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Environmental stewardship



Part of the non-financial report

As a science and technology company with manufacturing operations, we have an impact on the environment. Take for instance the emissions, wastewater and waste generated by our activities, or the materials we utilize that could adversely affect the environment if not handled properly. To mitigate this impact, all our sites meet a strict set of environmental regulations. Intelligent environmental stewardship reduces resource use and lowers costs, which makes it highly important to adapt our processes to new regulatory requirements.

Our approach to environmental stewardship

A holistic approach is needed to minimize negative environmental impacts and preserve the environment. Our goal is to diligently monitor detrimental emissions into the air, water and soil resulting from our operations and do everything possible to prevent them.

How we structure our environmental stewardship practices

Executive Board member Walter Galinat is responsible for overall environmental governance, which also covers climate impact mitigation, water management, waste & recycling, and plant & process safety. Our Group function Environment, Health, Safety, Security, Quality (EQ) is in charge of steering all environmental measures Group-wide. At our individual sites, each site director is responsible for environmental stewardship as well as occupational health and safety at the operational level. At larger facilities, the site directors receive day-to-day support and advice from Environment, Health and Safety (EHS) managers, with EHS coordinators

performing this role at smaller facilities. These local EHS organizations report to and work hand in hand with EQ.

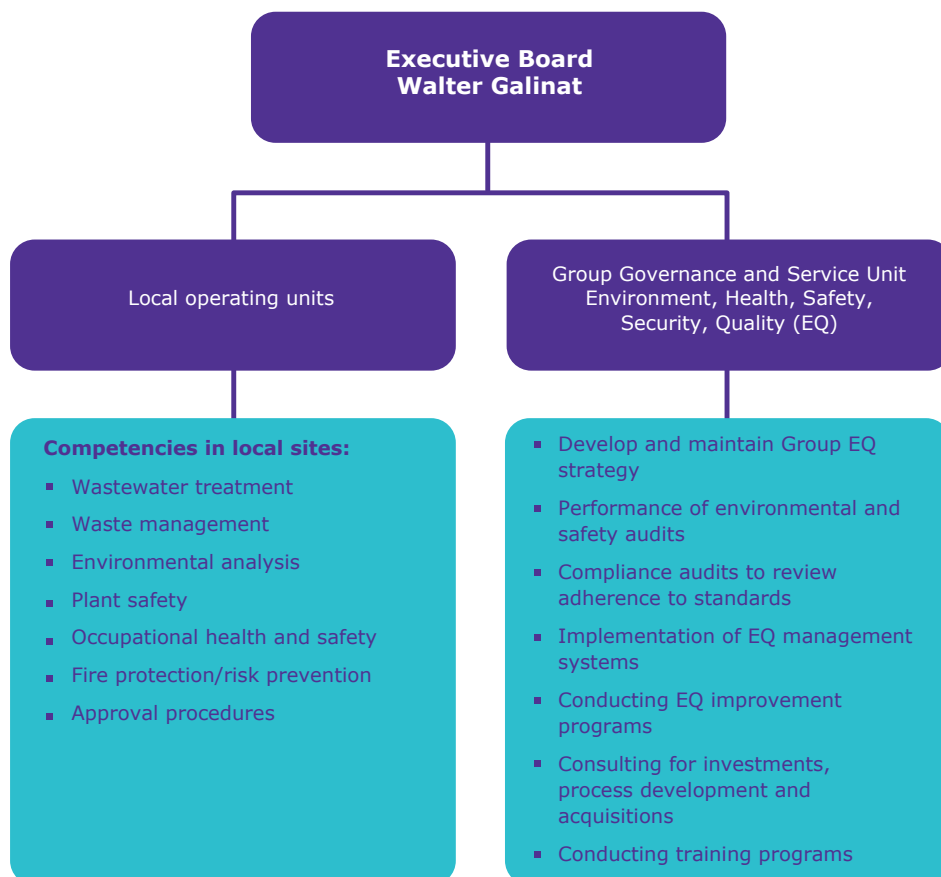
In 2017, our EHS organization comprised more than 200 EHS managers along with other EHS personnel. At the local level, these employees receive support from other units. Our Group function EQ conducts annual EHS seminars at our various sites.

In 2017, environmental stewardship efforts accounted for 26% of our EHS spending, which consisted of both ongoing expenses as well as investment costs. This includes items such as air pollution control, noise reduction and environmental remediation.

The EQ leadership meets with Walter Galinat on a regular basis, usually once a month, to report on their environmental stewardship efforts. Every six months, EQ provides the Executive Board with a report on environment, health and safety issues that also covers climate impact mitigation, water management, waste & recycling, and plant & process safety. This report focuses on our current progress, documenting and assessing the work EHS has accomplished. The Executive Board utilizes this brief as a source of information and as documentation for ISO 14001 and BS OHSAS 18001 certification.

Moreover, the Executive Board is responsible for approving internal guidelines such as our Environmental, Health and Safety (EHS) Policy. Internal standards are approved by the head of EQ. While standards provide a concrete framework, guidelines create an overarching outline of our company's position on a specific issue.

Our EQ Group function ("Environment, Health, Safety, Security, Quality")



Clearly defined incident reporting procedures

We have established a variety of reporting procedures to handle incidents as quickly as possible and take corrective action. In introducing our EHS Incident Rate (EHS IR (p. 100)) and EHS Leading Indicator Rate (EHS LR (p. 100)), two of our key performance indicators, we have created a reporting process that tracks the respective environmental incident, its degree of severity and all risk mitigation efforts. All incidents are logged Group-wide and reported every six months to the Executive Board.

In the event of major incidents, our Rapid Incident Report System (RIRS) promptly notifies the Executive Board, our EHS Group function and Group Communications. These could include fatalities, accidents with multiple casualties, or injuries and damage that occur beyond our premises, along with environmental disasters such as earthquakes and floods. Through the RIRS, we can coordinate the responses of all those involved and inform other potentially impacted sites immediately.

Our commitment: Standards and standard operating procedures

Our approach to environmental stewardship is built on our **Group-wide EHS Policy** (Corporate Environment, Health and Safety Policy), which has been endorsed by Stefan Oschmann, Chairman of the Executive Board. This policy is now aligned more closely with the stipulations of the chemical industry's Responsible Care® Global Charter, as well as with environmental management standard ISO 14001, and it emphasizes our leadership's responsibility toward environmental stewardship, health and safety (p. 80). Moreover, it addresses our suppliers (p. 104), encouraging them to adopt similarly enhanced standards for environmental sustainability and safety. In doing so, our Corporate EHS Policy complements the Responsible Sourcing Principles of our Group Procurement function.

