

# Environment

Resource consumption and climate change are major challenges for business and society. Our Climate Strategy 2030 is designed to significantly reduce energy consumption and carbon emissions at our own production sites. The Knorr-Bremse EcoDesign approach helps us to ensure that material sustainability aspects of our products can be taken into account across the entire life cycle. In use, our products facilitate the safe, efficient and sustainable mobility of rail and commercial vehicles.

# **Environmental Management**

By practicing holistic environmental management, we seek to continuously reduce the environmental impact of our business activities. Clear processes and local measures promote the conservation of resources as well as the reduction of emissions and waste at Knorr-Bremse.

The company's  $\checkmark$  Health, Safety and Environment (HSE) Policy, defines the principles of environmental and climate protection and energy management in the Knorr-Bremse Group. We want to prevent or minimize potential impacts that our processes, services or products could possibly have on people and the environment. To implement these measures, we have introduced divisional HSE management systems using standardized processes at our sites around the world. The HSE management systems are an integral part of our company management systems (Rail Excellence [REX] at RVS and Truck Excellence [TEX] at CVS). They are based on legal regulations, customer requirements, internal policies and process instructions. In addition, our processes are guided by national and international standards such as ISO 9001, ISO/TS 22163, IATF 16949 (quality management), ISO 14001 (environmental management), ISO 45001 (occupational safety) and ISO 50001 (energy management). Knorr-Bremse conducts regular internal and external audits to monitor its environmental management, auditing compliance with specified standards and the implementation of defined improvement measures.

We require selected locations to be certified in accordance with the environmental management standard ISO 14001. When implementing energy management, we follow the European Energy Efficiency Directive and have had all our European production sites certified in accordance with ISO 50001 or had energy audits conducted in accordance with EN 16247. In addition, largely energy-intensive sites in Brazil, India and the United States are also certified.

	2022	2021	2020
Based on environmental management standard ISO 14001	71	70	67
Based on energy management standard ISO 50001/EN 16247	37	38	36

#### Number of audited/certified business units with environmental management systems

The central HSE departments of the RVS and CVS divisions are responsible for managing and implementing environmental management. They develop strategic guidelines and bring together all cross-site management and coordination duties. Knorr-Bremse's senior management is involved in strategic and operational environmental management through regular meetings, ad hoc reporting or via the ESG Board. HSE managers implement the strategic requirements, goals and programs at the Knorr-Bremse sites with the local managers. Local environmental protection and energy officers, regional coordinators and experts from the departments involved provide support. We strive to have largely uniform HSE management across both divisions. There is a regular exchange of expertise both within and between the divisions to this end. This addresses aspects relevant to HSE, best practices, legal requirements and the associated reporting.

# **Climate Protection**

Knorr-Bremse has set itself the objective of making mobility more sustainable. Climate protection and reductions of carbon emissions are two key goals in this effort. With our Climate Strategy 2030, we want to make our contribution to the goals of the 2015 UN Paris Agreement to limit global warming to a maximum of 1.5 degrees.

In a first step, we are focusing on reducing emissions that arise as a result of energy use by Knorr-Bremse's production sites and vehicle fleet (Scope 1 and market-based indirect Scope 2 emissions). In 2019, the company set a goal of reducing production-related carbon emissions by at least 50.4% by 2030. This equates to an average  $CO_2$  reduction of 4.2% annually compared to 2018. This is to be achieved through the following levers:

「了」Increasing CO₂ and Energy Efficiency	Self-Generation of Renewable Energy	(r) Purchase of
Energy efficiency measures and the use of low-carbon fuels in heating systems and the company's vehicle fleet.	Investments in measures to increase the share of self-gene- rated renewable energy at Knorr- Bremse sites.	Increased use of renewable ener- gy purchased by the company through long-term power purchase agreements, green-power products and certificates. Most of Knorr- Bremse's environmental invest- ments are planned for energy efficiency and self-generation of renewable energy.

In a second step, we extended Knorr-Bremse's climate goals to the value chain at the beginning of 2023 and set an ambitious reduction target: We intend to reduce emissions of the upstream and downstream value chain (Scope 3) that are related to our business activities by 25% by 2030 compared to the base year 2021. We focus in particular on emissions from the Scope 3 categories 3.1 Purchased Good and Services, 3.4 Upstream Transportation and Distribution and 3.11 Use of Sold Products.



We want to reduce key Scope 3 emissions by 25% by 2030.

We conducted a detailed analysis of these three emission categories to identify the steps of the value chain that cause the largest amount of carbon emissions. As a result of this analysis, we were able to determine the biggest emission drivers during the reporting period and identify clear areas of action based on these findings. Increased transparency is essential for us to make our targeted improvements. With this thought in mind, we continuously work on refining our data collection methodology.

As another contribution to climate protection, Knorr-Bremse has committed itself to carbon neutrality at its sites from 2021. To this end, we offset Scope 1 and Scope 2 emissions still remaining after our own measures by investing in selected climate protection projects during the last reporting period (2021). Due to changed framework conditions for emission offsetting1, the emission reductions achieved in climate protection projects are currently counted toward the country-specific climate goals of the project host countries. Accordingly, we will make a contribution to the reduction targets of the respective project countries in the future2. This is because our commitment to climate protection remains unchanged. We will continue to finance selected climate protection projects to prevent global emissions at least by the amount of our remaining Scope 1 and Scope 2 emissions of approximately 50,000 metric tons of CO<sub>2</sub> in the

year under review. To this end, we finance two atmosfair gGmbH climate protection projects certified in accordance with the Gold Standard: the project for clean drinking water in Kenya and the project for efficient wood gasifier ovens in India.

