



Sustainability Report 2023

MAN Energy Solutions
Future in the making

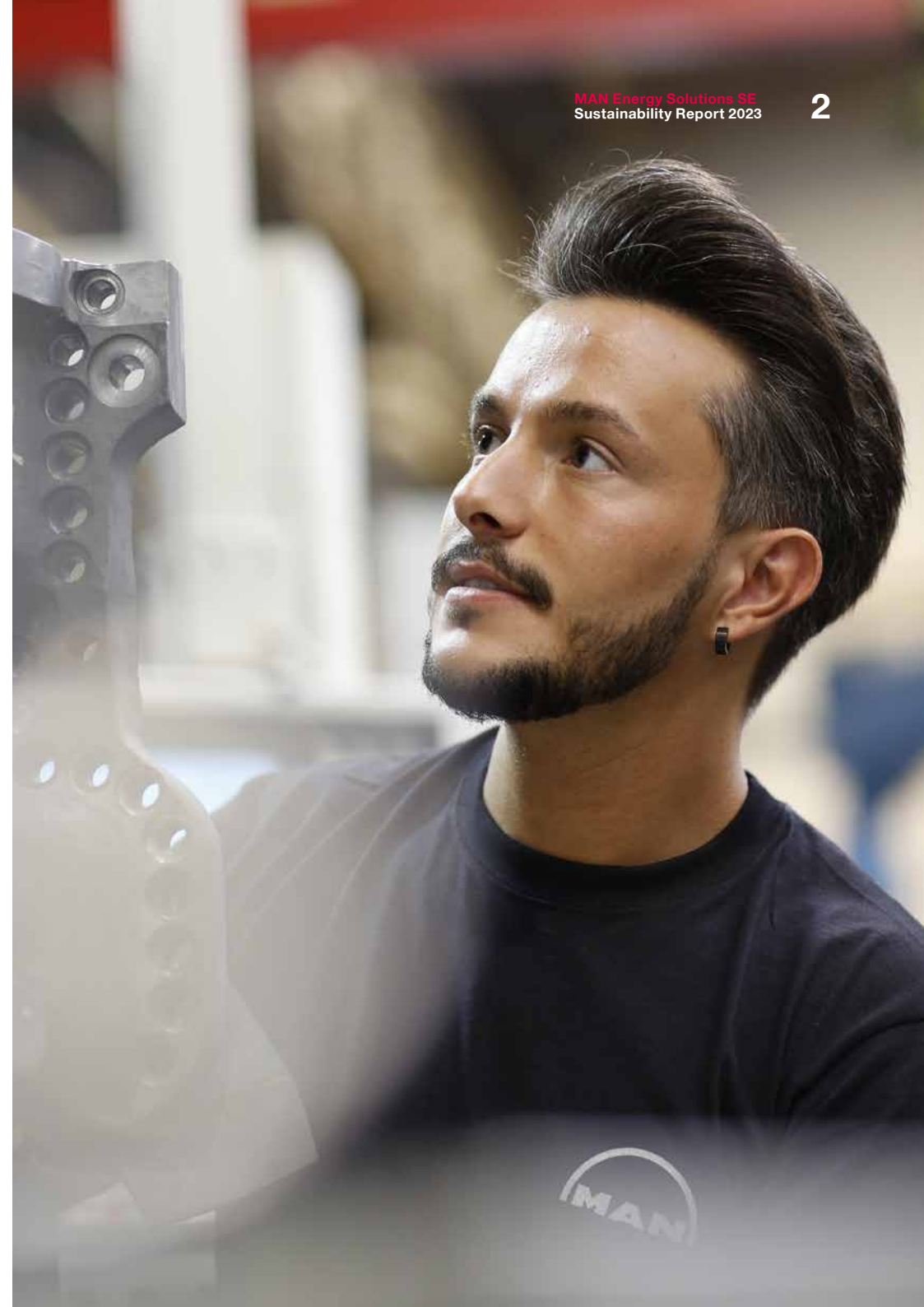


**Building a
sustainable
future**



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MAN Energy Solutions in brief

Headquartered in Germany, MAN Energy Solutions (referred to as MAN ES in this report) employs some 15,500 people globally. In addition to the twelve production sites, our after-sales brand, MAN PrimeServ, offers a vast network of around 130 service centers to our customers all over the world.

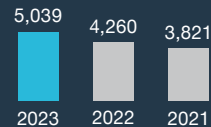
Leading the way in advanced engineering for more than 250 years, we provide a unique portfolio of technologies. It includes two-stroke and four-stroke engines for maritime and stationary applications, turbochargers and propellers, gas and steam turbines, compressors, and chemical reactors. We are the world's leading provider of large diesel and gas engines.

Our ambition is to develop solutions for profound decarbonization in the key sectors of the global economy, such as maritime shipping and the so-called "hard-to-abate" sectors – industries that are very difficult to decarbonize – and thus pave the way to a climate-neutral global economy. A significant driver here is digitalization: we are increasingly working digitally and offering innovative digital solutions that help our customers reduce their greenhouse gas emissions and achieve the goal of "net zero". The focus is on five technologies: large engines powered by future fuels, retrofits, industrial heat pumps, Carbon Capture Utilization and Storage (CCUS), and the PEM electrolyzers of our subsidiary H-TEC SYSTEMS.

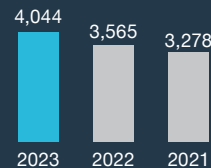


Finances

Order intake (in million €)

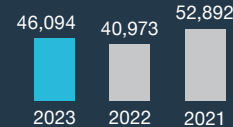


Revenue (in million €)

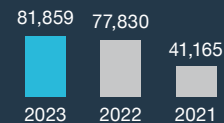


Decarbonization

CO₂ emissions Scope 1 & 2 (in t)

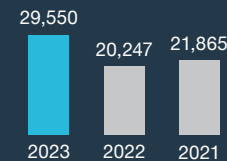


Energy consumption from renewable energy sources, external procurement (in MWh)

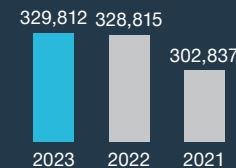


Circular economy

Total amount of waste (in t)

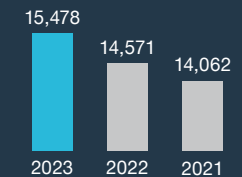


Amount of waste water (in m³)

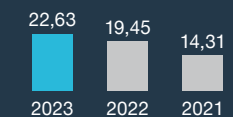


People empowerment

Workforce (Quantity on 31.12.)



Training & Qualification (in hours per employee)





Moving Big Things to Zero

Dear Readers,

2023 was a memorable year, for better or worse. Focusing solely on the development of our company, we can be delighted with the results: following the record order intake in 2022, we continued our successful course last year. With over 5 billion euros, MAN Energy Solutions booked more orders in 2023 than ever before in its more than 250-year company history. And for the first time, we reached the revenue threshold of four billion Euros.

This economic success is inextricably linked to the successful implementation of our strategy, which is entirely focused on decarbonization. You know: "Moving Big Things to Zero" is the mission to which we are committed. We aim to use our technologies to help drive the energy transition and combat harmful climate change, especially in those areas of the economy where electrification alone does not yet offer a path to climate neutrality. In these so-called "hard-to-abate" sectors of the global economy, technologies beyond batteries must be employed, which is our area of specialization.

In 2023, we achieved significant milestones on this path. A few years ago, we spoke only about concepts and plans. Today, we can point to tangible projects in the market. For example, in the Danish cities of Esbjerg and Aalborg, our

large heat pumps contribute to a climate-neutral district heating supply for more than 50,000 households. The breakthrough of large heat pumps in municipal and industrial heat generation is just beginning, and we anticipate significant new projects in 2024, both within and outside of Europe.

The development of our growth area for carbon capture and utilization (CCUS) from industrial processes continues to advance. Following our successes last year, we secured two more major European projects this year. Also, with the announcement by the German federal government to implement CCUS in Germany in the future, a long-overdue ban on this technology in Europe's largest market is finally being lifted.

The propulsion solutions from MAN Energy Solutions are advancing the maritime energy transition in the world's oceans. Last year, the world's largest container shipping company, Maersk, launched the first container ship in the world powered by "green" methanol, thanks to our technology. We are also leaders in retrofitting power plants and vessels with engines that can operate on synthetic fuels. Such retrofits are also relevant in the context of circular economy considerations: we provide our customers with

a clear roadmap to extend the life of their products through lifecycle upgrades and retrofits. This support benefits the customer as much as the environment, as resources are used longer and more sustainably.

Finally, I want to draw your attention to the growth of our hydrogen subsidiary, H-TEC SYSTEMS. In 2023, we laid the foundation for the largest electrolyzer manufacturing plant in Europe. This new facility will begin operations this year and significantly advance the urgently needed industrialization of hydrogen production.

These examples demonstrate that business success and sustainability are inseparable at MAN Energy Solutions. This fact was one of the reasons that we were awarded the German Sustainability Prize in 2023, an honor of which we are particularly proud and aim to live up to in the future.

Our growth program, "Move to Triple Ten+", guides us in this effort. We designed it to simultaneously drive our company's growth and our focus on decarbonization solutions. Therefore, all growth initiatives defined in the program must also contribute to CO₂ reduction, which we record and measure, just as the economic impact.



In examining our external supply chains, we increasingly focus on social and ecological aspects and impacts. We are following the Supply Chain Due Diligence Act, which the German government enacted in 2023. We welcome the legislative focus on adhering to environmental protection and human rights in global trade.

We focus on sustainable business practices and market behavior in the market and within our company. We want to engage our employees, which is why we have developed and successfully implemented the "Driving Change" training program, among others. The high acceptance and participation in the program among our workforce are strong signals that our strategy is supported by many.

As pleasing as the development of our company has been over the past year, the situation in many other areas of the world and the global economy has been grim. The ongoing Russian war of aggression in Ukraine, the war in Israel, and the continuous threat to international trade routes

by terrorism – massive geopolitical conflicts cast their shadows over the coming year and create a threatening level of uncertainty, further fueled by political uncertainties like the outcome of numerous elections and changes in the regulatory landscape.

Amid all the economic risks and uncertainties that these developments bring and which we must manage, it helps us all the more that we have firmly established the goals and direction of MAN Energy Solutions. They provide us, our employees, and you, our stakeholders, with direction and certainty: come what may, we are Moving Big Things to Zero.

Dr. Uwe Lauber
Chief Executive Officer
MAN Energy Solutions SE

Our sustainability strategy

Our main goal is consistently implementing our sustainable corporate policy and strategy "Moving Big Things to Zero". We strongly focus on products that contribute to decarbonization, resource-efficient and environmentally friendly production processes, safe workplaces, and the well-being of our employees, both in our core workforce and supply chain.

Our products and services operate precisely where the significant drivers of economic and ecological progress are. We are aware of this responsibility and, therefore, already offer system technologies today that help our customers increase the efficiency of their facilities and applications, particularly in reducing CO₂ significantly and sustainably.

These are our goals

We will halve the CO₂ emissions from our production by 2030 compared to 2018.

By 2030, our portfolio will have a more climate-friendly version for each main application in new construction.

Our solutions for decarbonization will account for at least half of our revenue by 2030.

By 2030, we aim to generate six percent of our energy needs from renewable sources ourselves.

We aim to reduce the Recordable Injury Frequency (RIF)¹ rate at all production sites to below five by 2030.

50%

2030

50%

6%

<5

¹ The RIF rate indicates the number of work-related accidents per one million working hours.

Moving big things to **zero**



Our four focus areas

Our [sustainability guiding principles](#) underlines our commitment to the principles and sustainability goals of the United Nations and sets the framework for our four focus areas.

We have defined these based on a materiality analysis and in alignment with the sustainability strategy of our parent company, Volkswagen: decarbonization, circular economy, responsibility in the supply chain, and people empowerment.

In this regard, MAN ES follows the world's largest and most significant corporate responsibility initiative, the UN Global Compact, of which our parent company, Volkswagen, is a member. The UN Global Compact encompasses ten universally recognized principles concerning human rights, labor standards, environmental protection, and anti-corruption, and 17 subsequent goals, the so-called Sustainable Development Goals (SDGs). We have assigned the relevant SDGs to our focus areas, to which we aim to contribute with our activities.

We implemented various sustainability activities and measures in each of these four focus areas last year, which we present in this report. Due to upcoming requirements of the Corporate Sustainability Reporting Directive (CSRD), we are currently (as of June 2024) conducting a double materiality analysis. This analysis considers the materiality of sustainability topics for companies from two perspectives: the so-called Impact Materiality and Financial Materiality. Based on the results, we may re-align our focus areas in the future.

Our sustainability organization

At MAN ES, sustainability is anchored in the executive board's overall responsibility. Our sustainability management is coordinated by the central function responsible for the QHSE-Management and Sustainability area.

A key instrument for aligning our sustainability activities is our Sustainability Council. It consists of representatives from different business units and group functions.

The Chairman of the Sustainability Council is the MAN ES Chief Operating Officer. The Council defines sustainability goals, sets the strategic direction of sustainability activities, and serves as a platform for knowledge transfer and exchange.

