



# SUSTAINABILITY 2023

FREUDENBERG SEALING TECHNOLOGIES  
IS GOING GREENER

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# A CULTURE OF SUSTAINABILITY



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**“WE UNDERSTAND THAT  
ENTREPRENEURSHIP  
AND SUSTAINABILITY ARE  
INEXTRICABLY LINKED.”**

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At Freudenberg Sealing Technologies, we understand that entrepreneurship and sustainability are inextricably linked and form the bedrock of our corporate culture. We are convinced that businesses must take ecological responsibility for their operations in an age when climate change is not just a looming threat but a present reality. At our company, we have long recognized that a sustainable approach to our products and processes is not merely a choice but a necessity that drives our innovation, customer value, financial stability, and operational excellence every day.

The journey towards carbon reduction involves asking critical questions: How much energy and how many resources are we consuming? Which industrial processes account for this consumption? Can we electrify our fossil-fueled systems? Can we design a road map that will get us to zero emissions by 2045 or sooner?

Our holistic approach to these – and other – sustainability questions has resulted in a number of actions. We have developed a strategy and embedded our projects into our operational excellence program, GROWTTH (Get Rid Of Waste Through Team Harmony). We have identified important targets for change, including electrifying our systems, using more green electricity, lowering our energy consumption, eliminating more waste from our processes, and applying

a filter of sustainability to all of our corporate operations. We are looking at other efforts as well – lowering our water consumption, increasing our development of bio-based materials, widespread installation of photovoltaic roof panels, and including sustainability parameters in all of our business decisions. We are committed to lowering our corporate carbon footprint at the same time we are working to enhance our carbon handprint through green technologies and products like battery housing gaskets and Premium Pressure Seals.

In 2023, we made impressive progress towards achieving these activities. They will help us reach our 2025 goal of a 30% reduction in carbon emissions per million euros sales from 2020 levels and complete carbon neutrality by 2045. Through GROWTTH, we have provided our employees with tools, training, and internal lean and continuous improvement experts who are leading our sustainability initiatives throughout the world. We continue to install energy monitoring systems in our production facilities that will provide consistent, transparent energy data and will facilitate more stringent energy monitoring throughout the organization.

Sustainability parameters are now a part of every facility acquisition or expansion project we undertake. In December 2023, for example, Freudenberg Sealing Technologies finished moving into a new factory in Parets, Spain, which was

built to LEED Gold standards. It uses a heat pump with energy recovery, low-consumption LED lighting and a photovoltaic system on the roof to supply green power. No fossil fuels are being used in the production and building-related systems. In our new Morinda, India facility – slated to open by the end of this year – waste heat will be captured to warm the building and provide power for production processes.

We are also transforming our existing facilities to reduce our carbon footprint. We are investing in widespread use of photovoltaic roof panels. We are exploring geo-thermal energy in Necedah, Wisconsin, US. We are conducting site-by-site assessments to identify ways to eliminate fossil fuels. As a result of these activities, 50% of our overall energy consumption comes from renewable sources.

Material expertise, process optimization and recycling also play a crucial role in our emissions reduction strategy. Innovations in materials, such as those eliminating the need for energy-intensive post-curing processes, have allowed us to save valuable energy resources. We are actively addressing downstream challenges such as the availability and transportation of material resources. We are also addressing customer needs. This year, we completed development of a methodology to calculate the carbon footprint of a seal or component. This data will help our customers and lead to more sustainable components.

Sustainability is never-ending at Freudenberg Sealing Technologies. As we continue to expand into new markets, we will undoubtedly encounter new requirements and challenges. But we will also see exciting opportunities as well. A culture of sustainability serves us well on both counts.



**Dr. Matthias Sckuhr**  
Chief Operating Officer (COO)  
and Chief Technology Officer (CTO)



## THE ANATOMY OF SUSTAINABILITY

As part of the Freudenberg Group, Freudenberg Sealing Technologies benefits from a Handprint/Footprint approach to carbon neutrality and sustainability initiatives.

Our footprint refers to our impact on the environment and resources that result from the procurement and processing of raw materials and the delivery of finished products. By reducing our footprint through the elimination of fossil fuels and increased use of green electricity, we will arrive more quickly at zero carbon emissions. Likewise, more sustainable processes, a reduction in energy usage, elimination of waste, and development of more sustainable materials will also help us achieve this objective.

Our handprint refers to the positive effect our products and services have on our customers' products. For example, dynamic seals are now operating at higher pressures, temperatures, and frequency load changes. By optimizing tribologic systems, we have developed a rotary shaft seal with a specific sealing edge profile that reduces friction and wear, and thus increasing energy efficiency and service life.

Smaller footprint, larger handprint. This is the way Freudenberg Sealing Technologies conducts business now and in the future.



# THE MATHEMATICS OF ENERGY CALCULATIONS

## FREUDENBERG SEALING TECHNOLOGIES PURSUES CONSISTENCY IN ITS SUSTAINABILITY REPORTING EFFORTS.

Freudenberg Sealing Technologies has set rigorous sustainability goals across the organization that call for employee engagement and the use of new technologies and approaches to usher in a greener future.

A major objective in the company's sustainability efforts is to reduce its carbon emissions 30% relative to sales between 2020 to 2025. The company is well on its way to achieving this goal and also is well-positioned to achieve a longer-term goal of becoming carbon neutral by 2045 or sooner.

The company is focusing on five key performance indicators to measure Freudenberg Sealing Technologies' progress in reaching its sustainability goals. These KPIs have been adopted by the Freudenberg Group to track the emissions and sustainability performance of all its business groups. They include tons of CO<sub>2</sub> emissions generated per million-euro sales, gigawatts of total

energy consumed, percentage of renewable electricity being used within the organization, energy efficiency measured in kilowatt hours per euro, and tons of waste produced per million-euro sales.

In order for the Freudenberg Group to efficiently consolidate sustainability and emissions data across all business groups, the organization has implemented a new reporting platform, Enablon®. Enablon®'s software provides an integrated framework for tracking the sustainability measures needed to calculate each KPI. Freudenberg Sealing Technologies has installed the Enablon platform in every one of its manufacturing facilities and is currently installing it in additional sites to comply with the company's legal reporting requirements.

"Freudenberg Sealing Technologies' global sites were using a variety of methods monitoring programs to collect sustainability data at a site level,"

said Jason Arthur, Global Director of Sustainability for Freudenberg Sealing Technologies. "Enablon® will ensure that our sites are reporting crucial KPI data using a standardized process. Data transparency is an essential part of the process."

"We understand that Enablon® will require the sites to adopt a new methodology for reporting sustainability KPIs," Arthur noted, "but this is an essential part of our effort to achieve our 30% emission reduction by 2025. We must speak the same language across our sites in order to achieve our sustainability goals."



## A POSITIVE PERFORMANCE, YEAR-OVER-YEAR

**397 GWh**

Total energy used

↘ 420 GWh in 2022

**46 %**

Share of Renewable Electricity

↗ 39 % in 2022

**0.16 kWh/€**

Energy Efficiency

↗ 0.17 kWh/€ in 2022

**28.0 Tons of CO<sub>2</sub>**

per Mio.€ Sales

↘ 38 Tons of CO<sub>2</sub> in 2022

**12.3 t Waste**

per Mio.€ Sales

↗ 11.9 t Waste in 2022

# THREE LETTERS, CRUCIAL ACTIONS

**FREUDENBERG SEALING TECHNOLOGIES FOCUSES ON ENVIRONMENTAL, SOCIAL, AND GOVERNMENTAL (ESG) APPROACHES TO SUSTAINABILITY AS PART OF ITS AUDITING RESPONSIBILITIES.**



The company is part of a Freudenberg Group ESG committee that aligns auditable reporting guidelines for all Freudenberg businesses. Martin Monnheimer, Vice President, Controlling Projects & ESG Reporting, discusses ESG activities.

## **Why are we pursuing ESG?**

As a global community, we're not doing enough. It's clear that countries, societies and entities that impact the economy need to increase their commitment and contributions to sustainability. Freudenberg Sealing Technologies is dedicated to doing its part, and that is why we've thoughtfully developed sustainability programs, action plans and goals to help guide us on our ESG journey.

