



# Connecting for impact

**Sustainability Report 2020**

**Teijin Aramid**





**General**

**External**

**Internal**

**Impact cases**





Introduction // Peter ter Horst, CEO Teijin Aramid

## The future for sustainability is exciting

**Our strategy and all aspects of our operations are built around advancing a fully sustainable and circular aramid chain and the safety and well-being of our people**

Looking back at 2020, the word that resonates the most is Impact. The impact we have on our planet, our people, and our customers. We strongly believe in transparency and strive to transform negative effects into positive change. We even upgraded our ambition: we used to want 'to be the best high-performance fiber company in the world' and raised the bar 'to be the best high-performance fiber company for the world'. The adjusted credo comes with even more responsibility, and we are happy to share our impact stories on the progress we are making in multiple fields.

Over the past few years, we have put the foundations in place to meet our targets. In 2020, we finalized our energy-efficiency program 2017–2020 and made progress with our energy transition plans. As part of our transition to greener raw materials, we completed an innovative pilot to explore the use of biobased feedstocks and also began to formalize a program to develop an extended technology toolbox to recover aramids from end-of-life applications. We now have a technology toolbox that includes advanced methods to recycle used aramids back into production and create new feedstocks.

Scroll down to  
read more





**“In our spirit of collaboration, we are working side by side with our partners on a journey toward a fully sustainable and circular aramid chain.”**

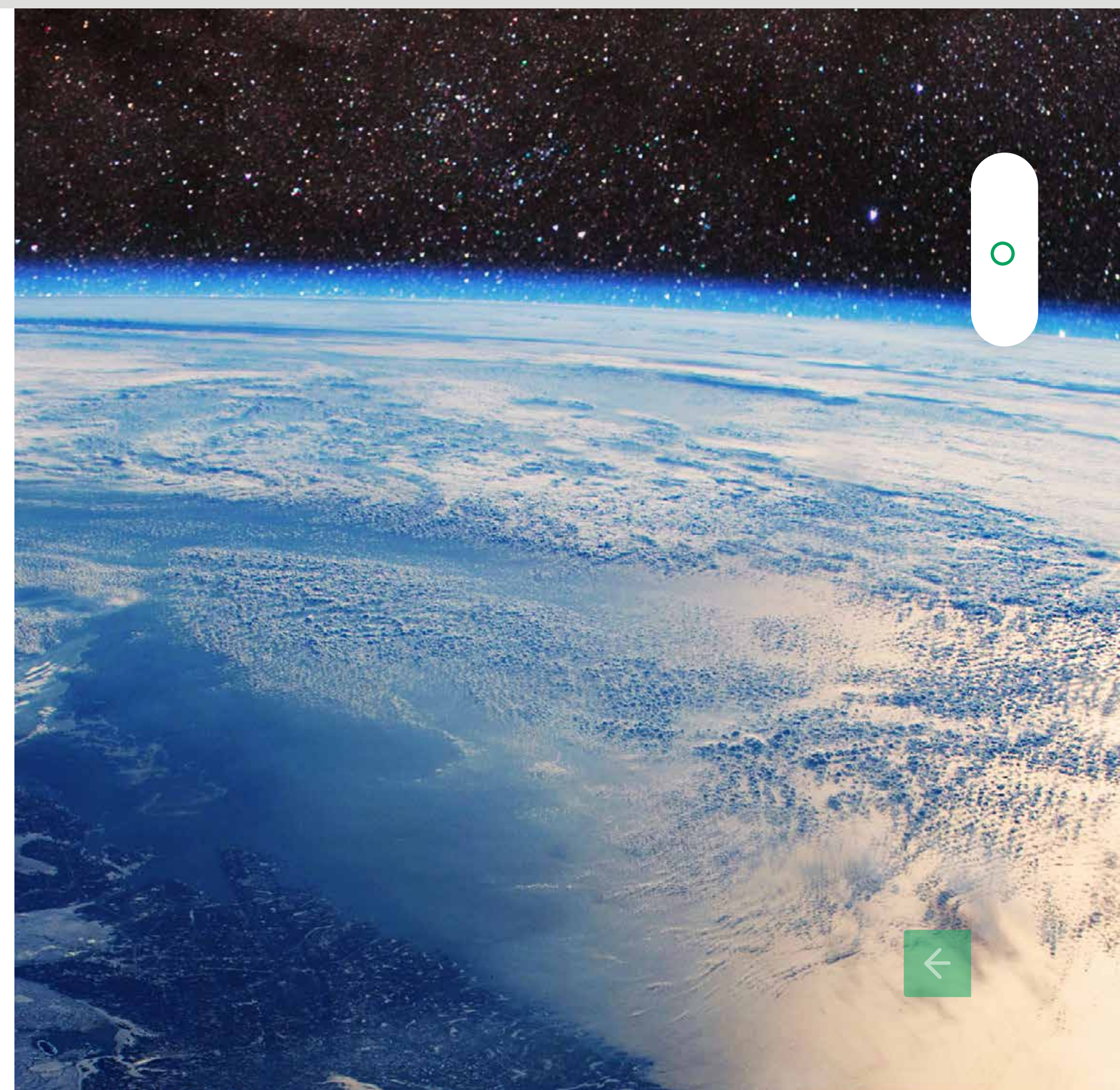
### **Together, we have the most impact**

We are now in a strong position to take the next steps in our sustainability ambitions. However, more than anything, our success will be driven by collaboration and open innovation. In 2021 and beyond, we remain committed to working with like-minded partners to maximize our positive impact. This will involve intensifying the cooperation with our traditional and new suppliers and customers to harness the unique contributions of knowledge institutes, research specialists, and other value chain partners. By pooling our knowledge and expertise, we can accelerate sustainable technologies and ways of working. We invite new partners to join us. Together, we can help safeguard our planet for future generations.

There is no doubt that 2020 will go down in history as a very challenging year. I could not be prouder of our colleagues across the globe for their commitment to our customers and to each other. During the pandemic we quietly moved into our new global headquarters. Unfortunately, we have not yet been able to celebrate this embodiment of our approach to sustainability and circularity. We believe it will be a happy place in which we can build partnerships and magnify our positive impact in the value chain and for the environment.

**We hope you enjoy reading about how we take sustainability seriously. More information on how Teijin supports the Sustainable Development Goals can be found in the [▶ annual Integrated Report](#).**

Scroll down to  
read more







**8%**  
energy savings from our Energy Efficiency Plan (EEP) in our manufacturing processes and chain measures (EEP period 2017–2020).




**13%**  
less recycled material used for pulp production compared to 2019, caused by limited availability of used aramids.




**1264**  
people on Teijin Aramid's total payroll in 2020.




**6.2%**  
Total Recordable Rate (TRR) of incidents (number of incidents per 1 million working hours) in 2020. Unfortunately, we registered four Lost-Time Injury incidents in 2020.




**11%**  
decrease in direct CO<sub>2</sub> emissions (scope 1) compared to 2019.




**16.4%**  
decrease in absolute water consumption compared to 2019.



**6.9%**  
illness rate in 2020.



**28%**  
Twaron® improved carbon footprint compared to 2014.



**255,600 tons CO<sub>2</sub>**

**Avoided emissions in the chain**

The use of aramids in applications such as tires and conveyor belts makes these applications considerably lighter, consequently saving energy and other resources. This has resulted in avoided emission of more than 255,600 tons of CO<sub>2</sub> equivalent in 2020.





Roadmap

# The road ahead for sustainability

**At Teijin Aramid, we recognize the critical challenges facing our planet. We feel that we need to do our utmost to help solve these issues. In the past, our aim has been to be the best high-performance fiber producer in the world.**

Now, our ambition is to be the best high-performance fiber company for the world. We have set clear sustainability targets through which we want to create positive impact in our industries and in society at large. Our dot on the horizon is a fully sustainable and circular aramid chain with a finite use of resources based on 100% renewable electricity and 50% renewable heat in 2030. In this report, we describe the steps we took toward these goals in the production of aramids in the Netherlands in 2020, focusing both on our own processes and on our impact in the chain.

We feel responsible for both our own impact – the environmental effects of our production facilities – and how our aramid-based products influence the wider value chain. The biggest contributors to our carbon footprint are our energy consumption and raw materials intake. This makes our transition to renewable energy and more sustainable feedstock a priority. Not only will improving in these areas help reduce the environmental impact of our plants, it will also significantly increase our already sizeable positive impact in the wider value chain. Any reduction in carbon and energy emissions at our production locations is multiplied four to five times further along the value chain.

Scroll down to  
read more

## Let's connect

We would very much like to receive your feedback on our approach and results, so that we can make further improvements next year. Please send us your views, comments, or observations by submitting the online form on our website ([www.teijinaramid.com](http://www.teijinaramid.com)) or by emailing [information@teijinaramid.com](mailto:information@teijinaramid.com). All feedback is greatly appreciated.





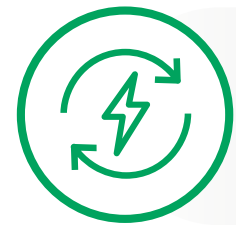
# Our sustainability roadmap

Our purpose is to create materials that are produced in a sustainable manner and that enable our partners to go beyond performance and realize a sustainable future. We know that we cannot achieve this goal alone. So, in the spirit of collaboration, we are working side by side with partners in the journey to a fully circular aramid chain. For our customers, the goal is to offer them a range of sustainable solutions and circularity concepts. We created this roadmap to show how we combine these elements – purpose, product, partners, and customers – to reach our sustainability goals for Twaron®.

## Our dot on the horizon



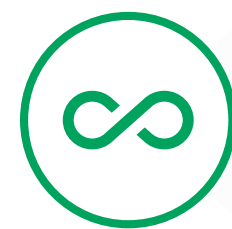
**All our plants run on 100% renewable and clean energy**



**All our plants run as energy efficient as possible**



**We produce aramids based on 100% renewable carbon only**



**Our internal and external loops are fully closed**



**We are a high-performance material & solution provider in the clean hydrogen economy**



**Organizational change & standardization embedded in the organization**

Scroll down to read more

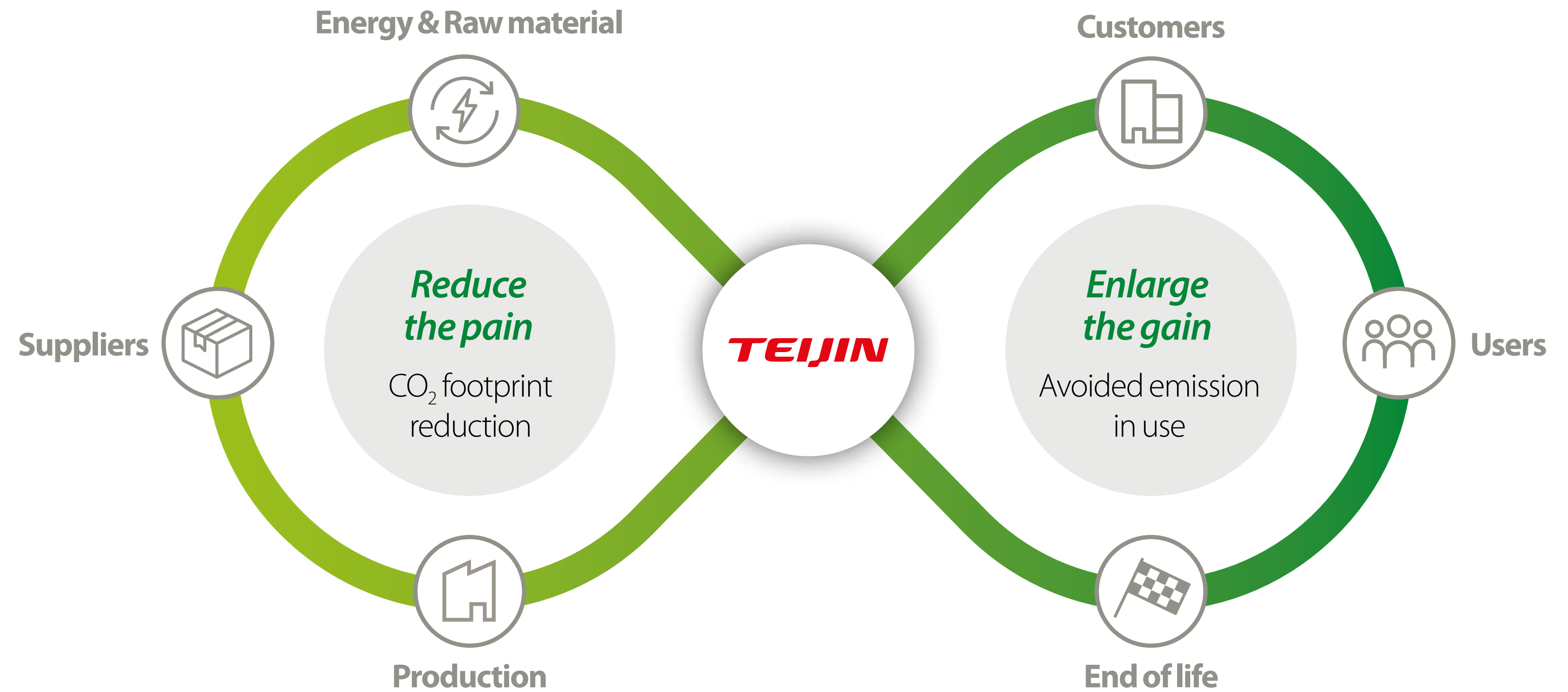
## Sustainability targets Twaron®

	2021	2025	2030
Renewable Electricity	100 %	100 %	100 %
Renewable Heat		40%	50%
Renewable Carbon		10%	25%
Eco Footprint kg CO <sub>2</sub> eq/kg	10	7	6
Avoided CO <sub>2</sub> emissions / Total emissions		50%	100%



**Value chain**

When it comes to sustainability, we are in a unique position to impact the value chain. We do this in three ways. First, by reducing the CO<sub>2</sub> footprint of our front-end processes. Second, by avoiding emissions in the use phase of our products. Third, by working hard to close the aramid chain and find end-of-life solutions that reintroduce aramids into production as a raw material.



## Towards a fully circular chain



Energy

# Ambitious on energy

**Our energy consumption is a significant portion of our carbon footprint. Optimizing the use of energy at our production locations is therefore a critical part of our sustainability strategy. There are two main pillars to our energy approach:**

1. Increasing efficiency to minimize our energy needs.
2. Transitioning to cleaner and renewable energy sources. We have set a clear target to run our operations on 100% renewable and clean energy by 2050 and to manage our production facilities as efficiently as possible.