Further information and important documents about our sustainability management and organization can be found [here](#):

- Code of Conduct
- Code of Conduct for Suppliers and Business Partners
- Anti-slavery and Human Trafficking Statement
- VW Social Charter MAN ES
- MAN ES Policy Statement



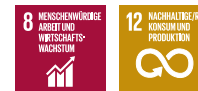
Decarbonization



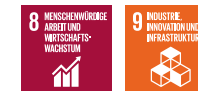
Circular economy



Responsibility in the supply chain



People empowerment



Decarbonization

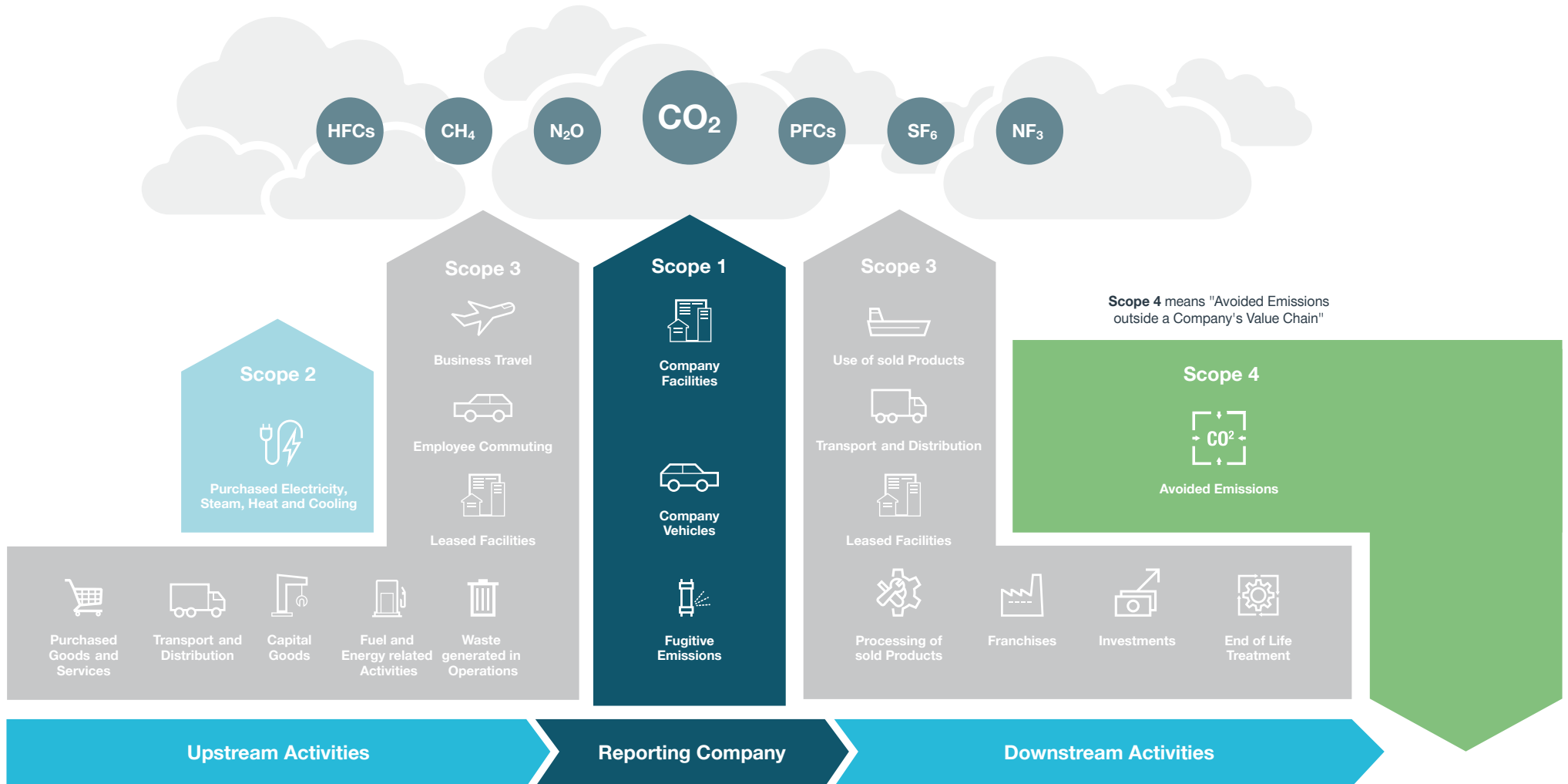


Alignment and strategy

Climate change and the need for decarbonization represent the greatest challenge of our generation. For MAN ES, this opens up two major areas of action: on the one hand, we aim to reduce our CO₂ emissions. On the other hand, our goal is to offer products and solutions that themselves advance decarbonization.

To continue to meet these challenges, MAN ES is assessing its climate impacts through a holistic CO₂ calculation approach. The greenhouse gas accounting, which has so far included direct (Scope 1) and indirect (Scope 2) emissions, will be expanded by upstream and downstream emissions along the value chain (Scope 3) according to the

Greenhouse Gas Protocol. As our technologies, such as Carbon Capture Utilization and Storage, heat pumps, or large engines operated with future fuels, contribute to the decarbonization of key industries, the determination of "avoided emissions" (Scope 4) also plays an important role. (See illustration on the next page.)



Decarbonization through our products and solutions

We aim to lead in our business sectors as pioneers and enablers of global decarbonization, paving the way for a climate-neutral future with our products – in the maritime sector, the energy industry, and industrial applications. We are committed to providing new technologies and solutions to decarbonize the economy, aiming to avoid, reduce, and neutralize CO₂ emissions wherever possible.

Specifically, this means: by 2030, sustainable technologies and solutions will comprise the majority of our business. Additionally, our portfolio for our main applications will each include at least one technological solution for more climate-friendly product operation. For the maritime industry, we aim to offer products by 2030 that pave the way for decarbonization.

We are working on enabling our customers to use a variety of alternative, so called future fuels which are synthetically produced and emit very low or no greenhouse gas emissions from well to wake. Many of our gas and dual-fuel engines can already operate on future fuels, such as synthetic natural gas (SNG). Looking ahead, "future fuels" like ammonia or "green" methanol will play an important role. Currently, these are not yet available in sufficient quantities on the market. For this reason, we are also preparing the corresponding solutions for producing these fuels to enable their use in our engines.

Hydrogen is crucial in the energy transition as an indispensable raw material for profound decarbonization. Where direct electrification is not feasible or technically possible, "green" energy and fuels derived from hydrogen pave the way to a climate-neutral future. Over the coming years, MAN ES will invest up to €500 million in its subsidiary H-TEC SYSTEMS to develop the hydrogen specialist into a

large-scale manufacturer of PEM electrolyzers as quickly as possible. H-TEC SYSTEMS is already successful in the market with solutions for hydrogen electrolysis and offers its customers integrated container solutions in the megawatt range. H-TEC SYSTEMS' electrolysis technology will significantly contribute to reducing global CO₂ emissions.

However, not all emissions can be effectively reduced or completely avoided. Approximately one-third of the world's greenhouse gas emissions are emitted from so-called "hard to abate" sectors. In this context, technologies for capturing, reusing, or storing CO₂ represent a significant lever and are increasingly gaining strategic importance for MAN ES. Our Carbon Capture Utilization and Storage (CCUS) solutions offer energy-intensive industries the opportunity to minimize their greenhouse gas emissions, make their processes more efficient, and thus contribute to decarbonization. We will continue to expand our commitment in this area.

Our retrofit business, which involves technological upgrades to existing products and facilities, makes another significant contribution to the maritime energy transition and the decarbonization of the global power plant fleet: upgrading or retrofitting is an essential part of the service spectrum of MAN PrimeServ, our aftersales brand. A retrofit extends the life of engines and plants, thereby making a vital contribution to the efficient use of resources. It can also significantly reduce their CO₂ emissions by, for example, adapting them to operate on alternative fuels. We are continuously expanding our retrofit solutions to advance the decarbonization of existing facilities and aim to quadruple the revenue in this area by 2025 compared to 2019 (see also the "Circular Economy" chapter).

Various regulations and legislative changes support the trend to retrofit products and facilities already in the field to a lower-emission or emission-free alternative fuel. For example, the International Maritime Organization (IMO) introduced the Energy Efficiency Existing Ship Index (EEXI) on January 1, 2023, requiring commercial and cruise ships over 400 GT (gross tonnage) to have an energy efficiency certificate. Alongside EEXI, the Carbon Intensity Indicator (CII) also came into effect. The goal is to align ship operations with strict CO₂ emission values, ensuring that the entire maritime sector contributes significantly to achieving the 1.5 degree target of the Paris Climate Agreement. These regulations require decarbonization plans and strategies for compliance with or improvement of CII, as well as measures to reduce fuel and energy consumption. This process includes operational and logistical changes, weather-related route changes, speed optimization, efficiency measures, and the use of alternative fuels.

In light of this, there is tremendous potential in our retrofit area: given that the average lifespan of ships often exceeds 25 years, decarbonization can only be achieved if it also includes the retrofitting of older ships.

In addition to our product-related efforts towards decarbonization, we are also committed to implementing regulatory and market conditions, for example, through our membership in the National Hydrogen Council of the German Federal Ministry for Economic Affairs and Energy. This effort supports the goal of providing the necessary fuels to the market at competitive prices in the future.

The construction of large heat pumps is another strategic area: instead of burning fossil fuels for heating and cooling, electrically driven heat pumps efficiently utilize various heat

sources such as lakes, rivers, seas, wastewater, industrial waste heat, geothermal energy, or ambient air. When powered by "green electricity", they are largely emission-free. Large heat pumps consist of compressors, expanders, and compounders. With MAN ES's electrothermal energy storage technology (ETES), an additional option is available to generate, store, and convert heat or cold. The market for heat pump solutions has seen a double-digit annual growth over the last ten years.

The most significant potential rests in the industrial sector, which is responsible for about half of the global CO₂ emissions from heat generation and district heating. Here, we see great potential for our solutions.



MAN ES heat pump for supplying the Danish city of Esbjerg

Decarbonization at our sites

Our commitment remains to reduce the absolute CO₂ emissions at our own production sites by 50 percent by 2030 compared to 2018. This includes our emissions in Scope 1 and Scope 2. It also includes emissions caused by our administrative areas, or those resulting from, for example, engine test runs.

We are very much on track with achieving our goal: in 2023, we reduced our CO₂ emissions by approximately 57 percent compared to the baseline year 2018 – thus even surpassing our current target. However, maintaining this reduction path until the target year 2030 will remain challenging due to various developments: in the coming years, we expect growth-related negative impacts on our CO₂ emissions. Moreover, technology alternatives (e.g., for certain heat treatment processes) are not yet technologically mature. Thirdly, the market availability of alternative and competitive fuels in the required quantity and quality (e.g., biomethane, hydrogen) is not yet established.

To measure and support the achievement of our goals, we continue our long-established central action management for energy reduction and energy efficiency improvement.

We are currently developing a decarbonization strategy according to the guidelines of the Science Based Targets Initiative (SBTi), an initiative that defines standards for developing emissions reduction targets in line with the Paris Climate Agreement. Volkswagen has already established climate targets that comply with and have been validated by SBTi. The targets for the production phase (Scope 1 and 2),

which also include MAN ES CO₂ emissions, contribute to limiting global warming to 1.5 degrees Celsius in line with the Paris Climate Agreement. A re-certification is due soon, and MAN ES aims to integrate its supply chain CO₂ emissions (Scope 3) into this framework. Capturing Scope 3 emissions is particularly challenging due to the wide range of products and applications involved. Specifically for this, a methodology for capturing emissions during the use phase of our sold products was developed. Initial assessments have shown that CO₂ emissions from this category constitute the largest share of CO₂ emissions. The project started in 2023 will continue in 2024 to eventually enable a comprehensive account.

Moreover, we are certifying the energy management system currently being introduced, according to ISO 50001, at our German sites in Augsburg, Berlin, Deggendorf, Oberhausen, Ravensburg, and Hamburg. Apart from contributing to decarbonization, using the energy management system leads to increased energy efficiency in business processes and thereby to cost reduction. The certification is expected to be completed by 2025.

In addition to reducing energy consumption through efficiency measures, we are also working to increase the share of electricity from renewable sources. Since January 1, 2022, all the electricity we purchase for all our European production sites comes from renewable sources. A centrally coordinated program to increase self-generation of electricity at our global production sites has been running in parallel. Photovoltaic systems became operational in 2022 in Changzhou (China), 2023 in Aurangabad (India), and 2023 in Augsburg (Germany). More are planned or under implementation. Looking ahead, by 2030 we aim to generate at least six percent of the electricity we use ourselves from renewable sources.



Photovoltaic system at the MAN ES site in Aurangabad (India)

Activities and actions in 2023

Initiatives relating to decarbonization

MAN ES has been committed to a maritime energy transition towards climate-neutral shipping for many years. For us, it is evident: developing engines and the corresponding infrastructure that enable the industry to use low-carbon and carbon-free fuels on a large scale is crucial in establishing more environmentally friendly shipping. Generally, last year, we also observed a significant increase in interest in lower-emission solutions for shipping – not only among container ships but also in other segments. We have increasingly been able to commercialize our future fuel technologies.

The International Maritime Organization (IMO) estimates the annual emissions from shipping to be just over one billion tons of carbon dioxide. This amount accounts for nearly three percent of all global greenhouse gas emissions. In 2023, the IMO member states adopted a revised greenhouse gas strategy – a milestone for shipping and global value chains. While the strategy adopted in 2018 aimed to halve emissions by 2050, the current goal is for "net zero" emissions by 2050. The new orientation sets indicative emission reduction targets for 2030 (mandatory 20 percent, targeted 30 percent) and 2040 (mandatory 70 percent, targeted 80 percent) and takes into account

greenhouse gas emissions across the entire life cycle, from the production to the combustion of fuels. With these goals, the IMO provides more clarity for the industry and fosters confidence that investing in the "green" transformation is worthwhile.

To achieve these goals, the IMO plans to implement a package of measures within the next two years. This approach signals a strong interest in future fuels. Given this context, the Getting to Zero Coalition, an alliance of 200 organizations and companies, also emphasizes the necessity of five percent emission-free fuels by 2030.

We are making a substantial impact by creating an oxidation catalyst named "IMOKAT II" for four-stroke engines. It aims to reduce methane emissions significantly. The goal is to achieve a 70 percent reduction in methane emissions at 100 percent load. The research project, which commenced in October 2020 and is set to conclude in May 2024, is being carried out at the MAN ES headquarters in Augsburg (Germany). Relevant tests are currently being conducted at the plant in Frederikshavn (Denmark). The German Federal Ministry for Economic Affairs and Climate Action funds the project. In the predecessor project, IMOKAT I, we investigated various catalytic materials and discovered a

sulfur-resistant material without precious metals that allows for high methane conversion. IMOKAT II is now a prototype and technology demonstrator that explores the material's potential on a test engine.

The IMOKAT II catalyst offers convincing advantages: it is more robust and economical and requires less installation space than previous approaches with expensive precious metal catalysts. The catalyst material without precious metals is sulfur-resistant, which is essential as even with the gas operation, traces of sulfur are present in pilot and lubricating oils. The integration of the catalyst before the turbocharger is necessary due to the pressure and temperature levels of the exhaust gases. It is more complex than installing it after the turbocharger. The project aims to make the catalyst available for retrofits and new builds.

In our opinion, the ammonia engine is a key technology for the maritime energy transition. We began developing an engine in 2019 that is CO₂-free during the combustion process and continue this work. Last year, we achieved a significant milestone for the maritime industry: in July 2023, we announced the first successful test run of a MAN B&W 4T50ME-X type two-stroke engine. This 50-bore dual-fuel two-stroke engine can run on carbon-free ammonia. The engine test occurred at the company's research center in Copenhagen (Denmark) and represented the culmination of extensive preliminary work. It provided promising data and a deep understanding of the unique properties of ammonia as a marine fuel and its effects on fuel supply and safety systems. The goal is to reduce greenhouse gas emissions by more than 90 percent compared to standard diesel engines, considering the entire life cycle emissions. We plan that operation aboard a commercial ship will be possible by around 2026. The prerequisites for using ammonia as fuel are favorable, so we have high expectations. The production costs are projected to be relatively low compared to other relevant e-fuels. We anticipate that by 2050, the share of ammonia as fuel onboard large commercial ships will exceed 25 percent. Accordingly, we expect significant demand for ammonia engines in the

coming years. We can customize the installation of a future ammonia engine to meet the preferences of our customers. Options include a dual, modular retrofit solution for existing electronically controlled engines, an "ammonia-ready" engine, or a completely new build. Our goal is to play a leading role in developing ammonia engines.