## **How is ESG defined in the broadest terms?**

When we discuss ESG, we're really talking about sustainability and our ability to meet current needs without compromising future generations. For a global supplier like Freudenberg Sealing Technologies, that translates into three areas of responsibility and action. The first involves environmental matters like protecting natural resources, the balancing of nature and the resilience of our plant. We often ask the question: What is the footprint of our actions?

The second area we consider involves social matters such as Freudenberg Sealing Technologies' interactions with people and issues including fair treatment, equal opportunities, diversity and inclusion, education, and more.

Governmental considerations are the third area we consider within ESG. This includes actions that ensure human rights, prevent corruption and bribery, safeguard fair competition, abide by taxation regulations, and maintain proper treatment of our business partners.

## **Does Freudenberg Sealing Technologies define ESG in a unique way or incorporate unique company elements?**

We often say that sustainability is part of our DNA. As a business, we do have some key focus areas. The first is the environmental aspect. Freudenberg Sealing Technologies focuses on energy and material efficiency to reduce greenhouse gas emissions and is committed to a product portfolio supporting the electrification of vehicles, the production and use of hydrogen, and wind-, solar- and hydropower applications. Secondly, we focus on our customers and support their duty to care for sustainability and transparency

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**“WE ARE WORKING TO SIGNIFICANTLY  
REDUCE GREENHOUSE GAS EMISSIONS,  
DECREASE ENERGY CONSUMPTION,  
ELIMINATE FOSSIL ENERGIES, MITIGATE  
WASTE AND AVOID POLLUTION.”**

MARTIN MONNHEIMER,  
VICE PRESIDENT, CONTROLLING PROJECTS & ESG REPORTING

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throughout the entire supply chain. We help them by providing creditable, smart, and useful information about our products' carbon footprints.

**When was the Freudenberg Group ESG committee established, and what are its purpose and objectives?**

The ESG committee was established in 2022 and represents all business groups and corporate functions. This team is working to prepare Freudenberg for auditable reporting, which becomes mandatory for the fiscal year 2025. While Freudenberg did voluntary reporting in the past, the new legislation requires specific ESG criteria. It's important to point out that these audits are not a threat. Validation builds trust, and Freudenberg is proud of the ESG processes and procedures we have in place.

**Where do we stand in terms of meeting these objectives?**

In many cases, it appears that ESG issues have their own language, grammar and syntax, so we're working to understand these nuances. In my opinion, we're well on our way. In terms of process, the gap analysis is done, and the overall validation of materiality is ongoing. As you can imagine, the appropriate IT infrastructure will be a key element, and we're working with partners to identify the appropriate tools and software solutions for the successful assessment of our efforts.

**How are our sustainability objectives aligned with ESG objectives?**

It's clear that our sustainability efforts align with the ESG objectives. For example, we are working to significantly reduce greenhouse gas emissions, decrease energy consumption, eliminate fossil energies, mitigate waste, avoid pollution – all actions that align with the ESG objectives. What's coming up is more formal documentation and, hopefully, we can keep the pain of bureaucracy small.

**How does ESG impact our employees?**

We all must be open to changes. In the operational area, a strong view on material efficiency and energy consumption, or the substitution of ingredients in compounds, will have an impact on production processes. And this will require a change in habits. From an organizational point of view, I see the need to establish a sustainability-related platform for a frequent and coordinated exchange among divisions and the central functions concerned. With the number of functions involved and the criteria for measurement, documentation and reporting, we'll need to adapt some of our systems. That said, I anticipate the team coming together successfully for this important goal.

# AN INTERNATIONAL EFFORT TO SAVE THE PLANET

## FREUDENBERG SEALING TECHNOLOGIES IS APPLYING OPERATIONAL EXCELLENCE TO ITS SUSTAINABILITY EFFORTS

Sustainability. A complex word that means different things to different people. Is it environmental protection? A green energy plan? Responsible consumption, economic opportunity and freedom from hunger and thirst? Maybe it's as simple as teaching kids to shut off lights when they leave a room?

In fact, sustainability encompasses all these things and more. In 2015, the United Nations (UN) used 17 different definitions and goals in its Agenda for Sustainable Development to define

what sustainable development must look like if the planet is to be saved for future generations. These Sustainable Development Goals (SDGs) address both ecological and societal changes.

As the largest company in the Freudenberg Group's industrial stable, Freudenberg Sealing Technologies is pursuing operational excellence as the only way to achieve sustainability within the organization. The company is within striking distance of meeting a Freudenberg Group target of a 25% reduction in CO<sub>2</sub> emissions per million

euros in sales by 2025. By applying a sustainability lens to five key areas – energy, waste, materials, emissions, and water – the company will achieve carbon neutrality by 2045 or sooner. Tucked into its sustainability plan are projects, programs and activities that address eight of 17 SDGs, including good health and well being; quality education; affordable, clean energy; decent work and economic growth; industry innovation and infrastructure; reduced inequalities; responsible consumption and production; and climate action.



Sustainable Development Goals: Freudenberg Sealing Technologies focuses on eight of the 17 goals.  
<https://sdgs.un.org/goals>



# SCOPING IT OUT

## WITH THE GHG SCOPES 1, 2, AND 3 ANALYSES COMPLETE, FREUDENBERG SEALING TECHNOLOGIES IS ROLLING OUT GREEN PLANS

**Scope 1 includes emissions directly generated by the company's operations.**

**Scope 2 emissions result from the company's purchase of energy.**

**Scope 3 emissions are generated upstream and downstream of Freudenberg Sealing Technologies.**

The Greenhouse Gas (GHG) Protocol provides standards and guidance for businesses and governments to measure and manage climate warming emissions. Freudenberg Sealing Technologies uses the Protocol's Scopes 1, 2, and 3 standards to track the CO<sub>2</sub> emissions being produced along its entire value chain.

The completion of Scopes 1 and 2 provided Freudenberg Sealing Technologies with identification and analysis of its largest emissions-producing processes. The result: elimination of fossil fuels through the electrification of machinery, the use of more green electricity and an overall lowering of energy consumption has been intensified. The company's greatest "energy-eating processes" – heating and cooling systems, thermal oxidizers, post-cure and conveyor ovens, and phosphating lines – are being modified or replaced to reduce their CO<sub>2</sub> emissions. The work is paying off – half of the company's production facilities have now achieved net-zero emission-status.

Scope 3 activities are also underway, and collaboration with suppliers and customers is paramount to their success. Scope 3 covers 15 different categories of emissions generated up-

stream and downstream of the company but included in its value chain. Emissions generated by everything from purchased goods and services to employee commuting must be factored into Scope 3 calculations.

"With our strategies and execution for reducing scopes 1 and 2 emissions in place, we are now addressing the ancillary, emission-producing activities that affect our total value chain," noted Lea Harmening, Sustainability Specialist, Freudenberg Sealing Technologies, and the Scope 3 project lead.

"Scope 3 emissions will be a required part of a company's overall emissions calculations as of 2025," she continued. "They will require we work closely with our business partners to optimize processes that will help lower value chain emissions. We launched a successful start to this collaboration in 2023."



# SUSTAINABILITY AND GROWTTH: A SYNERGISTIC APPROACH

## COMPANY'S OPERATIONAL EXCELLENCE PROGRAM PROVIDES A PERFECT FRAMEWORK FOR ACHIEVING NET ZERO EMISSIONS

Freudenberg Sealing Technologies has long championed operational excellence through its GROWTTH (Get Rid Of Waste Through Team Harmony) Program. The lean manufacturing and continuous improvement resources assembled under the GROWTTH umbrella have provided the company with the tools and methodologies required to optimize operations, improve quality, streamline administrative processes, and eliminate waste of all types.

During the past 30 years, the company has completed more than 100,000 Kaizen events that have yielded nine figure savings in areas like waste reduction and process optimization.



Such success is hard to ignore, and when the company outlined its sustainability objectives, it looked no further than GROWTTH to provide the framework for its environmental activities. The decision has helped Freudenberg Sealing Technologies link its sustainability goals to its continuous pursuit of operational excellence.