<sup>1</sup> With the implementation of COP 26, Article 6.4 of the Paris Agreement, reduction measures are automatically counted toward the project host countries unless contracts provide otherwise.

<sup>2</sup>To avoid counting achieved reductions twice, Knorr-Bremse will not claim as offsets the carbon emission reductions resulting from climate protection projects.

#### Financial Support for Climate Protection Projects in Kenya and India

As another contribution to climate protection, Knorr-Bremse acts jointly with atmosfair gGmbH, Berlin, to fund climate protection projects that are at least equal to the amount of Scope 1 and Scope 2 emissions remaining during the reporting period. To this end, we finance two atmosfair gGmbH climate protection projects certified in accordance with the Gold Standard: the project for clean drinking water in Kenya and the project for efficient wood gasifier ovens in India. These projects were selected together with Knorr-Bremse Global Care e.V.

In 2022, global emissions were lowered by about 50,000 metric tons with the help of a project called "Efficient Wood Gasifier Ovens" in India. With the assistance of the local project partner Sapient, based in Kolkata, low-income households in rural parts of West Bengal are given efficient wood gasifier ovens that use 50% to 60% less firewood. The ovens enable smoke-free cooking, while the gasification process also produces charcoal that can be sold. The reduced use of wood also protects the mangrove forests in West Bengal. A total of 30,000 new ovens subsidized by Knorr-Bremse are planned to be distributed by 2030.

The project "Clean Drinking Water" run by the local project partners Boreal Light GmbH and Waterkiosk Ltd. helps to provide access to clean drinking water for rural households in Kenya. This improvement will help prevent water-borne illnesses. Up to 20,000 liters of water are desalinated and cleaned by the first solar-powered water treatment plant in Burani, Kenya. The result is clean drinking water for 6,000 people, and the unit also produces process water. The certification of the project was completed in late 2022. There are now 31 units in operation. Alongside the monitoring of the carbon emissions prevented by the project, a study is being conducted in collaboration with Knorr-Bremse Global Care e.V. to identify the positive health effects enjoyed by the local population.



#### **Climate Risks**

The impact of climate change and global decarbonization efforts to limit climate change pose potential risks for Knorr-Bremse as a company. These include, for example, extreme weather events and regulatory requirements entailing costs. For this reason, we analyze our corporate climate risks and opportunities as part of Groupwide risk management. To evaluate our commercial climate risks and opportunities, we have started to implement the recommendations of the Task Force on Climaterelated Financial Disclosures (TCFD). With the help of qualitative scenario analysis, we have identified potential risks in our production operations, the supply chain and markets.

 $\rightarrow$  <u>TCFD Reference Table</u>

#### **Climate Strategy 2030 Interim Targets Achieved**

We achieved our climate protection targets in the reporting period: We reduced our Scope 1 and market-based Scope 2 emissions by 69% in 2022 compared to the base year 2018<sup>1</sup>. In doing so, we again exceeded our goal of lowering our carbon emissions each year by an average of 4.2%. Our increased purchase of green power has been our most important lever and contribution thus far. At the same time, we are strengthening our measures in the areas of energy efficiency and self-generation of renewable energies.



By 2022, we were able to reduce 69% of our carbon emissions compared with the base year 2018.

<sup>1</sup> Due to acquisitions and divestitures, the carbon emissions for the base year 2018 have been adjusted.



#### Knorr-Bremse Climate Strategy 2030

#### **1** Recalculation of the base year 2018

The values for the base year 2018 were recalculated on the basis of our restatement policy. Our mergers and acquisitions (United States, Japan, Germany) and divestments (Russia) had a significant impact on our CO<sup>2</sup> emissions. In addition, the emission factors for electricity were shifted from the standard of the German Association of the Automotive Industry to IEA data (link to appendix). The newly calculated base year now has 161,000 t of CO<sub>2</sub> as the new reference level for 2018 (market based) (compared to 133,000 t of CO<sub>2</sub> as the baseline in the  $\rightarrow$  2021 Sustainability Report).

#### **2** 69% Reduction of CO<sub>2</sub> Emission

In 2022, Knorr-Bremse reduced its carbon emissions by 69% compared to 2018, an amount that exceeds our minimum emission reduction target of 50.4% by 2030. To support the 1.5°C path, we intend to reduce our carbon emissions to the greatest degree and at the earliest time possible. We intend to maintain this commitment continuously.

#### **3** Residual Emissions 2022

With the reduction of our carbon emissions by 69% in 2022 compared to 2018, residual emissions of approximately 50 t of CO<sub>2</sub> remain. The rise of these residual emissions compared with the previous year's level resulted in part from the effects of mergers and acquisitions (United States, Japan, Germany) and from greenfield development (Mexico, United States, Thailand).

#### **4** Climate Protection Target 2030

Based on the findings of climate science, our support for the 1.5°C pathway requires annual emission reductions of at least 4.2%. This would result in emission reductions of at least 50.4% by 2030 compared to the base year 2018.

