Use-Phase & End-of-Life

The global economy was only 8.6 percent circular in 2020, compared to 9.1 percent in 2018. This downward trend reflects high rates of resource extraction, high stockpiling, for example of infrastructure, buildings and machinery, and above all a linear economy. About 100 billion tonnes of resources were industrially processed worldwide in 2017. 32.6 billion tonnes were collected as waste. Most of this is lost, ends up in landfill or is incinerated. Just 8.65 billion tonnes of materials were recycled and fed back into a circular economy. But if global warming is to be limited to 1.5 degrees Celsius below pre-industrial levels, creating a circular economy is essential. We are still a long way away from this.

"Millions of people use our products every day and there is no doubt that they create added value. Nonetheless, we must at the same time realize that the end of life of products that we consume is not compatible with a more sustainable future."

Ankit Aggarwal (Greiner AG)
Life Cycle Assessment Manager

Use-Phase Products

"Anyone aiming to become a circular company will have to move away from taboos. There is no law, for example, saying that single-use products cannot be reused."

Nicole Pingitzer (Greiner Bio-One)
Product Manager

Moving away from a throw-away society

We live in a throw-away society. Throwing things out is at the core of a linear economy. Under this system, products are usually incinerated or sent to landfill after they are used. Products are recycled or even reused far too infrequently. It is time for this system to come to an end. It raises the question of whether single-use products can be reused and whether this will create another economy. The goal must be to prolong the useful life. This is the starting point for reusing products. We also have to systematically change the "end of life" of products, i.e. their disposal, so that products never go to waste and are instead reused. Achieving this will create a systematic incentive to make products and materials a part of the circular economy.

Our goal

We want to be climate neutral by 2030.

Our targets

100%

By 2025, packaging at Greiner Packaging should be 100% reusable, recyclable or compostable.

Our performance

34%

Almost one third of Greiner Packaging packaging is recyclable according to the *Ellen MacArthur Foundation*'s definition of Global Commitment.

Innovation: an engine for change

Knowledge is the most important resource a company can have. All developments and transformations are sparked by one brilliant idea. Ideas that have been successfully put into practice – i.e. innovations – are the engine of success. Alongside numerous other factors, tailor-made processes are central to successfully positioning new products and services on the market. We use various awards to give employees the opportunity to pitch their ideas each year. The success of these internal company idea and innovation competitions speaks for itself, with hundreds of project ideas submitted in recent years. Accordingly, the personal mantra of the 2020 *IDEA Award* prize winner, Wolfgang Diesenreiter (Greiner Extrusion), serves as a guide for the group as a whole: "The most efficient way to multiply knowledge is to share it!"

Future Hunters: Thinking about our future today

Continually reinventing Greiner and permanently being on the search for new ideas, trends and technologies was the main task of Greiner Technology & Innovation. In the past, it looked for potential future issues, application opportunities and drivers of innovation together with partners from a diverse external network. In 2020, we also created an internal network called *Future Hunters*. The main aim of *Greiner Future Hunters* was to expand the internal network in order to evaluate current and future challenges facing the plastic and foam sectors and to initiate sustainable changes. After the initial phase of *Greiner Future Hunters*, this network was to comprise Greiner employees from all sites around the globe. Anyone with curiosity, imagination and a passion for innovation and who wanted to help shape the future of our company in the long term was invited to take part. *Greiner Future Hunters* aimed to establish a varied, diverse and creative network of innovators and unconventional thinkers to identify, discuss and evaluate issues of the future. This created a basis for developing future products and services and fertile soil for entirely new approaches to achieving the goals of our sustainability strategy.

IDEA Award: Ideas for the future

The focus of the *IDEA Award* varied. Because knowledge has to be accumulated and made available, the 2020 idea campaign looked at knowledge management. It asked where the greatest challenges lie in transferring knowledge, how knowledge can be provided automatically and whether knowledge services could be used externally. The *Greiner Future Hunters* network chose the winner: With his idea of a "Simple Expert System", Wolfgang Diesenreiter (Greiner Extrusion) aimed to collect expertise from all divisions in a database, systematically process this knowledge and make it available across the group. For his efforts, he received the *IDEA Award* 2020, which carries a prize of up to 200,000 euros. Christopher König (Greiner Bio-One) received the 2019 *IDEA Award* for his idea "Prediction of sequence dependent set up times". His idea should make the work of production planners far easier thanks to artificial intelligence. After choosing the annual winning projects for the *IDEA Award*, a feasibility study is carried out for the winning idea.

R&D Award: Products for the future

Any promising idea must first be made a reality. This is why we held the *R&D Award* over the past few years. Winners received prize money of 500,000 euros for implementing the project. All Greiner divisions were eligible to take part. The submitted products supported by universities, technical colleges or even start-ups had a bonus. Collaborations were expressly encouraged. The 2019 R&A Award was won by NEVEON colleagues with their "Greiner Intelligent Seat" project. The intelligent airplane seat features sensors that measure humidity, surface pressure and temperature, automatically informing the airline of the seat's current condition. Winner of the 2020 R&A Award was a project submitted by Stephan Laske (Greiner Packaging). The project is called "GPOil" and deals with the chemical recycling of plastic waste which is usually incinerated as a substitute fuel. Instead of burning the waste, under "GPOil" it is reclaimed as a high-quality material that is then used in food packaging. This innovation aims to get involved in plastic waste recycling, and in doing so take a decisive step towards creating a circular economy.

Innovation Award: Successful market launch

An innovation is successful when new products and services are launched on the market. Accordingly, we used our *Innovation Award* to take a look at new projects that have been successfully put to market. Daniel Scherhammer (NEVEON) received the 2019 *Innovation Award* for his "Vacuum Insulation Panel Module" project. The winner of the 2020 *Innovation Award* was the "VACUETTE® Stabilisation Tube" submitted by Moritz Wiesbauer from Greiner Bio-One. In light of global shortages of these kind of products caused by the coronavirus pandemic, this project aimed to provide a mass-produced tube for transporting swap specimens for SARS-CoV-2 tests in a very short period of time. This is to be done using standard Greiner Bio-One devices, processes and components to ensure a short development time and a quick ramp-up to large-scale production.