The company's targets are ambitious: By weaving sustainability into the fabric of GROWTTH, the company has tapped into its existing network of Black Belt and Green Belt experts who will lead the development of sustainability solutions. The culture of excellence GROWTTH has created will support its sustainability program too.

"GROWTTH offers an established foundation for our sustainability projects that accelerates decision-making and implementation. Sustainability isn't an afterthought; it's part of the DNA of every project decision," said Vicky Jandreau, Senior Vice President of Lean/GROWTTH and Sustainability for Freudenberg Sealing Technologies.

"Reaching operational excellence requires that we expand our thinking about waste reduction," Jandreau continued. "To achieve best-in-class status, however, our program of continuous improvement must be continuously improved. We need to consider new tools and ways to collaborate and network to eliminate waste across the organization."

Activities such as training, cross-functional meetings and consideration of new processes and tools has already begun. But the most powerful tool available is already in use, Jandreau noted.

"When we achieve even greater employee understanding and engagement in GROWTTH's operational excellence approach, then we can apply the most powerful tool in the toolbox to programs like sustainability," she said.

# 10 YEARS TO ZERO EMISSIONS

## FREUDENBERG SEALING TECHNOLOGIES' SUSTAINABILITY STRATEGY FOR REDUCING CO<sub>2</sub> IS A ROADMAP TO A MORE RESPONSIBLE FUTURE

Freudenberg Sealing Technologies is committed to achieving complete carbon neutrality by 2045 or sooner. The company's adoption of a 10-year strategy to zero emissions is key to its success. Founded on four key goals including energy reduction and optimization, electrification of processes, increased use of green electricity and renewable energy, the strategy provides a roadmap to a cleaner manufacturing future. It also provides a framework for how Freudenberg Sealing Technologies is eliminating its dependency on fossil fuels.

"It was essential that we move from a project-based to strategy-based emissions approach," said Vicky Jandreau, Senior Vice President of Lean/GROWTTH and Sustainability for Freudenberg Sealing Technologies. "Zero emissions is a big goal. When we first started developing the sustainability strategy, we knew we had to reduce the company's electrical energy demands, as well address the so-called "gray" electricity that is generated from fossil fuel sources and not renewable sources. These were driving up our emissions. Beyond this, we needed to understand what we were dealing with across the entire company. That was the start of our strategic approach."

By embedding its sustainability initiatives within its GROWTTH continuous improvement and lean manufacturing program, the company was quickly able to engage its existing Black Belts and Green Belts in the strategy's development.

Working in concert with the company's divisions, corporate lead functions

and sites, the sustainability team began crunching energy data, looking at current manufacturing technologies, evaluating replacement technologies, and estimating costs. A matrix was created to identify what changes could be made quickly and at a lower cost. These "low hanging fruits" included – among other actions – more efficient start-up and shut-down procedures, regulating thermostat temperatures more assertively, and addressing compressed air leaks.

More extensive and costly changes – replacement of heating and cooling units, the electrification of gas-powered equipment, heightened system efficiency through process changes, and the potential for the company to generate some of its own green electricity – are also being aggressively pursued using a phased approach.

"I think there was a collective sigh of relief when this plan was developed, presented and approved," Jandreau said. "We not only had a comprehensive approach, but we had a map to follow to achieve success."

The 10-year strategy targets four primary industrial processes, the source of most of the company's emissions. They include heating and cooling systems; thermal oxidizers; post-cure and conveyor ovens; and phosphating lines. These essential processes will undergo changes, largely through electrification and transition to green energy, during the next 10 years. Other technologies – photovoltaic panels and geothermal systems, for example – will also be considered.

## OUR GOAL: CARBON NEUTRALITY BY 2045



# A FOCUS ON FOUR

## INTEGRITY, SAFETY, WELL-BEING, RESPECT: THE OTHER SIDE OF SUSTAINABILITY AT FREUDENBERG SEALING TECHNOLOGIES

For 175 years, the Freudenberg Group's Guiding Principles have captured how a successful business should operate in a changing world. These tenets form the basis of how Freudenberg Sealing Technologies pursues an ethical, safe, legal, and diverse working environment for its employees, business partners, and communities.

Here, Freudenberg Sealing Technologies presents four short examples of how ethics, human rights, health and safety, and evolving workplace programs fit into its sustainability efforts.

### WORKING CONDITIONS

To maintain a positive working environment in its plants, Freudenberg Sealing Technologies is focused on talent acquisition and helping targeted groups of employees feel welcome and productive in their jobs. A new recruiting project introduced at the company's Findlay, Ohio, is getting good marks on all counts.

When it comes to recruiting, it's logical to hire locally. But what to do when a growing and eager talent pool doesn't speak English? Findlay was able to develop a solution. In 2023, the site launched an innovative recruiting project tailored to individuals who only speak Spanish. The project involves a buddy system, of sorts. Bilingual employees already working at the plant were identified and asked if they would partner with a new Spanish-speaking-only employees to help them with training and communications. The answer was a resounding yes. These same bilingual workers also provided significant project input in areas including offering English language classes, approving the use of a translation app on the plant floor, understanding cultural differences, and encouraging non-Spanish speakers to consider learning Spanish.

This bilingual approach is successful and enhances workplace collaboration, problem-solving, and morale. It has been instrumental in keeping Findlay's third shift running.

### HEALTH AND SAFETY

Health, Safety and Environment (HSE) practices and policies are integral to Freudenberg Sealing Technologies' success as a global industrial leader. The company's long-standing commitment to the welfare of its employees includes not only clean, safe plants but access to training and information as well. Now this commitment is paying big dividends in its manufacturing facilities. In 2023, the number of accidents within Freudenberg Sealing Technologies hit an all-time low – thanks to HSE initiatives, training courses, benchmarking activities and ingrained safety mindset.

“Never before have so few accidents occurred in our plants as in 2023 – and that's worldwide,” said Winfried Heiser, Vice President HSE Europe. “At 0.9, the Lost Day Incident Frequency Rate (LDIFR\*), which summarizes days lost to accidents at work, is below 1 for the first time in company history. This is extremely low.”

“The Work-Related Injury Frequency Rate (WRIFR\*), which we use to measure minor accidents at work, is also at an historic low of 2.5,” Heiser added. “In 2022, the LDIFR was still at 1.1 and the WRIFR at 3.1.”

Another first: The company experienced no serious accidents in 2023.

\*Accidents in relation to one million working hours. This corresponds to approximately 500 working years.



## HUMAN RIGHTS

Freudenberg Sealing Technologies recognizes that differences in people will drive success in the organization and has long prioritized diversity in its recruiting strategy. Its culture of inclusion promotes a workplace where all individuals feel valued and respected, and diverse ideas, approaches and experiences are considered opportunities for innovation.

In 2023, a 12-member committee dedicated to Diversity, Equity, and Inclusion (DEI) decided to expand the company's DEI efforts by establishing Employee Network Groups (ENGs). The concept was simple: ENGs would help connect employees with colleagues who share similar interests, backgrounds, and challenges. Participants would learn from each other's experiences and provide insight and support. In addition, the ENGs would increase the visibility of certain topics within the company.

As a starting point, three ENGs were launched: Women@FST, Pride@FST, and NextGen@FST and the response has been good.

"ENGs provide a safe space where employees can have an open exchange with one another," said Gill Hogarth, a member of the DEI Committee. "The ongoing development of employees and the company is a high priority. This is what the ENGs promote."

## ETHICS

Freudenberg Sealing Technologies abides by the Freudenberg Group's definition of business ethics, as defined in its Code of Conduct. This document covers standards of conduct that are valid worldwide and ensures that ethical, law-abiding, and responsible behaviors remain the cornerstone of the company's business conduct. The Code of Conduct is revised when needed to reflect changes in legislation and compliance standards.

The list of potential compliance violations is long. They range from bribery and corruption to the deliberate disregard of environmental regulations and discrimination, harassment, and bullying. The company encourages its employees to report violations by notifying to supervisors, managers, their HR departments, or the Works Council. Employees who do not want to use these reporting avenues can turn to the Freudenberg Ethics Office as an alternative. There is a main contact point in Weinheim, Germany, as well as three regional Ethics Offices for North America, South America, India and Asia. Each office has committees composed of internal and external experts. They are permitted to act without constraints and are not obligated to divulge identifying information to other offices. That means all inquiries and information are treated in the strictest confidence.