The principles of our EHS policy are implemented through internal guidelines, standards and operating manuals. For instance, our Group EHS, Security and Quality Manual describes how environmental stewardship and occupational safety are organized across the company. This manual was

revised in 2017 to reflect the updated ISO 9001:2015 and 14001:2015 standards. Our environmental management system was also updated in 2017 to bring it in line with the requirements of ISO 14001:2015.

Potential EHS risks posed by acquisitions, divestments or site closures are assessed through due diligence, a process defined in our EHS Due Diligence and Post Merger Transaction Standard. During audits, new sites are given priority.

We regularly review our internal guidelines, standards and operating manuals. In 2017, we updated and introduced multiple standards and processes. For instance, we revised safe chemical handling standards to reflect the latest findings and state-of-the-art safety concepts. Furthermore, we updated our requirements for external warehouses to align them with our Transport Safety and Warehouse Safety standards.

Sizable investments in environmental impact mitigation

Preventing and monitoring air, water and soil emissions involves large expenditures on our company's part, as does proper waste disposal. At our Gernsheim site in Germany, for instance, we have set aside provisions for the remediation of contamination. Moreover, we allocate **an annual budget for groundwater and soil remediation** to ensure our ability to execute all measures required throughout the year.

Our spending on environmental protection, health and safety efforts totaled € 200 million in 2017, which also includes investments made during the year. In this period, our provisions for environmental protection totaled € 137, 94% of which were attributable to Merck KGaA, Darmstadt, Germany.

Parking lot remediation continued

In 2017, we continued our efforts to decontaminate a parking lot at our Gernsheim site. The scope of the **environmental remediation** required has turned out to be significantly greater than originally anticipated. Since 2008, we've been working to remove hexachlorocyclohexane (HCH) residue from the soil under the parking lot and have been properly disposing of it in external incinerators. In the course of the ten-year decontamination process, we have increased the relevant provisions from € 27 million to approximately € 50 million.

Assessing environmental impacts and reporting violations

In general, we conduct risk-based assessments along with **internal and external audits** on all our production facilities every three years. Our goal is to analyze and minimize our environmental footprint as well as to ensure that our requirements are being met. Our Group function EQ is respon-

sible for these tasks. As needed, we use the results of such evaluations to define suitable measures. In addition, we have established grievance mechanisms to identify potential violations of our requirements. In 2017, our corporate EHS audits rated more than 86% of the 43 sites audited as "good" or "satisfactory". We assess performance on a five-level scale: "excellent", "good", "satisfactory", "poor", and "critical", which in turn determines how frequently an audit is conducted. If its findings are deemed to be good, a facility will undergo audits less often, while significant violations can increase the frequency.

Aside from using audits to identify issues, we also encourage our employees to report potential violations of our standards to our Compliance unit. All of these violations are reported to the Executive Board. In the 2017 period, no significant violations of environmental laws or regulations were recorded Group-wide.

ISO 14001 Group certificate

We have revamped our management systems to align them with the requirements of the updated version of ISO 14001:2015. In 2017, our environmental management system was successfully certified to ISO 14001:2015.

Since 2009, our company has held a Group ISO 14001 certificate, which means that all production sites with more than 50 employees must implement the requirements of the certificate. Other sites are not obligated to implement an ISO-certified environmental management system. New sites must gradually establish a corresponding **environmental management system with predefined indicators** for factors such as greenhouse gas emissions and water use, and furthermore obtain ISO 14001 certification.

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sites worldwide are currently covered by the ISO 14001 certificate.

Beyond this ISO standard, we have a variety of other internal standards in place that govern environmental stewardship, such as our Air Emissions Standard, Waste Management Standard (p. 95), and Energy Management Standard (p. 90).

Every year, we contract a third party to perform a certification audit. In 2017, we passed 13 ISO 14001 audits, which also included facilities newly incorporated into the Group certificate. All sites pertinent to the Group certificate have thus been transitioned to the new version of ISO 14001:2015. Furthermore, we conduct internal audits to ensure compliance with our requirements.

Stakeholder engagement and dialogue

By participating in a variety of industry associations, we exchange information and ideas on environmental issues. In 2017, for instance, we took part in discussions between the German Chemical Industry Association e.V. (VCI) and German legislators (p. 100) on eliminating the thermal value criteria. The head of our Group function EQ chairs the VCI plant safety working group. Additionally, we contribute to the dialogue on plant and process safety (p. 100) in our capacity

as members of the European Process Safety Center and the Commission on Process Safety of the German Federal Ministry for the Environment, Nature Conservation, Building, and Nuclear Safety.

Furthermore, we engage residents in the vicinity of our sites in discussions on issues of local relevance.

climate protection

Climate change is one of the most pressing challenges of the 21st century. Thus far, it has only directly affected us to a minor extent. Nevertheless, because our operations generate greenhouse gas emissions, we intend to do our part for climate impact mitigation, an approach that our customers and stakeholders expect of us. Shifting regulatory requirements can lead to planning and investment uncertainty. In view of burgeoning regulations and rising energy costs, however, climate impact mitigation is also becoming an increasingly smart investment.

Doing our part

We are taking action to mitigate our impact on the climate. Our **goal** for 2020 is to reduce our direct greenhouse gas emissions (Scope 1) and indirect emissions (Scope 2) by 20% relative to the 2006 baseline, an objective set by the Executive Board in 2009. Scope 1 covers emissions that we produce ourselves, for instance by burning fossil fuels to generate power, while Scope 2 pertains to emissions from the consumption of purchased energy, such as electricity or district heating.

Across the globe, 38 of our sites account for roughly 80% of our greenhouse gas emissions, which is why we are focusing our efforts here.

Energy conservation represents an important component of our climate impact mitigation activities. By adapting and updating our technology, we are improving the energy efficiency of our R&D operations, our production processes and our buildings. Just as important is the **reduction of process-related emissions**. Furthermore, we are working to lower the emissions resulting from energy generation. Where financially viable, we additionally utilize renewable energies to generate our own power.

How we structure our climate impact mitigation efforts

Our Group function Environment, Health, Safety, Security, Quality (EQ) is responsible for globally overseeing all climate impact mitigation measures (see also Environmental stewardship (p. 87)). At our individual sites, Facility Management is primarily in charge of implementing the specified measures.