INNOVENTURES: Incubator for the ideas of tomorrow

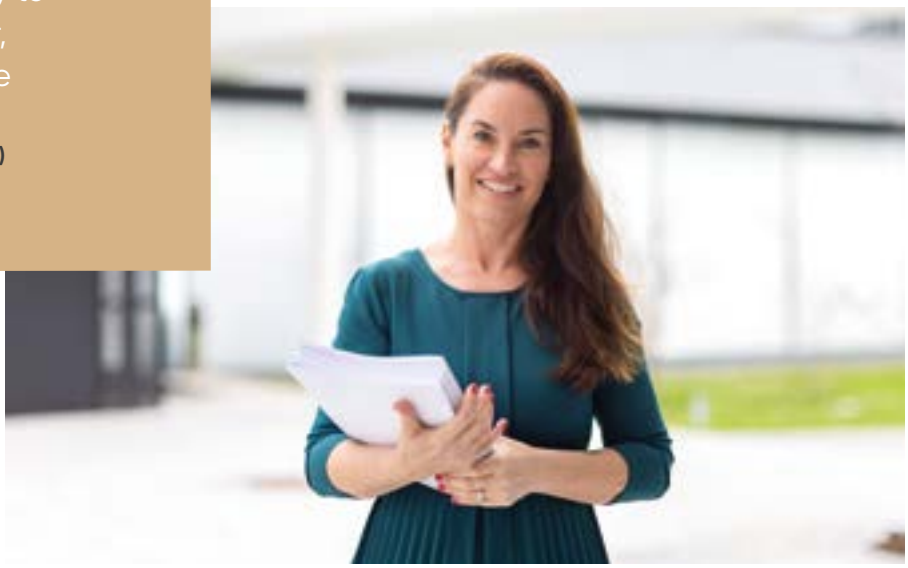
Having a protected framework to develop and establish new ideas benefits all areas of the economy and, in particular, those undergoing a process of transformation towards sustainability. As well as *Future Hunters*, our innovation hub Greiner Technology & Innovation thus created the corporate incubator INNOVENTURES, a platform for all innovations not directly related to Greiner's operating business. The corporate incubator offers an organizational structure that helps put radical innovations into practice. It provides an environment similar to that of a start-up, promoting creative, innovative and above all risk-on collaboration. Securing sustainable growth means thinking outside the box of the present and considering opportunities for future business areas and innovative products. Radical innovations needed to implement our sustainability strategy require agility and courage. The corporate incubator INNOVENTURES creates a suitable framework for doing this. The corporate incubator helps the entire group with innovations, analyzes future trends and conducts internal innovation projects to develop ideas for solutions that go beyond further developing divisions' existing activities. In the case of external innovation projects, non-company projects are linked to Greiner with the support of INNOVENTURES. The aim is to harness synergies by allowing external collaboration partners such as start-ups to benefit from our experience and reach in various markets and, in exchange, for us to benefit from their innovative spirit and the fact that they can put ideas into practice more quickly.

International awards for successful circular economy ideas

In collaboration with our customer *Henkel*, we developed cardboard-plastic packaging that *Henkel* uses for its Persil 4in1 detergent. 50 percent of the sustainable Persil packaging is made from recycled polypropylene (r-PP), which comes from household waste – a prime example of successfully thinking about the circular economy. The 100 percent recyclable packaging and the small amount of plastic used help reduce CO_2 emissions, with the cardboard sleeve ensuring that the container is stable. Both Greiner Packaging and *Henkel* have signed the *Ellen MacArthur Foundation's New Plastics Economy Global Commitment.* This commits us to eliminating problematic or unnecessary plastic packaging, making packaging reusable, recyclable or compostable and increasing our use of recycled materials. The new K3® packaging solution meets all of these requirements in their entirety. This packaging won us the 2020 *Green Packaging Award* at the 2021 *Worldstar Global Packaging Awards.*

"We use various awards to give employees the opportunity to pitch their ideas each year, allowing them to shape the future themselves."

Sylvia Felbermayr (Greiner Packaging)
Customer Service Coordinator



Turning the use of our products on its head

The future must be circular. To achieve this, all products will be put to the test. Do single-use products have to remain single-use products? Can a product be repurposed and used for longer? Can we as manufacturers do anything else to make the use of our products sustainable? These are just some of the questions we are asking ourselves. In many cases, some of which we will illustrate here, we have already found answers and made changes. In other areas, we are still researching, developing and thinking.

Greiner Bio-One

A tube in the fight against the pandemic

Since the onset of the coronavirus pandemic, at the latest, we have all been aware that a healthy life cannot be taken for granted. Covid tests have been an irreplaceable part of our repertoire of measures to tackle the Covid-19 pandemic since the start of 2020. To meet the immense rise in demand on account of this medical challenge, Greiner Bio-One very quickly developed the VACUETTE® Virus Stabilization Tube. This 3 ml tube made from PET plastic makes it easy to handle, safely transport and store Covid-19 test samples. The samples taken from the nose or mouth/throat area of the person being tested are put into the tube and sent to the laboratory for a PCR analysis. In turn, Greiner Bio-One's VACUETTE® Blood Collection Tube (e.g. serum or EDTA tube) is used to test whether a person has formed antibodies against SARS-CoV-2. In combination with the products from the VACUETTE® Transport Line, the sample material arrives, sealed, at the laboratory to be tested for SARS-CoV-2.

Greiner Packaging

Innovative refill solution to replace disposable containers

Reusing products multiple times is sustainable. Greiner Packaging developed a new refill concept for plastic spray bottles so that consumers do not need to buy a new bottle of household cleaner every time. This way, reusing and refilling spray bottles can become the new normal. The new refill bottle is made out of HDPE, PP or PET material, meets all current market requirements and saves four plastic spray bottles per bottle, including the top piece. The material savings increase to up to 85 percent over the intelligent refill cycle. Replacing 20 million standard spray bottles with our multi-use, refill solution would save up to 1,000 tonnes of plastic every year. We believe it is extremely important for the overall packaging to be recyclable as best possible. This approach is also consistently adopted when selecting the material and decoration and customers receive individual advice about the circular economy. Greiner Packaging also recommends choosing a compatible material for decorative labels that ensures maximum recyclability.

"At Greiner Packaging, we also produce plastic packaging that can be reused multiple times and is therefore particularly in line with our sustainability vision."

Elena Hoaghea (Greiner Packaging)
Assistant to General Manager

Circular economy: the example of school milk

Pupils in Upper Austria learn about how the circular economy works in day-to-day life as part of a school milk project developed by us. PETMAN GmbH, an Upper Austrian company that specializes in processing and developing new applications for PET, and the farmer Johann Strobl approached us with a desire to produce a PET cup for school milk. Our aim for the project was for it to be 100 percent recyclable and form a closed cycle. We also had to ensure that it meets all rules and regulations of the European Food Safety Authority (EFSA). At the end of 2020, we achieved our goal: The first truckload of cups made entirely from r-PET (recycled PET) was delivered to co-creator Strobl and to other school milk farmers. After pupils' milk break, the farmers collect the used cups and take them back to their farms, where they are collected again in exchange for new cups, shredded, washed and processed into new PET film.