# LOWER TEMPERATURES IMPROVE SUSTAINABILITY

## FREUDENBERG SEALING TECHNOLOGIES' WEINHEIM FACILITY HAS CUT ENERGY CONSUMPTION AND CO<sub>2</sub> EMISSIONS BY 50 %

“It works similarly to a standard household washing machine,” explains Project Manager Dr. Stanislaus Schmidt, Technology & Innovation. Modern detergents can remove red wine or oil stains from trousers, shirts and sweaters in an energy-saving way, even at low water temperatures. The innovative chemical cleaner used for pre-treating metal parts in Weinheim’s Simmerring® production originates from SurTec, a sister company within the Group.

Today, the cleaning solution only has to be heated to 40 or 45 degrees Celsius to reliably degrease metal rings during the pretreatment process. Previously, the water had to be maintained at a minimum of 65 degrees Celsius. This reduction by more than 20 degrees translates into nearly 50% less energy consumption and CO<sub>2</sub> emissions, which not only benefits the climate but also cuts energy expenses and manufacturing costs.

Some background: A durable bond between the metal component and the elastomer is crucial for the quality and service life of a Simmerring® radial shaft seal. The surface of the already punched and formed sheet metal is prepared for this permanent bond during the pretreatment of the metal parts, first by phosphating and then coating. The phosphating is divided into several sequential stages. The metal parts are placed in perforated drums as bulk material – with

up to 20,000 rings at a time in Weinheim, depending on the diameter. These drums are successively immersed in various baths in a mostly automated process.

The first step consists of degreasing. In this cleaning process, the drawing oils from the stamping and metal works are removed from the metal blanks – beginning with coarse cleaning in the first bath, followed by a “fine wash” in the second. In its current energy-saving project, Freudenberg Sealing Technologies was able to significantly reduce the washing temperature and thus, the energy consumption of these two baths, each of which have a capacity of 1,500 liters. This degreasing process follows the same pattern at all Freudenberg Sealing Technologies sites and suppliers – which means that the energy-saving solution can be replicated there. “I have already presented our approach to our sites in Europe. It is currently being evaluated there. We have also completed preliminary tests in the USA,” reports Schmidt.

The Weinheim team responsible for this process has long since completed these project stages and many tests on a laboratory scale. The 45-degree solution has succeeded reliably since the summer of 2023. “This is a very stable process. The subsequent coating with the binding agent remains as effective as before,” says Thomas Schwöbel, Manager of the



Emissions

Energy



Pre-Products business unit. Schmidt adds: “We don’t see any differences in performance. We actually need even less chemicals than before.”

In addition to the enormous energy savings, Schwöbel can list many other advantages of low-temperature degreasing with the special SurTec cleaner. In contrast to a household laundry process, the suds are not pumped out as waste water after each washing cycle during phosphating – instead, they are reused continuously for up to three months, helping protect the environment. The suds just have to be regularly degreased one level lower.

“The cleaner we used previously always created an undesirable crest of foam,” Schwöbel recalls. This necessitated

additional safety precautions for the employees, machines and environment. Additional cleaning work was also required to prevent wear and aging on pumps or suction systems. With the new method, the foam and associated extra maintenance are a thing of the past. Another benefit of the new solution: Much less washing solution evaporates now with the lower cleaning temperatures.

Freudenberg Sealing Technologies is also analyzing the other steps following degreasing in the phosphating process – pickling, activation, phosphating, passivation and drying. The company is currently examining ways to improve the sustainability of the pickling and activation bath. After phosphating, the metal rings receive a coating. Another opportunity for optimization.

**9 INDUSTRY, INNOVATION AND INFRASTRUCTURE**

The value of a robust infrastructure to an industrial company is obvious. We practice sustainable industrialization with ongoing investments in existing and new plants. Our products are used in large industrial projects.

**13 CLIMATE ACTION**

The industrial sector accounts for a high proportion of greenhouse gas emissions. Freudenberg is reducing its CO<sub>2</sub> emissions relative to sales by 25 % by 2025. By 2045 at the latest, we would like to be climate-neutral in terms of Scope 1 and 2, and we are adopting crucial measures to do this: first, maximizing energy efficiency and reducing our energy consumption; second, electrifying our energy supply; third, using green electricity, and fourth, using renewable energies.

SUSTAINABILITY CONTRIBUTION





## DOWN TO THE GRAM

### FREUDENBERG SEALING TECHNOLOGIES HAS DEVELOPED A METHOD FOR DETERMINING THE CARBON FOOTPRINT OF SEALS

How many grams of CO<sub>2</sub> are in a Freudenberg Sealing Technologies seal? How can this number be accurately calculated? These were the driving questions behind the company's development of a methodology for calculating the carbon footprint of its seals. Introduced in 2023 in response to growing customer requests for CO<sub>2</sub>-per-part data, the company's Green Index takes a cradle-to-grave approach to emissions calculations. For Freudenberg Sealing Technologies, this means that climate-relevant emissions are not the only environmental properties of chemical substances that should be considered when making internal evaluations of materials.

"For example, we try to avoid hazardous precursors as much as possible to ensure our employees' occupational safety," said Dr. Meike Rinnbauer, Director of Materials Compliance for Freudenberg Sealing Technologies. Rinnbauer was one of several company experts on a team who helped develop the Green Index. "We also take other environmental factors into consideration with our materials."

The team's preliminary analysis revealed that two considerations have a significant impact on the emissions balance of a component. The first is the selection of the material from which the seal is made and the second is the manufacturing processes used to make it. The team has pursued consideration of both in its calculations.

Freudenberg Sealing Technologies purchases the raw materials required to manufacture its products. These include rubbers, fillers, plasticizers, small chemicals, and metals. For the most important raw materials, the company looks at the "Global Warming Potential" (GWP): the CO<sub>2</sub> equivalent in kilograms as a measure of the relative contribution to the greenhouse effect. To determine the global warming potential (GWP) of a material, Freudenberg Sealing Technologies uses an expert database that complies with the ISO 14044 standard for life cycle assessments. The data base, however, does not fully account for a material's toxicity and environmental impact.

The Green Index expands the company's carbon footprint calculations by assigning Eco-points for considerations like how hazardous a material is to people and the environment, and how much energy is used in the production of the component. A Green Index value is calculated on the basis of three factors: the concentration of an ingredient in the formulation; the total GWP of all material ingredients as a sustainability criterion; and assignment of eco-points for environmental impact and toxicity. A toxicity value is derived by consulting Freudenberg's own occupational safety guidelines and the European REACH chemicals regulation. Depending on the harmfulness class, a penalty factor is assigned, which currently ranges from 1 (harmless) to 2



Emissions



(persistent). The highest single value determines the factor that is multiplied by the total GWP. This ultimately results in a dimensionless value that can be used to assign the seal material to a specific sustainability class in the Green Index. Once they have been determined, all index values are stored in a materials database used throughout the company and are then available to the development engineers.

Beyond material considerations, the company also considers CO<sub>2</sub> emissions generated by production processes, unless the processes run on clean energy. Correctly allocating these emissions to individual material batches or products is a challenge.

One prerequisite for this allocation is knowledge, backed up by measurements, of how much energy is used in the individual process steps, specifically in relation to the weight, volume, or surface area. The team examined the specific energy consumption of the company's core processes – mixing, molding, coating and reheating. Other parameters, such as the amount of engineered waste consisting of partially- or fully-processed material was also considered. This kind of waste arises, for example, because products do not receive their final shape until they are finely machined in the production process.

Even if many materials and processes still need to be studied in more detail before transferring the methodology, a clear tendency is evident: The greatest leverage for manufacturing components in a more climate-friendly way lies in avoiding waste during the production, at least as long as the company is still using fossil fuels. Therefore, Freudenberg Sealing Technologies is resolutely focusing on waste-preventing production technology. The team has already determined that the by using cold runner injection molding with valve gate technology alone, the company has eliminated approximately 70 tons of waste per year and 600 tons of CO<sub>2</sub>.

