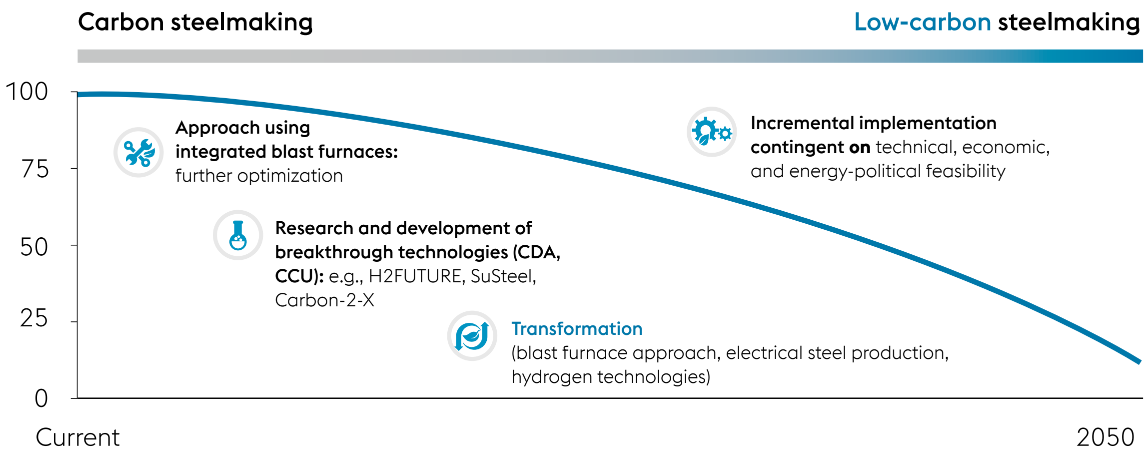
Several factors thus pose a challenge for the steel industry. In a first step, the industry must develop novel production technologies through research and innovation focused on metallurgy and process technology based on the use of renewable energy (e.g., green hydrogen) and upscale these new technologies. Subsequently, the industry will have to make heretofore unimaginable investments to convert existent production processes and, finally, competitively operate the new production technologies on a global scale.

While research and development are integral to companies' metallurgical know-how, the economic framework required for the broad-based implementation of novel technologies can only be created by way of a fundamental restructuring of the energy system.

6.4 TECHNOLOGY SCENARIOS

LOW-CARBON STEEL PRODUCTION: THE voestalpine SCENARIO

CO_2 emissions (in %)



As already described in detail in the previous CR Report, voestalpine is largely pursuing a concept that directly avoids CO_2 emissions (e.g., carbon direct avoidance (CDA)).

>> **voestalpine's decarbonization concept** aims to lower CO_2 emissions through the partial transformation of carbon-based steelmaking that requires integrated blast furnaces into electrical steelmaking that requires both the combined, flexible use of raw materials and an increase in the use of hydrogen (in the form of natural gas, coke gas, or pure hydrogen) and renewable energy. Depending on issues of technical and economic availability, in the long term the amount of hydrogen will be increased so that, in the end, the CO_2 emissions can be reduced by more than 80%.

>> **Research and development activities** including **upscaling** for the large-scale use of breakthrough technologies (e.g., H2FUTURE, SuSteel, Carbon-2-X):

> **H2FUTURE:**
Pilot plant in Linz serving to produce and test the industrial feasibility of green hydrogen. This EU showcase project at voestalpine's Linz facility receives major support from the Fuel Cells and Hydrogen Joint Undertaking (FCH JU) as part of the Horizon 2020 project.

> **Breakthrough technologies:**
Sustainable Steelmaking (**SuSteel**): Smelting reduction using hydrogen plasma and development of the technology in cooperation with a research facility at the Donawitz plant. The aim is to produce steel directly from iron ore without an intermediate step. This multi-year research and development project, which is supported by funds from the Austrian Research Promotion Agency (FFG), among others, is still at the bench scale.

>> **Bridging technology:**
Natural gas as a reducing agent in a direct reduction plant (currently in Texas, USA). Subsequently, this may be followed by the incremental use of green hydrogen (manufactured using renewable energy).

>> **Transformation of steelmaking in its current form,** i.e., from the carbon-based approach using an integrated blast furnace into electrical steelmaking that requires the combined, flexible use of raw materials (pig iron, scrap, hot briquetted iron (HBI)) and an increase in the use of both hydrogen and renewable energy.

>> **Incremental implementation** of the breakthrough technologies contingent on their large-scale technical maturity and the technically assured availability of renewable energy at competitive costs. These measures are intended to enable CO_2 reductions of more than 80% in steel production.

Aside from these carbon direct avoidance (CDA) options, voestalpine is also exploring the possibilities of carbon capture and usage (CCU). Ongoing and conceivable projects with respect to Carbon-2-X concern the conversion of CO_2 from process gases and the utilization of such gases along with hydrogen in both the energy and the chemical industry.

Above and beyond the technical feasibility, the use of raw materials and energy (using natural gas and hydrogen) in future steelmaking operations are material prerequisites for both CDA and CCU.

The funding requirements for all phases of this transformation are massive. Decarbonization also hinges fundamentally on the incremental restructuring of the energy system in the direction of a system where renewable energy is available in adequate quantities and on financially feasible terms so that the technologies available at the time can actually be operated competitively.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