## **Energy and Carbon Footprint at Knorr-Bremse**

Knorr-Bremse recorded total energy consumption of 524 GWh in 2022. This is equivalent to an approximately 22% increase compared to the previous year. This increase resulted largely from the consolidation of the past M&A activities relating to our subsidiaries R.H. Sheppard in the United States, Knorr-Bremse Steering Systems in Japan and EVAC in Germany. If the system parameters of previous reporting periods were applied, a decline in total energy consumption would have been recorded. About 64% of total energy usage was attributed to electricity and 26% to natural gas in 2022. The share of power generated by renewable energy sources totaled 94% in 2022 (2021: 98%), with 0.7% of this being self-generated (2021: 0.6%).

#### **Energy Consumption**<sup>1</sup>

		2022	2021	2020	2018 <sup>5</sup>
Primary energy consumption	GWh	180	131	119	159
Natural gas	GWh	138	99	91	126
Fuels	GWh	39	31	26	33
Self-generated renewable energy <sup>2</sup>	GWh	2	1	1	0
Secondary energy consumption	GWh	344	301	287	349
Purchased electricity <sup>2</sup>	GWh	336	287	273	338
Of which renewable energy <sup>3</sup>	%	94	98	86	12
District heating	GWh	8	14	13	11
Total energy consumption <sup>4</sup>	Gwh	524	431	406	508
Energy efficiency	MWh/€ millions of revenue	73.3	64.3	65.9	76.9

<sup>1</sup> The figure for 2022 relates to all sites under operating control, excluding sites with fewer than 50 employees other than production sites or service workshops. This covers around 97% of Knorr-Bremse's workforce.

<sup>2</sup> Figures for 2021 adjusted: 0.7 GWh was generated by an on-site PPA and corresponding credits were sold by the operator to the electricity market.

<sup>3</sup> The reduction of the figure is due to the higher electricity consumption from our M&A activities in Japan, for which no green power is currently being purchased.

<sup>4</sup>The increase in energy consumption is due to new sites included in the reporting Scope as a result of M&A activities and new buildings. Around 21% of the total energy consumption is attributable to these sites. The figures from 2021 and 2020 have not been retroactively adjusted.

<sup>5</sup> Data from the 2018 base year were recalculated in accordance with our Restatement Policy.

In line with our increased energy consumption, our absolute Scope 1 and market-based Scope 2 emissions in 2022 increased by approximately 15,000 metric tons of  $CO_2$  compared to 2021. The intensity of carbon emissions (Scopes 1 and 2) totaled 7.0 metric tons of  $CO_2$  emissions per million euros of revenue in the year under review (2021: 5.2 metric tons). The use of natural gas by Knorr-Bremse was the primary source of 38,000 metric tons of Scope 1 emissions that were produced in 2022 (2021: 28,000 metric tons). Indirect carbon emissions (Scope 2, location based) totaled 122,000 metric tons of  $CO_2$  (2021: 152,000 metric tons). These emissions are largely composed of purchased electricity in particular.

	Γ	2022	2021	2020	2018 <sup>2</sup>
Scope 1 direct carbon emissions	Thousands metric tons of CO <sub>2</sub>	38	28	26	34
Scope 2 indirect market-based carbon emissions	Thousands metric tons of CO <sub>2</sub>	12	7	27	127
Scope 2 indirect location-based carbon emissions	Thousands metric tons of CO <sub>2</sub>	122	152	147	151
Total market-based carbon emissions	Thousands metric tons of CO <sub>2</sub>	50	35	53	161
Total location-based carbon emissions	Thousands metric tons of CO <sub>2</sub>	160	180	173	186
Carbon intensity	Metric tons of CO <sub>2</sub> /€ million	7.0	5.2	8.6	24.4

#### Direct and Indirect Carbon Emissions<sup>1</sup>

<sup>1</sup>The recording of carbon emissions is based on the recognized requirements of the Corporate Accounting and Reporting Standard (Scopes 1 and 2) of the Greenhouse Gas Protocol. The increase in carbon emissions is due to new sites included in the reporting Scope. Around 33% of the market-based carbon emissions were attributable to these sites in 2022. The figures from 2021 and 2020 have not been retroactively adjusted.

<sup>2</sup> The levels from the base year 2018 were recalculated in accordance with our restatement policy. Our mergers and acquisitions (United States, Japan, Germany) and divestments (Russia) had a significant impact on our  $CO_2$  emissions. In addition, our emission factors for electricity were shifted from the standard of the German Association of the Automotive Industry to IEA data ( $\rightarrow$  <u>Carbon Calculation Method</u>). The newly calculated base year now has 161,000 t of  $CO_2$  as the new reference level for 2018 (market based) (compared to 133,000 t of  $CO_2$  as the baseline in the  $\rightarrow$  <u>2021 Sustainability Report</u>).

In the year under review, Knorr-Bremse moved forward with its work to expand its monitoring of upstream and downstream emissions (Scope 3). The focus of this effort was placed on those emission categories that are relevant to Knorr-Bremse: Scope 3.4 (Upstream transport and distribution), 3.9 (Downstream transportation and distribution) and Scope 3.11 (Use of sold products). The emission categories Scope 3.1 (Purchased Good and Services), Scope 3.3 (Fuel- and Energy-Related Activities), Scope 3.6 (Business Travel) and Scope 3.7 (Employee Commuting) were calculated during the reporting period.