Climate impact mitigation accounted for approximately 5% of our 2017 EHS costs, **which do not include** the spend on individual climate impact mitigation projects (Edison program (p. 91)).

Our commitment: Standards and legal frameworks

Our Corporate Environment, Health and Safety (EHS) standards on energy management and emissions from coolant ensure that energy and process-related emissions are managed consistently across the Group. We conduct audits at random to verify compliance with all EHS standards.

We know that **efficient energy management** plays a major role in climate impact mitigation and is also becoming increasingly important to our customers. With this in mind, 12 of our sites decided to obtain ISO 50001 certification, the international standard for energy management.

Our company is subject to a wide array of **national and international energy and emissions regulations** such as the German Energy Conservation Act and the German Renewable Energy Sources Act. Our activities are also governed by EU Directive 2012/27/EU, which stipulates that relevant companies must establish energy management systems and regularly audit their energy consumption. The sites subject to these requirements are responsible for implementing them and furthermore undergo audits conducted by internal or external experts.

The 2015 Paris Agreement on climate change is expected to lead to even more ambitious climate targets within the EU.

With phase four (2021-2030) of the EU emissions trading program due to start soon, we expect to see a tightening of greenhouse gas emission regulations. Going forward in phase four, we foresee having to purchase the emissions allowances that we're still largely obtaining for free during phase three (2013-2020). A global set of climate change regulations could, however, reduce existing competitive disadvantages.

Slight reduction in energy consumption

We used 2,270 gigawatt hours of energy in 2017, versus 2,241 gigawatt hours in 2016. Our energy intensity relative to sales totaled 0.15 kWh/€ in 2017.

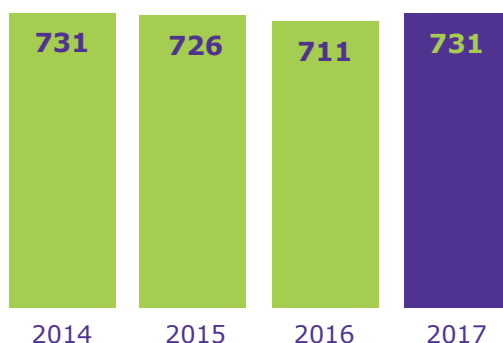
Emissions lowered despite growth

Despite growth in our operating business, we managed to reduce our greenhouse gas emissions by 8% relative to the 2006 baseline. In 2017, we emitted 731,000 metric tons of CO₂ equivalents, with 711,000 metric tons in 2016.

Between 2006 and 2017, we **more than doubled our sales**, which means that, relative to sales, our emissions dropped significantly.

Greenhouse gas emissions (metric kilotons)¹

(Scope 1 and 2 of the Greenhouse Gas Protocol)



¹ In line with the Greenhouse Gas Protocol, for all previous years (up to the 2006 baseline) the greenhouse gas emissions have been calculated based on the current corporate structure of the reporting year and retroactively adjusted for acquisitions (e.g. Sigma-Aldrich in 2015) or divestments of (parts of) companies, or for changes in emission factors (portfolio-adjusted).

Strategic climate program

In 2009, we launched our strategic EDISON program to consolidate all our initiatives for improving energy efficiency and reducing process-related greenhouse gas emissions. Under this program, our Group function EQ collaborates with a working group comprising representatives from all our business sectors. Any site can propose a project, with the working group subsequently assessing the proposals according to three criteria: 1.) the total absolute CO₂ savings, 2.) the potential cost savings, and 3.) the ratio of CO₂ savings to required spend.

Through more than 300 Edison projects initiated since 2012, we aim to save an annual amount of around 98,000 metric tons of CO₂ in the medium term. Since the program's launch, these efforts

have conserved around 75,000 MWh of energy in total, primarily from electricity.

By the end of the year, we had implemented or launched 40 of the 81 Edison projects approved for 2017. These initiatives are expected to achieve savings of around 4,100 metric tons of CO₂ in the medium term. We thus failed to achieve our goal of cutting up to 34,000 metric tons of CO₂. One reason is that technical issues forced us to postpone an initiative for reducing process-related emissions to 2018. As in previous years, we accepted project proposals for 2018. Through 30 new projects, we hope to realize potential savings of approximately 4,600 metric tons of CO₂.

In May 2017, the Executive Board approved a roadmap for achieving the remaining savings needed to meet our climate target.

Modern energy and cooling systems

In 2017, we invested approximately € 700,000 in a state-of-the-art energy station for our site in Modugno, Italy. As part of this project, we installed a new refrigeration unit and cooling tower. The facility went live in October 2017. These efforts are expected to cut energy use by roughly 950,000 kWh per year.

In Milwaukee, WI (USA), we optimized our HVAC system and thereby lowered our carbon dioxide emissions by 721 metric tons. At our Sheboygan, WI (USA) site, similar updates also led to an emissions reduction of 372 metric tons of CO₂. The systems were cleaned and new coatings applied, thus enhancing the efficiency of both plants.

Investing in renewable energies

At our Life Science facilities in Jigani and Peenya (Bangalore, India), we spent € 775,000 on solar power units. We installed **solar collectors** with a 920 kilowatt power rating. The plants produce 1,265,000 kWh per year and lower our emissions by approximately 1,200 metric tons per year, covering roughly 30% of the energy required by each site.

In August 2017, the Indian Green Building Council (IGBC) gave our facility in Peenya, (India) a gold rating (the second highest ranking) in its Leadership in Energy and Environmental Design (LEED) index. The site's energy and water reduction efforts garnered particular praise. LEED is the world's most commonly used evaluation system for sustainable buildings.

We also installed solar collectors in Burlington, MA (USA). With a power rating of 182 kilowatt, this system is expected to generate 218,000 kWh of electricity per year and thus reduce our emissions by roughly 60 metric tons.

Educating employees about climate impact mitigation

We encourage our employees to do their part to preserve the climate and regularly report on our Group-wide climate impact mitigation activities in our EHS newsletters while also providing helpful information and tips on our Intranet. Moreover, we support employees who prefer greener modes of transportation. For instance, we are constantly updating our pool of leased vehicles with more efficient models to reduce the average CO₂ emissions of our business car fleet by 30% by 2020, relative to 2013.