While the development of the ammonia engine in the two-stroke range is already advanced, it is just beginning to gain momentum in the four-stroke engine sector: MAN ES is transferring the technology to large-volume four-stroke engines. The project "Ammonia-Mot", which we initiated in 2020 and is still ongoing, aims to develop a four-stroke dual-fuel engine for medium speeds that can



run with diesel fuel and ammonia. The German Federal Ministry for Economic Affairs and Technology funds the project. It started in December 2020 and concluded in spring 2024. Evaluations are still ongoing at the time of this report's publication. The project develops the fundamentals for the combustion of ammonia in engines and the corresponding combustion models to enable rapid technology adaptation. Thus, AmmoniaMot aims to provide the basis for establishing ammonia as a fuel and promoting the maritime energy transition in the four-stroke sector.

Another vital component in decarbonizing shipping is "green" methanol. Compared to conventional fuels, "green" methanol reduces CO₂ emissions by up to 75 percent over the life cycle and nitrogen oxide emissions by up to 80 percent. Sulfur oxide and particulate matter are almost completely eliminated. We expect that the share of methanol in all dual-fuel engines will rise to over 30 percent in a few years, making this business area a

significant lever in decarbonizing shipping. In the area of "methanol-ready" or methanol-powered engines, we made significant progress in 2023. The development of the methanol-powered dual-fuel engine is advancing for four-stroke engines. The 175D is the latest new development by MAN ES in the high-speed sector and was previously available only as a diesel engine. In December 2023, we announced that a dual-fuel version of this engine, which can run with methanol, will be available by the end of 2026. The new engine, designated MAN 175DF-M, will be available for both new builds and retrofits. This model is optimized for diesel-mechanical and diesel-electric drives. The development aims for a high methanol content across a wide performance range while achieving maximum cylinder performance in its class of high-speed engines. It will be possible to operate the engines at an optimal operating point with the highest methanol content by optimizing for multi-engine diesel-electric installations. When using bio-fuels, the CO₂ footprint of the MAN 175DF-M is significantly reduced, while complete fuel flexibility for global operations is maintained. The engine has already received the "Fuel-Ready" certification from classification societies DNV and BV, ensuring the introduction of this dual-fuel methanol technology.

Our commitment to the hydrogen sector includes our gas-powered four-stroke engines already being "H₂-Ready": this means they can operate with a hydrogen content of up to 25 percent by volume in the gas mixture. The engines' necessary adaptive combustion control (ACC) reacts fully automatically to varying hydrogen levels in the natural gas and compensates for potential efficiency losses when operating with fluctuating H₂ proportions. Thus, we enable the use of hydrogen, for example, in power plants, significantly reducing CO₂ emissions. Gas engines currently in use can be upgraded for hydrogen blending operations by improving automation and adding extra ACC sensors.

Following the market launch of our "25-percent hydrogen engines" in 2021, a pure hydrogen engine is our next

logical step. To make hydrogen available as a fuel for maritime shipping and to develop a concept for a hydrogen-powered, medium-speed engine, last year we launched the "HydroPoLEn" project together with industry and science. It is supported and funded by the German Federal Ministry for Economic Affairs and Climate Action. The project aims to redesign propulsion systems in shipping and develop critical technologies such as injection, ignition, and advanced low-wear systems. Additionally, it involves creating a concept for integrating the drive unit and fuel storage as a single system. Besides addressing the combustion process challenges, the work also focuses on engine efficiency, safety issues, and the critical steps in integrating the technology into ships. This integration aims to enhance a hydrogen-powered engine's efficiency, performance, and durability and pave the way for sustainable propulsion in the maritime sector. We expect results from the project by the end of 2025.

A significant success within a series of hydrogen initiatives that we are currently undertaking in both the two-stroke and four-stroke sectors was the world's first successful test of a MAN B&W two-stroke engine using hydrogen as fuel, conducted by our licensee MITSUI E&S Co. Ltd. The preliminary work and necessary modifications for this test, which took place at the MITSUI plant in Tamano (Japan) in early 2024, were primarily carried out in 2023. In cooperation with MAN ES, MITSUI converted one of the four MAN B&W ME-GI engine cylinders to run on hydrogen. The hydrogen was supplied to the gas engine from a hydrogen

gas supply system developed by MITSUI in 2023. Stable operation was achieved under various loads and operating conditions, including successful hydrogen combustion at up to 100 percent load. Moreover, MITSUI confirmed a reduction in greenhouse gas emissions of up to 95 percent, with the remaining portion coming from the pilot fuel used during the tests. This test marks a milestone for the use of hydrogen as a marine fuel and demonstrates the advantages of our two-stroke engine technology.

A business area that gained further importance in 2023 is Carbon Capture Utilization and Storage (CCUS). In some industrial and combustion processes, large amounts of CO₂ are generated, which are currently unavoidable due to the nature of the process. For example, cement production accounts for about six to seven percent of all global CO₂ emissions. This fact makes it a key sector on the path to a decarbonized global economy – and demands specific solutions. For the HeidelbergCement site in Brevik near Oslo (Norway), we are realizing, in cooperation with Aker Carbon Capture for the first time by mid-2024, a jointly

developed, energy-efficient technology solution to reduce carbon emissions. The new technology, Carbon Capture Heat Recovery (CCWHR®), utilizes the compression heat of the RG compressor for steam generation, which is used in the CO₂ capture process. Thus, approximately 400,000 tons of CO₂ are expected to be captured annually at the Brevik plant, representing about 50 percent of the site's total emissions. The CO₂ gas is compressed, liquefied and then transported via new tankers to an onshore terminal near Bergen in Western Norway. From there, a pipeline leads to an underground storage site in the North Sea. The project achieves a net emissions avoidance of approximately 330,000 tons of CO₂ per year when considering the life cycle greenhouse gas emissions of the entire process chain (capture, compression, and transport). This MAN ES project is part of the Norwegian government's Longship project. This project aims to demonstrate that the technologies for realizing a continuous CO₂ chain, from capture through transport to storage and even usage, exist and can be applied in larger industrial facilities. They thus set a new standard for future industrial projects.



World's first large-scale CO₂ capture plant in the cement industry in Brevik (Norway)

Further activities to decarbonize our production sites

Here, we are implementing a set of measures that includes three elements, cascaded accordingly: first, increasing energy efficiency or saving energy through the renewal, conversion, and optimization of facilities, infrastructure, and processes; second, self-generation of energy from renewable sources (e.g., electricity from photovoltaics, heat via heat pumps); and third, the transition from fossil fuels to more climate-friendly fuels (operational heat generation, heat processes in production).

Last year, we realized a significant project involving self-generated energy from sustainable sources at our Aurangabad (India) site: a solar power plant has gone into operation there. The geographic location of the site, with its intense sunlight, and the size of the premises are ideal for generating electricity through photovoltaics. The facility, which was inaugurated in April 2023, has a capacity of 900 kWp and produces approximately 1.2 million kilowatt-hours of electricity per year. This corresponds to a reduction of 1,224 tons of CO₂ annually. Additionally, last year also saw the use of biogas instead of liquefied petroleum gas (LPG) to run the kitchen. This also reduces CO₂ emissions, and the site ultimately saves over 1,230 tons of CO₂ per year.

Last year, our subsidiary H-TEC SYSTEMS undertook a major construction project. In April, the groundbreaking occurred for a development and manufacturing facility for PEM electrolysis stacks to produce "green" hydrogen. This Gigahub in the Rahlstedt district of Hamburg will soon combine stack development, manufacturing, testing, and service at one site and will employ several hundred

staff members in the long term. We plan to have an annual output of facilities with a total electrolysis capacity of more than 6 GW by 2030. The stacks form the core of the PEM electrolyzers, which are built at our headquarters in Augsburg. Additionally, a training center is planned to support customers and interested parties around the globe in implementing hydrogen solutions successfully and with maximum efficiency and safety. To generate renewable energy, photovoltaic systems with a capacity of up to two megawatts will be installed on the building and the adjacent parking garage. The buildings will be heated with district heating, and waste heat from the testing area will be fed back into the heating system. Rainwater cisterns will provide irrigation for the green spaces, and the parking spaces for cars and bicycles will have electric charging stations. The hydrogen produced in the testing area will be "green" hydrogen and sold. For the property, we aim for certification according to the Platinum standard, the highest quality award that the German Sustainable Building Council can bestow. The goal is for the H-TEC SYSTEMS Stack Manufacturing and Development Center to be operational by mid-2024.



Gigahub for H-TEC SYSTEMS in Hamburg

In this context, it is important for us to emphasize that our decision to build in Hamburg is a clear commitment to the production site in Germany. The supply chains for the stack production are also predominantly based on German or European suppliers.

Electrifying our fleet is also a key concern for us: all our forklifts in Augsburg plant traffic (material distribution) already operate on 100 percent electricity from renewable sources. We also continue to use rail for heavy transport and the shipment of engines produced in Augsburg wherever possible. The company car fleet at the Augsburg site is already more than 30 percent hybrid or electric. For electric vehicles, since 2023, we have also increasingly provided charging stations: in November 2023, a new charging park opened at the Augsburg site, now offering additional charging options for both company and private vehicles of employees. This development supports everyone who comes to work by electric car.

The proportion of our employees who work remotely and are not in the office daily remains very high. Conferences

and meetings are still primarily conducted virtually. As a result, we were able to keep the number of business trips and commutes to workplaces at a low level last year, which also positively impacted our overall CO₂ emissions.

This change in work practices and the continued popularity of hybrid work models have led to us needing fewer fixed workspaces in the company buildings. Therefore, we continue implementing the "Shared Desk" concept, allowing employees to choose their workspace in the office building freely. Thanks to this solution, we can reduce office space, cut costs, and reduce our environmental impact.



100%

Electricity from renewable sources
at all European sites

1,140 kWp

Photovoltaic systems
installed in 2023

Over

57%

Tons of CO₂ savings
compared to baseline year 2018

Over

50%

Dual-Fuel engines sold

Over

130,000 t

CO₂ saved by the world's largest
methanol 2-stroke engine per year
compared to an engine operated with heavy oil

MAN ES receives the German Sustainability Prize

In November 2023, MAN ES received the prestigious German Sustainability Prize – an award recognizing our efforts and affirming our strategy. The German Sustainability Prize is Germany's most comprehensive national sustainability competition and is considered Europe's most significant ecological and social commitment award. It is presented by the German Sustainability Award Foundation in cooperation with the Federal Ministry of the Environment, the German Chamber of Industry and Commerce (DIHK), and the WWF. The 16th German Sustainability Prize honored the "pioneers of transformation" across 100 industries. More than 5,000 companies were researched and evaluated for this purpose. 150 jurors from research, associations, consulting, and civil society selected from this pool the companies that are pioneers of sustainable transformation in their respective sectors in the German economy. MAN ES impressed in the company category "Machinery and Plant Engineering. e-fuels". In their rationale, the jury highlighted that the company had "made particularly effective, exemplary contributions to the transformation, thereby acquiring a role model character and sending the right signals to its industry and beyond".



German Sustainability Prize ceremony in November 2023

"We operate in global key industries that contribute significantly to global CO₂ emissions, which, however, are difficult to decarbonize. Our product portfolio and the new solutions derived from it enable us and our customers to have a significant impact on the global energy transition and thus on the decarbonization of the world."

Martin Oetjen

Chief Operating Officer at MAN Energy Solutions SE



Lighthouse projects

E-Fuel pilot project "Haru Oni" (Chile): MAN ES participates in the development of direct air capture technology

MAN ES delivered a methanol reactor in 2022 for the facility producing synthetic fuel from methanol. Now, a solution is being developed for the facility to filter CO₂ from the air, which is necessary to produce e-fuels.

E-fuels, or synthetic fuels, have the potential to significantly contribute to decarbonizing transportation. They enable combustion engines to operate almost CO₂-neutrally throughout their life cycle, especially when produced from renewable energy sources, renewable CO₂, and hydrogen from water. When coupled with direct air capture technology, this approach goes even further by capturing the CO₂ needed for the manufacturing process from the ambient air, effectively utilizing and even consuming it in the process.

By December 2022, a pilot plant for the industrial production of synthetic fuel for gasoline engines was already operational in Punta Arenas (Chile). The operator is HIF Global, which Porsche AG is involved in. The facility is the largest commercial plant of its kind. In the initial pilot phase, approximately 130,000 liters of e-fuels are produced, with the capacity expected to increase gradually to an industrial scale by the mid-decade.

In this process, "green" hydrogen is produced using wind energy, which is then combined with CO₂ in the methanol reactor that MAN ES supplied. Until now, this CO₂ has been sourced from a biogenic source. And here, MAN ES comes into play again: in 2023, Volkswagen Group Innovation, HIF

Global, MAN ES, and Porsche AG began joint planning for the integration of a direct air capture plant that filters the CO₂ needed for the production of e-fuels from the air.

In this DAC (Direct Air Capture) process, ambient air is first cleared of particulate matter and passed through a silica-like filter material. The CO₂ adsorbed there is then released from the material and collected in tanks for further use as a raw material in a highly pure form. Water, which may arise as a byproduct, is discharged. This CO₂, separated from the atmosphere, can be reused in various ways in a circular economy – for e-fuels and, prospectively, for producing non-fossil plastics. Alternatively, to produce non-fossil products (CCU = Carbon Capture and Utilization), the CO₂ can be permanently removed from the atmosphere and stored long-term (CCS = Carbon Capture and Storage). A significant advantage of the DAC process is that the CO₂ can be captured wherever the energy required for operation comes from renewable sources. The electricity for the filter system in the e-fuel pilot plant "Haru Oni" is generated using wind power. The hydrogen production achieved in the e-fuels facility could provide a significant portion of the needed heat. Moreover, the technology is scalable, making it highly relevant for the future.



Pilot plant for the production of e-fuels in Punta Arenas (Chile)

Porsche and HIF Global now intend to examine whether and how CO₂ captured using DAC can be commercially utilized in the e-fuel plant "Haru Oni". They plan to set up a prototype facility to directly capture CO₂ from the air and test it in an overall concept to develop a scalable and commercially competitive direct air capture process. In future large-scale applications, the heat supply using industrial heat pumps and the CO₂ compressors could be implemented with MAN ES equipment. The goal is to deliver and install the DAC POC (Proof of Concept) plant by 2024.