[▶ See our roadmap](#)

[Click here to learn more about](#)



[Click here to learn more about](#)





## Energy efficiency

# How we are becoming a more energy-efficient business

Using our energy efficiently has long been a priority at Teijin Aramid. Since 2009, we have committed to the Dutch government's 'Convenant Meerjarenspraak Energie-efficiëntie' (Multi-Year Energy Efficiency Agreement: MJA3), which we have translated into a series of four-year Energy Efficiency Plans (EEPs).

In 2020, we concluded our third and most recent EEP for the 2017–2020 period. The steps taken by each of our production locations during this period, as well as by our research facility, contributed to total average energy savings of almost 8%, including both process and so-called chain measures.

At Delfzijl, we achieved significant reductions by optimizing the operation of one of the columns in the recovery plant and by [de-bottlenecking one of the reactors](#). At Emmen, we introduced more efficient production technologies at several spinning lines as well as more energy-efficient pumps. At our production location in Arnhem, we [redesigned our drying oven to reduce our natural gas consumption](#) and replaced part of our lighting system with more efficient LED lighting. Air treatment units have been optimized across our research facilities, where we have replaced water-cooled compressors with air-cooled alternatives.

[Click here to learn more about](#)



Scroll down to  
read more





## Energy efficiency

In addition to the energy savings achieved at our facilities, part of our overall energy reduction is realized through the positive impact of our aramids in the chain, for example by the application of lighter Twaron® in conveyor belts. We call these 'chain measures'. From 2017 to 2020, we achieved the following overall energy savings, compared with our 2015 reference year.

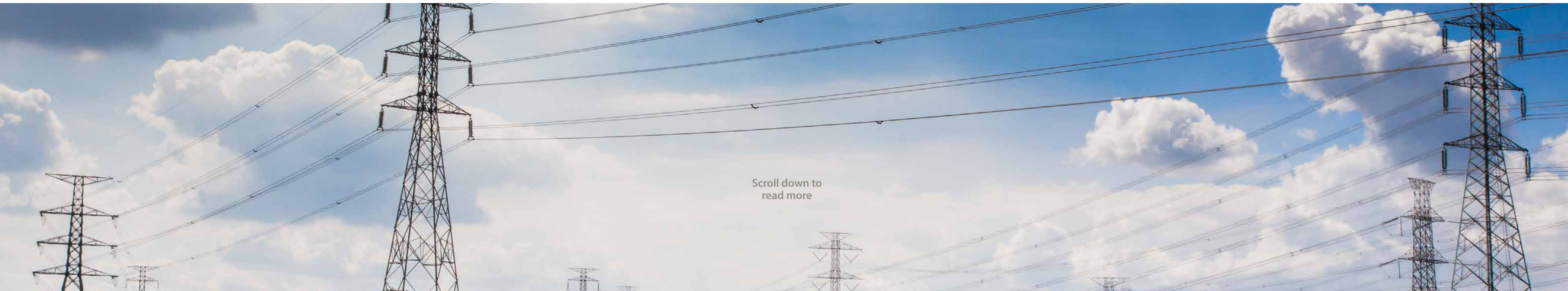
Reductions in energy usage 2017–2020	% (ref. 2015)
Location Delfzijl	7.7 %
Location Emmen	8.3 %
Location Arnhem/Kleefse Waard	3.4 %
Research and Innovation Center	9.9 %
Chain measures: Conveyor belts	5.7 %

### Impact ahead: energy-reduction measures for 2021–2024

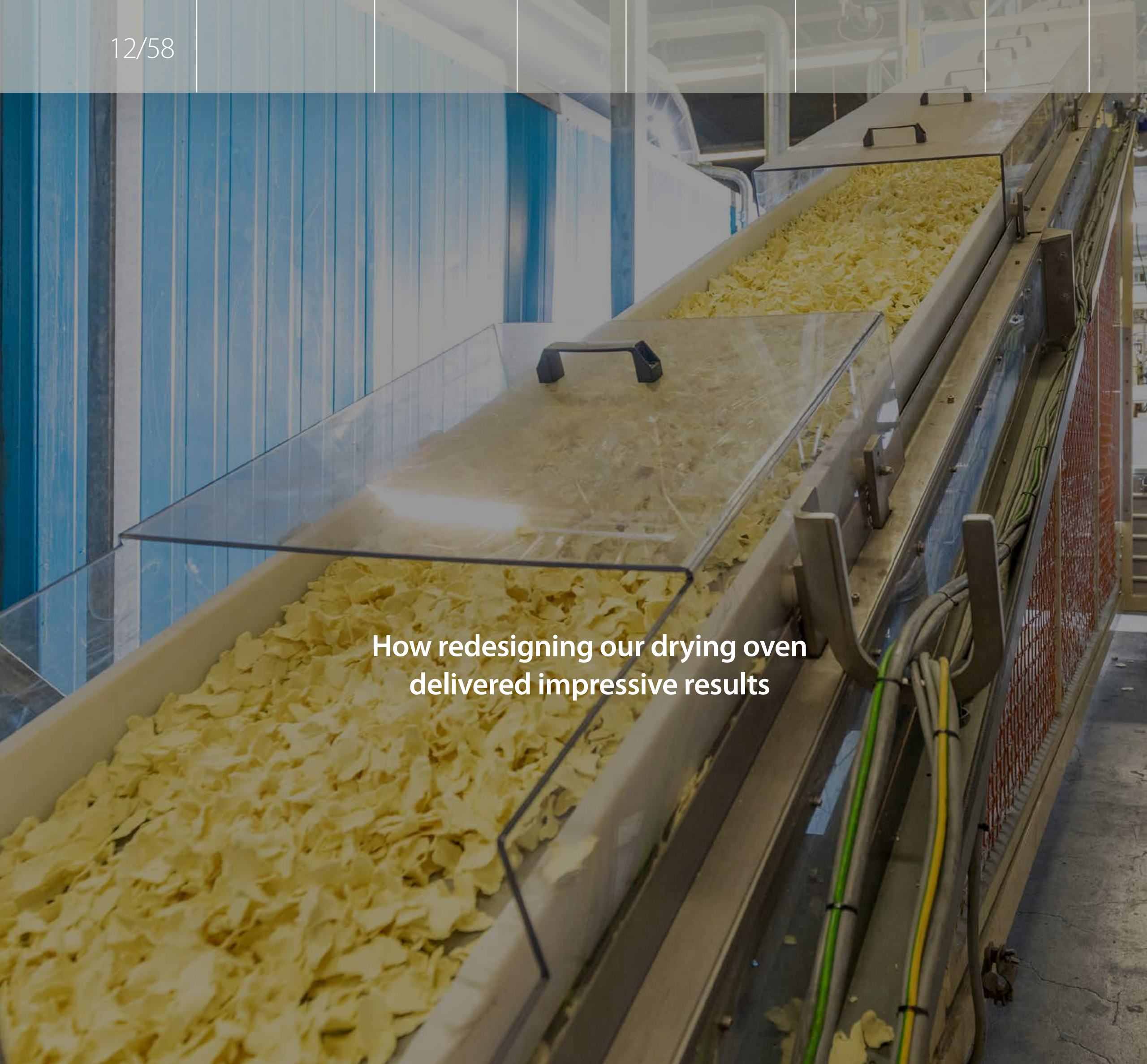
By concluding the 2017–2020 EEP period, we brought our EEP to a close. As of 2021, the EEPs will be replaced by so-called EED (European Energy-efficiency Directive) plans. Despite a new name and approach, the principle remains the same: under the EED, large EU organizations are required to complete energy audits every four years. The aim of the directive is to help companies and institutions better understand their energy consumption and identify opportunities to save energy and become more sustainable.

In 2020, we worked hard to develop a new EEP for 2021–2024 in line with the EED. However, achieving incremental energy savings is increasingly difficult. Many of the more easily implemented energy-reduction measures have already been introduced and new energy-efficiency projects require a more integrated approach. Despite the challenges, we have successfully submitted our new EED plans to the Dutch government: we aim to realize a 7.7% (weighted average) energy reduction of over the next four years compared to 2019. This EED plan includes the production sites Delfzijl, Emmen, and Kleefse Waard, our research center, and our offices in Amsterdam, Arnhem, and Venlo.

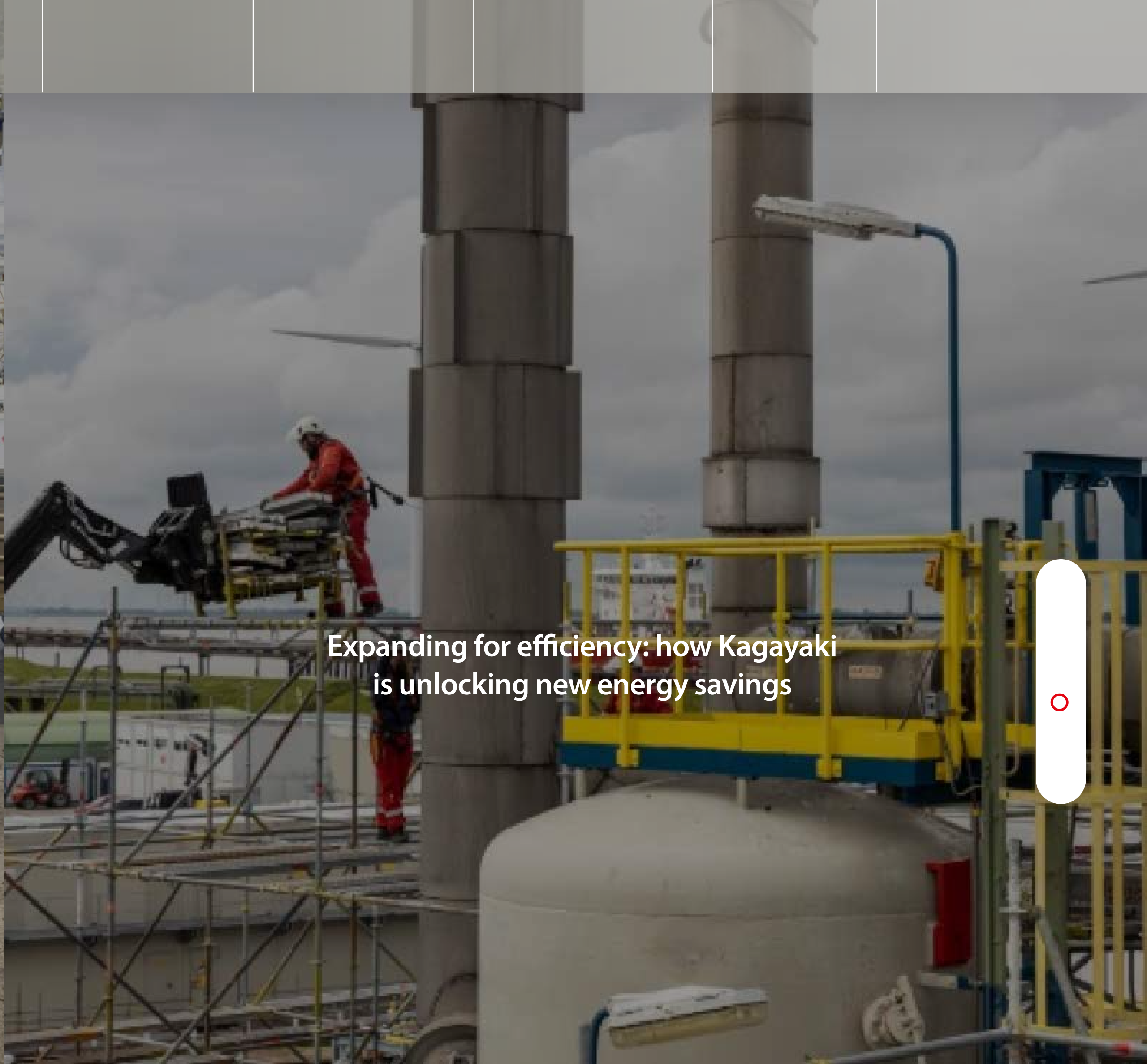
Scroll down to  
read more



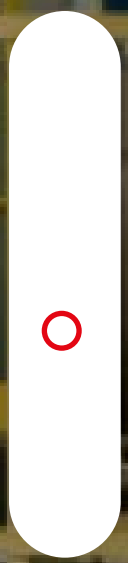




How redesigning our drying oven delivered impressive results



Expanding for efficiency: how Kagayaki is unlocking new energy savings



Scroll down to read more





Impact case

# Designing for impact: reducing heat loss during drying

**In producing our pulp material at our manufacturing site in Arnhem, an important step is drying our wet pulp fleece. This is an essential but energy-intensive step of the pulp production process. As part of our most recent Energy Efficiency Plan (EEP), we redesigned the drying oven at our Arnhem production facility to reduce our natural gas consumption. The original design of the oven consisted of two separate parts. Wet pulp flakes were heated to temperatures of about 230°C in the first section and transferred over a very short distance in open air to the second section of the oven. A significant amount of heat was lost during this process. The redesign aimed to connect both parts of the oven and to re-insulate the oven from scratch.**

## Surpassing our reduction targets

At the start of the project, we were aiming for a 14.6% reduction in our natural gas consumption at our Arnhem facility. After finalizing the project, when restarting the oven, we discovered that we were not meeting the target. Re-adjusting the burner settings of the redesigned furnace was more difficult than anticipated. Although we only achieved a 9.4% saving in 2020, we see this as an essential learning process for further improvements. With further adjustments being implemented, the results look promising. We expect to achieve a 22% total reduction in our natural gas usage in 2021 compared to the consumption before the closure, surpassing our original target by about one-third.

## A great team effort

This project is the result of close collaboration between Teijin Aramid's maintenance, technology, and research teams. Together, they were able to ensure the new furnace meets all required regulations while supporting the ambitions of the EEP program. They also took a more holistic approach by looking at the wider impact of the re-insulation and design. As well as helping to reduce our energy footprint, the project has unlocked other benefits for the Arnhem facility. In particular, the redesigned furnace has better accessibility, making it easier and safer to maintain it and clean it. All in all, a great team effort.





Impact case

# Expanding for efficiency: how Kagayaki is unlocking new energy savings

**Our production locations in Emmen and Delfzijl are undergoing a significant expansion of their production installations to boost their long-term capacity. Known as 'Kagayaki', this project will ensure these key facilities are equipped to meet future market developments and keep up with growing demand. It also creates new possibilities for energy savings that would be difficult to achieve in the existing operation.**

## Embedding energy efficiency in our plans

The installation of new equipment gives us a short window to introduce more energy-efficient technologies. However, this is a complex process as energy-saving technologies are constantly evolving. Much of the engineering work for a project of this size and complexity was already completed at an earlier stage, but introducing new insights can still be done as long as it matches the existing time schedule of the realization of the Kagayaki project

Our research, technology, and engineering teams are working side by side to harness these new advancements in a way that aligns with the expansion. This teamwork is bearing fruit: we have succeeded in implementing a far more efficient dissolving process in Emmen. And in Delfzijl we have successfully introduced new and more efficient technology in a crystallizer.