Subsidies for our employees

In January 2017, we lowered the CO₂ emission rate for newly registered company cars from 150 g/km to a maximum of 135 g/km. Starting in 2019, we plan to further cut this rate to 120 g/km. At most of our German subsidiaries, we offer a subsidy of € 100 towards monthly lease payments to

employees who voluntarily choose a greener car model. We intend to expand this incentive to include all subsidiaries in Germany.

The current average emission rate of our company vehicles is 131 g/km, with 10% of the fleet in Darmstadt and Gernsheim being electric.

In the United States, we provide our people with financial incentives **to live greener**. For instance, they receive up to US\$ 1,000 in subsidies towards the construction of a private solar power unit and up to US\$ 100 towards an energy audit for their home. They are also eligible for as much as US\$ 3,500 towards the purchase of a hybrid or electric car. To date, we've helped 55 of our employees install solar panels and motivated 361 employees to switch to a hybrid or electric car.

Recharging infrastructure at our sites

In addition to promoting electric vehicles within our motor pool, we also want to encourage our workforce to use electric cars in their private lives. To this end, our Darmstadt site offers eight **charging stations** in the employee parking lot, where our employees can recharge their vehicles for free.

Furthermore, we are working on an overall concept to expand the charging infrastructure at our German sites. In doing so, we are investigating other potential locations for charging stations along with alternative options Germany-wide for public charging and charging at home.

We have 42 charging stations across 12 Life Science sites in the United States, Ireland and France at which our employees can charge their electric vehicles for free. These facilities are currently utilized at an average rate of 50%.

Jobtickets and carpooling

We offer our workforce in Darmstadt a "Jobticket", an annual subscription to use local public transportation whose cost we partially cover. In 2017, more than 4,300 employees made use of this option. Our people also have access to an online tool that helps them organize carpools.

Leased bikes in Germany

We also encourage our people to employ eco-friendly forms of transport through "bike4me", a program enabling them to lease a bike at special rates with payments coming out of their pre-tax income. In 2017, we expanded the program from employees in Darmstadt and Gernsheim to include all employees at German sites.

Furthermore, our employees can also use the DB Call a Bike service throughout Germany and borrow a bike for up to half an hour free of charge. Deutsche Bahn, the German national rail company, has set up further rental stations all around our

locations in Darmstadt, and in 2017 we doubled the number of bikes we're sponsoring in the city from 50 to 100.

Switching to sea freight

In an effort to reduce greenhouse gas emissions resulting from the transport of our products, we utilize sea rather than air freight whenever possible. However, this is only an option for products that survive protracted transport times undamaged. At the same time, we cannot allow the quality of customer service to suffer due to extended transport times. The raw material mica, for instance, is transported primarily by ship. Furthermore, we have switched to using sea freight for shipping our Life Science products between France and Japan or the United States. These changes are cutting our annual CO₂ emissions by 3,000 metric tons in total.

Besides transitioning from air to sea transport, in 2017 our Performance Materials business sector also tested using rail to ship goods to Asia.

Transparency of CO₂ emissions and energy consumption

The CDP (formerly the Carbon Disclosure Project) assesses the ways in which companies are working to minimize the risks and consequences of climate change, along with their success and strategy for doing so. The rating scale ranges from A to D-, with A being the top score. We received a B in 2017 (A- in 2016), putting us among the top 37% of companies in the healthcare industry.

Since 2008, we've been reporting in detail on our climate impact mitigation efforts as stipulated by the CDP. We track our greenhouse gas emissions in line with the Greenhouse Gas (GHG) Protocol, an internationally recognized standard, reporting on Scopes 1 and 2 as well as parts of Scope 3. In terms of Scope 3 emissions, we only track emissions from business trips and employee commuting, from waste management, and from the manufacture and transport of fuel. Besides these emissions, we also measure energy consumption at our sites. However, this does not include energy use outside our field of activity such as the production of raw materials, as we do not have sufficient data available to perform these complex calculations.

Resource efficiency

Natural resources are growing ever scarcer, which makes it imperative for us to use raw materials as efficiently as possible and help reduce waste. By conserving energy, water and materials, we are not only mitigating our impact on the environment, but are also lowering our costs.

We are constantly working to reduce the environmental footprint of our products and even help our customers lower their own resource use, thus boosting our competitive advantage.

Our approach to resource efficiency

Our approach to resource efficiency helps us minimize our consumption of energy, water and materials while also maximizing resource reuse. Underpinned by our climate target (p. 90), we are driving energy efficiency across our company and conserving energy. Furthermore, since 2015 we've been implementing a sustainable water management system (p. 97) in a bid to reduce our water use. When it comes to waste and recycling, we are working to cut down the waste we produce by means of our Waste Scoring System (p. 95). Because we utilize a large chunk of resources for the manufacture of our products (p. 32), resource efficiency is a critical factor in developing our products and production processes.

How we structure resource efficiency

The measures we employ to utilize and conserve resources more efficiently are an integral component of our environmental practices and are overseen by our Group function Environment, Health, Safety, Security, Quality (EQ) (see also Environmental stewardship (p. 87)).

Our commitment: Guidelines and standards

Our key guidelines and standards for resource efficiency are detailed under Waste and recycling (p. 95) and Water management (p. 97). Overarching standards can be found under Environmental stewardship (p. 87).

Reducing resource use

Our manufacturing operations consume a great deal of energy, but our buildings likewise require energy in the form of electricity and heat. In a bid to lower energy use, we are investing in measures to boost energy efficiency through our Edison program. These efforts are a mainstay of our commitment to climate preservation (p. 90).

We use water primarily for cooling, for exhaust air purification and as process water. Our water management (p. 97) approach combines water use reduction with wastewater treatment.

Our waste and recycling management approach (p. 95) helps us lower waste and maximize reuse, objectives we achieve by separating waste and enhancing production processes.

We primarily use chemical and pharmaceutical raw materials for our manufacturing operations. Additionally, we also employ operating supplies and packaging materials such as folding boxes, glass bottles and ampules.

We utilized 400.2 metric kilotons of material in 2017. We only record the weight of the materials that are directly used in our pharmaceuticals and chemicals.

waste and recycling

Waste contains valuable raw materials that can be reused in the production stream, which is why we consider it highly important to both prevent and recycle as much of our waste as possible.

Our approach to waste and recycling

We work to minimize the environmental impacts of our waste disposal activities and limit the loss of raw materials. To this end, we have set the goal of reducing the ecological impact of our waste by 5% by 2025 (relative to the 2016 baseline). This objective was adopted by the Executive Board in 2017.