Shipping company Maersk opts for methanol-powered ship engines from MAN ES to achieve climate goals

In 2023, MAN ES marked a significant milestone by building and initially deploying the world's largest methanol two-stroke engine in a Maersk vessel. This achievement was followed by the order of 18 additional ships equipped with this engine.

MAN ES has developed the dual-fuel ME-LGIM engine, which can operate on both methanol and conventional fuel. The engine is based on the proven ME-series, which has around 8,500 engines in operation and operates on the diesel principle. When running on "green" methanol, the engine offers a more climate-friendly propulsion option for large commercial marine vessels. More than 100 of these dual-fuel ME-LGIM engines have been ordered so far or are already in operation.

The world's largest methanol two-stroke engine underwent a factory acceptance test in March 2023 conducted by MAN ES' two-stroke licensee, Hyundai Heavy Industries (HHI-EMD). The engine, developed by MAN ES and built by Hyundai with a 95 cm cylinder bore, saves approximately 130,000 tonnes of CO₂ annually when operated with "green" methanol. Hyundai is the first licensee of MAN ES, having built engines totaling over 200 million horsepower. Various technological challenges were overcome to realize an environmentally friendly drive for large commercial vessels.

Extensive preparations were made in 2023 for the first deployment of this methanol engine in a large container ship – successfully so that the ship of the Danish

container shipping company Maersk could be put into service as scheduled in January 2024. The Ane Maersk has a capacity of 16,200 twenty-foot equivalent units (TEU) and travels on the AE7 route connecting Asian ports with European ports. Maersk has since ordered a total of 18 of these large container ships from Hyundai Heavy Industries in South Korea.

Another significant milestone in Maersk's effort to gradually transition its fleet from fossil fuels to "green" methanol was the launch of the Laura Maersk, a smaller container ship with a capacity of 2,100 TEU, which is the world's first to be powered by "green" methanol, in September 2023 in Copenhagen. It has a dual-fuel engine and can operate on diesel- and methanol-fuelled ships. For "greener" operations, biogas from organic waste from landfills is refined into methanol. A sister ship with the same engine has been ordered. The godmother for the, Laura Maersk was European Commission President Ursula von der Leyen.

These projects underscore Maersk's commitment to environmentally friendly technologies, its goal of achieving "net-zero" greenhouse gas emissions by 2040, and the importance of our solutions in contributing to this goal.



Launch of the Laura Maersk

Circular economy



Alignment and strategy

We define the circular economy as a regenerative system for efficient resource and energy utilization. Its goal is to use materials and resources for as long as possible, keeping them within the cycle at the end of their life cycle while minimizing waste production. This process is essential, because our natural resources are finite. Sustainable growth is only possible if it is decoupled from resource consumption.

A circular economy reduces environmental impacts and contributes to the achievement of sustainable development goals. Key principles include reuse and recycling. Recovering materials from waste generates value. Essential tools here include operational excellence to enhance efficiency in production processes, lean principles to reduce waste and resource consumption, and digitizing processes for increased transparency and efficiency. A successful transition to a circular economy also depends on close collaboration along the entire supply chain. Conversely, reduced resource use contributes

to a responsible supply chain, optimizing material efficiency and reducing environmental impacts and CO₂ emissions.

When we extend the lifespan of our products already in circulation through upgrades (product improvements through retrofitting), retrofits (conversion of products, for example, to more environmentally friendly fuels), and optimal service and maintenance, we also contribute to lower CO₂ emissions for our customers. This lifespan extension is also a crucial aspect of decarbonization.

In the realm of circular economy, we operate in two main areas: firstly, we align our own production with energy and resource efficiency and continuously optimize our waste and recycling management. Secondly, our products' and solutions' high quality and technological performance ensure a long usage life, another crucial aspect of circular economy. Our facilities can achieve a lifespan of over 25 years, sometimes up to 50 years, with proper design, maintenance, and servicing. Therefore, durability and a service concept that allows for easy maintenance, servicing, and repair – and often retrofitting – are prioritized during development.

We support our customers with the operation and maintenance, repair, availability of parts, and possibly retrofitting of our products to more efficient technologies or different fuels to ensure as long service life as possible with minimal environmental impact. All these aftersales services are encapsulated under our independent brand, MAN Prime-Serv. Under this umbrella are various areas particularly relevant to circular economy: MAN PrimeServ Assist

as a digital service solution for our customers, component reconditioning, and retrofits

Various regulations and legislative changes support the trend toward retrofitting products and facilities already in the field to lower-emission or emission-free fuel variants. An example is the EU regulation "FuelEU Maritime". Adopted on July 25, 2023, it is part of the "Fit for 55" package, which aims to enable the EU to reduce its net greenhouse gas emissions by at least 55 percent by 2030 compared to 1990 levels and achieve climate neutrality by 2050. The CO₂ footprint of the maritime sector in the EU is to be reduced by increasing the use of renewable and low-carbon fuels.

The goal is generally to align ship operations with strict CO₂ emission values so that the entire shipping industry

contributes significantly to the maritime energy transition and the achievement of the 1.5 degree target of the Paris Climate Agreement. Due to the long product lifespan, this cannot be achieved solely with new vessels.

This situation has generated strong demand for our retrofits, i.e., the retrofitting of ship engines from the existing fleet as well as facilities in power plants or industrial applications. There is enormous potential here: our engines currently provide about half of the propulsion power of the global merchant fleet. Approximately 3,500 of these engines are fully electronically controlled and can be retrofitted to operate on alternative, more climate-friendly fuels such as "green" methanol or ammonia. About two-thirds of the ships qualify for more climate-friendly retrofitting. Operating with life cycle carbon-neutral fuels would reduce CO₂ emissions of up to 86 million tons annually.

Accordingly, we see great potential for more climate-friendly retrofits. By 2030, for example, we expect more than 100 life cycle upgrades for four-stroke engines. Here, we offer our customers the opportunity to overhaul their old engine completely and retrofit it to the most modern engine type simultaneously. This service alone brings about a CO₂ reduction of between 5 and 10 percent. If the engines are further optimized for operation with biofuels, the effect can be higher, depending on the biofuel content. Further retrofits are expected by converting to alternative fuels, such as Synthetic Natural Gas (SNG) and "green" methanol. A clear roadmap strategy for Life Cycle Upgrades helps to unlock further potential in the future.

Since retrofits significantly contribute to an effective circular economy by extending the operational lifespan of engines and substantially advancing the decarbonization of



shipping, this area is a crucial component of our efforts to reduce greenhouse gas emissions with our solutions.

Continued improvement in product quality and the associated reduction in non-conformity costs over recent years also support the circular economy: the less waste we produce, the more environmentally friendly we are, as fewer resources and energy are needed for rework or scrapping. This fact demonstrates the importance of product quality, not just for our customers but also for the environment.



Activities and actions in 2023

Activities related to the circular economy

With a focus on our supply chain and our own sites, we significantly contributed to sustainable circular economy practices in 2023 through many different measures.

Of particular importance in terms of sustainable resource management is our own foundry in Augsburg. Here, we produce huge components weighing up to 100 tons, such as crankcases or cylinder heads. Since this is an energy- and resource-intensive production process, its optimization is especially important. For example, the castings are made from approximately 85 percent secondary materials such as scrap and returned chips, keeping the use of primary materials low. Another relevant raw material in the foundry process is sand, which is used as a molding base material. We utilize a sand reclamation plant that reprocesses the used sand so it can be reused. The proportion of regenerated sand is over 95 percent. Consequently, we only need to purchase a small amount of new sand, thus conserving natural resources of mineral raw materials.

The agenda for 2023 also included the development of environmentally friendlier cardboard packaging solutions for the after-sales area. Establishing a functioning circular economy is not economically feasible here, as the countries where our international customers are based have very different regulations regarding packaging disposal. These range from very strict to non-existent.

Therefore, we have made it our mission to reduce the use of plastic packaging in this area as much as possible, thereby minimizing the negative impact of these packages on the environment.

We have developed new cardboard packaging specifically designed for solenoid valves, injectors, and pump element assemblies. These components have different dimensions and characteristics. The transition to the new packaging required us to clarify numerous details with our suppliers, internal customers, and involved departments, such as logistics, transportation, and warehousing.

Through close collaboration with these departments and innovative packaging manufacturers, we developed environmentally friendlier, cost-effective, and innovative new packaging solutions based on corrugated cardboard combined with VCI (Volatile Corrosion Inhibitor) products. For injectors, for example, this meant an entirely new packaging concept: very robust, more environmentally friendly cardboard boxes that replace the previously more expensive wooden crates with foam inlays. Special cartons and suitable multi-forms were developed for solenoid

valves, and for the pumps and pump assemblies, we switched to more affordable and environmentally friendly cardboard packaging.

In Operational Excellence, digitalization plays a crucial role as a central technological driver and opens up immense opportunities for sustainable development. Therefore, we specifically focus on digital sustainability innovations in our company to unlock these potentials, considering the interactions between digitalization and sustainability as a crucial factor.

The fact that we are on the right track with our efforts and are taking a leading role in digitalization is confirmed by the SZ Institute, the digital think tank of the German media company Süddeutscher Verlag. In the Top Digital Companies 2023/2024 ranking, we ranked second in the machinery and plant engineering category. The evaluation assessed how successfully companies have transformed their business into the digital world. This included internal digital processes and openness to new digital methods, tools, etc., and the company's external digital presence. The evaluation was based on an independent survey of

over 33,000 employees and five other indicators, including the companies' digital communication channels. The analysis was conducted between May and August 2023 and included more than 3,000 companies from 26 industries with sites in Germany.

An example of using digital tools is our project portfolio management system, SUSTAIN 4.0, which we launched at the beginning of 2023 and has since become a central element of our sustainability strategy. The program standardizes, digitizes, and simplifies the handling and management of projects at production sites in the areas of production, quality, logistics, and procurement. This program enables us to tackle the right projects in the right place at the right time and make optimal use of existing resources. Specifically, SUSTAIN 4.0 is based on a modern tool for project work in an Microsoft 365 environment. It focuses on the core content of projects and reduces the effort for status reports. Additionally, the tool interconnects projects, opening up the possibility to learn from similar projects. All projects are also clearly displayed on a type of "map," which prevents duplicative work, allowing projects to be planned, managed, and monitored more efficiently.

Within SUSTAIN 4.0, we can classify and prioritize projects based on their economic benefit and their contribution to

our sustainability strategy. In this regard, we go beyond the traditional notion of benefit or waste: for us, waste is not only about inefficient processes or loss of resources but also about not utilizing potential in terms of sustainability. We critically view any form of waste – whether it's energy, time, or resources – and strive for sustainable solutions.

Our new app, "Taste without Waste," developed over the past year, is a relatively small digital tool, but it has a significant impact. The app allows employees to select which days they will visit the company restaurant and what dishes they will eat. Just a few clicks for the employees represent a huge step towards greater sustainability for corporate gastronomy, as it allows for much better planning of restaurant utilization and food requirements.

The idea for the app emerged during the Innoflex Café, Innoflex_AUG, our innovation process, in January 2023. It was then developed over the past year with the help of coaches and specific employees who contributed to the programming and design of the app. The positive response was tremendous from the introduction of the idea throughout the app's development phase.

2nd Place as a "Top Digital Company 2023/2024"



Activities related to product use

MAN PrimeServ takes care of our customers, products, and solutions in the field. This gives us great leverage to improve the circular economy.

Through MAN PrimeServ Assist, we ensure the highest possible product reliability. The foundation of this is our digital platform CEON, where algorithms analyze product data from the field. Operational irregularities are detected quickly and reliably. Our experts, organized in a global network and available to our customers around the clock, proactively assess the results and provide recommendations or an action plan. Through this data-driven approach, we can increase the availability and overall efficiency of the plants in the field, optimize maintenance intervals, and prevent repair- and resource-intensive damages. This approach ultimately contributes to ensuring a safe working environment for our customers' employees. In many cases, problem resolution is possible via remote maintenance. This form of digital collaboration makes many trips unnecessary, which is also a significant contribution to reducing CO₂ emissions.

Furthermore, we aim to drive innovation and decarbonization in the maritime sector through our digital partnerships by collaborating with industry players on both large and small scales.

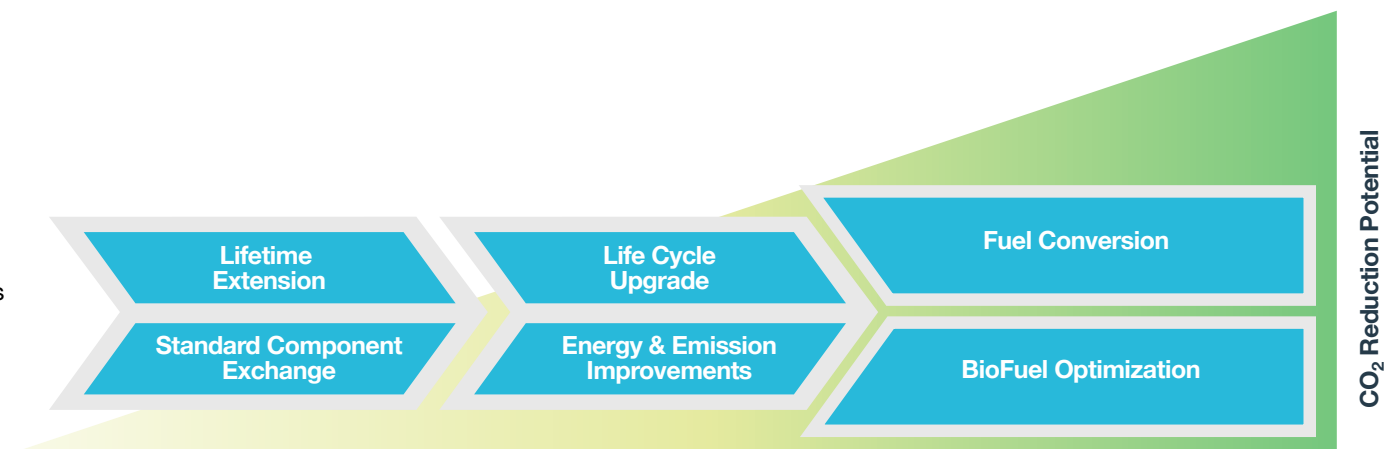
In 2023, MAN ES entered into such cooperation with Spire Global, Inc., a global provider of space-based data, analytics, and space services. The data obtained from Spire satellites provides information on global weather conditions and ship movements and data used in the automatic digital identification system (AIS). We will integrate this data into our digital solution, MAN CEON, among other applications. As described above, MAN CEON is a platform where product data is analyzed. Through MAN CEON, monitoring,

and advisory tools can support the decarbonization and optimization of ships and energy and industrial plants. These services will further improve Spire data by enabling faster troubleshooting and identifying decarbonization opportunities. Integrating Spire into MAN CEON aims to offer our customers enhanced performance, quicker troubleshooting, and decarbonization strategies. Together, we are developing AI models to analyze engine data and create more cost-efficient solutions.