Freudenberg Sealing Technologies has not yet made a final decision on how and to what extent sustainability factors should be considered beyond the GWP. "The important thing," Rinnbauer says, "is that our optimization isn't one-dimensional. When selecting materials, we also consider the service life and wear resistance that influence our customers' eco-balance."

## SUSTAINABILITY CONTRIBUTION



### 13 CLIMATE ACTION

The industrial sector accounts for a high proportion of greenhouse gas emissions. Freudenberg is reducing its CO<sub>2</sub> emissions relative to sales by 25 % by 2025. By 2045 at the latest, we would like to be climate-neutral in terms of Scope 1 and 2, and we are adopting crucial measures to do this: first, maximizing energy efficiency and reducing our energy consumption; second, electrifying our energy supply; third, using green electricity, and fourth, using renewable energies.





# A NEW, GREEN BEGINNING IN SPAIN

## FREUDENBERG SEALING TECHNOLOGIES' NEW MANUFACTURING PLANT IN PARETS FOCUSES ON COMMUNITY AND ENVIRONMENTAL RESPONSIBILITY

Freudenberg Sealing Technologies has successfully operated in Spain since 1968, when it opened its automotive components factory in Parets del Vallés, just north of Barcelona. During the ensuing decades, employees at this Fluid Power damper and steering facility have produced millions of seals and automotive components with an eye to quality and lean manufacturing. Most recently, the plant earned a company excellence award for its implementation of lean administration.

The company's presence in Parets has fostered regional appreciation for the employment and investment opportunities the company has brought to the Catalan province. Acknowledging this deep-rooted commitment to the region, the company has always prioritized its responsibility with good community relations and sustainability practices. As a result, when the decision was made to update its Parets facility, the company started building a new industrial facility that uses renewable energy and eliminates fossil fuels.

The groundbreaking ceremony for the new Parets plant took place in September 2022, and was well attended by local community leaders. The company would not only build a new plant, Freudenberg Sealing Technologies executives said at the ceremony, but would also preserve all jobs in moving from the old building to the new. The location chosen for the new plant is so close to the old plant

that existing synergies between Freudenberg Sealing Technologies and other Freudenberg Business Group companies operating in the region would be maintained. This would enable the company to continue its use of joint services such as surveillance and landscaping, as well as shared well water, truck access and parking lots.

Everything has gone as planned, and in September 2023 – just 12 short months after the groundbreaking – the facility welcomed its new occupants: the same loyal employees who previously supported the company's Damper and Steering operations.

The new, highly automated facility is 6,600 square meters in size, with more than half of this space being dedicated to the production of shock absorber components and steering systems. The company expects this business to grow by about 15% in the future. But in addition to providing the extra floor space needed for production expansion, the new Parets plant provides something more to Freudenberg Sealing Technologies: a successful example of how the company can incorporate sustainability into new and existing manufacturing building projects.

In fact, this updated building is now one of the most modern and sustainable Freudenberg Sealing Technologies



Emissions

Energy



factories in the world. And the location is fitting: In 2021, the U.S. Green Building Council ranked Spain among the top five countries in the world with buildings certified according to LEED (Leadership in Energy and Environmental Design). This is the most widely used, green building standard in the world and one that the company pursues with determination. In Spain, the company aimed for Gold. While any LEED certification shows exemplary leadership in sustainable building practices, the LEED Gold Standards are the most challenging to achieve and send a clear message that Freudenberg Sealing Technologies is serious about sustainability.

To achieve the LEED Gold standards, the new facility rigorously adheres to Spain’s energy regulations, with a special focus on insulation and sustainable materials. Key elements include a heat pump system with energy recovery capabilities and a low-consumption LED lighting system, both of which ensure a significant reduction in energy consumption. A photovoltaic system with a minimum capacity of 100kWp is installed on the roof to generate green power for the site, which can be utilized directly in the building.

In the manufacturing area, a core feature is the integration of an efficient energy recovery system for heating, ventilation, and air conditioning. Specialized cooling systems and insulation for tools and injection units ensure maximum efficiency. Waste heat generated by machines is fed into the heating and hot water systems, exemplifying the building’s closed-loop energy utilization. The facility also features a pioneering biological treatment system to render the exhaust air from dipping cabins CO<sub>2</sub>-free. By eliminating fossil fuels in all production- and building-related systems, Freudenberg Sealing Technologies has significantly reduced the carbon footprint of its manufacturing processes. And the integration of Industry 4.0 technologies means that the building will not only be sustainable, but also technologically advanced and ready to embrace the future. The company’s approach has resonated strongly with employees and communities in Spain and beyond, solidifying its role as a leader in sustainable industrial practices and community engagement.

**7 AFFORDABLE AND CLEAN ENERGY**

We plan to secure access to reliable, modern and affordable energy for all our locations. Around the world, completely different conditions prevail for procuring clean energy. Where possible, we are concluding long-term contracts that guarantee a supply of clean energy.

**9 INDUSTRY, INNOVATION AND INFRASTRUCTURE**

The value of a robust infrastructure to an industrial company is obvious. We practice sustainable industrialization with ongoing investments in existing and new plants. Our products are used in large industrial projects.

SUSTAINABILITY CONTRIBUTION





# SETTING AN EXAMPLE FOR ALL

## FREUDENBERG-NOK INDIA'S MANUFACTURING PLANTS ARE TURNING TO NOVEL TECHNOLOGIES TO EXPAND THEIR SUSTAINABILITY SUCCESS

India is currently undergoing a transformative shift, embracing stronger environmental and social responsibilities while growing its presence in international markets. Many Indian companies are adopting sustainability as a pivotal part of their business strategies, and Freudenberg-NOK India is no exception. The company's Chennai and Morinda facilities exemplify what a strategic approach to environmental stewardship can achieve.

When Chennai was opened in 2014, clean energy had been a crucial consideration in the site's development. Strategically located near India's vehicle production industry, the plant would operate in a humid, tropical climate where the sun shines more than 3,300 hours (about 4 and a half months) per year. The region's climate made it easy for Freudenberg-NOK India to see the long-term value of investing in a photovoltaic roof system that would supply a portion of the plant's electricity needs. Today, its 1,000-kilo-watt system provides 30% of the electricity the site needs to maintain operations – and it's completely green.

Chennai's climate was also a primary consideration in the plant's heating and cooling systems. With outside temperatures reaching as high as 40°C (104°F), the plant had to be fully insulated and air-conditioned to create a tolerable working environment.

"The cooling system is the greatest user of the photovoltaic output," explained Sustainability Coordinator Karl Ludwig Stein. Even here, the facility is betting on efficiency with the use of energy recovery systems. The exhaust air from the building is used to cool the hot external air before it comes in.

Other investments have also brought environmental benefits to Chennai. The company's decision to install an in-house sewage treatment plant on-site, for instance, lets it treat all its wastewater and re-feed it back into the system.

The company's investments in Chennai have, in fact, inspired employees to elevate other crucial aspects of sustainability – plant safety and maintenance – to new levels with excellent results. In 2023, the plant received top safety honors from the Tamil Nadu Safety Professionals Welfare Association (TNSPWA), a non-profit organization that promotes exchanges and training in the field of occupational safety. Just a few days later, employees learned they had earned Platinum status for safety and maintenance processes from the Confederation of Indian Industry (CII), a non-profit organization that rates plants on maintenance and safety performance.

In northern India, employees at Freudenberg-NOK India's Morinda facility have been following Chennai's achievements



Emissions

Energy



closely, and with good reason. The company has built a new plant to replace the current facility. When it opens in 2024, it will rely on many of the same technologies installed at Chennai. But it also will set new standards in green energy production and sustainability.

To optimize energy use, a 1.5-megawatt photovoltaic system will span the facility's rooftop, complemented by a fully insulated building and an air-conditioned shop floor. In contrast to Chennai, the cooler nights in Morinda allow the electrical energy from the photovoltaic system to be primarily channeled into manufacturing processes rather than air conditioning.

In addition, the facility will channel waste heat into production processes. The production equipment requires compressed air to operate, but the waste heat from the compression is typically lost in manufacturing. Here it will be harnessed through heat exchangers, making it possible to use the energy for shower water and other heat requirements. In an innovative approach, the plant will also use the waste heat to run its metal treatment processes, including the phosphating system, which uses significant energy to

run. Morinda will be the first site within the company to implement this technology.