We are in close communication with external engineering and technology partners working with us on the expansion project. Their experience will also help in defining new technologies. Going forward, our collaborations will help ensure energy efficiency remains a central focus as we continue to develop our locations.





Energy transition

# Transitioning to renewable energy

Transitioning to clean and renewable energy is the second pillar of our energy approach (next to energy efficiency) and a key priority for all our locations. By 2050, we want to run on 100% renewable and clean energy.

Our energy transition plans focus on our main energy carriers and how we can change our installations to run on renewable energy. We have set the following targets:

- Electricity** 100% renewable electricity in 2021 and beyond
- Heat** 40% renewable heat in 2025, 50% in 2030 and 100% in 2050

We are working closely with energy suppliers on switching to wind and solar power. Sourcing sustainable heat is another focus point – and one that requires us to take a close look at our own installations. We first need to determine whether we need to adapt our current technologies for the use of renewable energy. A major challenge we face is the use of high-temperature heating. For example, can we change to other, more renewable energy sources for our drying and evaporation section? Can we reuse excess heat in a more efficient way? To begin the planning process for these projects, we are working on the energy transition plan and are including the steps we need to take toward our clean-energy transition.

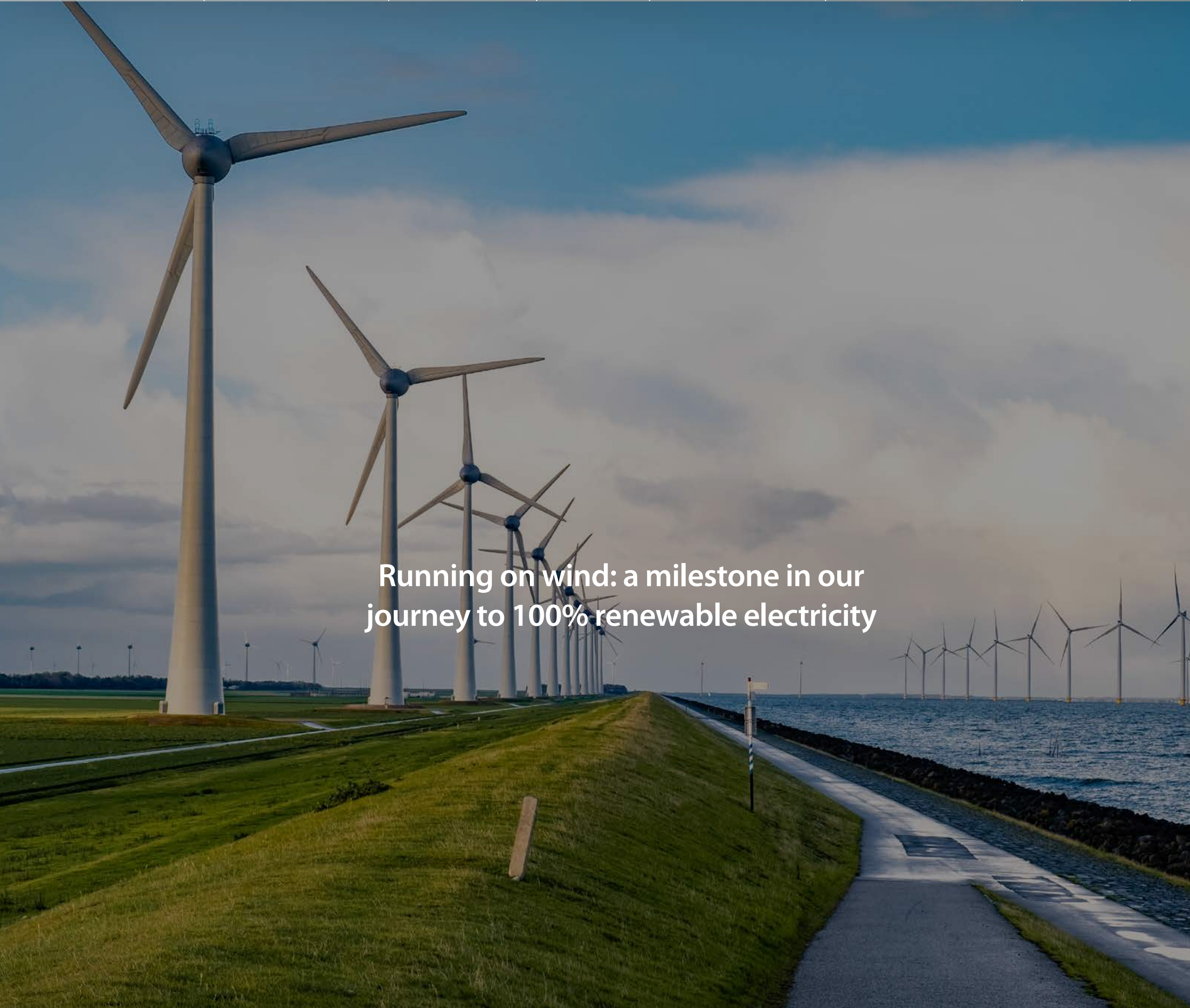
[Click here to learn more about](#)



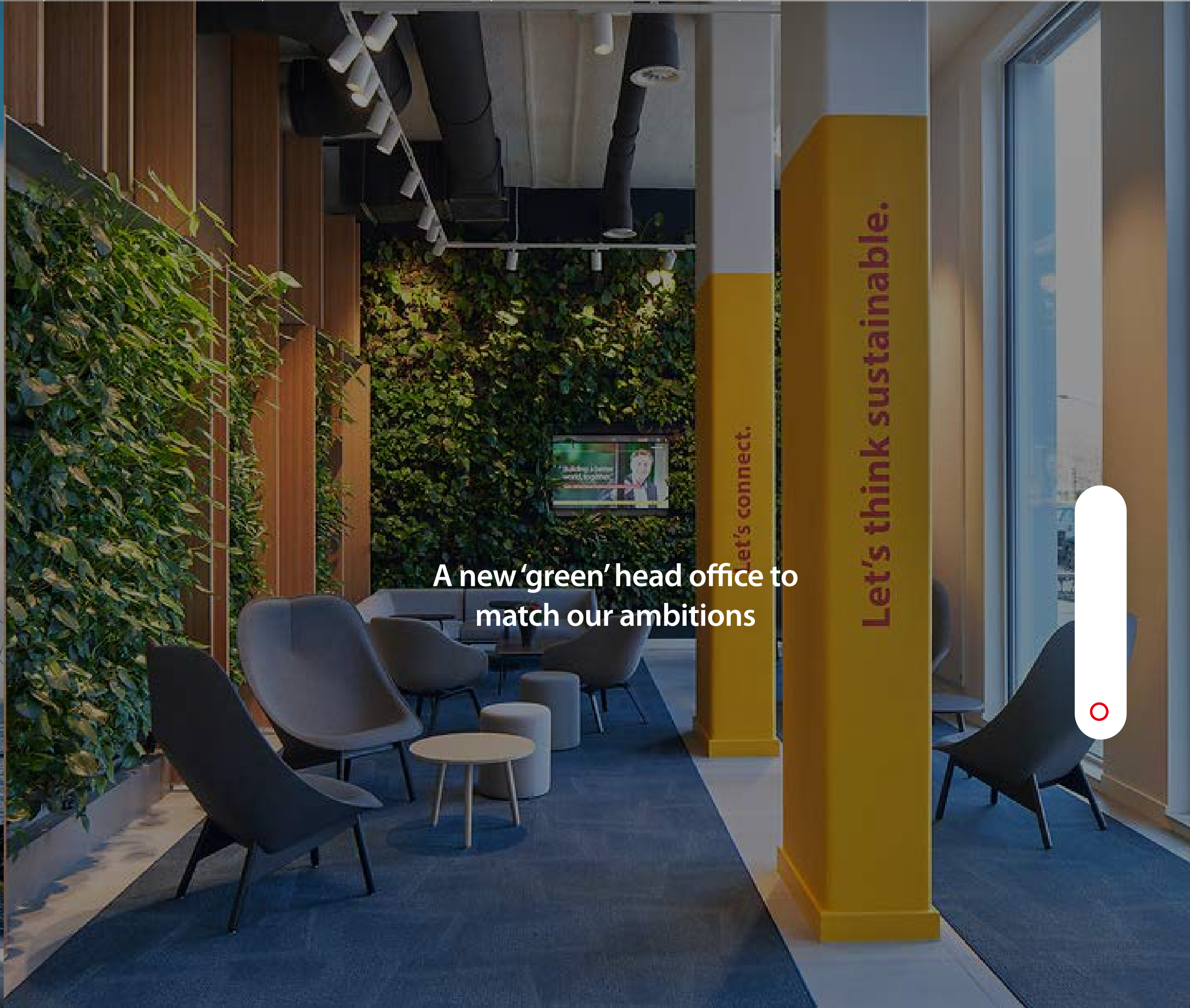
Scroll down to read more







Running on wind: a milestone in our journey to 100% renewable electricity



A new 'green' head office to match our ambitions



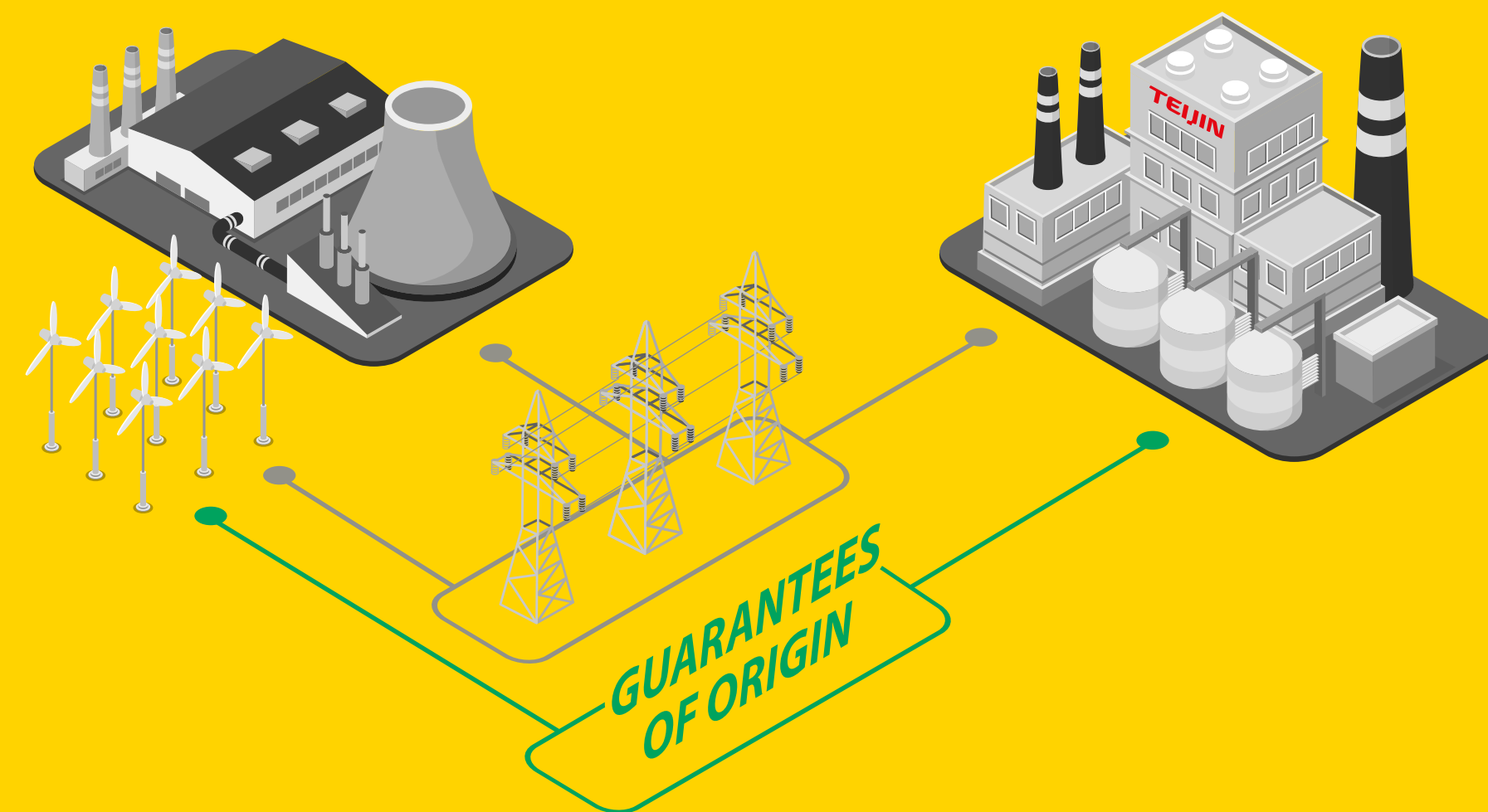
Impact case

# Running on wind: a milestone in our journey to 100% renewable electricity

**In 2020, we executed the first stage of our energy transition program: we purchased Guarantees of Origin (GO) certificates for the total electricity consumption of our manufacturing sites in Emmen, Delfzijl, and Arnhem. Our research facility and headquarters already acquired GOs in recent years. Purchasing GOs ensures the electricity used by all our locations is generated through sustainable means.**

The GO certification scheme is part of the European Energy Certificate System (EECS) and is controlled by the Association of Issuing Bodies (AIB). One GO guarantees that 1,000 kWh electricity has been produced in a sustainable way. As of January 1, 2021, all our production locations are supplied with 100% renewable electricity sourced from European windfarms via GOs.

Together with our electricity and utilities suppliers, we continue to look for improvements and renewable energy sources. We want to discuss with our suppliers how we can work together to further renew the energy we use at our locations. Our priority is to focus on the challenge to generate high-temperature heat with renewable resources.