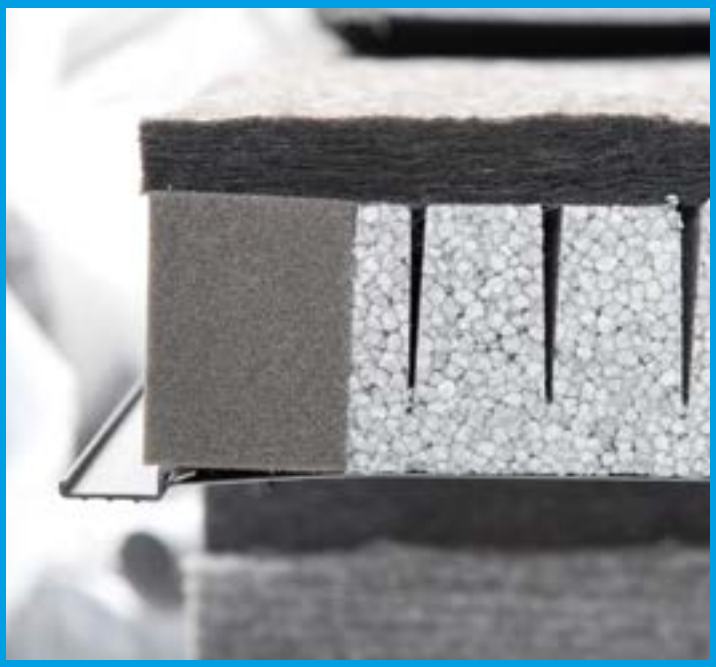
Reusable lids keep yogurt fresh – and much more

Most food and non-food packaging is used only once before, ideally, ending up in the recycling. At Greiner Packaging, however, we also produce plastic packaging that can be reused multiple times and is therefore particularly in line with our sustainability vision. For example, we have developed a reusable, dishwasher-safe snap-on lid. This can be reused for new yogurt pots, keeping the yogurt fresh and ensuring that it does not lose its taste. Our reusable lids are not only practical, they also help reduce plastic. They are also a way of avoiding large amounts of waste – once the pots are empty, our lids do not end up in the garbage.

NEVEON

Sitting intelligently

Rethinking products is part of NEVEON's DNA. Developing an intelligent aircraft seat demonstrates this. The seat systems, with are fitted with sensor electronics, allow predictive, targeted maintenance for parts that have worn out. This increases the lifetime of the seat cushions and so only seats that are actually faulty or worn out need to be replaced. By reducing waste, this smart solution is a win for the environment. As maintenance work can be done more selectively, aircraft downtime is also reduced. Last but not least, the seat also helps improve passengers' physical wellbeing. The sensors built into the seats generate data that can be used to analyze passengers' sitting positions and subsequently to prevent incorrect posture.



Extending the lifetime of foams

Extending the lifetime of products is good for the environment and good for society. All foams have a defined lifetime, which is affected by factors such as the weather, UV radiation and humidity. At NEVEON, we are committed to durability and therefore to optimizing this lifetime. xdura® is one example of this. This foam has allowed us to develop a durable and exceptionally stable foam that does not lose its shape even after many years of use. For example, the foam is tear-resistant. xdura® is also soft, supple and elastic – exactly what you want from a high-quality foam. With a far longer lifetime compared to other foams, it is also excellent in meeting our desire for greater sustainability.

Lighter aircraft, trains and cars

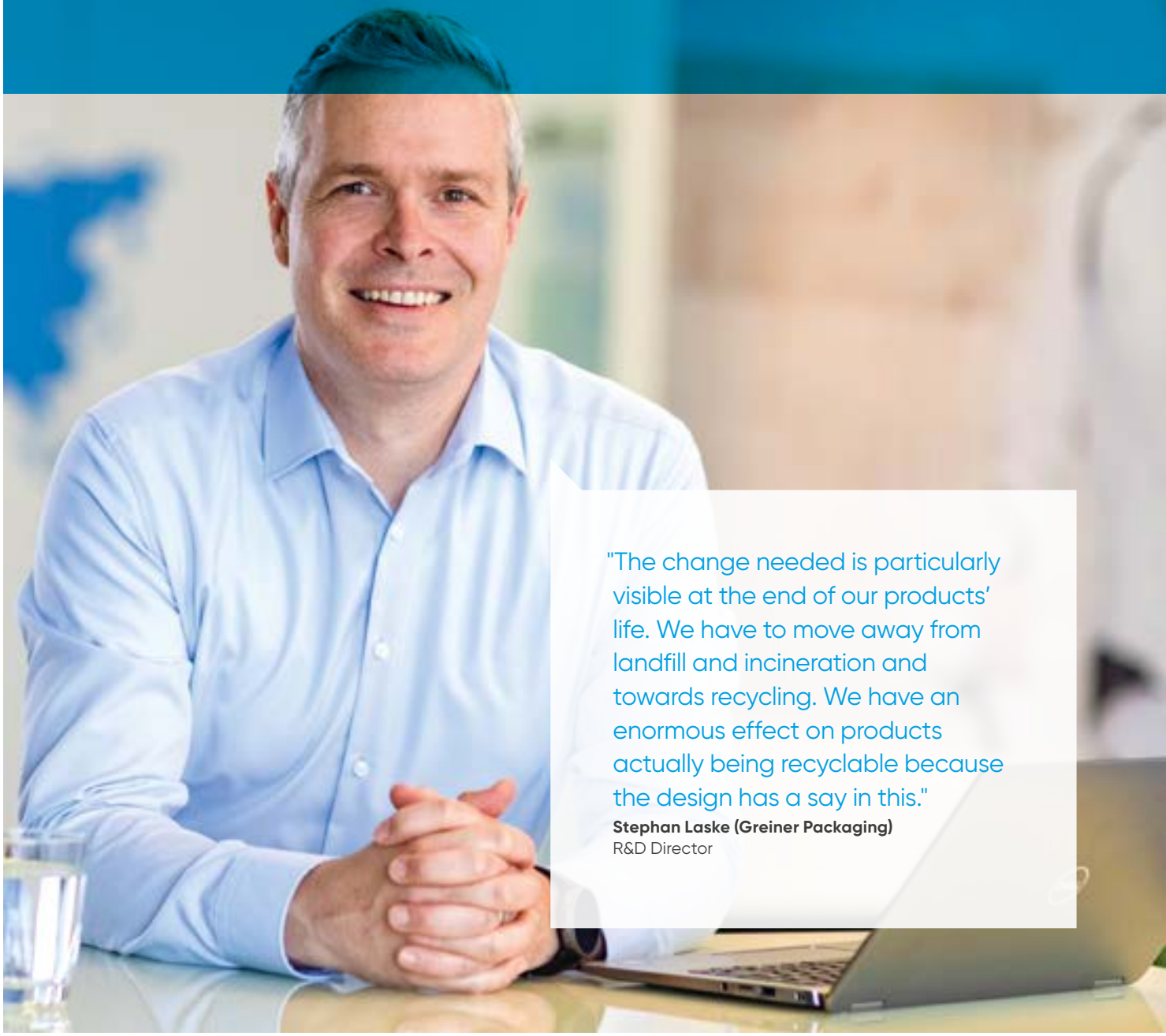
Comfortable, light, environmentally friendly – NEVEON's seat cushion is all of these three things. It combines the highest levels of comfort with minimal weight and, at the same time, closes the material cycle. This sustainability coup is based on a special knitting technology that uses recyclable or biodegradable fibers and technical zones of varying elasticity. Compared to traditional foam solutions, knitted seat systems reduce weight by up to 30 percent. Using NEVEON seat cushions in airliners reduces their weight by more than half a tonne. An Intercity train would be almost six tonnes lighter and a five-seater car 75 kilograms lighter. As well as saving energy when operating the mode of transport fitted out with this seat technology, there is also huge savings potential for resources and energy at all stages of manufacturing and supply logistics. Customized production also eliminates production waste. At the end of their lifetime, the use of sustainable materials (from renewable raw materials) means that the seats can be recycled or, in theory, biodegraded.