Thousands metric tons of CO<sub>2</sub>e

	2022 <sup>2</sup>	2021
3.1 Purchased goods and services	♥ 1,802	1,855 <sup>4</sup>
3.3 Fuel- and energy-related activities	45	53 <sup>5</sup>
3.4 Upstream transportation and distribution <sup>3</sup>	184	191
3.6 Business travel	6	4
3.7 Employee commuting	25	26 <sup>6</sup>
3.9 Downstream transportation and distribution <sup>3</sup>	⊘ 47	50
3.11 Use of sold products <sup>3</sup>	26,301	27,736
<ul> <li>3.4 Upstream transportation and distribution<sup>3</sup></li> <li>3.6 Business travel</li> <li>3.7 Employee commuting</li> <li>3.9 Downstream transportation and distribution<sup>3</sup></li> <li>3.11 Use of sold products <sup>3</sup></li> </ul>	<ul> <li>184</li> <li>6</li> <li>25</li> <li>47</li> <li>26,301</li> </ul>	27,7

<sup>1</sup>A detailed description of the calculation methodology can be found here ( $\rightarrow$  <u>Carbon Calculation Method</u>).

<sup>2</sup>The most material Scope 3 indicators with a Shave been reviewed with limited assurance by KPMG Wirtschaftsprüfungsgesellschaft ( $\rightarrow$  <u>Assurance Statement</u>). Scope 3.1, 3.4, 3.9 and 3.11 are estimated to account for more than 95% of Knorr-Bremse total Scope 3 emissions. Further key figures, including ones on energy consumption and Scope 1 and 2 emissions, were also reviewed as part of the limited assurance engagement for the separate non-financial statement in the Group Management Report ( $\rightarrow$  <u>Annual Report 2022</u>).

<sup>3</sup>The carbon emissions in the Scope 3 categories 3.4, 3.9 and 3.11 have been calculated for the first time for reporting years 2021 and 2022 in the reporting period 2022.

<sup>4</sup>Restatement of 2021 figure due to a change of the data model.

<sup>5</sup> Restatement of 2021 figure due to a change of the emission factor set in order to be consistent with the Scope 1 and 2 calculation, using IEA emission factors as well as DEFRA methodology for electricity.

<sup>6</sup> Restatement of the 2021 figure due to switch to well-to-wheel emission factors (from tank-to-wheel emission factors).

# **Climate Protection Measures at Sites**

The Knorr-Bremse Climate Strategy 2030 is implemented with the divisional HSE managers and with representatives of the Americas and Asia regions, the Sustainability department and Energy Purchasing. Local environmental and energy management has the task of evaluating and improving processes in the Group on an ongoing basis with respect to energy requirements. For example, consumption data can be monitored at sites, savings potential can be found and the efficiency of any measures implemented can be audited. You can find out here how we achieved our climate targets for 2022 with the help of three levers:

#### Energy and CO<sub>2</sub> Efficiency

To increase carbon efficiency and energy efficiency, we identify potential and, as a result, projects for saving energy using internal and external analyses. These are realized within the framework of a climate strategy budget set by the Executive Board. During the reporting period, the heating, ventilation and air conditioning were modernized at the Acuña site in Mexico, and a heat pump was installed as a replacement for gas burners at the Budapest site in Hungary. With the measures realized through the climate budget since 2019, we expect energy savings of around 8,750 MWh/year. In 2022, new energy saving projects with potential savings of approximately 7,200 MWh/year were also approved.

# Self-Generation of Renewable Energy

We are improving our carbon footprint by generating our own electricity from renewable energy at sites including Suzhou (RVS division), China; Faridabad (RVS division), India; Huntington (CVS division), USA; and Munich (headquarters), Germany. In 2022, we generated approximately 1,400 MWh/year more renewable energy ourselves compared to 2021. In 2022, we put photovoltaic installations into service in Getafe, Spain; Florence, Italy; Acuña, Mexico; and Darra and Granville, both in Australia. The plan is that these should increase our capacity to generate our own renewable energy by approximately 3,600 MWh/year. In addition, photovoltaic installations in Dalian, China; Melksham, UK, Buccinasco, Italy; and Budapest, Hungary, have already been approved. They will generate around 4,100 MWh/year in the future.

#### (ح) Purchase of Renewable Energy

The proportion of purchased renewable energy in total energy consumption remains at a high level. In 2022, about 94% (2021: 98%) of the electricity supplied to Knorr-Bremse came from renewable energy sources or was obtained via green power contracts or green power certificates. Renewable electricity is purchased via a green power contract for our sites in Austria, Sweden and France and via a power purchase agreement (PPA) in Brazil. We obtain green power certificates for other Knorr-Bremse sites around the world. In Europe, these are European proofs of origin, except for specific local proofs of origin in Poland and the United Kingdom. Renewable Energy Certificates (RECs) are used in the USA and Canada, and International Renewable Energy Certificates (I-RECs) are used in China, India, Thailand, Mexico, South Africa and Turkey.