Impact case

# A new 'green' head office to match our ambitions

**In September 2020, Teijin Aramid moved into its new corporate head office in Arnhem, the Netherlands. The custom-designed building embodies our sustainability and circularity ambitions and provides the perfect base for Teijin Aramid colleagues to pursue our shared goals. The 5,000m2 state-of-the-art office complex sits on the site of a former laboratory and directly opposite our current research building. The building is called T-ONE to reflect its bold ambition.**

## Sustainable to the core

Each part of the T-ONE building is designed with sustainability in mind. Much of the original core of the research building has been reused and carefully rebuilt around our needs. Innovative features like heat pumps take energy from the air to use for heating and cooling, providing a consistent indoor temperature all year round in an energy-efficient way. Solar panels on the T-ONE roof help to generate renewable energy, while the building's façade harnesses state-of-the-art techniques to maximize insulation and prevent heat loss. Water-saving taps,

external sun blinds, and an entrance wall lined with 1,500 plants further contribute to T-ONE's low energy footprint and A+ energy label.

## Encouraging sustainable behavior

The building further serves our ambition by actively encouraging sustainable behavior in employees and visitors. There are charging points for electric cars and e-bikes, there is a restaurant serving locally sourced food, and all floors are equipped with bins to separate waste. A full overview of the building and its features can be seen [here](#).

## Fostering collaboration

As well as reducing our environmental footprint, our new head office provides a welcoming and inspiring space for both employees and visitors to Teijin Aramid. This embodies our approach to sustainability and circularity: it is all about collaboration. By building partnerships with like-minded organizations, we can magnify our positive impact for the value chain and the environment.





# Innovative features



## Heat pumps

As a tenant, Teijin Aramid has chosen to equip the building with various sustainable features. For example, the building is fitted with heat pumps that ensure energy from the air is used for heating. They also make 'low-water temperature heating' and 'high-temperature cooling' possible. This will further reduce CO<sup>2</sup> emissions while ensuring a constant indoor temperature.



## Solar panels

The possible additional power consumption by the heat pumps is compensated by the installation of solar panels on the roof. These solar panels are also a specific investment by tenant Teijin Aramid.



## Energy meters

Another investment in the building are the smart energy meters. These give us clear insight into our consumption and enable us to monitor where additional measures may be taken if necessary.



## Reuse of existing building

Our head office used to be a laboratory. The construction company demolished half of it and used the skeleton of the other half. The architects designed the building to be adaptive: it can be adjusted to any necessary or requested changes in the future. It could even become a laboratory again someday if we wanted.



## Sustainable façade

The façade of the building has been developed using state-of-the-art techniques. This contributes to very high insulation values, resulting in very little heat loss.



## External Sun blinds

External blinds prevent unwanted light from entering the building to create a more pleasant working environment. Effective external sun blinds also ensure that thermal radiation from the sun cannot reach the windows. This results in a reduction of the required cooling load, which allows the energy-consuming cooling system to be designed with a more compact footprint.



## Heat recovery ventilation

We had the building's ventilation designed as a system that uses heat recovery. As a result, we have a pleasant indoor climate in both summer and winter.



## Low-flow watertaps

Simple but effective: water-saving taps are installed throughout the building. These save hundreds of liters of water every year.



## On the charger

We have opted to place 10 charging points for electric cars in the car park. Not enough? We have already prepared for the installation of extra charging points if needed in the future. This way, we hope to further encourage electric driving. We encourage all employees to get on their bikes. If we cycle to work on an e-bike, it means there are enough points to charge our batteries.



## Waste separation

Of course, the demolition of the old building took place carefully, so that usable materials could be reused. The contracting company ensured that reinforcement steel was fished out of the rubble for recycling together with all other steel. And, of course, glass ended up with glass and cardboard with cardboard.





## Environment

# Less is more: improving our environmental impact

Managing our impact on our surroundings in a responsible way is a key aspect of our license to operate. We strive to remain fully compliant with evolving and ever-more complex environmental legislation. At the same time, we look beyond government requirements as we explore different ways to reduce the long-term impact of our activities. Our top-to-bottom approach considers the individual characteristics of our facilities as well as the wider environmental ambitions and targets of the Teijin Group.

### 2020: an evolving environmental landscape

Several new environmental topics entered the national agenda during 2020. Topics such as the so-called PAS crisis (the Dutch government's approach to tackling nitrogen emissions) impacted Dutch industries and society in various ways. Throughout the year, our dedicated environmental experts in Arnhem, Delfzijl, and Emmen met regularly to discuss the effects of these developments and explore their impact. The outcome of these discussions has guided our approach to reviewing our environmental permits.

Scroll down to  
read more





### Permit revisions

In 2020, our manufacturing locations each began the process of revising their (local) environmental permits to reflect the changing scope of our operations in the Netherlands. New permits are needed for Emmen and Delfzijl due to the planned expansion and growth in production at [these facilities](#). At our Arnhem site, we are pursuing a single overarching permit to replace a series of permits issued over the years. The revised permits will also consider changes to environmental regulation in the Netherlands.

### Teijin Group Targets

Complying with national and international legislation is a constant priority at Teijin Aramid. Being part of the Teijin Group, we also comply with the targets set by the Teijin Group. In 2020, Teijin Group set new long-term environmental targets for 2030 (all compared to 2018):

#### Resource recycling (landfill waste)



10%

improvement in 2030

#### Hazardous chemicals emissions



20%

improvement in 2030

#### Water (fresh water intake)



30%

improvement in 2030

### Defining a new approach

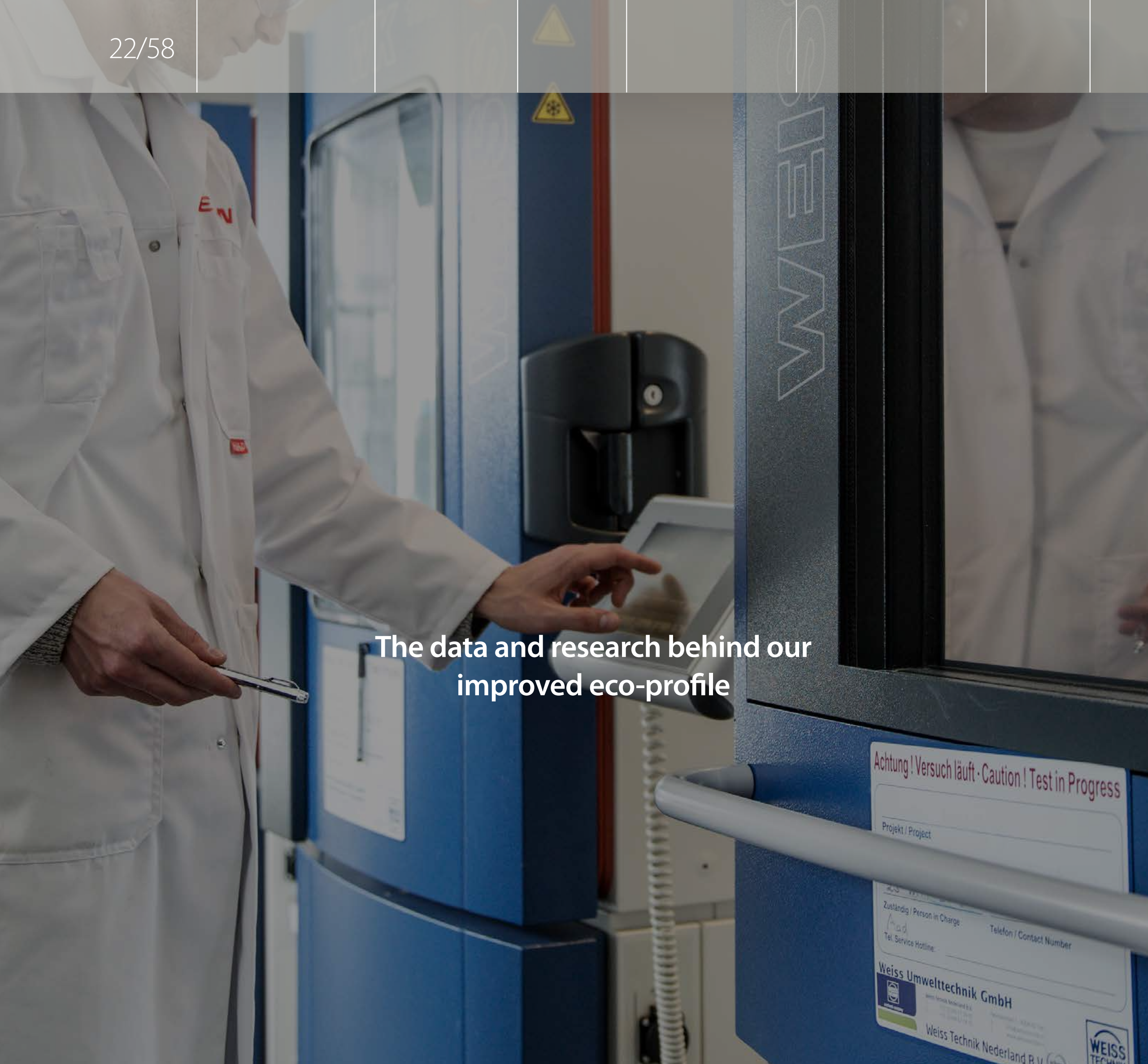
Using Teijin Group targets as a baseline, we aim to go one step further in 2021. By exploring new ways to improve our environmental impact, beyond our focus areas of energy and raw materials, we should be able to create additional impact. This will involve examining the individual environmental characteristics of our facilities in more detail and defining potential areas for improvement. In 2021 we will start with the development of concrete roadmaps to define our overall environmental ambitions and the way forward.

### High environmental score: EcoVadis assessment

For the past six years, we have been assessed by independent ratings platform EcoVadis on four relevant corporate social responsibility [\(CSR\) topics](#) of which 'Environment' is one. We are proud to have secured – and maintained – a very high score (Outstanding: 90%). This important assessment shows we are in a strong position to develop and implement our ambitions regarding environmental performance. We were advised to revisit our Code of Conduct and have committed to align the Code of Conduct to our high ethical standards.

Scroll down to  
read more





The data and research behind our improved eco-profile



How independent assessment by EcoVadis helps us to remain a top sustainable supplier





Impact case

# The data and research behind our improved eco-profile

**A key element of our sustainability approach is to reduce the ecological impact of our own production processes. This begins with understanding the so-called carbon footprint of our products, which we do by performing Life Cycle Analysis (LCA) studies. Our LCA covers the key stages of our production cycle ‘from cradle to factory gate’; the extraction of our feedstocks, the production and transportation of raw materials, and the production of Twaron®.**

### Reducing our Twaron® carbon footprint by 28%

Our most recent LCA in early 2021 showed a 28% improvement in the carbon footprint of Twaron® compared with 2014. This significant reduction is the result of our continued focus on sustainability, and most notably of the energy-efficiency efforts at our factories and the Guarantees of Origin for our electricity consumption to ensure that our production sites run on 100% renewable electricity. The outcome of the LCA study has been peer-reviewed in accordance with International Organization for Standardization (ISO) standards 14040 and 14044 and is presented in the table on this page.

### Improved eco-profile of Twaron® (scope: cradle to factory gate)

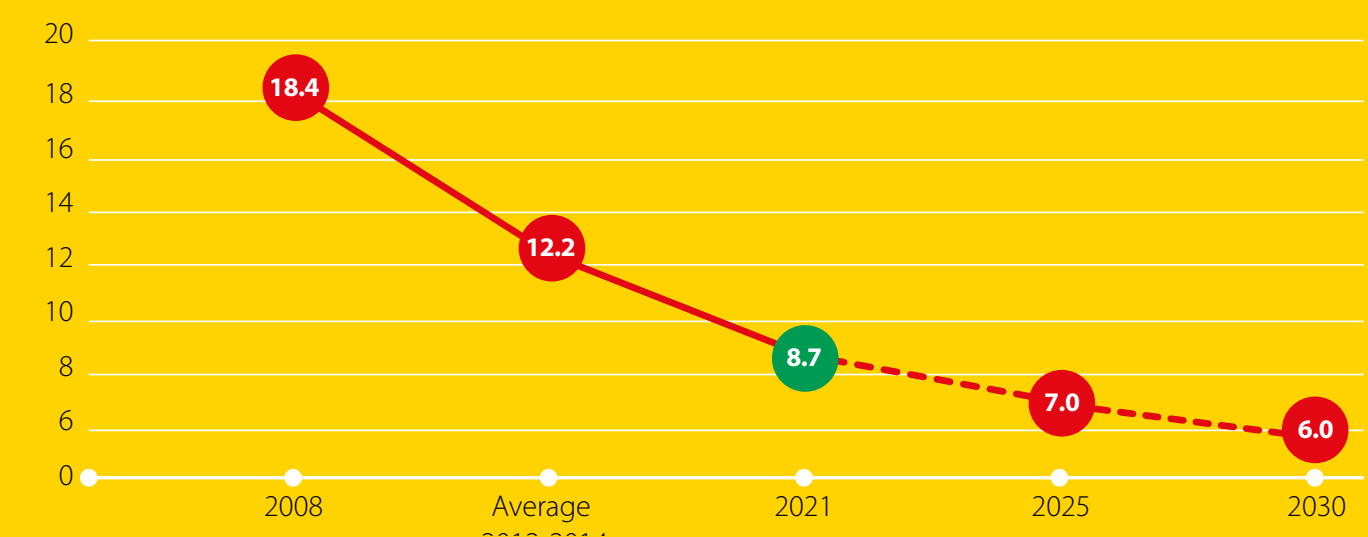
Twaron® product carbon footprint 2021	Climate change
Average Twaron® yarn (incl. converted yarn)	8.7 CO <sub>2</sub> -eq/kg <sup>1</sup>
Average Twaron® pulp (HC and LC)	8.8 CO <sub>2</sub> -eq/kg <sup>1</sup>

<sup>1</sup>The EU product environmental footprint version 2.0 environmental impact categories are used to determine the climate change impact.

### The benefits for our customers

Each improvement to our eco-profile directly benefits the environmental footprint of our customers’ products. We communicate our carbon footprint to customers and end-users, so they can calculate the environmental footprint of relevant aramid-based applications. These

results are also incorporated in our Customer Benefit Model (CBM). The CBM enables us to calculate the environmental and financial benefits of using Twaron® together with customers and value chain partners. In short: the lower the carbon footprint of Twaron®, the greater the sustainability benefits for our customers.





# Impact case

## How independent assessment by EcoVadis helps us to remain a top sustainable supplier

When it comes to sustainability, organizations find it increasingly important to work with responsible suppliers and partners who share their values. EcoVadis, a leading independent sustainability rating platform, works with multiple industries to help them find the right suppliers. In fact, more than 75,000 organizations worldwide undergo EcoVadis' evidence-based assessments, which are based on an extensive range of corporate social responsibility (CSR) criteria.