Greiner Extrusion

Maximum material consumption savings

The DIGI.LINE developed by Greiner Extrusion regulates the extrusion process digitally and optimally in real time, ensuring not only exact geometry of the profile but also making it possible to produce this close to our lower tolerance limits. DIGI.LINE's innovative features also accelerate the start-up process and lower the error rate, dramatically cutting back waste and in turn reducing material consumption. The automated melt flow control FLOW.MATIC also ensures exact profile geometry. FLOW.MATIC measures the filling level of the individual full profile sections and, together with the FLOW.CONTROL nozzle function, closes a control loop. The result is extremely constant profile dimensions – without any manual intervention. The settings can be reproduced at any time using DIGI.CONTROL. The profile weight is monitored by the precise DIGI.SCALE in-line profile weighing system, while the WEIGHT.MATIC control loop permanently controls the haul-off speed. This, in combination with FLOW.MATIC, enables production close to the lowest weight tolerance. Trends in profile weight development can also be called up at any time using the permanent data recording. The intuitive 15" DIGI.CONTROL centrally controls the entire extrusion process. For complete reproducibility and a fast start-up process, the recipes are stored with the set processing conditions and are available for future production. This ensures an automated and error-free reproduction of the process parameters in subsequent productions. Thanks to this technology, DIGI.LINE reduces typical profile weights by almost three percent, considerably reducing the amount of material used in connection with this.

End-of-Life Products



"The change needed is particularly visible at the end of our products' life. We have to move away from landfill and incineration and towards recycling. We have an enormous effect on products actually being recyclable because the design has a say in this."

Stephan Laske (Greiner Packaging)
R&D Director

Recycling begins with the design

Feeding products back into the circular economy requires them to be recyclable. For recycling to be a success, in many cases we have to rethink the design of our products. "*Design for recycling*" is our approach and the key to this much-needed change. Several years ago, we committed to making the design of our plastic packaging recycling friendly. In 2018, we signed the *Ellen MacArthur Foundation's New Plastics Economy Global Commitment*. Signing this signaled the start of our recyclable packaging offensive and set a specific goal for Greiner Packaging that serves as a model for all areas of the company: Products must be developed in a way that ensures that can be fed back into the circular economy and that they are more sustainable in the future than they were in the past.

Our goal

We want to be a fully circular business by 2030.

Our targets

100%

By 2025, packaging at Greiner Packaging should be 100 percent reusable, recyclable or compostable.

0t

Not to send any more waste to landfill, in Europe by 2025 and globally by 2030.

By 2020

Until 2020, we designed *EcoDesign-Guidelines* that establish a framework for our product design.

Our performance

34%

Over one third of Greiner Packaging packaging is recyclable according to the *Ellen MacArthur Foundation*'s definition of Global Commitment.

2,212t

2,212 tonnes of our total waste (hazardous and non-hazardous waste) were sent to landfill in 2020.

2020

At Greiner Packaging, we developed *Design-Guidelines* in 2020 that serve as a benchmark for developing and refining products.

We want to operate in cycles

Circular, not linear – changing the global economic system is easy to describe, difficult to implement and a necessary transformation process. In a linear economy, also known as a throw-away economy, raw materials are exploited and products are produced, sold, consumed and thrown away. This creates raw material shortages, waste and environmental pollution. One might say we are living on borrowed raw materials. The earth has and produces billions of tonnes of new natural resources every year. But if we do not change our linear system, at some point in the not too distant future this stock of raw materials will run out. In light of this, we need to think of a new way of doing things, especially in terms of how we produce and what we throw away. Resources can no longer be allowed to go to waste. We have to move away from a linear economy and towards a circular one, from a throw-away society to a sustainable circular economy. This aims to create a system where resources are not thrown out and are instead kept in the cycle, and thus continue to be used, for as long as possible and at the highest possible value. Stepping up our focus on the end of products' and goods' life cycle is the order of the day.

Alongside the key topics of climate and people, at Greiner we have put the circular economy pillar at the heart of our Blue Plan sustainability strategy. Establishing a functioning circular economy is certainly the most challenging of the three pillars. Especially for the packaging industry, the transition to a circular economy is not a foregone conclusion. This because a functioning circular economy requires answers to questions like how can we change the design so that products can be recycled? Where do we get secondary materials that meet the highest standards of quality? What role can technology play in improving recycling? Our responses to these questions have a coal: To systematically evaluate the interplay of nature, people and the economy to create circular products and services and strike a balance between the needs of mankind and natural resources.