# New Photovoltaic Systems Produce Electricity for Production Sites

#### Bendix, Huntington

#### **Award-Winning Solar Project**

The 1,168 megawatt solar project at Bendix in Huntington, USA, received the prestigious Governor's Award for Environmental Excellence from the state of Indiana in 2022. Connected to the grid in 2021, the PV system significantly reduces Bendix's environmental footprint while saving costs.

ElectricityCoverage ofCO2 emissionsproduction per yearinternal demandreduction per year	1.500 MWh	approx, 10%	<b>530</b> tons
	Electricity production per year	Coverage of internal demand	CO <sub>2</sub> emissions reduction per yea

#### Bendix, Acuna

#### **PV Systems for Two Plants**

PV systems at two plants have been supplying self-generated electricity to the plants in Acuna, Mexico, since December 2022. The future total annual output is expected to be approximately 2,000 MWh. For this purpose, 1,296 solar panels were installed on each factory roof.

Electricity production per year	Coverage of internal demand	CO <sub>2</sub> emissions reduction per year
2,089 MWh	approx. <b>9 %</b>	<b>835</b> tons

#### Knorr-Bremse Rail Systems Italia, Florence

#### "Florence Sunlight" Project

The new PV system at Knorr-Bremse Rail Systems Italia, Florence, generates approximately 350 MWh of energy annually with 900 photovoltaic modules and a peak output of 320 kWp. This covers up to 80% of the site's electricity requirements and can reduce carbon emissions by well over 100 tons per year.

350 MWh	up to <b>80 %</b>	<b>100</b> tons
Electricity production per year	Coverage of internal demand	CO <sub>2</sub> emissions reduction per year







#### Knorr-Bremse Spain, Getafe

#### **PV System for Energy Self-Sufficiency**

In Getafe, a photovoltaic system installed on the factory roof entered operation in 2022. With annual production of 569 MWh of electricity, it will provide for roughly 30% of the site's electricity consumption. In addition to considerable financial savings, carbon emissions are expected to decline by 97 tons per year.

569 MWh	approx. <b>30 %</b>	<b>87</b> tons
Electricity production per year	Coverage of internal demand	CO <sub>2</sub> emissions reduction per year

Knorr-Bremse Australia

#### **Four New PV Systems**

In Australia, new PV systems have been supplying self-generated green power at four sites since 2022. Major systems have been installed, including 728 solar panels (300 kWp) in Granville and 242 in Darra (100 kWp). The systems are expected to reduce carbon emissions by almost 360 tons per year.

530 MWh	29 %	<b>360</b> tons
Electricity	Coverage of	CO <sub>2</sub> emissions
production per year	internal demand	reduction per yea





#### **Flight Compensation Paid into Climate Protection Projects**

As another climate protection measure, Knorr-Bremse implemented an automated compensation process for delayed flights. Flightright GmbH is the company's partner for this. In a process that applied initially to the company's locations in Germany, employees could surrender their entitlements to compensation payments for delayed, overbooked or canceled flights. An automated claim submission process was introduced for this purpose and affected individuals can have their compensation payments made out to Knorr-Bremse instead. The money from the compensation payments is put toward two different climate protection projects. The first project involves the production of synthetic fuels for business flights. The goal is to have up to 1% of flights taken by Knorr-Bremse employees be powered by synthetic fuels. In doing so, Knorr-Bremse is supporting the world's first production plant for jet fuel made from CO, electrolysis. Overseen by Knorr-Bremse's partner atmosfair gGmbH, the facility went into operation in 2021 in Werlte, Germany. Secondly, financial support is being given to a carbon offset project called  $\rightarrow$  Efficient Wood Gasifier Ovens in India. Knorr-Bremse is also carrying out this project in partnership with atmosfair. By mid-2022, total donations of €10,000 were collected from sites in Germany. These employee donations supported the production of 400 liters of synthetic jet fuel and reduced carbon emissions by 345 metric tons. The project was expanded to the company's European sites in the second half of 2022.

# **Conservation of Resources**

Knorr-Bremse wants to reduce the use of raw materials, consumables and supplies and, as far as possible, recycle them. This concept of reducing use and the circular economy applies to all waste as well as water. In principle, our waste management practices are designed to avoid waste – be it raw materials generated during production, packaging or other waste on-site. At the same time, we strive toward the sustainable use of water and, in doing so, account for the different requirements and needs of our locations around the world.

## **Global Waste Management**

For its waste management, Knorr-Bremse is guided by the principle of a sustainable circular economy. Waste prevention is the top priority. If waste cannot be avoided, we strive to recycle it in an environmentally friendly manner. In essence, Knorr-Bremse's global waste management is based on three principles:

- Avoiding waste through the systematic and optimized use of resources
- Substituting materials with more environmentally friendly substances, for example avoiding the use of single-use plastics
- Promoting a circular economy based on environmentally friendly recycling and reusing materials

Waste at Knorr-Bremse primarily consists of scrap metal, paper and residual waste. As a manufacturing company, Knorr-Bremse generates waste containing steel and iron materials, lightweight metal, polymers, supplies and packaging. In addition, the surface treatment of metallic materials produces galvanic sludge.