### A strong track record of performance

Teijin Aramid has participated in the EcoVadis assessment program since 2015. Every year, our organization and our operational processes undergo a rigorous evaluation based on four CSR-related categories: 'Environment', 'Labor and human rights', 'Ethics', and 'Sustainable procurement'. In December 2020, EcoVadis renewed our Gold status for the fifth consecutive year, providing us with an EcoVadis Gold rating for 2021. This means that Teijin Aramid remains among the top 2% of all suppliers in the synthetic fiber production category, and the top 1% of suppliers in all categories.

### Raising the bar together

EcoVadis continuously strengthens its assessments by introducing ever-more stringent CSR criteria. This constant rise in standards is also helping us to raise the bar for sustainability at Teijin Aramid. The insights we receive through the EcoVadis assessment help us to better understand the sustainability impact of how we organize our processes.

In this way, we can improve our way of working and look at how we can add more value for our customers – an important step in our ambition to create a more responsible and circular aramid value chain.





Suppliers

# Together from start to finish to start. How collaboration is helping our raw material transition.

Our suppliers are an integral part of our sustainability ambitions and strategy. They deliver essential raw materials that, in turn, provide the building blocks for our aramids. Finite, fossil-based resources are still the primary feedstocks for our products. However, we are pursuing partnerships and collaborations that can help guide our transition to renewable alternatives such as biomass, used plastics, and used aramids. While we are at the beginning of this journey, our studies clearly show the long-term potential of using non-finite resources for aramid production.

Scroll down to  
read more

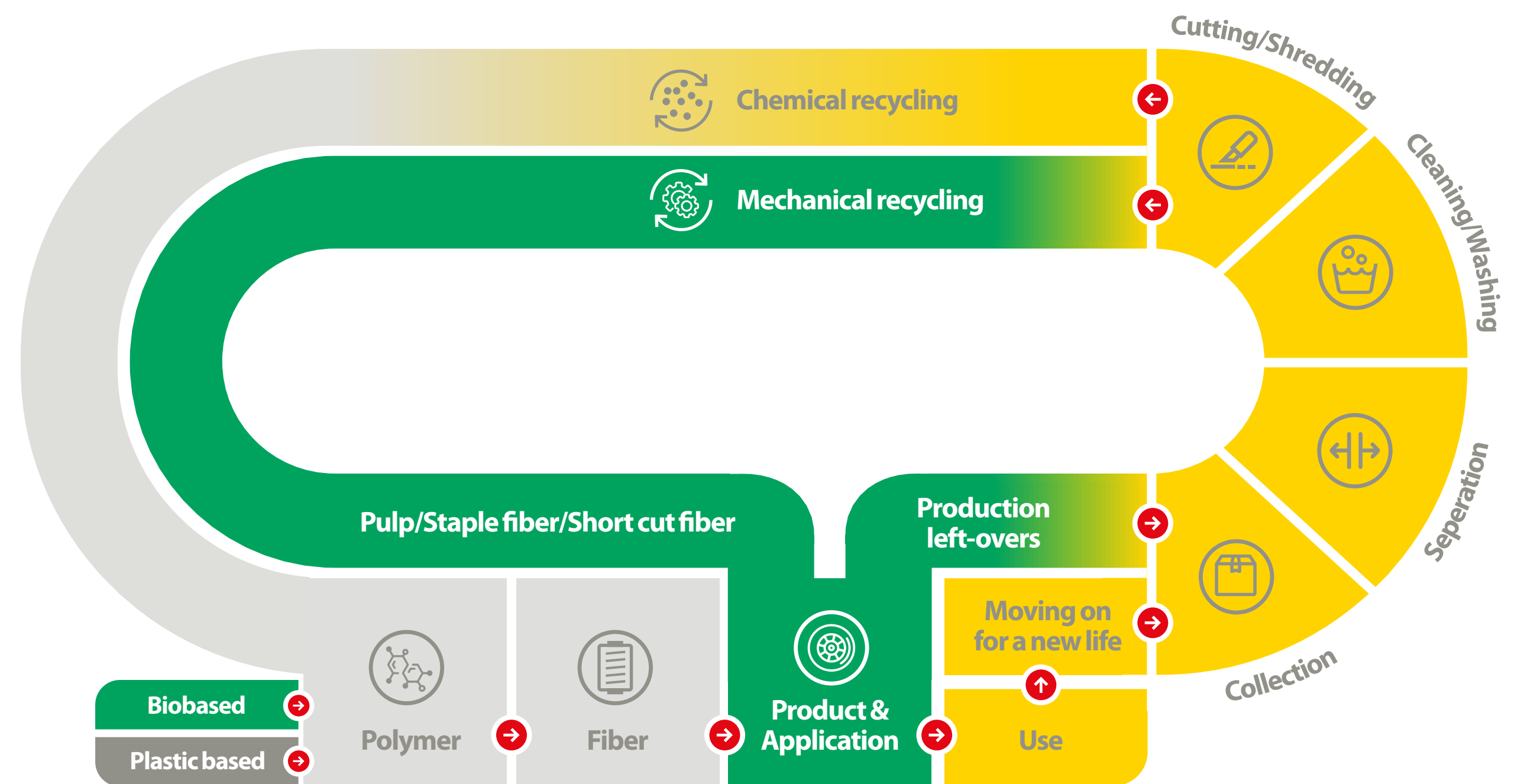




## Replacing fossil materials through renewables and recycling

### Our raw materials transition is based on a three-tier approach:

1. The core of our approach is to replace the fossil-based raw materials for the production of our polymer in Delfzijl (from which our yarn is spun) with less impactful, renewable alternatives. We have identified biomass and recycled plastics as offering excellent potential for replacing fossil-based feedstock for the production processes of our monomers.
2. We are exploring the potential to reuse aramid yarn as feedstock for chemical recycling into new raw materials for our site at Emmen.
3. We continue to recycle used aramids into pulp at our production location in Arnhem. This mechanical recycling is a technology that we have already been applying for more than twenty years. We are currently investigating the application of different sources of used aramids.



Scroll down to read more



### Collaboration is crucial

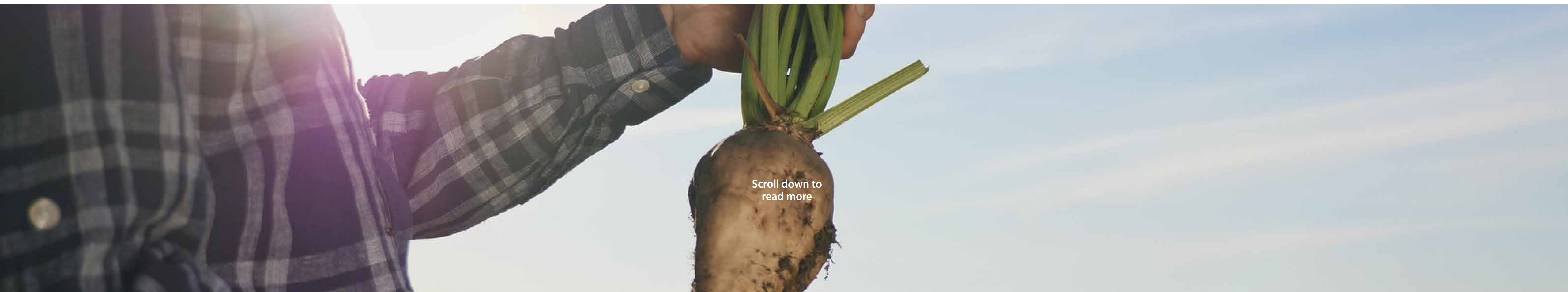
Working with partners across the materials value chain, Teijin Aramid is at the forefront of studies to understand the viability of using alternative feedstocks such as biobased materials or plastics. These collaborations are starting to deliver promising results. 2020 saw the completion of a successful pilot with our partner BioBTX to prove on a lab scale the potential of biobased [▶ BTX feedstock to produce high-quality aramids](#). Building on the knowledge gained through these lab-based studies, we will continue our collaboration as we explore how to scale up our project to full commercial level.

Teijin Aramid also participates in the 'SPACECRAFT' initiative: a collaborative study with Groningen University and other knowledge institutes to investigate using carbohydrates from sugar beets to create, for example, the aromatic compounds for aramids.

Besides biomass, we see plastic waste as a possible long-term replacement for oil-based materials in our production processes. In particular, we see opportunities to harness [▶ polyethylene terephthalate \(PET\), which contains monomers that can be used to build our aramids](#).

### Reaching our mid-term targets

Whether through biomass or used plastics, we aim to obtain at least 10% of our overall Twaron® feedstocks from renewable sources by 2030. The support and expertise of the wider value chain will be crucial as we work toward this important milestone. One of our priorities in 2020 was therefore to strengthen our relationships with our suppliers, as well as R&D specialists, knowledge institutes, and other partners.

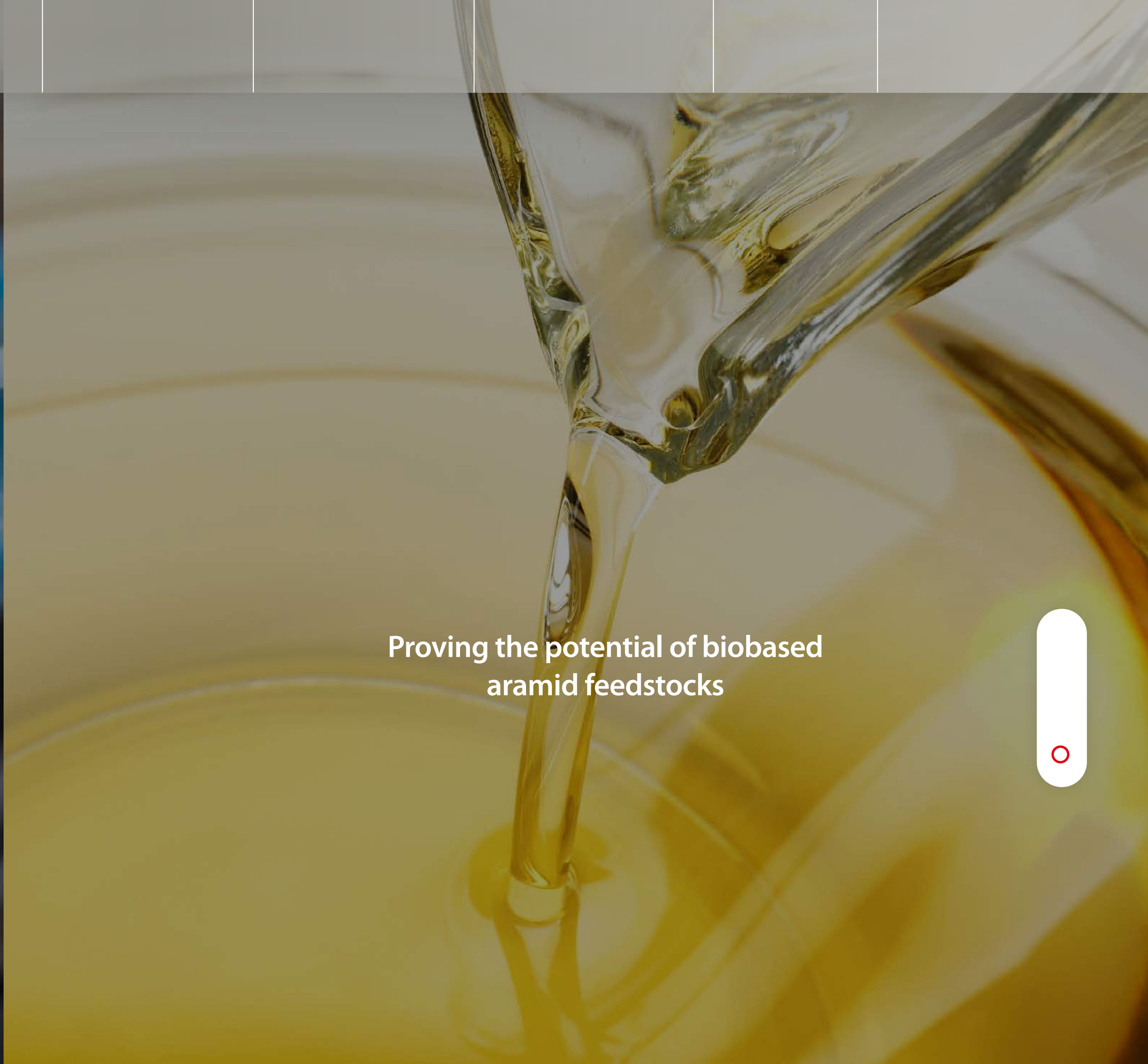


Scroll down to  
read more





**Exploring impact: the potential  
of plastic feedstocks**



**Proving the potential of biobased  
aramid feedstocks**



[Share this report](#)



Impact case

# Exploring impact: the potential of plastic feedstocks

**Recycled plastic is a potential long-term alternative to oil-based raw materials used to create the monomers for our aramids. The advantages of reusing plastic are twofold: finite resources are kept in the ground and less plastic waste ends up as landfill or gets incinerated.**

Furthermore, unlike biomass, used plastic does not use up agricultural resources such as land and water. Two types of mass-produced plastics hold particular potential: polyethylene, which is used to make plastic bags, for example, and is by far the most produced and used plastic; and polyethylene terephthalate (PET), which is in the main ingredient of plastic drinks bottles and synthetic textiles. It is based on similar chemical building blocks to Twaron®'s para-aramid.

## A circular solution for recycled plastic

While fossil raw materials have been used to produce our fibers for several decades, little is known about how using plastic waste as a feedstock impacts the quality and performance of aramids. To answer this question, Teijin Aramid helped to launch the Integrated Approach towards Recycling of Plastics (InReP). Funded by the Dutch government, the coalition draws together more than 25 organizations ranging from sorters, recyclers, and producers to knowledge institutes such as schools, a university, and R&D institutes. In 2020, all parties agreed to collaborate on driving circularity by upcycling used plastics into aramids and other high-end products. One such party is BioBTX, Teijin Aramid's partner on a recent pilot to explore the use of biobased raw materials in aramid production.





Impact case

# Proving the potential of biobased aramid feedstocks

**Aramid fibers are traditionally derived from fossil resources such as oil. Through a series of chemical conversions, separations, and purifications, these non-renewable feedstocks provide the feedstock for our processes. However, using fossil-based resources has negative implications for the environment in two ways. First, additional hydrocarbons are extracted from the ground, depleting the earth's natural remaining resources. Second, harmful carbon emissions are released during the production, use, and disposal of aramid fibers.**

## Seeking an alternative to fossil-based resources

We wanted to know whether we could replace fossil-based resources with renewable, biobased BTX materials without affecting the quality of the final aramid product. The right solution could help to improve the environmental impact of producing Twaron®. Moreover, it could significantly enhance the sustainability profile of countless aramid-based applications over their product lifecycle.