The end has to be different

The end of life of products that we produce and sell impacts the environment. We affect this impact, both directly and indirectly. Reducing it is our responsibility. The Greenhouse Gas Protocol estimates that about 90 percent of total greenhouse gas emissions stem from company supply chains. Key drivers include the production of commodities and materials, as well as the disposal of products after they have been used. As most of our products are single-use products – some with shorter, others with multi-year use-phases – the end of our products' life cycle presents a particular challenge for us.

Regardless of their useful life, at the end of their life most of our products have been incinerated or, unfortunately, sent to landfill in some countries. Essentially, this inefficient use of resources is because the envisaged transformation to a circular business model is still in its infancy. Neither plastics nor foams can usually be reused or recycled. As part of our Blue Plan strategy, we are therefore aiming to transition to a sustainable circular economy. We can achieve this by ensuring we use materials in a way that conserves resources, thereby reducing the negative impact on the environment (e.g. emissions from end of life). Our goal is to make sure that our products can be disposed or and/or reused sustainably. No matter whether these are food packaging, mattresses or anything else, they all have to be incorporated into the cycle and recycled so that they can become a part of further life cycles.

Working together with skilled partners

Dividing, reusing, repairing, reprocessing and – as a last resort – recycling extend the life cycle of materials and products and ensures circularity along the entire value chain, from extracting the raw materials to taking back products to reusing or reprocessing them. Achieving this goal also requires new forms of collaboration and ways of thinking by everyone involved. At the moment, we still have to acknowledge that we have a massive disposal problem, i.e. we are experiencing a crisis in the disposal of plastics. One of the main reasons for this is a lack of infrastructure for plastic packaging disposal. Given the global scale of this problem, as a global community we must dispose of our waste properly.

This calls for a focus on developing and emerging markets in Africa and Asia, but we must not forget that a lot is still going badly wrong in Europe and North America, too. Our products are used across the world. As a result, we are involved in numerous initiatives and project to promote education, research and infrastructure for efficient waste prevention and disposal. Greiner has been a partner of the *Ellen MacArthur Foundation*, a British foundation named after the English sailor known for sailing around the world that champions a global transition to a circular economy, since 2016. "When you sail around the world on a boat, you take the absolute minimum of resources with you and waste nothing," said Ellen MacArthur, drawing a comparison between her past profession as a professional sailor and the circular economy advocated by her foundation: "Only by building an economy that uses things, rather than using them up, can we create a sustainable future."

"Only by building an economy that uses things, rather than using them up, can we ensure a sustainable future."

Robbin Wang (Greiner Bio-One)
Key Account Manager

In October 2018, the *Ellen MacArthur Foundation*, working with the United Nations Environment Program (UNEP), launched the *New Plastics Economy Global Commitment*. This commitment brings together over 500 companies, representing almost 20 percent of all plastic packaging produced globally. Numerous governments, NGOs, universities, industry associations, investors, and other organizations have also backed the joint vision of tackling plastic waste and environmental pollution at its source. The Global Commitment 2020 Progress Report shows that the signatories have made progress in reaching the defined goals but that efforts need to be stepped up considerably in the years ahead.

By signing this commitment, Greiner Packaging agreed to uphold a series of specific targets. These include eliminating necessary plastic parts in our production processes by 2025 and coming up with innovative solutions to ensuring that all plastics can be reused, recycled or composted in order to keep our plastics in the value chain.

According to Global Commitment 2020 Reporting, almost one third of our plastic packaging is currently reusable, recyclable or compostable. We are committed to making this 100 percent by 2025. To achieve this, we will put all product groups to the test. This also includes working even harder on sustainable product design than we are already. The design process for products shapes how they are disposed of. To put it another way, the start is vital in determining the end. Crucial materials decisions are made in the design development stage that have a significant impact on the lifetime and end of life of our goods. At Greiner Packaging, we have therefore prepared *Design-Guidelines* that show what design aspects, materials and packaging concepts we need to achieve our goal of a circular economy. As early as during the product development stage, the guidelines help us make sure that only products that can really be recycled are brought to market.

The end starts at the beginning

Intelligent sorting with digital watermarks

Unfortunately, plastics and foams are all too often still incinerated or even sent to landfill. Where products are recycled, this is usually done through mechanical recycling. Under this system, the plastic waste is initially separated by the consumers, before being sorted by type of plastic, washed, melted down and then processed into recycled materials. These recycled materials are then used as the starting materials for new products and replace plastics made from new materials. Waste can only be fully sorted if we as consumers first separate our waste properly. Innovative technologies such as developing and using digital watermarks on plastic packaging are playing an increasingly vital role in making this sorting process more efficient. It is already clear that digital watermarks will be essential on the packaging market and in Europe's sorting facilities in the future when it comes to recycling.

Since 2017, we have been involved in the HolyGrail project as part of our work with the *Ellen MacArthur Foundation*. As a partner of the *HolyGrail 2.0 Initiative*, managed by the *European Brands Association* (AIM), Greiner Packaging supports the use of digital watermarks in the designs of various packaging systems: Greiner Packaging employees develop intelligent K3® packaging that makes digital sorting at facilities easier. Crucially, this more precise sorting also improves the quality of the recycled materials. However, it requires corresponding technical innovations at the sorting facilities.

Yet as difficult as implementing this is, how this intelligent digital sorting works is simple: If the plastic packaging ends up at a sorting facility after being used, disposed of and collected, high-resolution cameras detect the digital watermarks of the different types of plastic. The various codes are read and the packaging is automatically sent to the right sorting stream depending on the properties of the product. This ensures that flows of waste are strictly separated by type and ensures high-quality recycled materials, in turn contributing to better efficiency and sustainability in the value chain.

Turning our backs on black waste

Continuing to increase packaging recycling rates requires packaging solutions targeting recyclability that are developed from the start of the product's life onwards. However, the "*design for recycling*" concept is being put to the test primarily for black plastic packaging. This is because the dye used means that optic sensors at the waste sorting plants cannot correctly identify and sort black products.

The carbon black masterbatches cannot be detected under the sorting plant's near infrared module (NIR), which is responsible for ensuring that products are correctly sorted. Accordingly, the plastics cannot be assigned to the right group of waste. To address this shortcoming, together with partners we developed an innovative solution for black plastic packaging that is fully recyclable. Its slogan is "carbon free". The new packaging material uses an alternative black dye that does not contain soot particles and can therefore be detected.