The Knorr-Bremse Production System (KPS) helps the company to reduce the amount of waste generated in production. Value stream mapping is used to uncover and eliminate various types of waste, such as overproduction or substandard products. Knorr-Bremse itself tries to avoid or

#### Making Packaging Resource-Efficient

Using packaging in a smart way has the potential to save tremendous amounts of resources and lower costs. These benefits can be achieved by reusing materials or using a new packaging solution. The two projects below have received the Knorr-Bremse HSE Award:

In the field of waste, the "Kartofix" projected conducted by **IFE in Brünn, Czech Republic**, made a lasting impression, giving a second life to cardboard packaging. The packaging is shredded and then used as cushioning in other packages. The result: 55% less cardboard waste. The investment made in the machinery pays off quickly thanks to the use of cost-saving cushioning material produced in-house. The principle of the circular economy is practiced effectively.

In the past, **Knorr-Bremse in Daxing, China**, delivered brake calipers to its customers in wooden crates. While these crates were secure, they consumed a lot of resources and had to be dismantled and disposed of following delivery. New packing crates for the brake calipers were designed in consultation with the customer and are now made of reusable material. After Knorr-Bremse delivers the components, the used packaging is taken back to Knorr-Bremse Daxing for recycling. The process reduces wood consumption and waste, which are two reasons why the project won the HSE Award in the environment category.

reduce packaging to the greatest extent possible and to use recyclable materials and containers. Our quality guidelines urge our suppliers to use the same practices.

## **Global Water Management**

We aspire to use water as efficiently as possible and to reuse it as many times as possible in a recirculation system. In particular, Knorr-Bremse uses water for the surface treatment and cleaning of its products, for test applications as well as for drinking and sanitary purposes. The usage of water varies strongly by location. We obtain our water from public utilities. As a way of conserving drinking water, some of our business locations use rainwater for cleaning purposes, sanitary facilities and green space irrigation. We dispose of wastewater via public wastewater systems.

#### Water Consumption<sup>1</sup>

# In thousands of cubic meters 594 2020 594 2021 533 2022<sup>2</sup> 657

<sup>1</sup>The figure for 2022 covers more than 80% of Knorr-Bremse's employees.

<sup>2</sup> The increase from the previous year is due to new production processes and the inclusion of new locations in the reporting.

#### Knorr-Bremse Brazil: Sustainable Water Management Pays Off

Sustainable water management results in improved costs and environmental benefits for the company and the environment. For this reason, Knorr-Bremse Brazil, based in Itupeva, uses its own wastewater treatment plant (WWTP) for oily and galvanic industrial wastewater. Since 2020, the plant has treated 100% of all oily and galvanic industrial wastewater. The process is made possible by a management and quality control plan. The final disposal costs have plummeted as a result of the improved wastewater quality. The new system has also enabled the company to eliminate 673 transportation movements to a wastewater treatment facility, a step that saved 4,000 liters of diesel fuel and 13 metric tons of carbon emissions. Moreover, Knorr-Bremse applies the principle of a circular economy, with a third-party company using the treated sewage sludge (2022: 32 metric tons) to make fertilizer.

To conserve resources, the intake of well water was reduced by 33,500 m<sup>3</sup> between 2020 and 2022 thanks to the wastewater treatment plant. This is equivalent to three days' total consumption of water by residents in the Itupeva area (about 64,000 people). The 50 m<sup>3</sup> currently being taken from the well each day is well below the level licensed for Knorr-Bremse Brazil by the Department for Water and Electrical Energy (DAEE). Another step taken for conscious water usage in 2022 included the recycling of water in all toilet cisterns and in selected industrial processes. Water intake was reduced by 50% as a result.

# **Environmental Product Design**

Knorr-Bremse can make a contribution to climate and environmental protection with systematically environmentally oriented product development, while also achieving a medium- and long-term competitive edge. Knorr-Bremse EcoDesign – environmental product design – enables us to develop products, processes and services with an improved environmental impact across the complete product life cycle. In this way, we want to ensure a future-proof product portfolio and, at the same time, pursue our corporate vision and HSE Policy. With the EcoDesign approach, in addition to various internal requirements, the requirements of regulatory stipulations, standards and customer expectations also influence product development. The focus here is on sustainability aspects such as long service life, resource conservation and avoiding emissions.

# **EcoDesign Integrated into the Organization**

EcoDesign is organizationally incorporated into both divisions in such a way that it supports strategic R&D planning and creates synergies and standardized processes between the Group divisions. The EcoDesign experts of the RVS and CVS divisions have one central function here. They are integrated into the development processes and help, for example, with the assessment of product development. They are supported in this work by divisional analysis teams that analyze Knorr-Bremse products and components with regard to compliance with internal, legal and customer requirements on contents. The EcoDesign experts also form the cross-divisional EcoDesign working group with representatives of the Sustainability department and, where required, the Remanufacturing department. In regular dialog, they develop, among other things, standards for product development and processes for the product life cycle. In the year under review, the focus was mainly on recording the Scope 3 emissions in product use and identifying reduction potential.

Intensive training of engineers and developers in the past few years has given them a shared understanding of EcoDesign standards for evaluating product development. We continue to offer this training on an ongoing basis. In 2022, we focused on specialized departmental training. As part of this program, the new EcoDesign analytics team in the RVS division was trained on the self-developed EcoApp. The app can be used to transfer analytical results on the contents of components into an internal database and customer formats using a digital workflow.