There is great potential in using this data: according to McKinsey & Company, the shipping industry can reduce fuel consumption by one percent through optimizing ship execution and performance management, as well as utilizing AIS and weather data in route planning.

We leverage a significant advantage for a sustainable circular economy through our retrofit measures for ship and power plant engines to achieve lower emissions and more efficient operation. Our product portfolio in this area includes various solutions, depending on the product, applicable regulations, or the goals to be achieved.

One measure is our MAN oPL solution (overrideable Power Limitation), which electronically controls the engine power to limit it but can still provide full engine power in justified exceptional cases. We developed MAN oPL to meet the regulatory requirements of the Energy Efficiency Existing Ship Index (EEXI) of the International Maritime Organization (IMO). The solution is available for both mechanically and electronically controlled ship engines. The dual-fuel sector



plays a unique role in the retrofit area. Due to their modular design, MAN ES's slow-running engines, which are conventionally operated with diesel or heavy fuel oil, can be easily retrofitted to operate with alternative, more climate-friendly fuels. We currently offer several retrofit options for ME-C engines, including LNG, ethane, LPG, and methanol variants. An ammonia option is currently in development. These dual-fuel engines ensure seamless switching between different fuels.

An essential part of the Lifecycle Upgrades project is establishing a process for the reusability of parts that

result from this measure. Parts may be repurchased, so the shipowner does not have to dispose of or scrap them. We also continued the basic idea of component reusability in the sense of circular economy in 2023 with our existing comprehensive reconditioning offerings for the overhaul, repair, or calibration of old or defective components. Reconditioning extends the lifespan of the components, and the customer receive their own component back in full working order. Generally, the cost of reconditioning a part is significantly lower than manufacturing a new part, which reduces resource consumption and the CO₂ footprint.



Lighthouse projects

How the MAN ES Augsburg site simplifies the disposal of aqueous waste and increases production security

It went into operation in December 2022 and has already proven its worth in its first year, 2023: our evaporator system at the Augsburg site dewateres about 1,000 tons of hazardous waste annually, making disposal easier.

Approximately 950 tons of drilling and grinding emulsions from metalworking plants and around 200 tons of aqueous washing liquids from cleaning systems are generated annually at the Augsburg plant as hazardous waste. Disposing of this waste is costly and only sometimes promptly possible through disposal companies. Our new evaporator system helps by extracting the water content from the liquids to be disposed of. What remains is a concentrate with only five to ten percent of the original volume.

It took about two years from the idea to the commissioning of the evaporator system. Besides numerous evaporation trials to assess the suitability of the waste for the intended treatment method, two environmental approval processes for the operation of this waste treatment system had to be completed. An important aspect was ensuring that the discharged distillate meets the requirements

of the wastewater ordinance of the city of Augsburg and that we can permanently comply with these standards.

Specifically, the evaporator system, which operates automatically with remote monitoring, works as follows: first, the aqueous waste is pretreated by measuring and adjusting the pH value and cleaned through various filtration systems. Then, the waste is heated under pressure with an evaporation capacity of 200 l/h for washing water and emulsions, causing it to evaporate. The separated water, or distillate, is post-treated and subjected to various measurements before being discharged into the wastewater channel. The remaining concentrate is collected in IBC containers for disposal.

In its first year of operation, the evaporator system has already shown impressive results: it reduces hazardous waste by approximately 1,000 tons annually.

The necessary truck trips for disposal are reduced from 82 to 15 per year, significantly lowering CO₂ and exhaust emissions.

Moreover, in November 2023, there were two incidents where 45 m³ and 15 m³ of washing liquids were released. We were able to buffer these internally and completely treat them using the evaporator system, ensuring that there was no environmentally significant impact.

In general, the fact that we no longer rely on specialized companies to dispose of such waste is a huge advantage, as these companies often need help with waste acceptance. Thus, the evaporator system also contributes to production security at our Augsburg site.

Responsibility in the supply chain



Alignment and strategy

As a large manufacturing company, we bear tremendous responsibility for human rights and environmental stewardship both within our external supply chain and our internal business operations. We fulfill this responsibility by adhering to our own voluntary commitments, regulations, and standards concerning environmental, human rights, and occupational safety. These principles guide our actions and are essential to our strategic vision. We implement them through specific programs, management systems, and initiatives.

A significant influence on our actions in this area is the new "Act on Corporate Due Diligence Obligations in Supply Chains" (Lieferkettensorgfaltspflichtengesetz, LkSG), which came into force in Germany on January 1, 2023. This law imposes new, stricter requirements on companies of a

certain size regarding environmental protection and human rights compliance throughout the supply chain. This law encompasses both the external supply chain and our own business operations. Consequently, 2023 was significantly marked by efforts to meet the requirements of this law.

Own business area

In general, we interpret our obligations in many areas far more broadly than the legal requirements dictate. Our Integrated Management System (IMS), which encompasses the three standards of quality management, environmental management, and occupational health and safety, forms the strategic framework for our measures within our business operations. All our production sites are certified.

In addition to the HSE Management System (Health, Safety, and Environment) compliant with ISO 14001 and 45001, we are currently working on implementing a certified energy management system according to ISO 50001 at our six German sites in Augsburg, Berlin, Deggendorf, Oberhausen, Ravensburg, and Hamburg (see also the "Decarbonization" chapter).

We also continually extend our requirements and efforts. For example, since 2021, we have been using a new Compliance Management System for Health, Safety, and Environment (CMS-HSE), which expands our environmental protection and occupational safety requirements with additional aspects and establishes a unified, transparent process for quickly and effectively reporting suspected irregularities if necessary.

We have increased our efforts within the framework of our central management of energy measures. Our current focus is evaluating the feasibility, planning, and implementation of measures for self-generating electricity from renewable energies, primarily photovoltaics. Our ambitious goal is to

self-generate at least six percent of our consumed electricity by 2030. This goal may sound like a small percentage, but it represents a significant absolute amount and provides a substantial lever in avoiding CO₂ emissions. We are also aiming at making significant strides in the decarbonization of heat generation through various measures, such as heat pumps.

Our [Code of Conduct \(CoC\)](#) plays a crucial role and is mandatory for all our employees. Comprehensive information, including topics like human dignity, environmental protection, and practical examples, make the CoC valuable in everyday work life. The mandatory training for all employees, which can be completed online or in person, emphasizes the importance of the CoC.



External supply chain

MAN ES aims to maintain a stable supply chain, which is particularly challenging in these turbulent times. Additionally, our broad product portfolio, which includes both series production and project-based business, adds complexity to our procurement chain. The longevity of our products also requires that components remain available for extended periods. For these reasons, supplier and partner companies play a crucial role in our value chain. We currently have approximately 12,000 active suppliers from about 70 countries, primarily in Europe and countries with production facilities.

To meet our significant human rights and environmental responsibilities for this extensive external supply chain, MAN ES has implemented comprehensive regulations, processes, and audits, which we continuously update to align with current legal frameworks and our own expectations and ambitions.

Our binding [Code of Conduct for Suppliers and Business Partners](#) plays a key role in risk management. This agreement sets out very specific expectations regarding adherence to human rights and environmental protection.

Product safety and the safety of our customers who work with and on our products are also critically important. We ensure this safety through our high quality and safety standards throughout the entire product development and usage process. We are aware of the risks associated with the development and use of our products and strive to ensure that we do not manufacture anything that poses unacceptable risks to people and the environment. We train our employees involved in the development, manufacturing, sales, and operation of our products on relevant aspects of product safety. Employees specifically tasked with risk management in product safety receive appropriate training and continuously update their knowledge. For our customers, we offer training through our MAN ES Academy, both in-person and remotely, to ensure efficient and safe use of our products – an offering that exceeds legal requirements.



Additionally, through the PrimeServ customer information service, we share current tips and advice arising from the field application of our products with our customers.

Activities and actions in 2023

Initiatives related to supply chains

Own business area

The Supply Chain Due Diligence Act Lieferkettensorgfaltspflichtengesetz, LkSG), which came into force on January 1, 2023, was also the reason for numerous activities and measures within our own business area throughout 2023. Relevant MAN ES policies and instructions were adjusted within a group-wide project to address the protected legal positions. Additionally, we conducted the central risk analysis mandated by the law for the first time under the direction and guidelines of the Volkswagen Group and in coordination with the respective MAN ES departments. This analysis was accompanied by various informational events and workshops at our numerous international sites to involve the relevant employees.

Moreover, 2023 was marked by active inquiries from HR Compliance, Health and Safety, and Environment regarding compliance with the protected legal positions of the Supply Chain Due Diligence Act (LkSG).

The respective Volkswagen Group function provided the questionnaires, and the survey was conducted through the group compliance reporting tool. Group Compliance, HR Compliance, and the Central HSE Office coordinated the self-assessment inquiries.

Identified areas for improvement are promptly integrated into our certified management systems, which play an important role in our company. These systems are essential for market entry, support our systematic approach, and help us continuously improve our quality level, environmental performance, and occupational health and safety. Our Integrated Management System (IMS) offers an easy way to introduce additional management systems, such as an energy management system, and to leverage synergies.

A notable recognition for our environmental protection activities was awarded to one of our sites last year: MAN ES Brazil was

honored by the city of Niterói for measures to decarbonize the site and its environmental management. Specific measures included installing a photovoltaic system on the company premises, which is the largest in Niterói, and the certification of emissions and knowledge management. Additionally, there were employee training sessions and further education on climate protection. MAN ES in Brazil also uses rainwater for various purposes, reducing dependence on drinking water sources, preventing overexploitation of springs and groundwater, and helping preserve aquatic ecosystems and maintain the hydrological balance in the region.

Our Aurangabad site in India also received an award in 2023: the Indian state government praised the site for its outstanding occupational safety and health achievements. This assessment was made during an audit process conducted by the relevant authorities. Employees in Aurangabad

implemented the 5S program for order and cleanliness (Sort, Set in Order, Shine, Standardize, Sustain) and introduced occupational medical care for all colleagues.

Another topic our employees at various sites worldwide are engaged in is the promotion of biodiversity. Measures include converting lawns into flowering meadows and sowing wildflowers on barren areas to create habitats for native plants and insects. The commitment of global employees who independently initiate biodiversity projects is particularly noteworthy. For example, employees at our production site in Aurangabad (India) planted around 5,000 tree seedlings both on and off the company premises. In Indonesia, a joint action was to plant mangrove trees in the Mangrove Tourism Park in North Jakarta. These aquatic plants play an important role in the Indonesian ecosystem, providing habitat for numerous species and reducing coastal erosion.

Over
5,000 trees
were planted in 2023

by employees in India and Indonesia

Around
1,000 service
workers
trained for boarding on the open sea

External supply chain

In the area of external supply chains, 2023 saw the creation of uniform regulations across Germany with the enactment of the Corporate Due Diligence Obligations in Supply Chains Act. The aim is to increase transparency regarding human rights risks in the supply chain. As a company, we have initiated or further developed various measures in line with the law, such as the [publication of our policy statement](#).

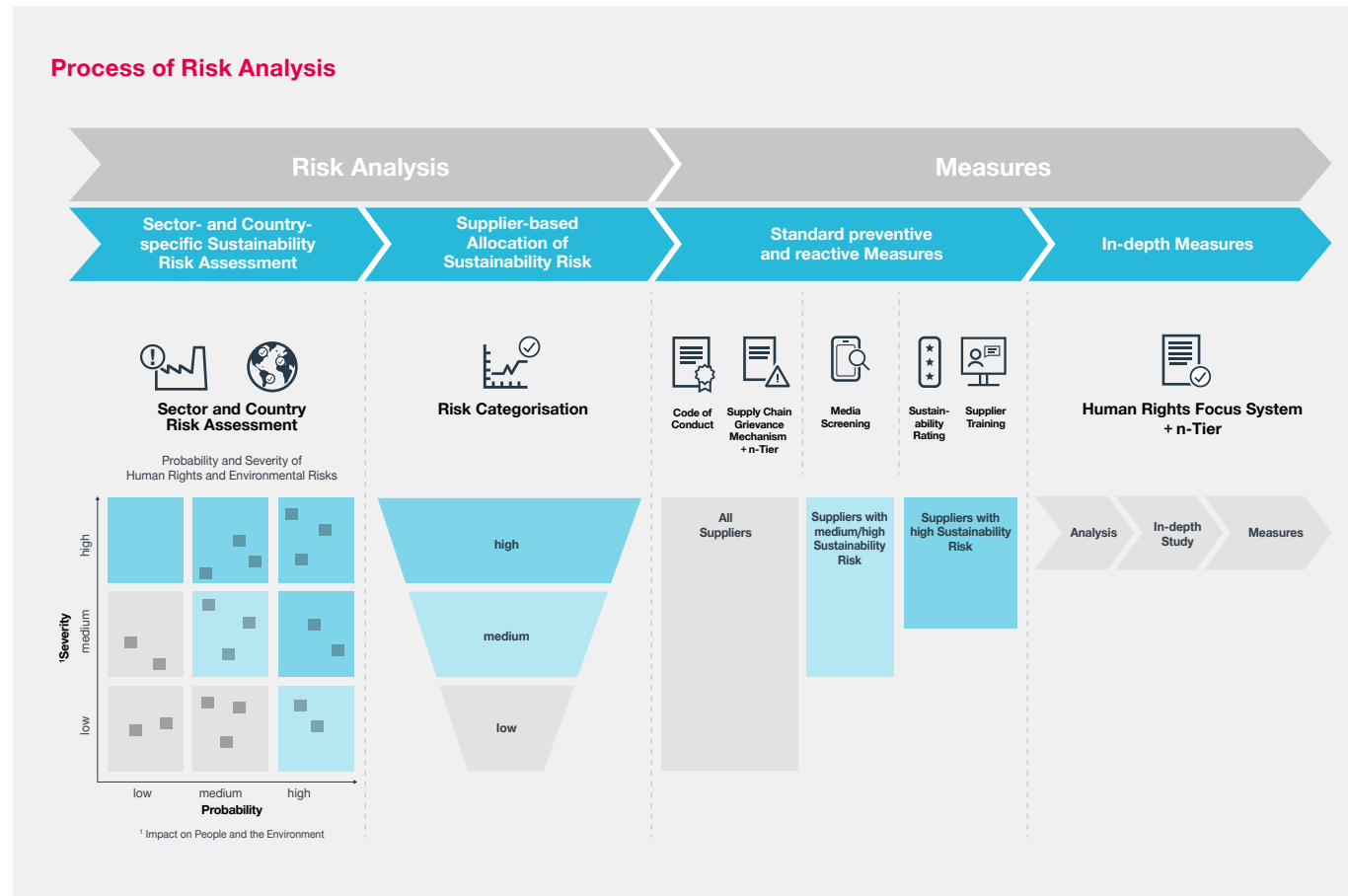
We continued the evaluation of our external suppliers, which began in 2022, regarding relevant risks in light of the Supply Chain Due Diligence Act. For this purpose, we chose different approaches for our production and general material suppliers (energy, electricity, office supplies, consulting, etc.) to address their respective risks specifically. In the area of general material, a matrix was used for risk analysis to assess the risk exposure of particular industries or sectors. For example, areas such as security services or IT are considered more critical regarding potential human rights violations. We used country indicators for production materials to classify the suppliers based on their potential risk. This systematic approach to categorizing suppliers was supplemented by individual workshops with our various purchasing departments to incorporate the individual risk perceptions of our experienced buyers. This is an annual and ongoing process.