The German Cyclos-HTP Institute, which specializes in the classification, assessment and certification of product recyclability, has already confirmed that the soot-free black dye is effective for plain plastic bottles. Tests conducted by our customer *Henkel* also found that bottles that had been dyed black using this method are fully identifiable after removing the perforated sleeve and can therefore be sorted into the right group of waste and then reused.

For more successful chemicals recycling

There is no change to the chemical structure of the plastics during mechanical recycling. Chemical recycling, by contrast, takes exactly the opposite approach and is therefore an important addition to mechanical recycling. It makes it possible to recycle plastics that cannot yet be recycled or at least not satisfactorily. This includes waste made out of different plastics or that contain impurities and plastics that cannot be efficiently sorted. Chemical recycling helps reduce the share of plastic waste that ends up at landfill or being incinerated. It may also result in new products that meet the highest quality standards.

Research has already been going on for years into chemical recycling processes such as pyrolysis and gasification as potential alternatives to simply burning plastics. These processes are not cost-efficient, which is why there has not yet been a major breakthrough. Given this, our goal is to do everything we can to ensure that chemical recycling does not remain merely a theoretical concept and instead makes its way into practice, allowing this form of recycling to play a part in helping create a functioning circular economy.

Food packaging: Ending the recycling impasse

The devil is in the detail – including and in particular for chemical recycling. The use of recycled materials in new packaging is subject to very strict quality standards and a zero tolerance policy towards material contamination of any kind by the European Food Safety Authority (EFSA). This means that only a very small portion of mechanically recycled waste is suitable for being made into new food packaging material. This applies particularly to heavily contaminated plastic waste.

One alternative for particularly heavily contaminated plastic waste would be to use chemical recycling. Using current technology, however, this is possible only with very high-quality waste. To break this recycling impasse and have the greatest possible impact on sustainability, Greiner Packaging's GPOil project is taking an entirely new approach, starting with waste that is of a very low quality but available cheaply and in large quantities around the world. From this material, which has not yet been recyclable, and which is generally incinerated in cement or waste processing plants, we are attempting to produce food-grade material, i.e. high-quality raw material which can be reused for food packaging. Together with partners in the Upper Austrian consortium for raw material procurement and processing, we are currently developing the necessary production and processing technology. The objective of this innovation is to cover our annual recycled materials requirements of more than 20,000 tonnes, thus making another decisive step in the direction of the circular economy.

From foam into oil, gas, coke and electrical power

Chemical recycling of foam compounds for mattresses, padding and technical foams is also related to as yet unsolved technical challenges. The general difficulty is that polyurethane (PUR), the starting material for foams, is very difficult to melt and to break down into its initial components. Various PUR mixtures and organic impurities resulting from use make chemical recycling more difficult. However, together with our partner institute at Trier University, we have made progress in developing a process for hydrothermal carbonization (HTC) on a laboratory scale. Further development projects in the chemical recycling area are ongoing. After all, in HTC, particles similar to coal are formed, which are well suited as starting material for thermochemical conversion processing (pyrolysis). For the pyrolysis oil as well as the pyrolysis coke and gas gained in this way, there would be application possibilities in the petrochemical and industry (tires, rubber production, pigment pastes), in the form of activated carbon or in generating electricity using gas engines. Here too we will establish further development steps over the next few years, ensuing, together with our partners, that chemical recycling of foams is a markable and sustainable disposal option.

Asa Kelly (Greiner Bio-One)
Quality Control Technician

CHASE – research cooperation for more recycling quality

New sustainable business requires new thinking and research in different sustainability categories. Here research cooperations between industry and science are becoming increasingly important. This is particularly true in respect to chemical recycling. In Austria, the so-called COMET centers promote such research cooperation. In 2019, the CHASE competence center was opened, with Greiner as a cooperation partner. The research focus at CHASE is the need the chemical industry has to develop more agile, more flexible and more synergistic production methods, while at the same time reducing its carbon footprint, energy consumption and waste production. Currently CHASE is examining how high-quality recycled materials can be gained, despite a wide range of different plastic products, materials and processes. CHASE is collecting data knowledge along the entire process chain, so as to allow a holistic quality control. For Greiner, the results from this research mean that flawless products can be manufactured, also independently of the quality of the recycled materials.

The end to the throw-away mentality – worldwide!

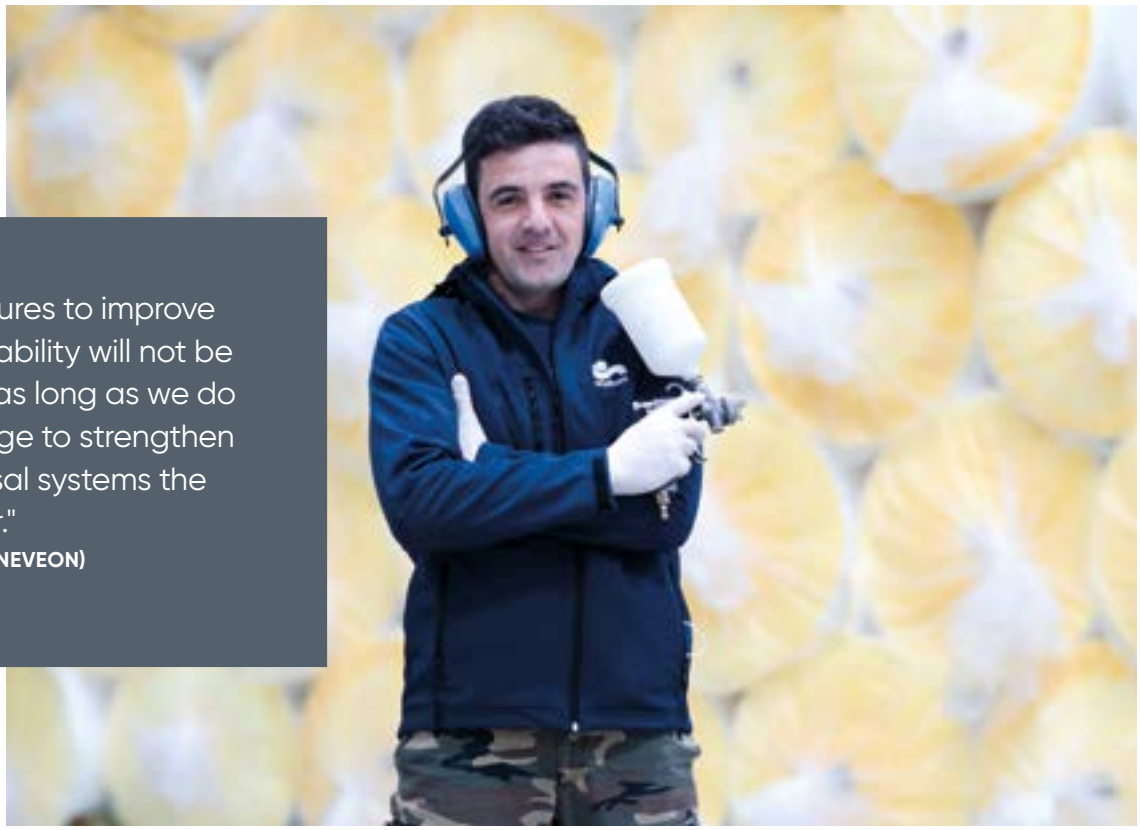
We can, must and will continue working to improve our products, thus ensuring that these can be integrated into the circular economy. Here lower material consumption and the selection of the most sustainable material also have an important role to play. Not infrequently product complexity prevents recycling and thus the chance of integrating materials into the circular economy. Key factors for solving this problem are design and material reduction, but more is needed. As early as 2016, the authors of the Rethinking the Future of Plastics report published by the *Ellen MacArthur Foundation* showed clearly that any drastic reduction of the leakage in oceans requires joint efforts along three axes:

- Improving after-use infrastructure in high-leakage countries,
- Increasing the economic attractiveness of keeping materials in the system and
- Reducing the negative impact of plastic packaging when it does escape collection.

The report continues: "Creating an effective after-use plastics economy is the cornerstone of the *New Plastics Economy* and its first priority. Not only is it crucial to capture more material value and increase resource productivity, it also provides a direct economic incentive to avoid leakage into natural systems and will help enable the transition to renewably sourced feedstock by reducing the scale of the transition."

An end to the pollution of the environment and the oceans will take place only when we create an infrastructure for waste disposal across the world, making sure it does not get there in the first place. The WWF, a non-government organization, confirms this view: the largest problem with plastic waste is in the countries in which there is no controlled waste collection. A key focus here is the Southeast Asian countries. Here all too frequently the waste is collected, separated or recycled without control. Via rivers and unsecured dumps, a stream of plastic waste flows into the oceans. According to scientific estimates, the lion's share of the plastic released into the oceans comes from regions close to the coast; however up to 20 percent flows into the oceans via rivers. Leipziger Helmholtz Center for Environmental Research researchers have calculated which water routes carry the most plastic debris into the sea. The result: eight of the ten river systems with the highest plastic loads are in Asia.

Rivers with high level of plastics



"Our measures to improve the recyclability will not be sufficient as long as we do not manage to strengthen the disposal systems the world over."
Adrian Baciu (NEVEON)
Stock Keeper

Furthermore, the global export of plastic waste, predominately from Western countries, exerts additional pressure on countries with inadequate disposal infrastructures. It is true that the waste exports from the European Union are prohibited to countries in the southern hemisphere, but this applies only to unsorted plastic waste. After all, this mixture of waste is virtually impossible to recycle. However, sorted waste not classified as hazardous waste, can still be exported anywhere, i.e. also to countries with a poorly structured waste disposal system. The only condition is both the exporting and importing country must approve the shipment. However, as most countries are already facing enormous challenges with their own plastic waste, we at Greiner advocate the disposal of waste at the point of origin and the reduction of waste exports to other countries. Each country should be responsible for disposing its own waste.

Companies demand UN Treaty on Plastic Pollution

In the fight against plastic waste in the environment, establishing a global disposal infrastructure is essential. For this reason, together with 28 international companies, in 2020 we demanded that the member states of the United Nations establish a global agreement to address plastic pollution of the environment (Business Call for a UN Treaty on Plastic Pollution). Each year over eleven million tonnes of plastic flow into the environment. This problem will be amplified if we do not radically rethink the way we produce, use, reuse and dispose of plastic. In the manifesto, the signatory companies demand that the UN member states initiate a global treaty on plastic pollution. The call accents four critical areas of action:

- Harmonized regulatory standards for plastics
- Development of national targets and action plans for plastic waste
- Support innovation for plastics
- Infrastructure development for disposal of plastic waste

The call of the companies was to have take place in the run up to the Fifth session of the United Nations Environment Assembly. This was originally scheduled for the spring of 2021, but had to be put back due to the pandemic. Our demand remains – to do justice to the dimensions of this problem, an international treaty is needed. But what are we doing as a company to support establishing a disposal infrastructure in those countries which do not yet have the relevant facilities? As a globally operating company, we asked ourself this question. With our answers, we place the focus of our support precisely on the countries and regions which are impacted particularly by the issues.

The name says it all: *Alliance to End Plastic Waste*

Establishing a disposal infrastructure is not one of our core competences. In this matter, it would be presumptuous to act alone and independently. What is more, we are convinced that to combat plastics in the environment – particularly in the southern hemisphere without an existing infrastructure – a broadly based alliance is what is needed: governments and municipalities, NGOs, grass roots organizations, international players, and science must work together to successfully confront the problem. For this reason, in 2020, we joined the international non-profit organization *Alliance to End Plastic Waste*. Our common objective is to find permanent and sustainable solutions to prevent plastics becoming waste.

At the beginning of 2021, the *Alliance*, which is based in Singapore, had 57 member companies and *Alliance* partners across the entire plastic value chain, which together want to remove the plastic waste problem from the world. In the context of programs and partnerships, the *Alliance* focuses on solutions in the strategic areas of infrastructure, innovation, education, engagement as well as cleaning up work.

Infrastructure, innovation & education

"Greiner Packaging has been driving innovation in sustainable packaging, through initiatives to *design for recycling*, reducing plastic use, and adopting alternative materials," declared Manfred Stanek, CEO at Greiner Packaging on the motivation for joining the *Alliance to End Plastic Waste*. As a member company, Greiner makes a commitment to provide resources, expertise and investments for the *Alliance*. Stanek emphasizes: "We are confident that our new partnership with the *Alliance* will help us to bring these efforts to greater heights and make a difference to the future of packaging." Greiner's membership is also a further step in implementing our Blue Plan sustainability strategy.