We generally try to prevent waste, for instance by developing new production processes and optimizing existing ones. Since this is not always feasible, whenever possible we endeavor to reuse the accrued waste to produce materials or generate energy. Through measures such as waste separation, we ensure that **raw materials are recycled** and that unrecyclable waste is discarded in an environmentally sustainable manner in line with the strictest waste disposal standards. In doing so, we comply with local legal requirements, taking into account the available disposal options.

Responsibility for waste disposal process

As a generator of waste, we are responsible for the ultimate disposal of our waste products and therefore choose our service providers with the utmost care, contractually stipulating disposal requirements. Each of our vendors must prove that they properly discard our waste. Through random internal audits (and external audits in the United States), we ensure the **appropriate disposal of our waste**, especially when it comes to hazardous substances.

Failure to comply with disposal regulations could result in a fine or damage to our reputation. In terms of our service providers, such a violation may lead us to terminate the business relationship.

How we organize our waste management and recycling activities

Our Group function Environment, Health, Safety, Security, Quality (EQ) bears overall responsibility for our waste

management and recycling activities, while our EHS managers are in charge of implementing our guidelines and requirements at our individual sites (see Environmental stewardship (p. 87)). In 2017, waste management accounted for around 25% of our EHS spending. This includes the personnel expenses of the units concerned as well as the costs for waste disposal via external service providers.

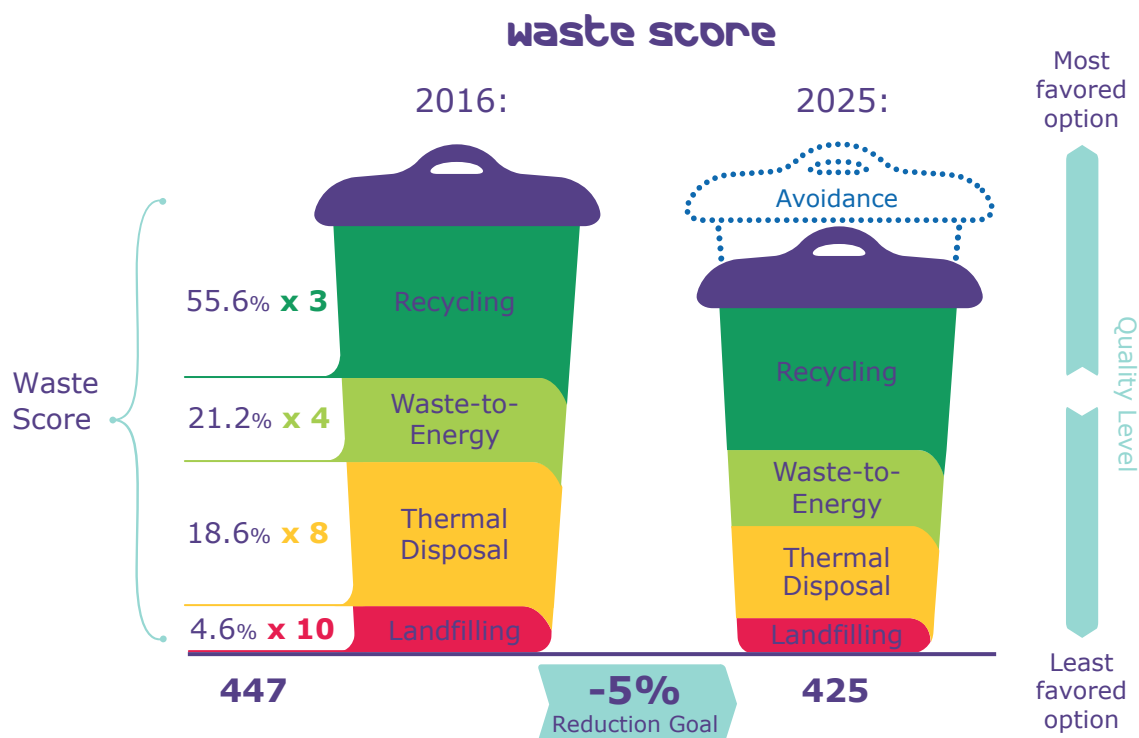
Waste management is part of our Group-wide ISO 14001-certified environmental management system. As well as undergoing external certification, we also conduct internal Corporate Environment, Health and Safety (EHS) audits to review our waste management practices. Moreover, we regularly inform and educate our local EHS managers and site directors on various waste disposal issues, for instance through EHS forums or conferences, in an effort to ensure Group-wide compliance with our environmental standards.

Our commitment: Group-wide EHS standard

Our Group-wide EHS Waste Management standard provides a **consistent framework for waste management across all our sites**, defining organizational structures and minimum requirements. In line with this standard, all facilities document their waste by type and quantity, reporting this data to EQ.

Our Waste Scoring System

At our company, we use a variety of methods for recycling and disposing of waste, each of which have a different impact on the environment. To take these impacts into account in our waste reduction efforts, in 2016 we created the Waste Scoring System, which allows us to compare the amount of waste our individual sites are producing and monitor our various waste streams. Under this system, the volume of waste is assigned to one of five categories according to how it is disposed of (see diagram), and then multiplied by a factor that increases based on the disposal method's environmental impact. The sum of the scores of each category provides the total Waste Score of our company.



Reducing the environmental impacts of waste by 2025

In 2017, we calculated our Group-wide Waste Score for 2016. Based on this score, in 2017 the Executive Board adopted the goal of reducing the environmental impact of our waste by 5% by 2025. To achieve this objective, in 2016 we started examining our production processes and disposal methods to identify potential areas for improvement, continuing these efforts into 2017. All sites are expected to do their part to **reduce waste**. The Waste Score excludes construction and demolition waste, along with waste resulting from the treatment of wastewater.

Relative to 2016, the amount of waste we produced in 2017 remained unchanged at 252 metric kilotons. Construction and demolition waste continue to account for the majority of our total waste – 37% in 2017 and 31% in 2016. In particular, the remodeling of our global headquarters in Darmstadt, to be completed in 2018, has generated large quantities of such waste material.

Establishing eco-friendlier disposal methods

At our site in Molsheim (France), we are already working towards achieving our new waste disposal target. In April 2017, we switched from incinerating all solid media waste from production activities to composting it. This new method involves filling biodegradable bags with the solid media waste and shipping them to a local composting facility, where the waste is mixed with vegetable and green waste. Once turned

into compost, it can be used by municipalities or individuals for planting. This method is set to reduce the amount of incinerated waste by 80 metric tons annually.