Suppliers with high-risk exposure must next disclose extensive information about their business practices through detailed self-assessment forms via an external service provider. These details are reviewed, and appropriate measures are taken if necessary.

The suppliers are assessed using a "traffic light system". The results of this risk analysis have been considered in our procurement processes since 2023, such as in the weekly procurement meetings of our Sourcing Committee.

Since mid-2023, if a contract is awarded to potentially critical suppliers, the fulfillment of sustainability criteria must be

closely examined, and consultation with the relevant supply chain department management must occur. Additionally, supply companies identified as high-risk in the evaluation are trained on environmental and human rights issues through an external service provider. Internally, we conduct continuous training and regular informational sessions on sustainability topics for our procurement staff.



Paving the way for CO₂ reduction in our upstream supply chain

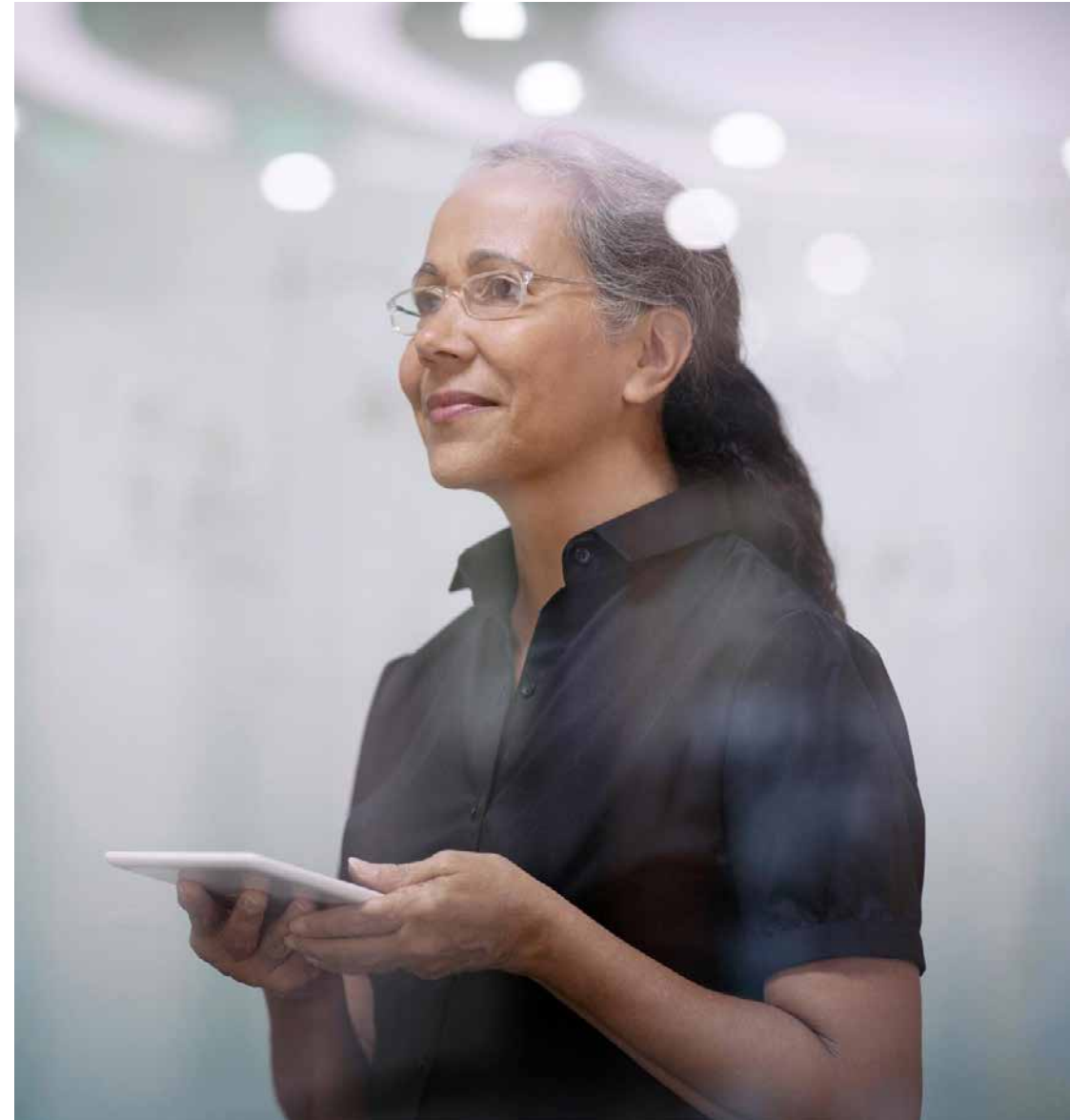
Decarbonization is at the core of our corporate strategy. Our procurement department plays a crucial role in this effort, as producing products and materials we source generates greenhouse gas emissions. In 2023, we closely examined our upstream supply chain.

Achieving transparency in emissions along the supply chain is a significant challenge – especially in our case, given the wide variety of product categories, materials, and suppliers our procurement team deals with daily. The goal for 2023 was to identify the "hot spots" within our supply chain that are exceptionally high in terms of greenhouse gas emissions.

To this end, we conducted a spend-based analysis of the goods and services purchased. These were recorded, and each item was linked to specific emission factors. This involved detailed, sometimes manual

work to connect product categories and material descriptions with the emission categories of a service provider, which then carried out the final calculation.

The project revealed that certain product categories, materials, and suppliers – viewed generically – contribute significantly to the greenhouse gas emissions of the upstream supply chain. In 2024, the focus will now be specifically on these "hot spots" to further increase transparency, validate our calculations, and discuss reduction measures in direct contact with suppliers.



Lighthouse project

Comprehensive qualification for safe working: approximately 1,000 employees trained for boarding at sea

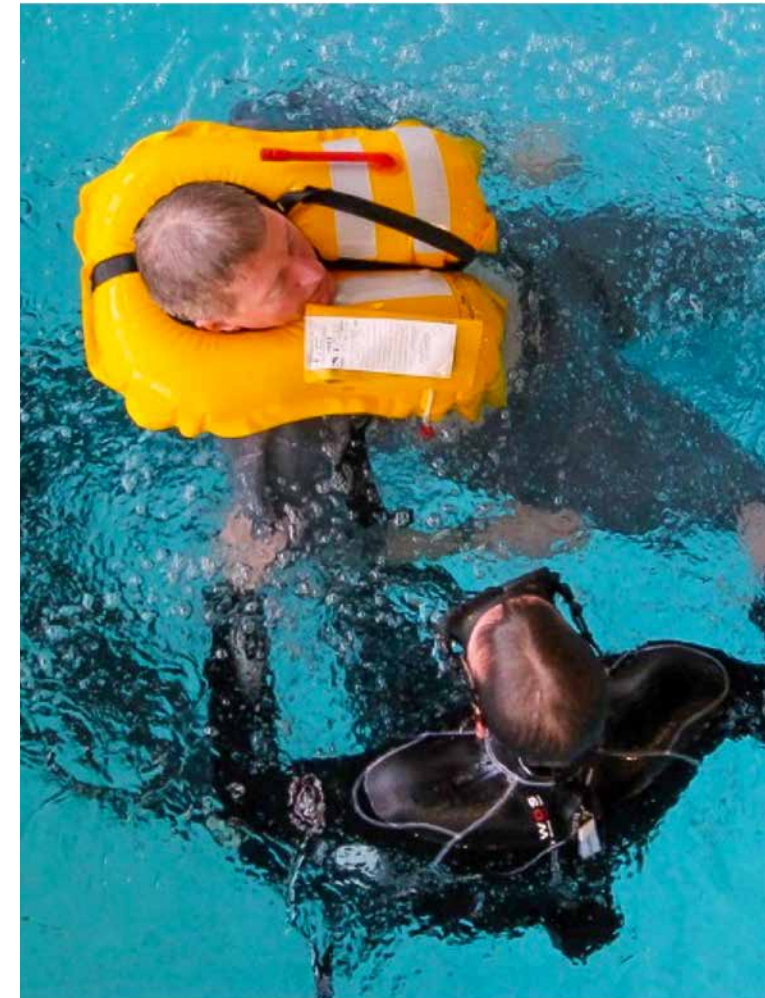
When MAN ES employees from PrimeServ conduct service activities or repairs on ship engines, they often need to board or disembark at sea. In 2023, a specialized training program was conducted worldwide to better prepare them for this dangerous situation.

A significant project coordinated by our central HSE (Health, Safety, and Environment) Office last year, in collaboration with the expertise of the PrimeServ Product Centers in Denmark, Germany, and France, resulted in the development of the common standards. The program "Boarding@Sea" was specifically designed and included a comprehensive theoretical part and practical exercises in the water.

The goal was to provide around 1,000 service engineers with advanced, proper qualifications for the hazardous task of "boarding at sea", which they frequently face during service or repair operations on ships. This subject is crucial for occupational safety, often involving safety violations and incidents. Globally, boarding at sea is considered one of the ten most dangerous occupations. The new training aims to increase awareness of occupational safety, especially in such scenarios, so that safety standards are internalized and the risk of accidents is minimized. Four dedicated teams

assessed the training needs of sites in various regions and coordinated local implementation. The training focuses on imparting theoretical and practical knowledge, emphasizing the practice of emergencies under actual conditions. This focus enables our engineers to assess risks adequately and ensure the precautions for safe boarding and disembarking at sea. The mandatory practical part can be completed either at the harbor or in a pool and includes exercises such as jumping from a height into the water and swimming in clothing, survival suits, or life jackets. Additionally, a rescue situation is simulated to effectively train our service engineers for potential emergencies while boarding at sea.

By the end of 2023, 99 percent of our service engineers had completed the qualification, and the feedback was very positive. Additionally, 20 service companies were qualified to conduct this specially developed training for MAN ES at our sites worldwide.



People empowerment



Alignment and strategy

As part of further developing the corporate strategy, our HR department has positioned itself to meet upcoming requirements even more effectively. The "People Strategy" has also been newly formulated in this context, focusing on our employees' participation, development, and empowerment. We developed these important guidelines collaboratively in 2023 and brought them to life through corresponding initiatives and projects. Overarching themes include employee recruitment, personnel development, leadership, change, and retention.

Until the end of 2023, MAN ES implemented the "Performance 2023" program. This program aimed to sustainably secure the company's future viability and support the transformation into a provider of more climate-friendly solutions for the maritime industry, the energy sector, and industrial production. Thus, Performance 2023 also shaped the strategy, goals, and activities in the Human Resources

department last year. The focus was primarily on closely involving all employees in the change process, supporting the transformation, and fostering individual growth. Performance 2023 laid the foundation, followed by the growth program "Move to Triple Ten+". This means our transformation process is far from complete with the conclusion of Performance 2023; instead, it is moving into the next phase.

Our nationwide qualification initiative, which started in 2021 in cooperation with the works council and continued in 2022 and 2023, continues to play an important role in this journey. Its goal is to secure important core competencies within the company and develop additional future-oriented skills. The international rollout of this measure remains a priority.

Also related to transformation and change is the extensive international training initiative Driving Change@MAN ES, which was launched in the fall of 2022, extended throughout 2023, and will continue in the future. It imparts change competencies to managers around the globe, optimally preparing them for the company's changes and challenges. As mentioned above, our growth gives this initiative even greater significance.

Additionally, another focus in 2023 was on the topic of diversity: we want to leverage diversity as an opportunity against the backdrop of a highly dynamic business world. The goal is to establish a culture of diversity and

acceptance within the company even more strongly than before, to create optimal working conditions for everyone, and thus, not least, to enhance the attractiveness of MAN ES as an inclusive employer.



We embrace diversity in terms of age, cultural background, gender, and sexual orientation and actively advocate for inclusion.

Diversity of thought, skills, and experience backgrounds fosters creativity, innovation, and dynamism.

We create an environment that promotes each person's individuality in the company's interest.

Around
30 %
of newly hired employees
in engineering are women

Around
5,500
training
measures
conducted

in 2023



Activities and actions in 2023

Initiatives relating to people empowerment

Diversity

Strengthening the diversity of the workforce in terms of age, gender, origin, disability, worldview, and many other aspects is a goal that has come into even sharper focus at MAN ES in 2023. At its core, it is about creating an even more diverse working environment and further cultivating respect and acceptance. Diversity in the workforce offers advantages: different perspectives and cultural backgrounds help foster innovation and creativity to optimize processes and products. Additionally, a culture where everyone is welcome is one of the best prerequisites for positioning oneself as an attractive and inclusive employer for all, thus addressing the shortage of skilled workers. This employer profile should also lead to employees increasingly recruiting new employees for MAN ES within their circles.

To enhance diversity within the company, we implemented several initiatives in 2023. For instance, our Zurich site, as part of the Zurich Pride campaign in June, promoted the theme "Diversity in the Workplace" for the first time. In the Neue Zürcher Zeitung and nationwide at train stations, on posters, and e-screens, MAN ES stood alongside 31 renowned companies for a strong message: "The fight for freedom has a long tradition in Switzerland. We are continuing it – for more diversity in the workplace".

Breaking down language barriers among employees is another critical issue we are actively addressing. Since 2022,

networking events at our Augsburg site have allowed employees to connect with "language buddies" who support them in their day-to-day work. This approach was revisited in 2023 and used, for example, during the internal Diversity Days to allow production area employees to build and expand such a network. Furthermore, existing networks were actively maintained and promoted in 2023 at the participants' initiative.