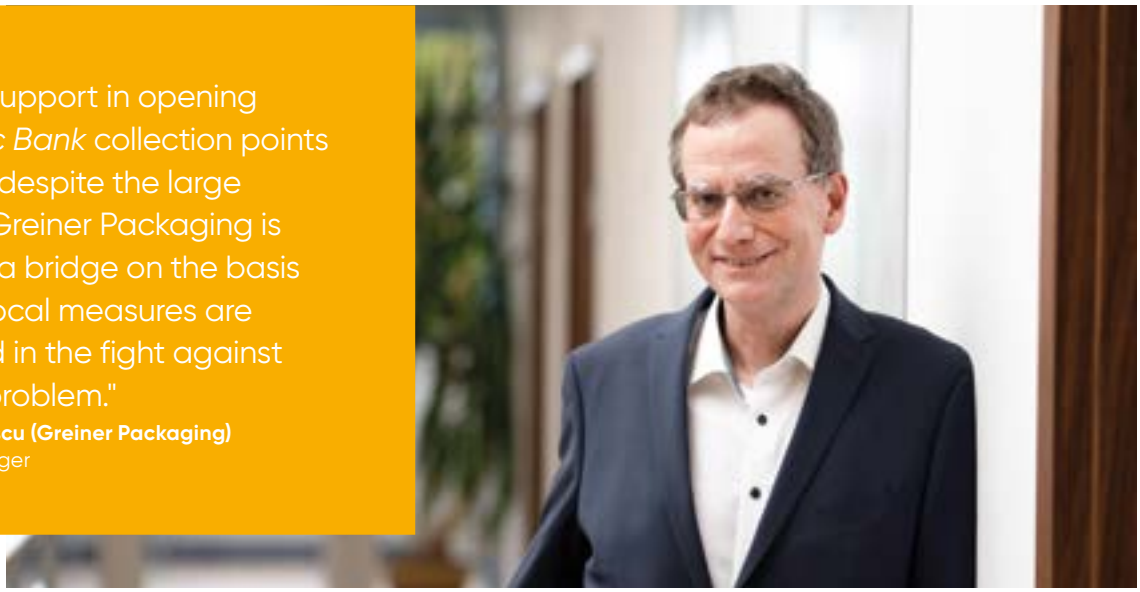
Jacob Duer, President and CEO of the *Alliance to End Plastic Waste* commented positively and with optimism on Greiner joining: "This addition expands our global footprint and is set to bring us closer to our 2025 vision to divert millions of tons of plastic waste in more than 100 at-risk cities across the globe, improve livelihoods for millions, and contribute to a circular economy." The *Alliance* places the accent of its work on supporting cities and communities in developing sustainable disposal systems catering to different social and geographical circumstances. The projects and programs concentrate on cities in Africa, Latin America and Asia. Two *Zero Plastic Waste Cities* projects are currently being implemented in two cities particularly impacted by plastic waste – Puducherry on the Indian south-eastern coast and Tan An am in the Vietnamese Mekong delta.

There is a need for better waste disposal systems

A second focus of the *Alliance* activities is developing innovations at the earliest product design stages, making it easier to reduce and recycle plastic. Currently the *Alliance* is acting primarily as a networker, combining innovative corporations across the whole world with project partners and supporters at political, business, scientific and society level. The objective of these networking activities is to bundle the necessary business and specialist expertise with the required resources so as to implement solutions to contain and prevent plastic waste in large quantities and promote the circular economy.

"With our support in opening five *Plastic Bank* collection points in Manila, despite the large distance Greiner Packaging is spanning a bridge on the basis of which local measures are supported in the fight against a global problem."

Adrian Paunescu (Greiner Packaging)
General Manager



Moving plastic from waste to worth

The fight against pollution of the environment, rivers and oceans is also the focus of our partnership with the social company *Plastic Bank*. Responsible action, social and sustainable commitment knows no boundaries and can bridge even the furthest distances. As the crow might fly, it is 10,010 kilometers between the Greiner headquarters in Kremsmünster and Manila. With our support in opening five *Plastic Bank* collection points in Manila, Greiner Packaging established a bridge despite the large distance, on the basis of which local measures can be supported to fight against a global problem.

Plastic Bank is a company building ethical recycling ecosystems in coastal communities and reprocessing the materials for reintroduction into the global manufacturing supply chain. All material collected is upgraded to Social Plastic by using it to produce new products and packaging. At the same time, the flood of plastic waste is reduced, recycling and the circular economy promoted and income for plastic collectors created. For the materials they collect, they receive a premium to cover basic family necessities such as groceries, fuel, school tuition, and health insurance. "We have to understand that it is not only about us, but is a problem for the whole of humankind," says Gidget Velez, Country Manager of *Plastic Bank* in the Philippines, at a meeting with Greiner managers in Manila. "As far as I am aware, Greiner is the first company processing plastics providing support to *Plastic Bank*," he comments, thanking us as a cooperation partner: "Greiner believed us when no one else did."

Greiner Packaging supports *Plastic Bank* where it is most needed. After China and Indonesia, the Philippines are classified as the world's third-largest plastic polluter. Every year, an estimated two million tonnes of Philippine plastic lands in the ocean; only the River Pasig, which divides Manila into two parts, carries approximately 64,000 tonnes of plastic waste into the South China Sea each year. When Greiner was looking for a project partner in the fight against plastic waste in 2019, *Plastic Bank* moved quickly into the focus. The double-pronged strategy of preventing plastic from getting into the ocean and helping people out of poverty was decisive in reaching a decision. What is more, *Plastic Bank* visibly upgrades the value of plastic: Collectors no longer regard plastic as waste, but as a valuable resource. An important step to contain plastic pollution in the oceans.

By providing the collectors more income and thus educational opportunities, *Plastic Bank* allows groups of the population at the edges of society to build up a better future. *Plastic Bank* manager Gidget Velez describes the goal of her work: "We want to help people feel stronger. We want to give them hope." *Plastic Bank* is successful in doing this, not only in the Philippines, but now also in Haiti, Indonesia, Brazil and Egypt. For Michael Frick, Global Key Account Director at Greiner Packaging, this project shows how a circular system can actually work: "Poverty is tackled by collecting plastic waste, while at the same time the environment is cleaned up and a major contribution made to the circular economy. The collectors bring the plastic. It is then sorted and subsequently processed into granulate. This is then sold to a manufacturing company which wants to use recycled materials for its products or packaging." Greiner and the representatives of *Plastic Bank* are well aware how serious the situation is, says Theresa Wieser, Marketing Manager at Greiner Packaging when opening one of the collection points: "We have committed to support the communities in the fight against plastic waste on a local basis. In the period spanning only May 2019 to February 2020, a total of 175 tonnes of plastic was fished out of the sea, exceeding expectations in absolute terms."