#### EcoDesign in the value chain



#### **EcoDesign in Development Processes**

Knorr-Bremse wants to proactively integrate EcoDesign aspects into product development and is working on systematically integrating sustainability criteria into the processes – from strategic planning through innovation to product development:

#### کے Strategic Planning

In strategic planning, the business units determine their goals on a product and system level for the next five years. In addition to many other aspects, product sustainability is an integral part of this process. As such, EcoDesign criteria such as selection of materials, energy efficiency, reduction of emissions and life cycle are taken into consideration.

# () Innovation

In our innovation process, we assess the potential for refining and realizing projects and product ideas, including on the basis of their alignment with strategically relevant megatrends. In the RVS division's innovation projects, EcoDesign is one of five different assessment criteria in the planning process. In the reporting period, around 80 projects were classified based on EcoDesign criteria. All innovation projects are assessed using a criteria catalog that includes the topic of sustainability. The resulting priority list for the projects is discussed and adjusted at the management level. A higher priority generally means a higher probability of project implementation. The size of a project budget is based on the responsible department's coordinated project and budget planning.

## √ Product Development

When developing new products and solutions, we want to incorporate and minimize their environmental impact from the start. This is why we assess them across the product life cycle in accordance with EcoDesign criteria and derive improvements from this. Both divisions have introduced a binding process that takes the following EcoDesign criteria into account:

# Material extraction and production phase:

- hazardous substances
- weight (CVS division)
- choice of materials (incl. proportion of secondary material)
- the origin of materials (conflict minerals)

#### Usage phase:

- weight (RVS division)
- energy efficiency
- longevity
- direct emissions

#### End of product life:

recyclability

#### Product Development: Analysis and tools for minimized environmental impact

In the RVS division, the EcoDesign assessment form is provided to the development teams for the mandatory assessment of innovation projects and complex customer projects. It defines the requirements for product design and makes assessment tools available, such as supporting standards and methods for evaluating environmental impacts. For example, the recyclability analysis of the materials used helps us to identify and reduce their potential environmental impact. In 2022, a total of 21 projects in the RVS division were reviewed on the basis of a recyclability analysis in accordance with ISO 22628 and/or ISO 21106. Here, the result of the rail vehicle business area's products is in average more than 90% recyclability for Knorr-Bremse products. RVS also conducted four life cycle assessments (LCAs) of new developments compared to their reference system in 2022. These assess the environmental impact of Knorr-Bremse products and systems, and in this context on climate change in particular. The analyses deliver valuable insights on the use of materials and energy in production and impacts in the product usage phase through to disposal. The LCAs were conducted in accordance with standards such as ISO 14040 and the UNIFE Product Category Rules, and their findings were presented to the leading trade fair InnoTrans in 2022.

The CVS division has defined concrete EcoDesign requirements and targets in the product development and commercialization (PDC) process for new products and products with significant changes. These requirements and targets – for example, a minimum reduction in weight – need to be implemented in the phases of project planning through to the product and process development. In this process, specific guidelines and concrete tools and methods provide support. These include the IMDS system for identifying hazardous materials and materials requiring declaration, comparative analyses of material-specific environmental impacts and the EcoDesign assessment form.

#### Life cycle analyses: environmental impacts of selected Knorr-Bremse products (RVS)

**LIFEDrive** is an innovative sliding door system which for the first time has a linear motor drive that controls the two door leaves of an entry system independently of each other. If one door leaf is blocked, passengers can continue to enter and exit through the other door leaf. This helps with passenger flows on platforms, especially in metro transportation, and therefore contributes to timetable stability. There is a further benefit, too: The reduced weight of LIFEDrive emits less CO<sub>2</sub> than conventional sliding door systems over the product's life cycle, as it prevents unnecessary energy consumption during operation.

**Air-conditioning** systems for trains from Knorr-Bremse's brand Merak use efficient technologies, such as heat pumps and natural refrigerants (with a GWP value  $\leq$ 1), to boost energy efficiency and environmental protection, reducing CO<sub>2</sub> emissions over the lifetime compared to conventional air-conditioning systems.

**LEADER** is a driver assistance system for rail freight transportation. It can provide smart recommendations for an efficient driving style and thus help reduce carbon emissions.\*

\* Installed on several hundred freight locomotives in Europe, LEADER contributes to a more than 5% reduction of energy consumption in operation. The potential is even greater: Knorr-Bremse is consistently driving technology and connected solutions for infrastructure and fleet forward.

# **Conservation of Resources through Industrial Remanufacturing**

Our RailServices and TruckServices business is another driver of sustainable product design. This activity focuses on, among other tasks, remanufacturing in the CVS division and overhaul in the RVS division, which are significant lines of business. In this work, Knorr-Bremse industrially remanufactures products so that they can perform an identical function in the transportation industry once again. The longer product life cycle also reduces the amount of material used and saves energy, two improvements that have a positive impact on our life cycle assessment and the life cycle assessment of our customers.

We are able to extend the useful lives of our products by incorporating remanufacturing and overhaul into the development and construction process. Rail vehicle customers who turn to one of Knorr-Bremse's





×



-28 %

CO, emissions

Over a lifetime of **30 years**, this means saving **8 flights around the world by plane**.