For people with disabilities, the focus at the German sites was on further strengthening the sense of community. We have identified how we can provide even better support in the future, such as which government services are available and how these measures can be coordinated. Both the employer and employee representatives support the initiatives in the area of participation. Above all, the focus remains on creating inclusive working conditions and establishing adequate workplaces tailored to individual needs to keep employees productive and employed in various roles or tasks. Additionally, it is necessary to create contact opportunities with the appropriate agencies to receive quick and targeted support.

Across the group, an important goal for MAN ES is to increase the proportion of women in the company further, especially in management. The overall proportion of women in the workforce is currently around 16.4 percent. Measures are already underway to support this development, such as

promoting women in the promotion process, which shows initial success. For instance, the reinstated international trainee program offers career opportunities for potential female managers. A fixed component is a three-month assignment at another site, preferably abroad. The current proportion of women in this program, around 30 percent, is expected to increase further. The mentoring program also contributes in this direction, allowing women to engage as mentors or mentees. Currently, the proportion of women here is just under 20 percent and is expected to grow. In this program, a junior employee has the opportunity over six months to engage in direct, non-technical exchange with an experienced manager, discussing experiences, ideas, and perspectives and learning from each other. We emphasize fostering interaction between participants and allowing flexibility in the meetings' duration, length, frequency, or nature.

The existing internal women's network at MAN ES, which has been active for several years, also empowers female specialists and executives. In 2023, it remained active with events and meetings at various German MAN ES sites.

Notably, the proportion of women among newly hired engineers has risen to around 30 percent worldwide. We attribute this to the company's strategic positioning and existing flexibility measures such as mobile working and part-time models.

Women in our French team demonstrated true "women power" last year: every year, the "Fem'Energie Award" is presented in France by the "Women in Nuclear" programs WIN France and WIN Europe, in collaboration with various scientific institutions. This award advocates for the importance of women in technical and scientific professions. In 2023, the MAN ES team "Les électriquEs," consisting of seven women with diverse professional backgrounds, achieved a commendable 3rd place in the "Collective Application" category against 27 competing teams.

Working conditions

In 2023, the German Supply Chain Due Diligence Act, which came into effect on January 1, 2023, significantly impacted the Human Resources department. The law requires companies to ensure that no human rights violations, such as forced labor, discrimination, or child labor, occur within the external supply chain or their own business operations. This law impacted HR by causing a revision of our corporate policy, expansion of existing measures, and introduction of new ones. This process included, in particular, the review and, if necessary, adjustment of the documentation of existing processes or the introduction of new processes for MAN ES at all sites and subsidiaries worldwide. In 2023, we focused on the sustainable anchoring of the previously established processes.

One aspect that broadly falls under working conditions is modern workplace concepts. In addition to mobile working options, we were also able to further expand the "Shared Desk" concept in 2023 (see also the "Decarbonization" chapter). This offering is already being intensively used in various company areas.

Training and development

The new strategic direction of MAN ES from a component supplier to a solutions provider also requires the

preservation and development of the necessary competencies within the company. We implemented the transformation qualification for our employees, which began in 2021, as originally planned, until the end of 2023. Initially focused on Germany in 2021, we rolled out the training initiative internationally in 2022 and 2023.

For our new growth strategy, our employees' targeted and future-oriented qualifications are essential, and our stated goal is to preserve valuable know-how within the company and develop future-critical competencies. Throughout 2023, we conveyed this expert knowledge through targeted individual training measures and by expanding competencies in larger groups, enabling our employees to professionally meet new requirements (reskilling) or expand their knowledge (upskilling). Numerous employees were trained accordingly:

- Reskilling: 241 participants in individual measures
- Upskilling: 2,727 participants in a total of 268 measures

Specifically for the area of upskilling, a survey of departments in 2021 identified the following focus areas where we clustered the future-oriented competencies we consider necessary:

- Digitalization & Automation
- Technologies & Solutions
- Sales & Business Performance
- Work Methods, Collaboration, and Change

In addition to reskilling and upskilling, securing core competencies in the departments and preserving or rebuilding crucial know-how within the company (Retaining: 607 participants in individual measures) was also important. During the efficiency program Performance 2023, we implemented measures for job cuts, which also meant adapting job descriptions for employees, thus opening opportunities for colleagues to expand their competencies and skills. Overall, 3,575 people participated in the qualification measures (retain, reskilling, and upskilling combined) over the entire implementation period of 2022 and 2023.

Our major global training initiative, Driving Change@MAN ES, started in October 2022 and extended its training modules throughout 2023. The core aim remains to impart change competencies to leaders and managers to optimally prepare them for the changes and challenges brought by the current transformation process. Consequently, the associated goals and guiding principles are integral to the training. The training concept was developed jointly with external experts and MAN ES departments.

The virtual training modules cover six topics:

- From Corporate Strategy to Action Plan
- Leading Successfully in Times of Change
- Making Decisions in Uncertainty
- Tools for Successful Change
- Leading with Resilience
- Foundations for Building Sustainable Business Branches

Additionally, the "Learning out loud" kick-off format addresses individual implementation challenges and the transfer of learned concepts to one's own tasks. Weekly "microlearnings," such as new methods, videos, or self-tests that encourage reflection, deepen the learning content. Employees can complete the training in either German or English.

Beyond the target group of leaders and managers, we made the Driving Change@MAN ES program available in a slightly reduced form to other employees with change-related tasks, such as team or project leaders, change ambassadors, and agile mentors, as we recognized a significant need for this knowledge and these competencies in this target group as well.

From October 2022 to December 2023, a total of 1,461 leaders participated in 179 training sessions. In the extended target group, there were 500 participants in 58 sessions during the same period. The training received very positive feedback from participants in a final survey.

Due to the success of Driving Change@MAN ES, we are now continuing the initiative with a new focus to support the "Move to Triple Ten+" program. We plan to align the content

with growth-related changes, such as managing new business complexities and team dynamics due to personnel expansion.

In addition to Driving Change@MAN ES and the transformation qualification, we naturally offer our employees training and development opportunities tailored to their respective competencies and needs. Our online platform, MAN eAcademy, plays an important role here with a comprehensive training offering, which, as a digital format, further underscores the significance of digitalization as a core element of our corporate strategy.

Additionally, for employees at our German sites and MAN ES in Switzerland, we use the FutureMatch training portal, through which various training sessions can be booked and completed. FutureMatch includes training from internal instructors, external further education, and recordings of events and videos from all competency areas. Many of the offerings are web-based training (WBT). The diverse content ranges from product-specific competencies to personal skill development.

In 2023, we developed and added a new web-based training specifically on the sustainability reporting process to our MAN eAcademy. As the requirements for sustainability reporting in terms of data volume and complexity continue to increase due to public expectations and new regulations such as the EU Corporate Sustainability Reporting Directive (CSRD), understanding correct sustainability reporting is crucial. We also benefit from better data quality and analysis to track our sustainability performance and derive improvement measures.

The course is aimed at employees involved in sustainability reporting and those responsible for maintaining energy measures. It teaches which indicators and values should be reported, when and how within the company, and how certain data should be evaluated. This training measure also aimed to reduce the support effort for reports and evaluations in the central function and enable better data quality and insights directly at the sites.



Lighthouse projects

Fresh thinking for decarbonization: how trainees contribute their ideas for more sustainability at the site

By 2030, we aim to reduce our CO₂ emissions at our production sites by 50 percent compared to 2018. Everyone can make an essential contribution to this. Various measures in 2023 raised awareness among young people on the topic and allowed them to contribute their ideas.

At the Augsburg site, we initiated a lecture series in the spring of 2023 specifically for first-year apprentices to inform and sensitize them about our sustainability strategy and the importance of sustainability. The idea behind it is to utilize this generation's fresh, unclouded perspectives and ideas. The young people are highly interested in the topic and willing to engage in sustainability privately and professionally. This lecture series, which combines a short theoretical input with an interactive workshop in small groups, is now conducted annually as part of the onboarding process for our new apprentices.

For this reason, we have also expanded the scope of our Environmental and Sustainability Group: the focus is now not only on environmental issues, but includes all aspects of sustainability. Moreover, apprentices from all years now have the opportunity to participate – previously, participation was limited to first-year apprentices. The goal is to develop and implement projects themselves – for example, building an insect hotel and bird nesting boxes. All trainers support the Environmental and Sustainability Group. A rollout of this idea to other sites is planned.

At our Zurich site, our apprentices successfully participated in the "Energy and Climate Workshop" competition last year: the two MAN ES teams took first and fifth place. This "Company Challenge" is a project of a foundation that emerged as a spin-off from the Swiss Federal Institute of Technology Zurich. In 2023, apprentice groups from 26 different companies participated in this competition. The central question was: how can apprentices make their own contribution to climate protection and make Zurich more climate-friendly? In small groups, the young professionals developed and presented concrete project ideas that contribute to energy savings and climate protection. External experts guided the young people in their tasks. A jury evaluated the ideas and voted on them publicly.

Our winning apprentices convinced the jury with a proposal on how to make previously unused thermal energy from the test stand at the MAN ES Zurich site usable for the company and, furthermore, contribute to sustainable heating throughout Zurich by feeding it into the district heating network.

We see so much potential in this idea that we are pursuing it further at MAN ES: a team of apprentices and Future Makers – employees engaged in various groups or communities for sustainable development towards a climate-neutral future – is jointly creating a business process analysis. This will be presented to management before the end of 2024.



Prize ceremony of the "Energy and Climate Workshop" competition in Zurich (Switzerland)

Lighthouse projects

Diversity and gender equality: progress at MAN ES Denmark

Last year, gender equality and diversity were particularly in focus at our site in Denmark. The goal was to achieve measurable progress in a short time. A concept was developed and implemented to this end. With success: the proportion of women and employees with an international background increased in the first year.

Specific goals for MAN ES in Denmark are to increase the proportion of international employees to 15 percent from at least 50 different countries by the end of 2025 and raise the proportion of women in the company above that in the Danish maritime industry – which is 21 percent – to 25 percent.

As a first step, a 360-degree analysis of the situation was conducted, and various interconnected activities were derived from it, such as cooperation with various universities and colleges, presence at fairs and congresses focusing on women in STEM professions (science, technology, engineering, and mathematics), the rephrasing of job advertisements to better appeal to a diverse target group, especially women, "Break your bias" trainings for managers, etc. Additionally, we addressed the pay gap identified in some professions: women in certain positions received lower salaries than men of comparable age with similar responsibilities. Following the "equal pay for equal value" principle, appropriate measures were taken and implemented.

By the end of the first year in which MAN ES Denmark implemented these measures, successes were visible: the

proportion of women increased from 20.1 percent (2022) to 21.4 percent (2023). Additionally, the number of women in leadership positions rose from 11 percent to 15 percent. The proportion of employees with international profiles increased from 8.5 percent in 2022 to 12.7 percent in 2023.



Selected key figures at a glance

Economic development

The financial key figures continue to develop very positively. This fact shows us that our strategic direction and our efficiency program Performance 2023, which we successfully completed in 2023, are having a positive impact. Order intake increased significantly again by 18 percent compared to the previous year, and revenue also increased by 13 percent. As in the previous year, 5.3 percent of

revenue was invested in R&D, leading to a corresponding increase in R&D expenditures. Profitability (return on sales) increased by 1.3 percentage points to 9.1 percent, corresponding to an EBIT of €369 million. This development helps us to further advance the transformation of MAN ES into a solutions provider for more climate-friendly energy solutions.

	2023	2022	2021
Order intake (in million €)	5,039	4,260	3,821
Revenue (in million €)	4,044	3,565	3,278
Investments (in million €)	110	72	53
% of revenue	2.7	2.0	1.6
Research and development (in million €)	214	188	174
% of revenue	5.3	5.3	5.3
EBIT (in million €)	369	280	176
RoS (in %)	9.1	7.8	5.4

Employees

After a decline in 2021, the number of employees has been increasing again since 2022 and is expected to continue growing in a qualified manner in the coming years, according to the strategic direction. The increase in female employees is also disproportionately high in 2023. As a result, the proportion of women in the permanent workforce has risen again and now stands at 16.4 percent. The increasing utilization of the plants is also reflected in the growth of the value-adding workforce, allowing more temporary workers to be employed again in 2023.

The number of trainees is still slightly declining due to more cautious hiring in previous years, but it is expected to rise again, as hiring increased in 2022 and 2023. Particularly noteworthy is the still high number of excellent graduations. For example, in 2023, MAN ES had a German national winner in the field of machining mechanics. The proportion of female trainees has also increased. Since MAN ES has been committed to high-quality training for many years, thereby fostering its own junior staff, the retention rate of trainees remains very high at 95 percent.