In 2019, Teijin Aramid started partnering with BioBTX, a producer of biobased BTX (Benzene, Toluene, and Xylene), and Syncom, a specialist in organic chemistry, in a groundbreaking lab-based pilot study. As project partners, we

set out to understand the potential sustainability benefits of transitioning to renewable raw materials in terms of CO2 emissions. A second important goal was to determine whether switching to biobased feedstocks would alter the traditional material properties of Twaron® yarn, namely high strength, low weight, and outstanding durability. We experimentally manufactured the monomers, the polymer, and a Twaron® yarn on lab-scale, all with biobased BTX, made out of vegetable oil, as a starting point.

## Proving the possibility of a fully circular aramid chain

After two years of intensive research, in November 2020 the partners were finally able to reveal the result they

had been looking for: the ability to spin high-quality Twaron® fibers containing up to 92% biobased materials with no change in the fibers' material properties or loss of functionality. The pilot proved it is possible to improve the environmental impact of Teijin Aramid's production through this innovative biobased approach.

Our next step is to scale up the study to produce biobased BTX on an industrial scale. Ultimately, by working with our customers and suppliers, we expect to reduce fossil CO2 emissions over the lifespan of aramid-based applications by 25%. This will be a major milestone in our journey toward a fully circular aramid chain.





## Health

# 2020 – a historic year

**From a health and wellness perspective, 2020 will be remembered as a unique year. Like other organizations around the world, Teijin Aramid has felt the wide-ranging effects of the COVID-19 pandemic, which really put our resilience to the test.**

Since the first outbreak of the virus in February 2020, our priority has been to ensure the health and safety of all our employees as well as our contract workers. Meanwhile, we have worked hard to maintain business continuity across our facilities. The first wave of the pandemic proved especially challenging, as so little was known about the virus and its effects. This was particularly difficult for [those in charge of taking decisions](#). The second wave was much more challenging with regard to infections. Similar to the overall trend in the Netherlands, more people at our locations were infected, some very seriously. This impacted the individuals involved, of course, but the effect was also felt at the production locations. Keeping infections in check while maintaining continuous production was a major challenge.

Thanks to the proactive approach of our locations and wider organization, we have been able to limit the number of infections, keep working areas sufficiently safe, and maintain a consistent service for our customers.

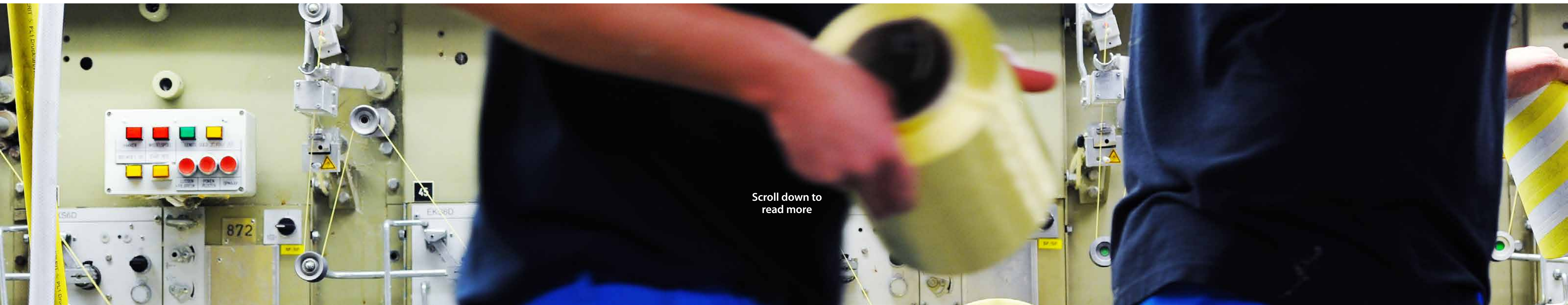
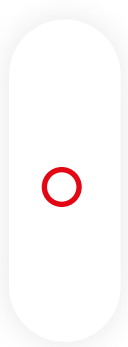
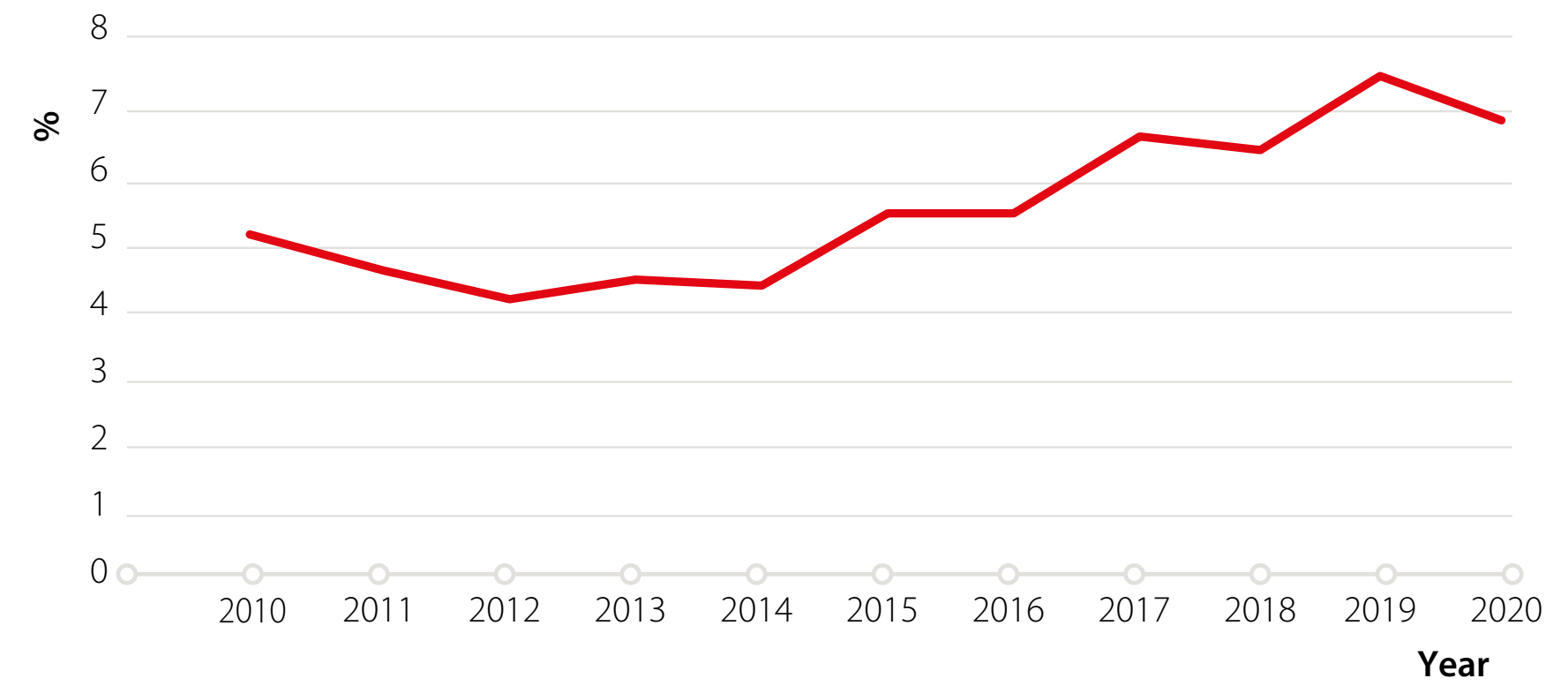




**Health results: signs of progress**

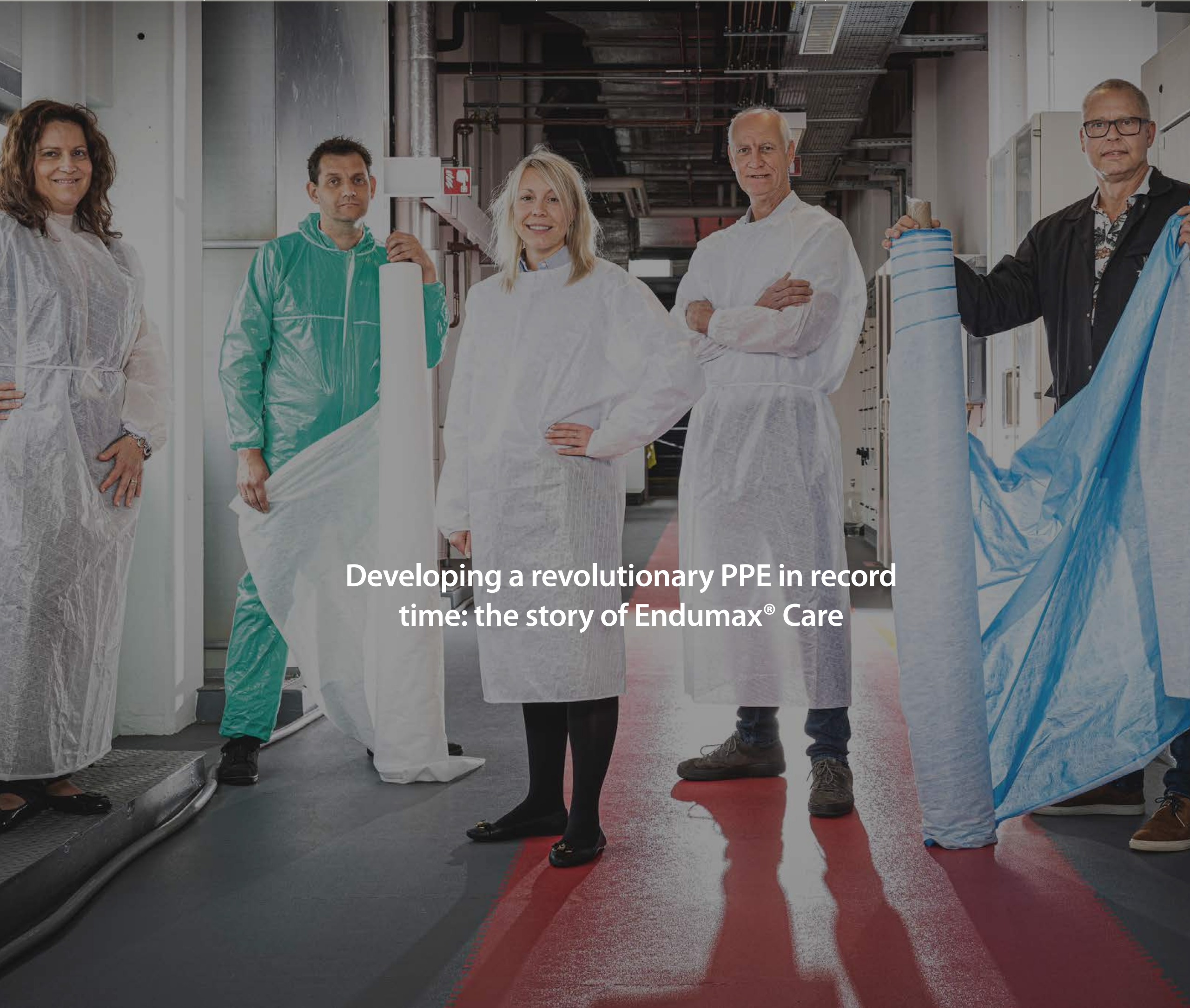
Aside from the pandemic, health has always been top of mind at Teijin Aramid. We monitor the wellbeing of our colleagues closely through our 'absence due to illness' rate, which has risen steadily in recent years. To address this increase, we have introduced various programs aimed at tackling the causes of work-related illness. Our approach also aims to help our employees maintain healthy lifestyles and achieve a good work-life balance. We also hired a dedicated case manager to improve our follow-up on absence due to illness. Our efforts are starting to pay off: in spite of COVID-19, illness-related absences fell in 2020. While we are encouraged by this trend, our absentee rates are still too high and reducing this will remain a priority going forward.

**Health-related absences**



Scroll down to read more





Developing a revolutionary PPE in record time: the story of Endumax® Care



A coordinated, company-wide response to the crisis







Impact case

# Developing a revolutionary PPE in record time: the story of Endumax® Care

**At the start of the COVID-19 pandemic in 2020, the world was in turmoil. As healthcare workers faced a running battle to treat a sudden influx of patients, the lack of personal protective equipment (PPE) added to an already challenging situation. Our extensive network in the protective apparel market alerted us to the potential value of polyethylene-based clothing to protect workers from the virus. As a manufacturer of PE-based tape – our Endumax® tape – we decided to see if we could lend a helping hand.**

## Working with partners to accelerate the solution

We saw an opportunity to use Teijin Aramid's Endumax® material – a polyethylene-based product – to make protective garments. Endumax® tape is naturally very stiff, so our research teams began exploring ways to convert the tape into a more flexible protective fabric. Using early samples, Teijin Aramid's marketing colleagues connected with a healthcare professional who was looking for a protective material to make medical aprons. Drawing on her knowledge, we developed a flexible protective fabric suitable for making aprons and other PPE in under a week. The next step was to make the fabric ready for mass production while meeting the necessary quality requirements. Less than six weeks later, Endumax® Care was born – an unprecedented turnaround time for a high-quality protective material.

## Our ambition: to create the first reusable non-woven PPE

The rapid development of Endumax® Care not only highlights our innovation capabilities but also our ability to work effectively with partners toward a common goal. Fortunately for the world, trade routes were re-opening and cheaper PPE options were once again available. However, this did not stop us from further developing Endumax® Care. Our material is now being developed for use in reusable protective garments worn by chemical workers. As well as being biologically repellent, our solution offers excellent chemical resistance and is washable, which makes it reusable. This unique combination of properties creates a revolutionary proposition for a PPE market where the vast majority of non-woven garments is discarded after being used once. With our Endumax® Care proposition we are aiming to impact the amount of waste generated by current PPE solutions. This approach goes hand in hand with our sustainability strategy, which promotes the reuse of materials wherever possible.







Impact case

# A coordinated, company-wide response to the crisis

**COVID-19 reached the Netherlands in February 2020. We had to move quickly, putting protocols in place for the potential progression of the crisis. Fortunately, we could rely on previously developed protocols for pandemic scenarios such as swine flu. We prepared for different eventualities, set up a business continuity plan, and organized protective equipment for our workers. We also defined hygiene and cleaning procedures, put steps in place to support infected employees, and made arrangements for essential business travel. Using the government's COVID-19 guidelines as our starting point, we created preventative measures to protect people from catching the virus at work.**

## Taking proactive measures against the virus

With working from home not being possible for many Teijin Aramid workers at our production facilities, we drew up 'corona scenarios' for each of our locations in the Netherlands. We also gave managers clear guidance on how to act and – ultimately – how to shut down operations in a safe manner in the worst-case scenario of an outbreak. We introduced rapid testing at all our locations, to minimize the risk of infections.