Reducing filter waste

In 2015, we switched our multi-step filter process for photoresists to a single-step process. Instead of requiring several filters we now use only one, thus decreasing filter waste by around 50%-70%. Already an established practice at our facilities in Hsinchu (Taiwan), Shizuoka (Japan), and Suzhou (China), in 2017 we also introduced the process to our Anseong site in Korea.

Optimizing and modernizing our Darmstadt site

At our site in Darmstadt, we have initiated various processes to prevent waste and recycle materials. In 2016 and 2017, for instance, a solvent recycling process enabled us to recycle 500 metric tons of methanol, which is generated in the manufacture of excipients for cosmetic products and the amino acid glycine.

In addition to these efforts, in 2016 we replaced our old exhaust air purification system that used an oil scrubber with one that employs a catalytic burner. In 2017, we thus reduced waste generation by 340 metric tons, which translated to savings of around € 150,000.

water Management

More and more regions across the globe are facing potable water supply issues, and the number of areas suffering from water scarcity is also on the rise. Both the United Nations and the International Council of Chemical Associations (ICCA) consider water conservation a major objective for future efforts. At our sites, we too are dependent on a reliable supply of water that meets certain quality standards. We use water in our manufacturing activities as process water as well as for functions such as cooling and air exhaust purification, which makes sustainable water management a key focus of our environmental stewardship. In doing so, our wastewater may contain traces of heavy metals or pharmaceutical active ingredients. With heightened public awareness of water pollution and increasingly stringent legislation governing water conservation, protecting water as a resource is one of our top concerns.

Our approach to sustainable water management

We seek to lower our water use and have therefore set ourselves the goal of **implementing a sustainable water management system** at sites with high consumption levels **by 2020**. Along these lines, we are focusing our efforts particularly on regions where water is growing scarcer and therefore intend to cut water use by 10% by 2020 at sites in such water-stressed areas, i.e. those regions where the demand for water exceeds the amount available. At the same time, it is our responsibility to minimize the impact of our wastewater across all our sites, which is why we oblige each individual site to develop and implement a water pollution response plan.

How we organize our water management activities

Our Group function Environment, Health, Safety, Security, Quality (EQ) (see also Environmental stewardship (p. 87)) bears overall responsibility for water management. At our

individual sites, our Environment, Health and Safety (EHS) managers work closely with engineers to implement water conservation and wastewater treatment measures. In 2017, our water management spending, including the costs associated with purification of wastewater and sewage charges, accounted for approximately 9% of our EHS costs.

Our commitment: Standards and guidelines

Our processes and responsibility for clean wastewater are defined in our EHS Water Protection standard, which focuses on trace residues that impact the environment. Through internal audits, we verify compliance with our EHS Water Protection standard, which is based on the commitments we've made under Responsible Care®. In line with this global initiative, all our sites are required to measure and assess the risks and impacts of the hazardous substances in their wastewater.

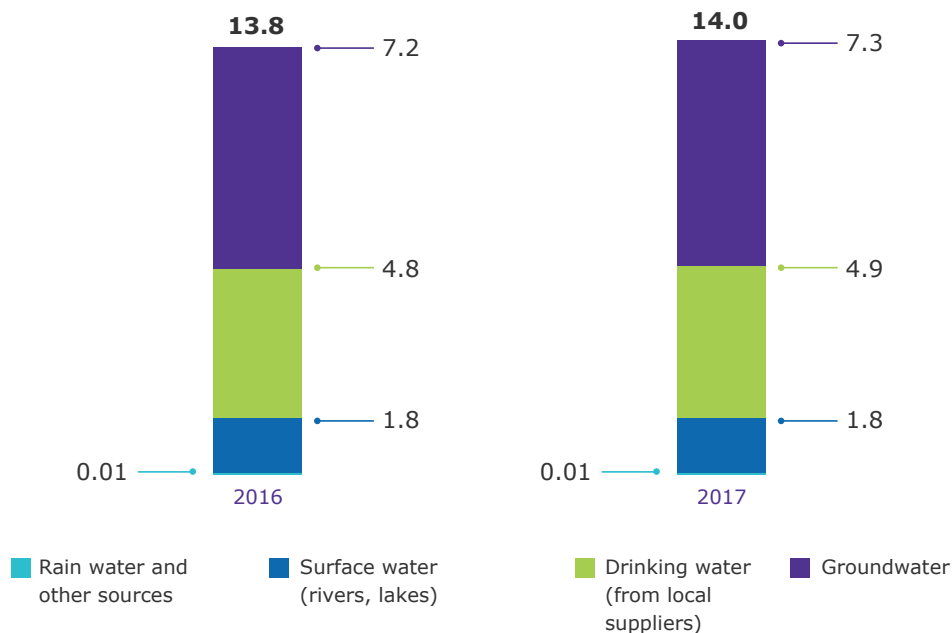
We are optimizing our production and purification processes to minimize the amount of pharmaceutical active ingredient residue in our wastewater. All our pharmaceutical manufacturing facilities also have **wastewater treatment plants** and regularly assess the composition of their wastewater.

Our Group-wide ISO 14001-certified environmental management system (p. 87) also covers aspects of water management. This system places a greater focus on manufacturing sites than administrative facilities since they have the highest potential impact on water.

Water from our own sources

For the most part, we draw our process water from our own wells and drinking water from local suppliers. We never do anything to compromise sensitive water sources. However, within the scope of our **sustainable water management activities**, we keep an eye on trends that could potentially lead to sources being classified as sensitive.

Water use (millions m³)



The cooling water used for production processes generally runs in a circular system. Depending on regulatory standards, we sometimes use fresh water in a once-through cooling system if it improves our energy footprint. For certain applications, we treat production wastewater and reuse it. In 2017, we reused a total of 22.4 million cubic meters of water.

Sustainable water management

For us, sustainable water management means not negatively impacting the bodies of water from which we obtain fresh water, or into which we discharge purified wastewater.

In a bid to mitigate our impact on the water supply, we've set the goal of implementing a **sustainable water management system** at all sites with high consumption levels by **2020**.

To lay the ground for this undertaking, we are systematically analyzing our water data utilizing tools such as the Water Risk Filter of the World Wide Fund For Nature (WWF) and the Aqueduct Water Risk Atlas of the World Resources Institute (WRI). These tools help us determine, for instance, whether a site is located in a water-stressed area.