Employees of MAN Energy Solutions

	2023	2022 ¹	2021
Workforce (value-adding)	15,070	14,036	13,468
Germany	7,148	6,675	6,511
Abroad	7,922	7,361	6,957
Share abroad in %	52.6	52.4	51.7

¹ From 2022, including H-TEC SYSTEMS (calculated without H-TEC SYSTEMS: 2022: total 13,763, worldwide 7,361, Germany 6,402, proportion 53.5 percent; 2023: total 14,613, worldwide 7,922, Germany 6,691, proportion 54.2 percent)

Age structure

	2023	2022	2021
Core workforce	14,702	13,836	13,331
≤ 30	1,756	1,828	1,615
31 – 40	4,187	4,080	4,013
41 – 50	4,167	3,794	3,615
51 – 60	3,500	3,395	3,361
> 60	1,092	739	727

Structure of the workforce²

	2023	2022	2021
Core workforce	14,702	13,836	13,331
of which female	2,409	2,166	2,012
of which male	12,293	11,670	11,319
of which part-time employees	580	516	480
of which female	351	320	304
of which male	229	196	176
of which temporary employees	426	413	377
of which female	66	73	70
of which male	360	340	307
Apprentices	468	488	519
of which female	86	80	81
of which male	382	408	438
of which in Germany	303	335	369
of which new hires in Augsburg	45	43	39
Augsburg retention rate in %	95	96	100
Employees in semi-retirement passive phase	308	247	212
Workforce	15,478	14,571	14,062
Temporary workers	368	137	149

² At the end of each year

Women in leadership positions

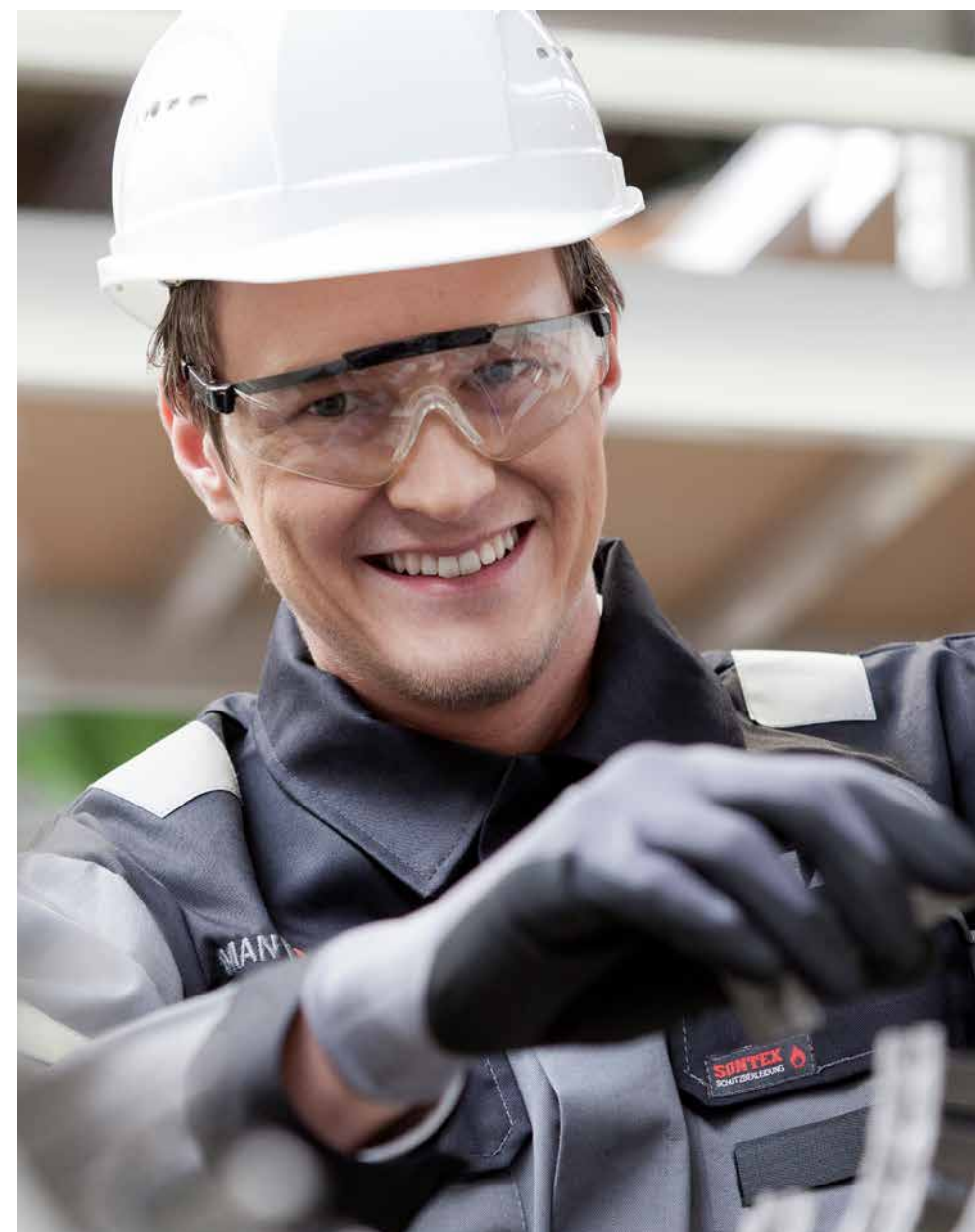
Despite the restructuring program running until 2023, the proportion of women in the permanent workforce had already increased in previous years. In the reporting year, there was also an increase in the proportion of women across all groups of our employees. Fortunately, the trend of recent years caused by individual departures in leadership positions, particularly in upper management, has been stopped and reversed positively. Another positive outlook for 2024 is that we are expected to have a female executive in the top management circle for the first time.

	2023	2022	2021
Percentage of women in core workforce	16.4%	15.7%	15.1%
Percentage of women in management group (MK)	11.1%	10.4%	9.3%
Percentage of women in upper management group (OMK)	6.2%	4.2%	4.8%
Percentage of women in top management group (TMK)	0	0	0
Percentage of women in management (MK, OMK, TMK)	9.2%	8.0%	7.7%

Vocational training/qualification

The focus area of people empowerment already places special emphasis on their qualifications. In particular, transitioning to a solutions provider and developing new technologies require method, technology, and change competencies. The qualification program established for this purpose was in high demand and will continue to be expanded in the future. Overall, we conducted around 5,500 measures with almost 73,000 participants. Many of these training sessions continued to be completed through our MAN eAcademy or were web-based, but topic- and target-group-specific in-person events were also offered.

	2023	2022	2021
Initiatives implemented	5,488	5,257	3,367
Participants	72,730	89,696	51,115
Qualification hours	341,944	262,886	203,893
of which time-independent qualification (E-learning)/persons	50,965	70,047	32,240
of which time-independent qualification (E-learning)/hours	45,731	54,053	27,688
Ø Qualification hours per employee	22.63	19.45	14.31



Occupational safety and environmental protection

The following key figures for the year 2023 apply exclusively to our 12 production sites: Augsburg, Oberhausen, Berlin, Deggendorf (Germany), Copenhagen, Frederikshavn (Denmark), Zurich (Switzerland), Saint-Nazaire (France), Velká Bíteš (Czech Republic), Aurangabad, Bangalore (India), and Changzhou (China).

Accidents at work

Fortunately, the number of lost workdays in 2023 was below the previous year's level. The accident frequency index (RIF) remains stagnant at a high level. For this reason, we continue to give great attention to occupational safety. Both the accident frequency index and accident severity are to be significantly reduced. Numerous measures are already being implemented, and additional measures are being derived.

	2023	2022	2021
Accidents at work with an absence of ≥ 1 day	150	145	141
Days of absence due to accident	2,363	2,513	2,170
Fatal accidents at work	0	0	0
Index of accident frequency - RIF (Recordable Injury Frequency) ¹⁾	11.81	11.21	12.17

¹⁾ Number of work-related accidents per one million working hours



Energy consumption in MWh

The share of renewable sources in electrical energy consumption was significantly increased from 2021 to 2023 and reached 97 percent in the reporting year 2023. In absolute terms, the most significant increase was in external generation. We had the most significant increase in self-generated renewable energy in relative terms. Individual projects, such as the commissioning of a new PV system in Aurangabad, are mentioned in this report. The consumption of thermal energy (approx. -5 percent) also developed positively, while fuel use at the sites increased in 2023.

	2023	2022	2021
Total energy consumption	288,591.42	285,424.06 ¹	292,913.74
Electric energy consumption	85,623.26	83,257.99	79,099.46
Elec. energy consumption from renewable energy sources - own generation	1,173.61	741.40	18.68
Elec. energy consumption from renewable energy sources - external generation	81,859.45	77,829.95	41,164.62
Elec. energy consumption from conv. energy sources - external generation	2,590.19	4,686.64	37,916.17
Thermal energy consumption	34,950.59	39,099.45	49,360.46
Thermal energy consumption from renewable energy sources - own generation	0.00	0.00	0.00
District heating consumption from renewable energy sources - external generation	0.00	0.00	0.00
District heating consumption from conv. energy sources - external generation	34,950.59	39,099.45	49,360.46
Fuel usage at the sites	164,373.03	158,476.37 ¹	161,586.62
Heating oil	2,243.02	1,289.89	1,018.17
Natural gas	125,507.36	127,552.04 ¹	136,017.70
Diesel for company vehicles	1,622.15	1,482.08	920.94
Gasoline for company vehicles	444.05	342.76	22.51
Consumption of light and medium-weight mineral oils as fuel on test beds	35,555.60	27,418.34	23,847.91
Heavy oil consumption as fuel on test beds ²	108.63	1,771.30	142.14

¹ Value was adjusted due to a correction in natural gas consumption after the publication of the 2022 Sustainability Report. Corresponding changes to total consumption and emissions were also corrected.

² Heavy oil consumption depends on the number of test runs. In 2023, only a few test runs with heavy oil were conducted.

Kerosene consumption as fuel on test beds	450.07	444.8	560.70
Propane on test beds ³	508.34	0.00	0.00
Biomass	0.00	0.00	0.00
Fuel gases for manufacturing processes	1,186.34	2,368.41	1,923.75
Acetylene (Ethin, C ₂ H ₂)	1,060.82	1,846.14	818.79
Propane ³	22.13	437.34	1,051.63
Hydrogen	103.39	84.92	53.33

CO₂ emissions in t

Due to significantly increased production, among other things, CO₂ emissions in Scope 1 have risen compared to the previous year. In contrast, thanks to further measures, emissions in Scope 2 were reduced again, continuing the positive trend in this scope.

	2023	2022	2021
Total CO₂ emitted	46,094.28	40,972.85 ¹	52,891.79
Directly emitted CO₂ (Scope 1)	40,516.75	33,389.90 ¹	33,351.54
Indirectly emitted CO₂ (Scope 2)	5,577.53	7,582.96	19,540.25

³ Since 2023, propane for test beds has been reported separately. Until then, propane for test beds was included under propane for manufacturing processes.

Recycling and waste in t

Despite the significantly increased total amount of waste due to the higher production volume, the amount of waste for disposal was reduced considerably (-42 percent) during the reporting period. The amount of hazardous waste remained at a constant level.

	2023	2022	2021
Total amount of waste	29,549.81	20,246.57	21,865.28
Total amount of waste for recycling	18,962.06	9,016.07	11,537.13
Hazardous waste for recycling	1,754.36	1,590.58	2,060.41
Hazardous construction waste for recycling	610.09	139.18	166.30
Other hazardous waste for recycling	1,144.27	1,451.40	1,894.11
Non-hazardous waste for recycling	17,207.70	7,425.50	9,476.72
Non-hazardous construction waste for recycling	9,204.65	567.8	3,480.18
Other non-hazardous waste for recycling	8,003.05	6,857.70	5,996.54
Total amount of waste for removal	1,337.93	2,043.35	1,785.88
Hazardous waste for removal	937.86	865.94	903.11
Hazardous construction waste for removal	13.46	12.52	132.92
Other hazardous waste for removal	924.40	853.42	770.19
Non-hazardous waste for removal	400.07	1,177.42	882.77
Non-hazardous construction waste for removal	116.45	813.11	549.08
Other non-hazardous waste for removal	283.62	364.31	333.69
Metal waste	9,249.82	9,187.14	8,542.27

Water and waste water in m³

Overall, utility water consumption has increased due to the higher demand in production and at the test beds. It is encouraging that the amount of recycled water and the amount of utilized rainwater could be increased.

	2023	2022	2021
Total fresh water volume	159,073.96	3,502,161.91	3,435,615.99
Fresh water volume from external supply including drinking water	106,789.06	108,333.01	102,375.29
Amount of fresh water from own sites (well water)	51,934.90	3,393,828.90	3,333,240.70
Surface water from lakes, rivers, seas volume¹	7,596,400.00	3,234,366.00	3,678,610.00
Utilized rainwater volume²	350	120	100
Recycled water volume	3,588	3,531	1,401
Waste water volume	329,812.70	328,815.27	302,836.87

¹ Due to an adjustment of the indicators, a significant portion of the water quantity that was classified as freshwater from own production in previous years is now counted as surface water from lakes, rivers, and seas.

² An improvement measure at one site significantly increased the amount of utilized rainwater in the reporting year 2023.

Air pollutant emissions in t

	2023	2022	2021
Sulphur dioxide (SO₂)³	7.37	13.41	4.77
Nitrogen oxides (NO_x)	177.68	149.85	123.80
Total dust	3.38	2.97	2.00
Emissions of volatile organic compounds (VOC)	38.18	36.08	37.07

³ Only a few test runs with heavy oil were conducted in 2023, resulting in significantly decreased sulfur dioxide emissions again in the reporting year.



Certificates for production sites

All of our production sites are triple-certified according to the standards below.

	2023	2022	2021
Site with ISO 14001	12	12	12
Site with ISO 9001	12	12	12
Site with ISO 45001	12	12	12



Production hall in Augsburg

Reporting methodology

Sustainability is an integral part of our corporate strategy. Our sustainability report publishes essential information about our sustainability activities, including aspects such as strategy, organization, initiatives, programs, management systems, and goals. This 2023 sustainability report aligns with internationally established frameworks and requirements, such as the Global Reporting Initiative (GRI, as referenced) standards, ESG sustainability ratings, and stakeholder expectations. As part of the Volkswagen Group, MAN ES participates in the UN Global Compact, the world's largest initiative for sustainable corporate governance.

Reporting period and boundaries

This report pertains to activities conducted by MAN ES during the fiscal year 2023 (January 1, 2023, to December 31, 2023). Any exceptions are marked as such. We report annually on our progress. Typically, the report encompasses all MAN ES business units and companies. Possible exceptions regarding the data pool used are marked (e.g., only production sites in scope). Minority interests are not included in the report. To ensure comparability, key figures from previous years may be adjusted and appropriately marked.

Data collection and reporting

MAN Energy Solutions uses an energy, environmental, and occupational safety information system to collect and analyze reports from all relevant sites in all relevant countries. The criteria for reporting were established based on the size and nature of a site. Our production sites and larger branches report the full range of parameters such as energy use, resource consumption, and emissions. Smaller sites report only selected parameters relevant to their specific location. Given the size and global presence of MAN ES, data collection requires the use of a distributed IT and data environment. The non-financial data collected may comply with local rules and regulations, which may differ from the reporting requirements at the corporate level. To ensure consistent non-financial reporting, we reconcile and adjust the collected data to meet the company's reporting requirements. All information presented in this report that is subject to significant data limitations is marked as such. To ensure data quality and maintain the value of the information, we identify and assess data limitations in accordance with our internal policies. This may require excluding affected data sources if necessary, such as for consistency. As a result, our figures may be different from

data published by other companies under the same or similar designations. The key figures shown here are consistent with those of previous years. The respective figures explicitly indicate significant changes in data collection and measurement methods for our sustainability performance. Retrospective corrections of estimates may result in deviations from the figures published in the previous year's report. All figures in the report are rounded individually, which may also lead to slight discrepancies. The use of the term CO₂ emissions in this report includes considering and determining other climate-damaging greenhouse gases such as methane (CH₄). All data in this report on CO₂ emissions correspond to CO₂ equivalents.

Report review

We have prepared our sustainability report in compliance with high-quality standards. MAN ES is also a subsidiary of Volkswagen AG. Volkswagen AG's sustainability report includes all significant domestic and foreign subsidiaries directly or indirectly controlled by Volkswagen AG, including MAN ES. Volkswagen AG's consolidated group sustainability report is subject to an annual voluntary business review by an independent auditing firm.

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All data provided in this document is non-binding. This data serves informational purposes only and is not guaranteed in any way. Depending on the subsequent specific individual projects, the relevant data may be subject to changes and will be assessed and determined individually for each project. This will depend on the particular characteristics of each individual project, especially specific site and operational conditions.

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