## A coordinated, company-wide response

To coordinate the COVID-19 response efforts, a very effective crisis organization, comprising representatives from both production facilities and management, was established. The COVID-19 crisis team oversaw both internal and external communications. After each press conference by the Dutch government, we issued a company-wide announcement, while our location-based management teams communicated with staff on site. In total, more than 35 communications were issued regarding COVID-19.

Looking back, the pandemic has taught us to learn fast and prepare for the worst. Fortunately, many of the emergency measures we designed were not needed. Although some of our employees or their relatives were severely affected by the virus, we were able to avoid serious outbreaks at work. And while the first wave resulted in a significant dip in sales, we were able to recover quickly in the course of the year. We are indeed proud of how we overcame this challenging year as a team, while moving forward with our long-term ambitions and maintaining high standards for our customers.





Safety – Process & Labor Safety

# Keeping our people healthy and safe

## Safety

Health and safety are our top priorities in the development and manufacturing of our products. The core of our business, aramid production, involves handling hazardous chemicals and working with highly technical and rotating machinery. It is essential to always keep our employees and contractors, as well as people living in our local communities, safe. Safety, therefore, is our license to operate.

We aim to be among the best in class in terms of our safety levels, to ensure all our employees and contractors return home in good health at the end of each working day. Our safety approach focuses on the integrity of our installations (process safety) as well as the safety of our employees and contractors (labor safety). We have set up programs to further improve our safety levels across both areas.

## Labor safety: preventing incidents and injuries

Labor safety refers to the level of safety required to prevent personal injury. An injury is often the result of an unsafe situation or unsafe behavior. Every unsafe situation has the potential to result in an incident. We strive to eliminate unsafe situations as much as possible by remaining attentive and taking steps such as safety studies and toolboxes to prevent them. Unsafe situations are always reported and discussed: every report is an opportunity to learn and improve our safety levels.

Scroll down to  
read more





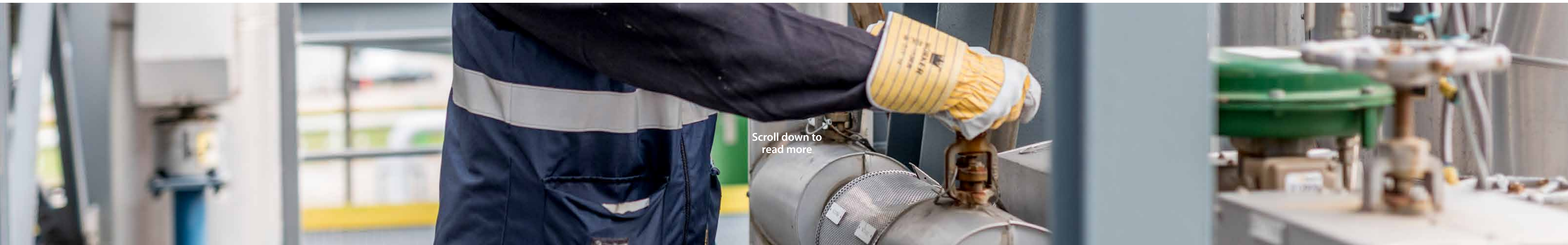
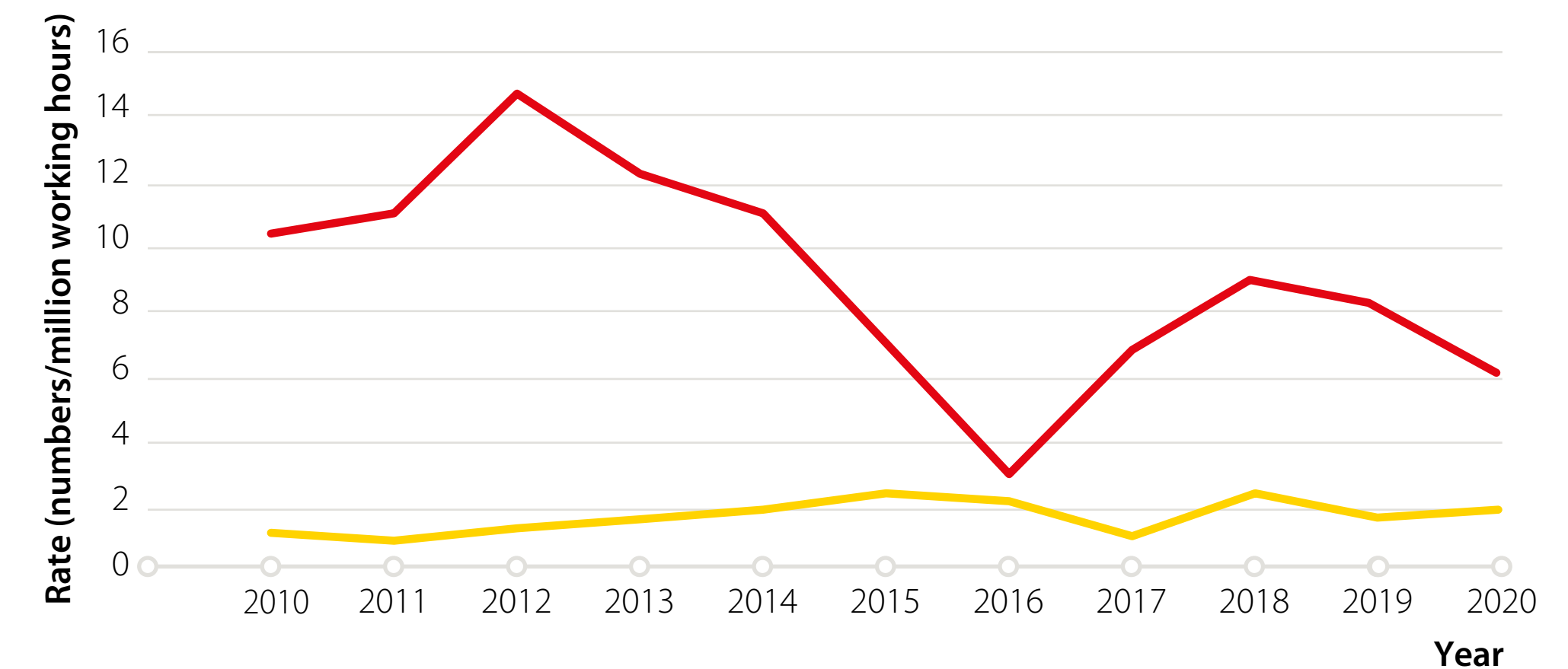
## Evaluating our safety performance in 2020

Despite our efforts to improve labor safety, hazardous situations still occur and, unfortunately, incidents still happen. We do as much as possible to prevent this, as we believe that each incident and unsafe situation is one too many.

We measure our safety performance by recording all unsafe situations. On top of that, we indicate the trend of our safety performance by means of the following metrics: (1) Incidents leading to absence (Lost Time Injuries [LTIs]), (2) Incidents leading to temporary alternative work (Restricted Work Cases), and (3) Incidents requiring medical treatment (Medical Treatment Cases).

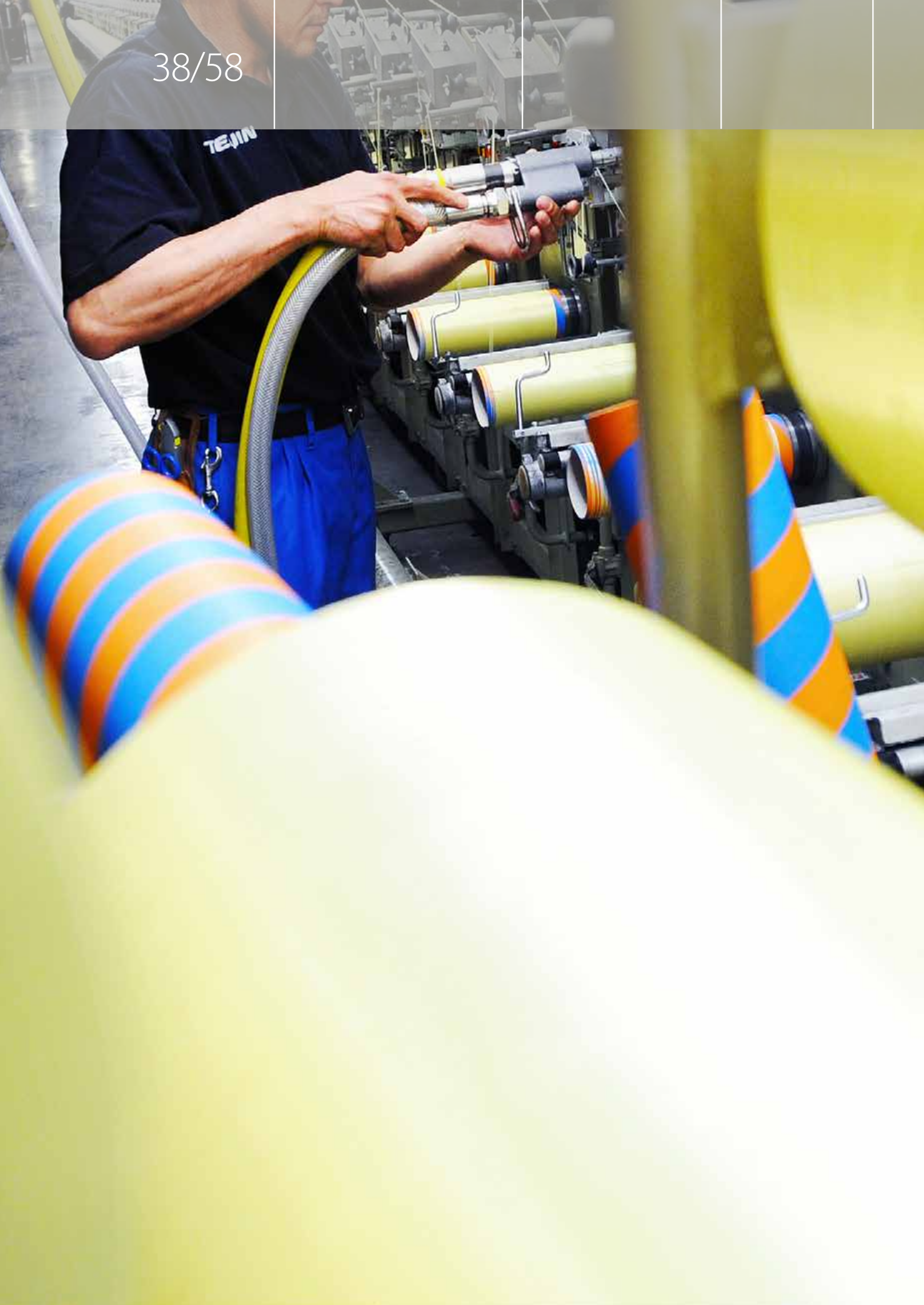
Using this information, we calculate the Total Recordable Rate (TRR), which is the total number of incidents (i.e., the total of Lost Time Injuries, Restricted Work Cases, and Medical Treatment Cases) per one million working hours. We also calculate the LTI frequency rate, which is the total number of LTIs per one million working hours.

**Safety incidents** — Total Recordable Rate (TRR) — LTI Frequency rate



Scroll down to  
read more





Our safety performance in 2020 showed a mixed perspective. Although we saw a decline in the number of recordable incidents, too many incidents still occurred. We also noted an increase in serious injuries: four LTIs in 2020. This number is too high and goes against our ambition to be a safety leader. Two out of four of the LTIs involved stumbling with sprained muscles as a consequence. The other two incidents were more severe and involved a broken hand bone and an injured finger that needed stitching.

The decline in recordable injuries was mainly the result of the improved labor safety performance of our Emmen facility, where we worked hard to prevent a particular kind of accident; namely, cuts.

#### **Getting to the bottom of every incident**

We have investigated the reasons behind the incidents that take place at all our facilities and have observed a trend we need to address. Human error is the most common cause. Specific issues we need to address are people not taking the time to consider the safety consequences and/or not following the agreed procedures. There is no quick fix: it requires a deep dive into the way we do things. Like our approach in process safety, we are exploring how to connect best practices both within our own company with benchmarks and standards in the industry. Our main goal is to increase employee awareness and develop a robust safety culture throughout the organization, from the shop floor to central management – one that we can all contribute to.

**"Our main goal is to increase employee awareness and develop a robust safety culture throughout the organization, from the shop floor to central management"**



### Process safety

Our production facilities in Delfzijl, Emmen, and Arnhem all use hazardous chemicals and highly technical installations daily. Process safety ensures the integrity of these installations to prevent chemical leakages and minimize the risk of events such as fires and explosions.