For our sustainable water management efforts, we use an assessment tool of the European Chemical Industry Council (CEFIC) to evaluate water management practices and progress at our facilities. Based on this assessment, our sites draft a list of steps that need to be taken and implement them gradually. This often results in the establishment of

best practices such as methods to identify water-saving measures at our various sites.

In 2016 and 2017, we conducted water risk assessments on our sites to investigate where they obtain their water from, what it is used for and where the purified wastewater is discharged. To make their internal water consumption more transparent, several sites installed additional water meters.

However, we also encourage efficient water management at facilities in areas of low or moderate water stress, which is why we are expanding our best practice sharing platform for sustainable water management. Through this medium, our EHS officers can share ideas and lessons learned.

Reducing water use

We seek to minimize our impact on the water situation at our sites, which is why we require facilities in areas of high water stress to **transparently report their water use** and identify the process steps that require a particularly high amount. In response to this information, we execute measures to help our individual sites lower their water use. We aim to cut water use at sites in water-scarce regions by 10% by 2020.

Our production sites in Mexico City (Mexico), Mollet del Vallès (Spain), Kankakee, IL (USA), and Norwood, OH (USA) are located in water-scarce regions and consume more than 30,000 cubic meters of water per year. Furthermore, our facilities in Savannah, GA (USA), Hsinchu (Taiwan) and Taoyuan (Taiwan) are at increased risk due to local ground-

water conditions and/or seasonal water scarcity. At each of these sites, we aim to reduce water use by 10% by 2020 relative to 2014. By the end of 2017, we had achieved savings of approximately 9%.

High marks for our water management practices

In addition to our climate impact mitigation measures (p. 90), since 2016 we've also been reporting water-related data to the CDP (formerly the Carbon Disclosure Project). This initiative collects environmental data from companies once a year, evaluating their processes and performance on a scale from A to D-. In 2017, we were awarded a B for our water management, thus moving up two places over 2016. This positive score was particularly attributable to three factors, namely our Water Protection standard, the strategic water use goals we set in 2016, and the concrete steps we took to conserve water.

Water stewardship

We also implement measures to minimize our negative impacts at sites not located in water-scarce regions. Our manufacturing facilities in India, for instance, abide by a zero discharge policy that requires used water to first be treated before being drained back into the soil. Furthermore, our Goa site collects rain water and lets it seep back into the soil as well, a process that has enabled us to prevent the water level there from sinking further.

Our wastewater

In 2017 we generated a total of 12.3 million cubic meters of wastewater, with around 50% of our total wastewater being discharged by four sites. Our Gernsheim site in Germany discharges its purified wastewater into the Rhine, our

Savannah, GA (USA) facility into the Savannah River and our Onahama site in Japan into the Pacific Ocean. The wastewater generated at our Darmstadt site is purified in our treatment plants before being fed into Schwarzbach-Ried Creek, a tributary of the Rhine River. In 2017, we discharged a volume of water representing approximately 5% of the average annual discharge of Schwarzbach-Ried Creek. We constantly work to meet the increasingly stringent quality regulations set forth by law, coordinating our efforts with the respective authorities.

Wastewater continuously monitored

In 2017 our wastewater management practices were monitored and reviewed in line with our Water Protection standard. As such, 43 internal EHS audits were conducted along with 12 ISO 14001 audits performed by an external certifier. Improvements for self-monitoring were pitched at several of our sites.

Antibiotic residues in wastewater

We manufacture antibiotic active ingredients on a small scale. The wastewater generated from these activities is subject to an additional purification process before being discharged into the environment, as is the case, for instance, in Darmstadt. At this site, analyses showed that the amount of active ingredients contained in the wastewater was roughly comparable with that contained in household sewage.

Stakeholder dialogue

Starting in 2018, as part of our sustainable water management efforts we intend to engage other local water users in an exchange aimed at further reducing water use.

plant and process safety



Part of the non-financial report

The safety of our plants and processes is a key element of our environmental sustainability efforts. This approach allows us to ensure the safety of our workforce as well as the people in the vicinity of our sites. Furthermore, functional safety systems help minimize production errors, which in turn lowers the risk of financial losses.

Our approach to plant and process safety

We seek to eliminate as many manufacturing hazards as possible in an effort to prevent workplace accidents, production outages and chemical leaks. We also attempt to detect technical defects before they have a chance to cause damage. By training our employees, we prevent human errors as far as possible.

How we organize our plant and process safety

Our Group function Environment, Health, Safety, Security, Quality (EQ) oversees plant and process safety at our company. At the operational level, responsibility for plant and process safety falls to our individual sites and their EHS managers. Crucial to the safety of our plants and processes is above all **fire protection**, which makes up approximately 22% of our EHS spending and primarily encompasses the costs for the fire departments at our sites.

We conduct internal EHS audits to review the safety of our plants and processes. During this process, we also evaluate relevant suppliers, using criteria such as purchasing volumes, criticality of the incoming raw materials and geographic location to decide which ones to audit. Our suppliers are obliged to address any deficiencies identified. Auditors use a follow-up system to monitor the implementation of any corrective measures required.

Our commitment: Standards and legislation

All our sites are subject to the same requirements for plant and process safety as set forth by our Group-wide EHS Plant and Process Safety standard, which describes the safety rules for all production plants and warehouses. This document encompasses the entire life cycle of a plant from cradle to grave. Before commissioning a plant, we draft a **safety concept** that is subject to constant review and, when necessary, updated until the facility is decommissioned. This concept contains an overview of potential risks and the corresponding protective measures.

Our Group-wide EHS Spillage Control standard governs the handling of hazardous materials and stipulates organizational measures to prevent toxic substances from spilling or leaking during storage and transport. In addition to this standard, our Risk Management Process guides all our sites in identifying and assessing risks. As needed, this process can be used to develop and implement measures to minimize such risks. In 2016, we conducted our Group Procedure Hazard and Operability Study, which clearly defined the individuals responsible for identifying potential hazards during a project as well as the manner in which hazards should be identified and documented.

The 2012 EU directive on the control of major accident hazards involving dangerous substances (aka Seveso III) was transposed into German law at the end of 2016 and entered into force on January 14, 2017. Numerous amendments to this directive affect, for instance, the German Hazardous Incident Ordinance (aka 12th BImSchV). In 2017, we updated the existing processes and documents on the assessment and communication of potential hazards presented by our production plants and warehouses.