Over a lifetime of 10 years, this means saving 21 flights around the world by plane. 50 service centers around the world can have these vehicles overhauled and repaired. Components can be regularly reconditioned here and used once again in a particular fleet or vehicle following a successful test. The goal is to maintain a component's functionality until the end of a particular train's service life. One example is compressors that are reconditioned after they have been used for defined periods of time or operating hours. The replacement of a component or the installation of an additional function can also be done as part of a complete upgrade or modernization project. This complete overhaul can extend the useful life of an entire train.

In 2022, Knorr-Bremse's service center in Berlin remanufactured about 63,600 products used for the widest range of jobs. In China, the brake systems for more than 4,400 cars for high-speed trains, 1,900 locomotives and nearly 3,200 product units for metro trains were remanufactured in 2022. In addition, about 3,200 entrance systems and 1,100 air-conditioning units for high-speed and metro trains were remanufactured.

The portfolio of the CVS division in the region Africa/Europe comprises remanufactured products with about 1,000 product numbers. The portfolio is available under the brand name EconX®. In the year under review, 2,045 tons of  $CO_2$ , 736 tons of material and 8,750 MWh of energy were saved as a result of industrial remanufacturing.



#### Share of revenue from remanufactured products in Group revenue

# **Eco-Friendly Logistics**

Knorr-Bremse strives for eco-friendly logistics throughout its entire value chain. We continuously optimize our operational transport management, including with the support of external service providers. These contractors assume responsibility for the planning, consolidation and operational execution of deliveries from external suppliers to Knorr-Bremse, goods transportation between Knorr-Bremse sites and deliveries to our customers.

We strive to minimize both costs and the environmental impact of product transportation. We also continuously optimize our coordinated usage of rail, road and shipping connections. We achieve this through the use of standardized processes and methods, which, at the same time, increase our service quality across all distribution channels with regard to delivery reliability, delivery quality and delivery

#### **Smart Logistics in Munich**

In Munich, Knorr-Bremse works with a strategic logistics partner, which benefits the efficiency of processes and communications. One specific example of this is the new e-truck that has been helping internal logistics operations in Munich since 2022. It travels between the company's warehouse in Garching and Knorr-Bremse's sites in Munich. On an annualized basis, the e-truck covers a distance equivalent to a mini-world tour – a journey that is now carbon neutral.

deadlines. In 2022, we continued to primarily use ships for most of our intercontinental product transportation. Our target utilization rate of at least 85% for sea freight containers (CVS) supports efficient goods transportation. Rail transportation to China, an option that was increasingly used during the regional Covid-19 restrictions imposed in the country, had to be temporarily halted as a result of the war in Ukraine. They were partially resumed to toward the end of 2022. We avoid air freight transport whenever possible. We are also working to reduce the carbon footprint of our global transportation network. As part of our efforts, we measured the carbon footprint of this global network for the first time ( $\rightarrow$  <u>Climate Protection</u>). Both divisions will increasingly consider the carbon emissions from transportation as a decision-making criterion for optimizing logistics. The Commercial Vehicle Systems (CVS) division plans to introduce a transport management system (TMS) to evaluate and monitor the impact of carbon reduction measures. CVS is already quantifying and evaluating the transport-related carbon emissions when there are new sourcing activities. A further monetary evaluation will serve as a financial incentive to reduce carbon emissions, in addition to the transparency that is created.

Knorr-Bremse continuously monitors and analyzes transportation flows in conjunction with its logistics contractors. This work enables shipments to be consolidated and carbon emissions to be reduced. It has also resulted in the creation of local projects like the restructuring of internal goods transportation in the Munich region.

Another emission-lowering measure completed during the reporting period was a project called the NextGen European Distribution Network. The revised European distribution structure near our sites in Spain, Hungary and Germany will improve the efficiency of transportation flows and lower their emissions. This successfully implemented project received the Supply Chain Management Award 2022 in Germany.

The CVS division is reducing its carrier portfolio in the Europe/Africa region by increasingly focusing on strategic partnerships. Another step being taken to enable more efficient carbon emissions management involves reducing the number of interfaces with freight-forwarding companies. We will work on similar steps in the Asia/Pacific region and South America in the future.

The CVS division has introduced a central tracking process for the Europe/Africa region to optimize the logistics of special freight shipments around the world. Completed and scheduled special freight shipments are analyzed in a regional process for sales inventory operations planning (SIOP). The results will be used to define countermeasures such as increases in inventories on a cyclical basis.

#### Reducing Carbon Emissions in Logistics: Successful Transformation Project

The NextGen European Distribution Network is a transformation project in the Rail Vehicle Systems (RVS) division. It stands for increased efficiency, lower costs and reduced carbon emissions in logistics throughout the supply chain. The purpose of this project was to refocus the company's logistics and supply chain network in Europe and it was implemented so successfully that it won the Supply Chain Management Award 2022 in Germany.

The project is aimed at optimizing economic as well as environmental factors. Eleven criteria were applied in this process, including targets for logistics quality. The result: a 15% decrease in logistics costs, significant carbon emission reductions due to a 20% decline in ton-kilometers driven and increased logistics speed and flexibility for customers.

How was this achieved? By using a "digital twin," among other things. This digital twin was a virtual, data-based model of Knorr-Bremse's logistics footprint in Europe. By taking this approach, Knorr-Bremse significantly boosted transparency in its network, which is used to transport shipments worth more than € 1 billion annually. It is a model that can be used in other regions, too.