Another first for Morinda is the installation of an efficient, biological exhaust air purifier for its coating processes. This eco-friendly solution employs microorganisms within a compost environment to transform harmful chemicals into water and CO<sub>2</sub>. As a result, the plant will not require external heating or gas-based purification systems.

To ensure the fulfillment of its sustainability objectives, the Morinda site will rely heavily on a comprehensive energy monitoring system, using efficient tracking methods to record its progress over time. Energy meters are being installed on the production floor to measure energy use and identify the largest energy consumers among machinery. This information will be captured in a data system that tracks the plant's total energy use. The data will provide Morinda with a transparent means for addressing its energy consumption and conservation. The data will also be shared with customers who are more frequently seeking the CO<sub>2</sub> footprint for every production part.

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SUSTAINABILITY CONTRIBUTION





# NO MORE FOSSIL FUELS

## FREUDENBERG SEALING TECHNOLOGIES IN EMMERICH, GERMANY, OPTIMIZES ITS ENERGY SYSTEMS TO SWITCH ON THE POWER SUSTAINABLY AS IT IS CONSOLIDATING ITS FACILITIES

When the Integrated Precision Solutions (IPS) Lead Center in Emmerich am Rhein began the process of consolidating its facilities from two sites into one expanded location back in 2021 to improve efficiency, it also had another goal: utilizing green power at the site and not relying on fossil-based energy sources. To achieve this, the site planned to use a combination of machine-generated heat, concrete core activation – which makes use of the energy of the water flow through the floor – and the production of green electricity in-house using a photovoltaic system.

“It was crucial for our onsite team to optimize the consumption of energies and to fully avoid fossil fuels while improving the working conditions for the employees significantly,” says Dennis Wally, Vice President of the Lead Center.

The ambitions were big, as the newly consolidated center was being expanded by 6,500 square meters beyond its existing size, with multiple tons of large equipment and machinery installed onsite, including molding machines weighing an average of 26 tons each, plus automation cells, measuring equipment and many peripheral devices, plus stocks of raw materials and finished goods.

But the justification for the efforts were even larger, as the products that the Lead Center produces were in strong demand in the automotive industry and growing more each day.

With global sustainability requirements resulting in the need for lighter-weight vehicle components, the center’s two-



Emissions

Energy



part and multi-part plastic components are in greater demand. The many products manufactured onsite fulfill the needs of an ever-adapting industry, including plastic battery carriers and housings, sensor and radar housings, 3D plastic tubes, and covers and connecting pieces made of polymer materials for use in thermal management.

Today, the Lead Center team can happily report that its sustainability-focused goals for the updated facility are a success. The facility uses a double-heat recovery system to collect waste heat in the air that results from manufacturing and uses two heat pumps to generate the required heat and cooling for the site's processes and operation of its infrastructure. There are no fossil energies in use in the new building.

In the last year alone, the Emmerich site generated around 410 MWh of energy that was consumed directly for its manufacturing. This process avoided the production of approximately 240 tons of CO<sub>2</sub>, according to the average power mix in Germany that is comprised of coal, gas, nuclear and renewables. In addition, Freudenberg Sealing Technologies upgraded the power supply to 100% renewable energy for all its sites in Germany, including at the Emmerich site, meaning that any remaining power supply at the facility is also green.

"The effort made by the team here at Emmerich has been huge," says Wally. "To generate all the connections of the different systems, to utilize the waste heat of the compressors, to fully utilize the heat pumps and concrete core activation and later, the management of the temperature levels to get full control of the automation of the building, and to also streamline the settings of all the new components of the infrastructure – it's been a group effort resulting in great success."

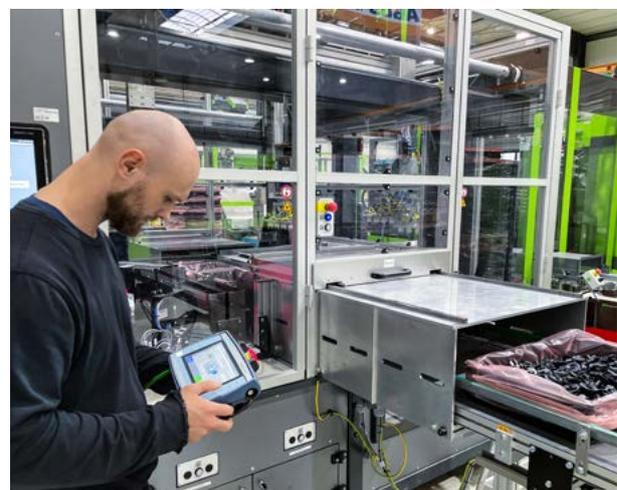
Beyond the sustainable energy achievements at the facility, the consolidation efforts also brought the team closer and made them more resourceful as a group. Being together at a single, advanced facility ended time-consuming travel between the two previous facilities, resulting in better efficiency among the people, beyond the building itself.

## SUSTAINABILITY CONTRIBUTION



**13 CLIMATE ACTION**

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## FREUDENBERG SEALING TECHNOLOGIES' FLUID POWER MANUFACTURING FACILITY HAS LOWERED CO<sub>2</sub> EMISSIONS YEAR-OVER-YEAR SINCE 2021

When it comes to achieving sustainability goals in North America, Freudenberg Sealing Technologies' Fluid Power Competence Center in Troy, Ohio, is ahead of the curve. The key to this success? An early commitment to waste reduction and the on-site presence of a Sustainability Black Belt.

At the forefront of its energy optimizations is the site's transition to 100% green electricity, which has been secured through a purchase agreement with external providers. The shift from natural gas ovens to electric ovens also marks a significant environmental and safety-related milestone: It reduces potential hazards for the workforce, diminishes the plant's reliance on fossil fuels and lowers costs. This transition has resulted in an impressive 85% drop in the overall usage of natural gas since the removal of the last oven in the first quarter of 2023. Even smaller-scale accomplishments, such as optimizing the plant's startup and shutdown procedures, have contributed to the site's progress.

Collaboration with the local community has been central to these achievements. The plant has partnered with the nearby University of Dayton Industrial Assessment Center, funded by the U.S. Department of Energy, to receive free energy assessments. The assessments, conducted by university faculty, analyze the plant's ovens, air compressors and other energy systems, and provide actionable recommendations

for optimizing energy use, waste management, and production costs. The resulting insights and data have been instrumental in identifying areas for efficiency improvements.

The site has also made great strides in scrap traceability and reduction. The introduction of a pelletizer in 2014 for recycling engineered waste marked a change in thinking towards a more sustainable mindset, enabling the company to reclaim raw materials that would otherwise end up in landfills. This effort alone has prevented approximately 20 tons of material from going into landfills each year, translating to annual savings of about \$600,000. Similarly, the elimination of 10 tons of shrink wrap waste from landfill disposal every year underscores the plant's commitment to waste reduction.

In 2023, Freudenberg Sealing Technologies launched an intensive training program across Europe and North America to start cultivating a group of Sustainability Black Belts experts. The program was created to equip these employees with the tools and skills they need to refine processes and provide expert sustainability advice. The company expects to have a sustainability Black Belt located at every manufacturing site. The Troy facility is one of the first in North America to have such an in-house expert. Employee engagement has been highly encouraging. With an effective suggestion program, the company has made it easy for workers to contribute



ideas for process or safety improvements, which are then discussed at a weekly round-table meeting. Implemented changes include replacing petroleum-based packing peanuts with those made of plant starch, which are non-toxic and dissolve in water. The company has also switched to biodegradable packing slips.

“An on-site Sustainability Black Belt has empowered our team to lead improvements in sustainability across our facility,” said Jay White, Director of the Fluid Power Competence Center in Troy. “Overall, we implement more than two-thirds of the suggestions we receive. This instills confidence in employees that they are being heard.” While some of Troy’s efforts may seem small, they have collectively

packed a punch since Freudenberg Sealing Technologies unveiled its CO<sub>2</sub> reduction goals in 2020. Troy has been able to consistently lower its CO<sub>2</sub> emissions year-over-year since then. Between 2021 and 2022, its emissions dropped 21% per million euros in sales and dropped another 21% in 2023.