In 2017 we also made the necessary **amendments to all our safety reports** in accordance with the new Hazardous Incident Ordinance. On request, members of the public may access these safety reports at any time. We furthermore fulfilled our obligation to provide the public with information, including general information such as the potential hazards caused by an industrial accident, common accident scenarios, and the measures needed to prevent or mitigate their consequences. We update our Hazardous Incident Brochure on a regular basis and, in the case of our Darmstadt site, send the publication to approximately 17,000 households in the site's vicinity. The brochure is also available on our website.

Making safety measurable

Our **EHS performance indicators** make it possible to measure safety and identify opportunities for improvement. We track EHS performance indicators at all our production and warehouse facilities, as well as at major research sites such as Billerica, MA (USA) and Chilworth (UK). In doing so, we record both accidents and near-accidents. We investigate each individual incident before devising appropriate countermeasures in an effort to prevent such accidents from repeating themselves in the future.

Of particular relevance are the EHS Incident Rate (EHS IR) for recording and evaluating all minor and major incidents, as well as the associated Loss of Primary Containment (LoPC) indicator. Also important is the EHS Leading Rate (EHS LR), which is calculated based on an analysis of near-accidents and critical situations.

In collaboration with our individual business sectors, we have defined specific targets for our EHS performance indicators. The Executive Board receives semi-annual reports detailing the progress of these indicators.

EHS Incident Rate

Since 2013 we have been tracking the EHS Incident Rate, an indicator that synthesizes the following four categories of data:

- the number of workplace accidents involving our employees and contractors who work at our sites
- environmentally relevant incidents as defined by the European Chemical Industry Council (CEFIC) and the German Chemical Industry Association (VCI), for instance product spills
- the activation of operational safety precautions with no adverse impact on people or the environment, such as a preemptive systems shutdown
- deviations identified during external reviews and audits

The calculation of the EHS Incident Rate includes the number of incidents and the severity of the accident relative to the number of man-hours worked. The lower the EHS Incident Rate, the safer the site is.

3.4

was our EHS IR in 2017. It has thus remained at the same stable level as in 2016.

In 2017, we recorded no significant incident-related spills across all production, research and storage sites.

Risk Management Process

Our Risk Management Process guides all our sites in identifying and assessing risks. In 2017, various measures were implemented as part of this process:

Following its acquisition in 2014, we conducted a comprehensive audit of our Suzhou site in China in which we identified shortcomings and subsequently took steps to address them. Continuing with these efforts, in 2017 we improved the plant and process safety of the site's distillation facility.

Training and sharing lessons learned

The safety of our plants and processes is predicated on the successful **interaction between man and machine**, which is why it's crucial for us to educate our employees and provide them with regular training. Our internal continuing education programs for site, production, engineering, and EHS officers also cover plant and process safety. Likewise, newly hired EHS managers are trained in plant and process safety during their onboarding. In 2017, 19 new employees completed the onboarding process.

In the interest of improving safety, it is extremely important to **share best practices and lessons learned**, an approach that enables all our production sites to learn from incidents at other facilities and thereby implement preventive measures. Once a month, for instance, site directors and EHS managers participate in safety leadership calls to share new lessons learned. Additionally, discussion rounds are held by the EHS managers at our sites.

Biodiversity

The increasing loss of biodiversity is a global challenge that impacts our company as well. After all, we depend on ecosystems for natural resources such as raw materials. Prime examples include red algae (*polysiphonia elongata*), whose cytoplasm is used in our cosmetic active RonaCare® RenouMer, and comfrey root extract, which is used in our Kytta® pain relief cream. We therefore have a vested interest in preserving and promoting biodiversity.

Our holistic approach to conserving biodiversity

Across all our sites, we consider the unique features of the ecosystems in our immediate vicinity with the goal of minimizing our direct impacts. Our wide array of **environmental sustainability efforts**, such as water management (p. 97) and climate impact mitigation (p. 90), directly contribute to the conservation of biodiversity.

Our own production sites are located in established industrial and commercial zones. Before acquiring a company – and thus its sites – we first conduct an ecological risk assessment, taking into consideration information from public sources such as neighbors and non-governmental organizations (NGOs). The results of the assessment influence whether we decide in favor of the acquisition.

How we conserve biodiversity at our sites

Our measures to protect biodiversity are overseen by our Group function Environment, Health, Safety, Security, Quality (EQ) (see also Environmental stewardship). In designing new sites and plants, we always include our Environment Health and Safety (EHS) unit to ensure that the ecological aspects of a project are also taken into consideration. EHS is on hand to assist all sites with support and advice, and furthermore carries out evaluations in the case of large-scale projects.

Our commitment: Standards and agreements

Substances that compromise biodiversity should not be discharged into the environment, which is why we design and operate our plants in accordance with our Group-wide safety and environmental requirements. For instance, our Corpo-

rate Environment, Health and Safety (EHS) standards define the way we manage waste (p. 95) and wastewater (p. 97) treatment as well as how we improve plant safety (p. 100). To minimize our impact on the environment, we furthermore adhere to internal standards governing air emissions and energy management.

The Nagoya Protocol is an international supplementary agreement to the UN Convention on **Biological Diversity** (CBD), which was transposed into German law in 2015. The aims of the CBD include the conservation of biodiversity and the sustainable use of its components. An important instrument in achieving these aims is access and benefit sharing. We are currently developing processes that will create a consistent framework for systematically handling resources that fall under access and benefit sharing. We hope to conclude these processes in the course of 2018. In developing products, for instance, we always apply the requirements of the Nagoya Protocol when using genetic resources originating in countries covered by the protocol.

Biodiversity conservation at our sites

Unsealed surfaces represent an important habitat for plants and animals. At our facilities, however, we are required to seal certain surfaces to minimize the risk of chemicals ending up in the ecosystem. Our goal is to increase the **percentage of unsealed surfaces** insofar as safety requirements permit.

Our Darmstadt site is a prime example of our commitment to preserving biodiversity. Since 2016, we've been conducting an assessment of our facilities there to **evaluate the site's nature conservation efforts**. Based on the results, we have developed an action plan for improving the surrounding ecosystem for plants and animals and have implemented measures to create places of refuge for insects and reptiles. In addition to these efforts, we also assess the flora and fauna of new project sites before commencing activities there. Around 30% of the premises (0.4 square kilometers) have already been greened. In 1995, we developed a green open space concept for our Darmstadt site, while a 2008 agreement with the City of Darmstadt stipulates the ecological, economic and design optimization of our site's green areas.