This progress can be attributed to the site’s commitment to sustainability and the dedicated involvement of its employees. Both have played a role in making high-impact changes in Troy and demonstrate that conscientious environmental practices can coexist with industrial efficiency.

**4 QUALITY EDUCATION**

Demographic changes in Europe will make shortages of skilled employees likely in the future. Other continents have overwhelmingly young populations. In either situation, we rely on robust training courses. We promote lifelong learning for our employees with many training and continuing education courses.

**13 CLIMATE ACTION**

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SUSTAINABILITY CONTRIBUTION





# TRANSPARENCY TODAY AND TOMORROW

## FREUDENBERG SEALING TECHNOLOGIES TAKES A CONNECTED APPROACH TO THE WORK OF EVALUATING SUSTAINABILITY INVESTMENTS

With entrepreneurial and ecological sustainability objectives at the center of its investment approach, Freudenberg Sealing Technologies has turned to the world-wide power of the Web to ensure it is minimizing consumption of energy and other resources in its daily – and future – business operations. WebInvest, a powerful software tool, has been installed to help the company evaluate sustainability investments, run approval processes, and track the status of sustainability projects across its operations. The program can evaluate everything from machinery purchases to real estate decisions on the basis of their environmental impact.

“Energy consumption is determined not only by our behavior but also by our machines and other properties,” said Hans Kloos, who oversees the Sustainability Program, Investments & Energy Auditing / Reporting for Freudenberg Sealing Technologies. “These investments represent a long-term capital commitment, as the machines we buy today have an operational life of around 20 years and the real estate we invest in can have a useful life of significantly more than 40 years. This means the decisions we make today will impact the world of our children and grandchildren, which underscores the importance of applying sustainability considerations to them now and in the future.”

WebInvest has been installed globally across Freudenberg Sealing Technologies. It supports an electronic project approval process that provides all necessary stakeholders with the most up-to-date energy data and information to understand the impact the project may have on the company's sustainability. “Providing our company's decision-makers with detailed information about changes in energy consumption, both positive and negative, that could result from our planned investments, in advance of a project's approval, helps create important transparency,” says Kloos.

When it comes to analyzing potential new real estate investments such as buildings, the company works in collaboration with Freudenberg Real Estate. Together, they focus on reducing the use of fossil energy sources as they analyze potential options to help reduce environmental impact at new or acquired facilities. When renting or constructing new properties, the team ensures compliance with the Freudenberg Green Building Policy by utilizing the location-specific Freudenberg Green Building Index (FGBI), which is an audit questionnaire on building conditions, energy efficient infrastructure, technical equipment, building management and sustainability commitment, operations and more. All the data culled from this audit process is entered



Energy



into the WebInvest platform, resulting in easy access for review and planning.

Looking beyond real estate to capital investments in tools and machinery, the audit process focuses on avoiding the use of oil and gas for power generation and focuses on available electrification options. It also assesses equipment steam and water needs. These sustainability indicators are collected for all capital investments and then compared to sales data to produce reports that can be used for analytics and decision making. The result is a clear picture of whether Freudenberg Sealing Technologies' investments bring it closer to the goal of CO<sub>2</sub> neutrality while pursuing desired business growth.

"Ultimately, we don't want to shrink and suffer a decline in business but rather expand business and production volumes while at the same time achieving our sustainability goals," said Kloos. "In order to achieve this, we need transparency to determine whether we are investing in the appropriate technologies." He added that the analytical process moves beyond upfront investment analysis by capturing vital total life cycle data. "If we replace an old compressor, we expect that the new compressor will consume less electricity and will also be equipped with a heat exchanger to utilize the wasted heat coming from it," said Kloos. "In some cases, this leads to increased investment costs upfront, but the total cost of ownership is significantly lower due to the savings in energy costs over time."

Freudenberg Sealing Technologies is also using applying the WebInvest process to existing facilities that are scheduled for improvements or other changes. The sustainability impact of these changes is assessed and added into the WebInvest system for analysis. Upgrading facilities in the most sustainable manner possible maintains alignment with the company's overall carbon neutrality objective and helps drive site-specific sustainability programs.

While 2023 marked the first year that the company has incorporated energy and CO<sub>2</sub> considerations into its investment decisions, Kloos can envision the long-term impact of the WebInvest process. "In the future, I can imagine that investments will only be approved if the absolute CO<sub>2</sub> footprint is reduced or decreased," he concluded.

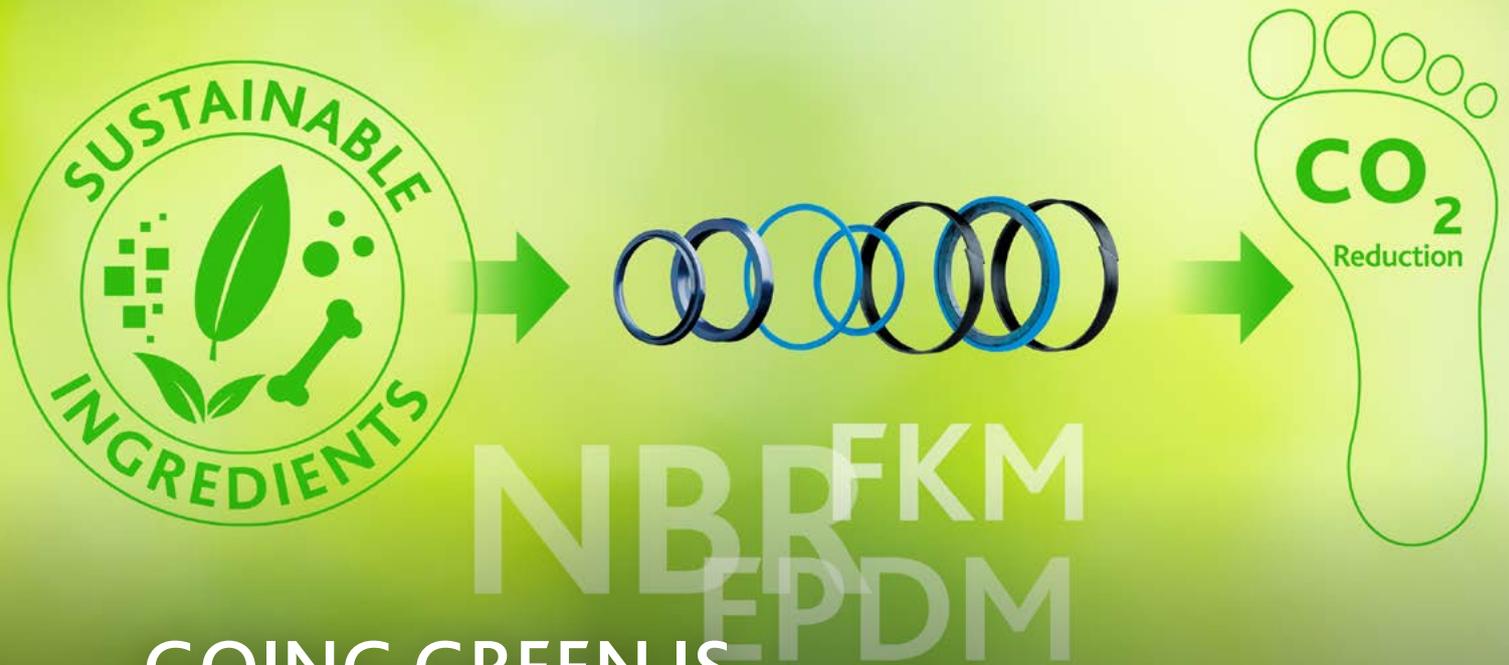
## SUSTAINABILITY CONTRIBUTION



### 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

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# GOING GREEN IS ABSOLUTELY MATERIAL

## FREUDENBERG SEALING TECHNOLOGIES' CO<sub>2</sub> EMISSIONS EFFORTS HAVE INTENSIFIED RESEARCH INTO BIO-BASED MATERIAL INGREDIENTS

Materials are the foundation of Freudenberg Sealing Technologies' products and services. The company invests millions of dollars annually to support the research, development, and testing of new elastomers and high-performance plastics that successfully address customers' sealing requirements. Recently, the company has intensified its research and testing of bio-based material ingredients to replace those derived from fossil fuels.

"Our goal is to decrease the CO<sub>2</sub> footprint of our products," confirmed Dr. Boris Traber, Director of Advanced Material Development for Freudenberg Sealing Technologies in Germany. "Some of our base polymers have a high CO<sub>2</sub> footprint, and if we use sustainable fillers, we can reduce this. But at the same time, we do not want to compromise our sealing properties. The sustainable material must provide the same level of quality and performance as the original material."

The company is currently analyzing a variety of sustainable substances that could replace the fossil fuel-based ingredients in EPDM, NBR and FKM – elastomers that are commonly used in industry applications including batteries and fuel cells. Customers are becoming more interested in sustainable materials, Traber noted, as they work to lower their own corporate CO<sub>2</sub> emissions. Sustainable sealing materials contain ingredients derived from renewable resources.

These include plant or animal sources and recycled materials. While fossil fuels are also formed from plants and animals, these reserves are ancient and cannot be readily replenished.

Base polymers exhibit many properties that make them excellent for sealing applications – temperature and chemical resistance, high flexibility, excellent elastic behaviors. But these polymers can also lack stiffness and strength. Mineral fillers are typically added to increase these properties, and it is these ingredients that the company's Advanced Materials team is working to replace.

In the company's global R&D laboratories in Plymouth, Mich., Materials Fellow, Paul Hochgesang, has assembled an inventory of sustainable ingredients and their sources. There is calcium phosphate derived from incinerated pig bones. There is an antioxidant extracted from Eucalyptus plants, and Rapeseed Oil from Rapeseed flowers. A bottle of beef tallow – a sustainable source for processing acids – sits next to material fillers made from lignins that are extracted from forestry processes. Others – sugarcane, grain chaff, recycled rubber – can all be processed into useful and sustainable polymer ingredients. Such renewable resources hold promise, but only if they can replace fossil fuel ingredients, one for one, while maintaining the quality and performance of the original polymer.

Materials

- Materials
- Recycling
- Energy
- Water

“Freudenberg Sealing Technologies specializes in developing and mixing elastomers that are a combination of polymers and reinforcements,” said Hochgesang. “There are plenty of sustainable ingredients out there, including materials that can be recycled. But we are researching sustainable ingredients that will result in an optimized product performance.”

Finding that perfect match involves extensive evaluation and testing. The company will not exclude any sustainable ingredients from its initial consideration. These ingredients are benchmarked against their fossil fuel-derived brothers, and if the performance and quality of a material using sustainable ingredients does not deviate from the original material, the company’s scientists and chemists will recommend to Freudenberg Sealing Technologies’ divisions that the new, more sustainable material formula is considered for use.

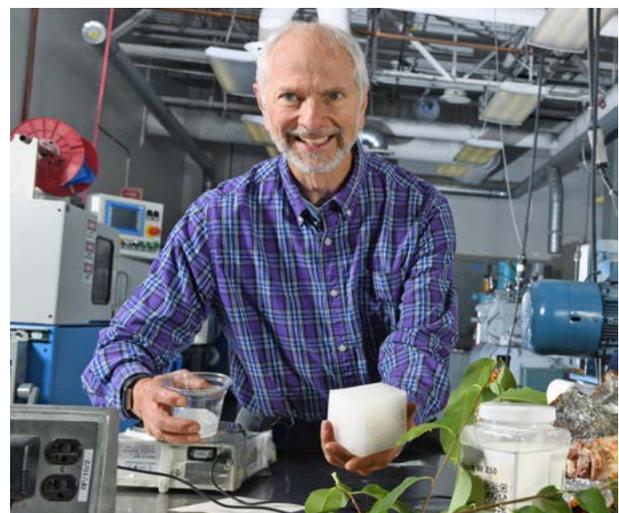
Still, a key consideration in the switch to sustainable ingredients is their consistent availability and quality. Sustainable carbon black is an example. Despite landfilling more than 58 million tires annually in the U.S. and Europe, processing sustainable carbon black from recycled tires is both energy intensive and reliant upon a consistent, high-quality source of tires. Since tire producers are also interested in lowering their CO<sub>2</sub> footprint through reuse and sustainable carbon black, competition for what has largely been landfill trash is now heating up.

This development, of course offers environmental benefits of its own. And Freudenberg is working closely with its supply base to secure consistent, high-quality, high-volume sources for sustainable ingredients.

## 12 RESPONSIBLE CONSUMPTION AND PRODUCTION

The Earth’s growing population is putting immense pressure on resources. We need to adopt sustainable consumption habits, including a global shift to energy supplies produced from renewable resources. Economic and social progress during the last century was accompanied by environmental degradation. Moving forward, we need to improve resource efficiency, consider the lifecycle of products, and embrace a circular economy. Products must be designed for longevity, repairability and recyclability. Individuals must adopt more sustainable lifestyles through lower consumption, the use of products with lower environmental impacts, and reducing the carbon footprint of their day-to-day activities.

### SUSTAINABILITY CONTRIBUTION





## A LAB TO SUPPORT E-MOBILITY



In support of electric mobility, Freudenberg Sealing Technologies completed a state-of-the-art battery testing laboratory at its Plymouth, Mich., US, regional headquarters in 2023. The multi-million-dollar investment facilitates in-house battery and battery component testing, including simulated thermal runaway. The lab will increase the company's functional knowledge and product development capabilities for electric vehicles. In addition, simulation testing that replicates battery cycling is possible.

Safety was also a top priority. The company consulted with design and construction specialists in building the laboratory. Concrete walls with reinforced steel were installed, along with pressure vents and multiple sensors that monitor pressure, heat, gases, and other laboratory functions.

Going forward, the lab will help Freudenberg Sealing Technologies better understand its customers' needs, and where it can offer more support with an evolving product portfolio.



Freudenberg Sealing Technologies is committed to investing millions of dollars during the next 10 years to retrofit or replace energy guzzling processes and systems. Of the 502 sustainability projects funded last year, 100 will help lower the company's energy demands by 17.8 GWh/a. This equals the energy demand of approximately 600 average households. The other investments made were energy neutral or led to further business growth.

The company has identified four industrial operations – heating and cooling systems; thermal oxidizers; post-cure and conveyor ovens; and phosphating lines – as the primary source of its CO<sub>2</sub> emissions. These operations will be transitioned to green electricity and more sustainable processes through long-term infrastructure investments and new technologies. Smaller projects, like switching to LED lighting, are also underway.

## A LONG-TERM INVESTMENT IN CLEAN ENERGY





# SUSTAINABILITY IN BRIEF



## AN EXPANDING COMMITMENT TO HYDROGEN



Freudenberg Sealing Technologies has identified hydrogen as a core business. The company has developed sophisticated sealing solutions for electrolyzers and fuel cells that address the unique requirements of sealing hydrogen systems. The effort has been so successful that in 2023, the company created an interdisciplinary team to look at the changing needs in other hydrogen applications, including distribution, conversion, storage, applications for generated hydrogen, and plant engineering requirements.

“With this interdisciplinary structure, we are breaking away from our familiar approaches and considering all aspects: cross-regional, across segment and division boundaries, and across different sales channels,” explains Marcel Schreiner, Global Segment Director Energy, General Industry. He now coordinates four hydrogen-focused project teams – Technology & Innovation, Product Commercialization, Sales, and Business Development – as part of a holistic approach to the hydrogen economy.

In 2023, Freudenberg Sealing Technologies’ sustainability team hosted six Best Practice Exchange Sessions to capture the knowledge and experiences of its global workforce. Each session brought a broad cross-section of company experts together to discuss topics like linking lean concepts with sustainability, lifecycle assessments, engineered waste, recycling

## IN CONSTANT PURSUIT OF BEST PRACTICES



and circularity, and the need for continual improvements. The sessions have resulted in more cross-functional cooperation, a broader exchange of ideas between plants, more widely distributed best practices and a renewed understanding that employee engagement is essential to the support and success of the company's sustainability goals.

**Imprint:**

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April 2024

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