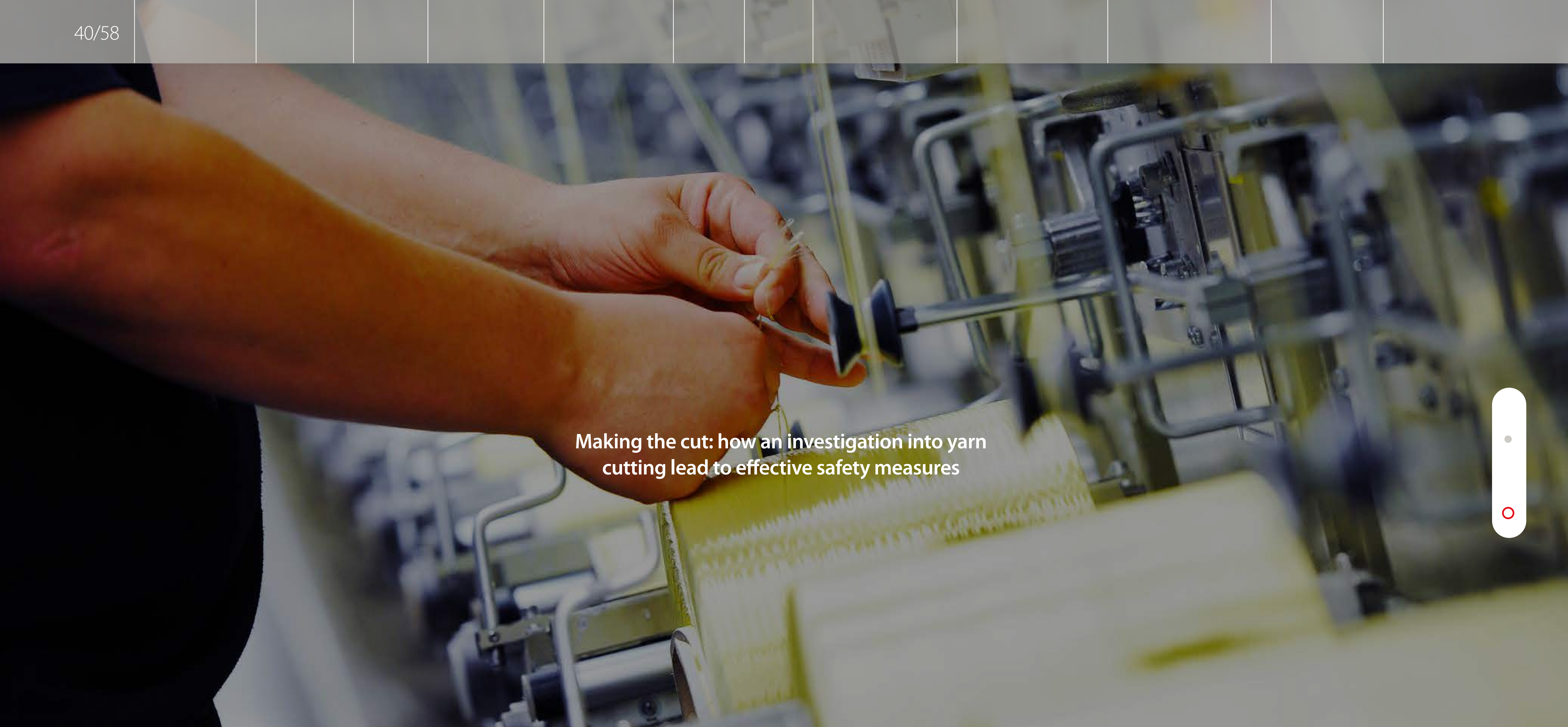
A process safety incident can potentially occur at any major production facility, threatening the safety of our own people as well as those residing in surrounding areas. Our process safety management (PSM) system is based on the industry standards for process safety from the Centre for Chemical Process Safety (CCPS). This is an integrated, risk-based process safety approach, where dedicated assessments have been translated into corresponding PSM plans. All our locations work with a plan that is designed to give us full control over our operational processes. Therefore, skilled and informed people are required to make training and instructions an important part of the PSM plans.

A number of process incidents occurred in 2020, which underlines that there is still room for improvement. We experienced several chemical leakages at each of our locations. Fortunately, these did not have a negative effect on personal health and the local environment. While this demonstrates that our secondary containment measures work as intended, any leakage incident is still one too many. Similar to our approach to labor safety, we have identified human behavior as the main cause of these kinds of incidents. Over the coming year, we will develop a company-wide safety excellence program, with the aim of improving safety awareness and behavior throughout our organization.

Scroll down to  
read more







**Making the cut: how an investigation into yarn cutting lead to effective safety measures**



[Share this report](#)



## Impact case

# Making the cut: how an investigation into yarn cutting lead to effective safety measures

**To produce aramid yarn, the ends of winding yarn sometimes need to be cut off – a task often performed by hand. In 2019, ‘cuts’ were the most common injury on our list of recordable incidents. These injuries ranged from small cuts to serious injuries requiring multiple stitches. Our aim is to prevent all accidents, however minor, so in 2020 we launched an investigation into the root causes.**

### On the fly

Cutting winding yarn seems like an easy task that can be done quickly. But it requires specialist skills and expertise. We discovered that one of the main causes of cutting incidents was people cutting yarn ‘on the fly’ without due care and attention. Furthermore, knives and scissors were used in inappropriate ways. As a first step, we investigated the types of tasks for which knives were being used and asked the operators in which cases the use of knives was deemed necessary.

### A much safer process

In several cases, our operators were able to propose new cutting methods that did not require workers to handle sharp objects. For example, cutting off the end piece of an Endumax® polyethylene tape spool is now done by rotating the spool in the opposite direction, which causes the tape to drop off automatically.

We have developed a special cutting toolbox for tasks where knives are required with dedicated cutting specialists given sole authority for cutting winding yarn. Operators are no longer allowed to carry knives and doing things ‘on the fly’ is no longer an option.

Adopting this new way of working was not easy for some workers as it was felt that an important tool was being taken away. However, with no serious cutting incidents recorded at Emmen in 2020, the results clearly show this was the right approach when it comes to the health and safety of workers.





Impacting the chain

# Maximizing our impact along the chain

We are in a unique position to positively influence the wider value chain. Our aramids act as a key sustainability multiplier for multiple industries: they help to improve product performance and efficiency and reduce the environmental footprint of manufacturers and end-users. Our challenge is to maximize this impact over the entire product lifecycle – from cradle to grave, and beyond. Day by day, we are improving how we design, produce, and recycle our aramids. At the same time, it is important that we clearly communicate the benefits of our products to our value-chain partners and extend their use to new areas of society.

## A positive impact across the product lifecycle

The positive steps we take when making our products filter through to final applications – whether [▶ using green energy in our production processes](#), or [▶ renewable or recycled raw materials](#) as the building blocks for our aramids. We can also have a positive influence at the end-of-life stage, by recovering our aramids from used products and giving them a second lease of life in new applications.

However, our sustainability impact is greatest during the use phase. Our solutions improve durability and extend the usability of countless applications – this means fewer replacements, less production, and less use of virgin materials. Given their excellent strength-to-weight ratio, our aramids are also crucial in light-weighting moving applications, reducing the energy needs of traditional fossil fuel installations. But more importantly, our technology can play a key role in the energy transition – by helping to drive the adoptability and usability of electric vehicles (EVs), mining conveyor belts, reinforced thermoplastic pipes, and many other sustainability-focused technologies.

Scroll down to  
read more







### Adding value – for customers and the environment

We see opportunities to extend the sustainable benefits of our technology to new industries. From aquaculture to [▶ professional motor racing](#), we can offer a unique value proposition: our aramids not only help reduce the carbon footprint of applications, they also unlock significant cost savings through applications that consume less energy and last longer. Using our [▶ Customer Benefit Model \(CBM\)](#), we help our customers quantify the economic and ecological benefits of our aramids over the entire product lifecycle. We have also launched an [▶ eco-datasheet](#) that provides detailed facts on the carbon footprint and recyclability of Twaron®. With these tools, we support our value-chain partners in making informed, responsible decisions – and taking concrete steps to improve their own environmental impact.



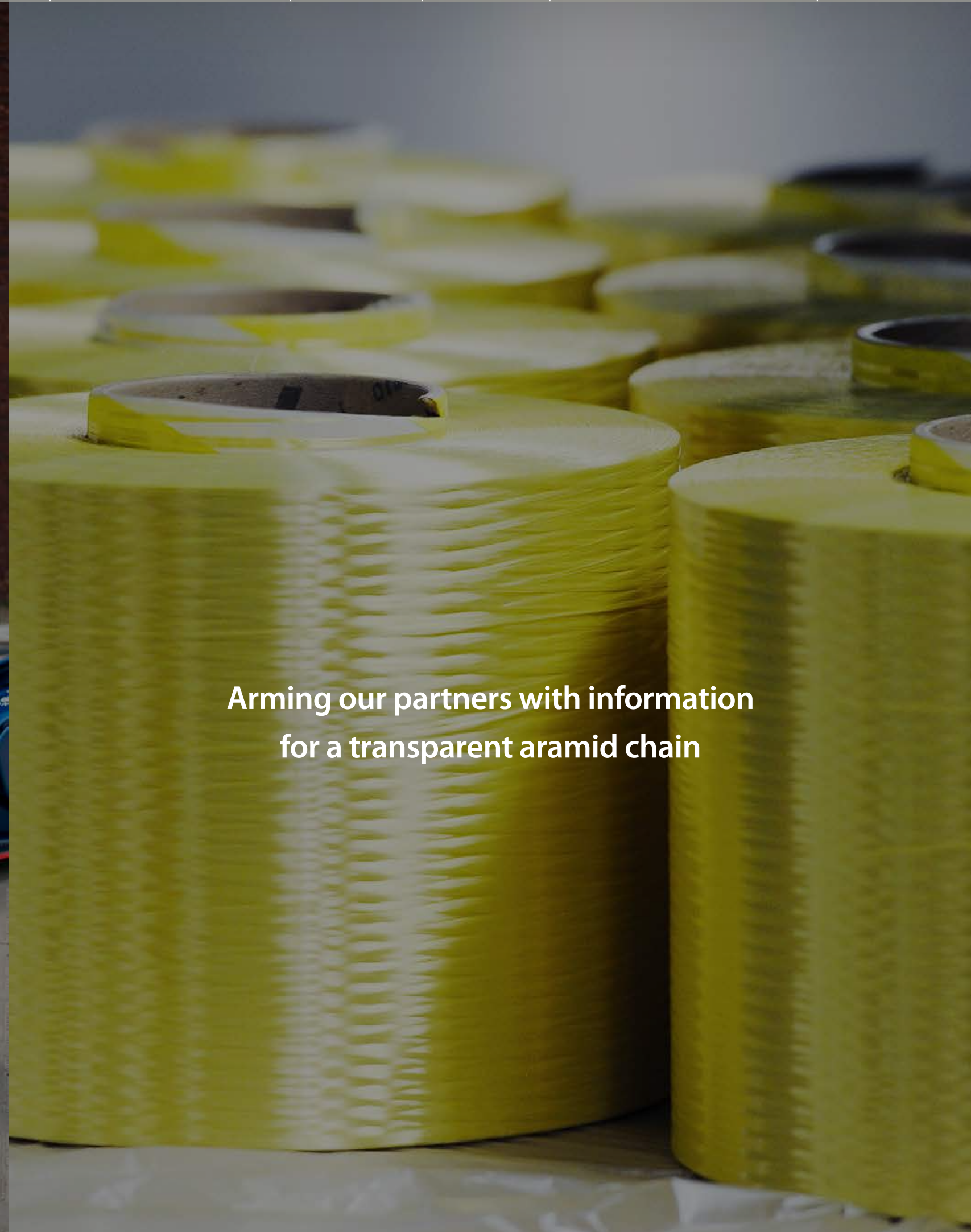
**“Our aramids act as a key sustainability multiplier for multiple industries: they help to improve product performance and efficiency and reduce the environmental footprint of manufacturers and end-users”**

Scroll down to  
read more

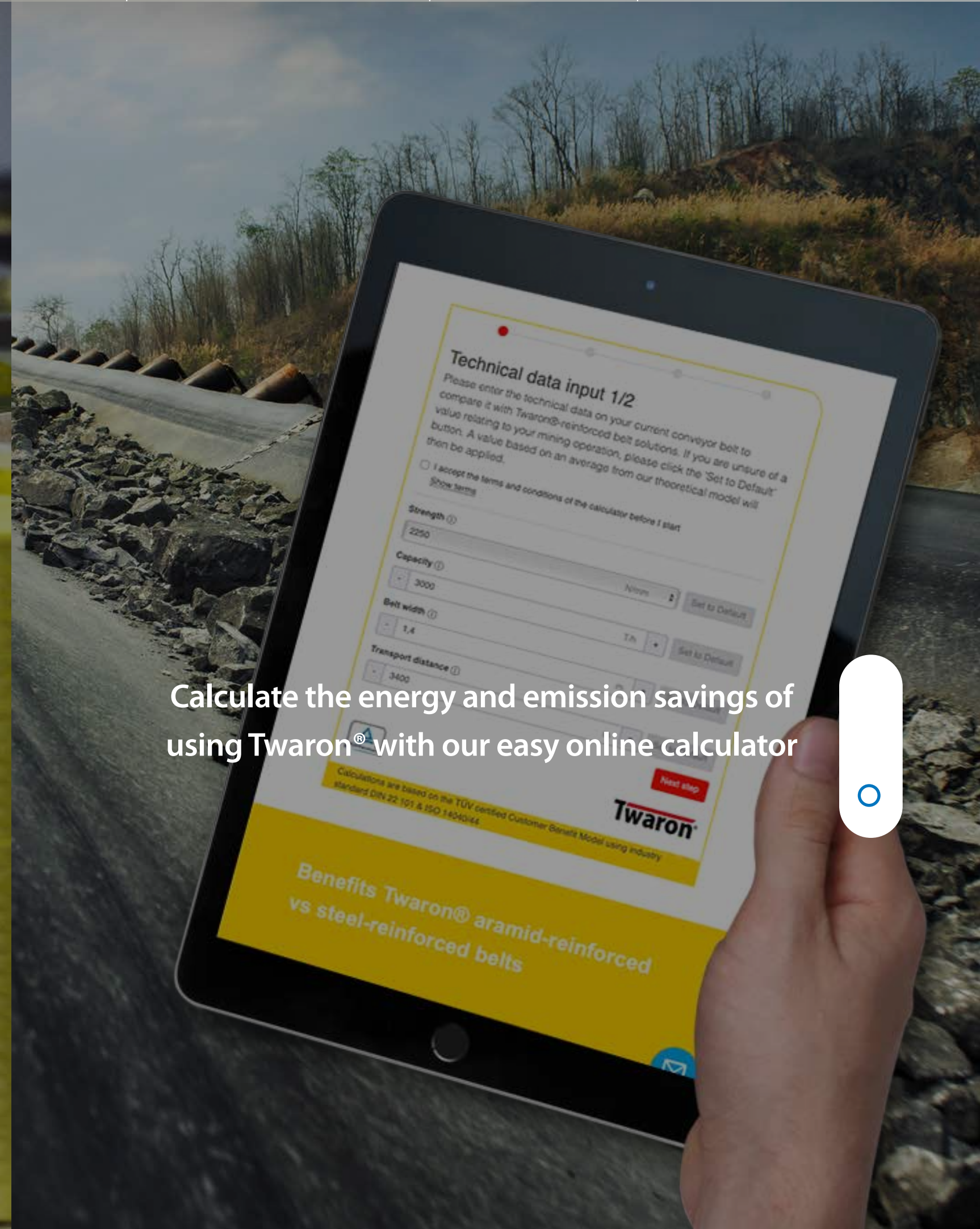




How our EVR-partnership supports sustainability in automotive



Arming our partners with information for a transparent aramid chain



Calculate the energy and emission savings of using Twaron® with our easy online calculator



## Impact case

# EVR: breaking new ground for automotive sustainability

An interview with Hendrik de Zeeuw, Executive Vice President of Marketing & Sales at Teijin Aramid



**“Teijin Group entered a multi-year sponsorship of Envision Virgin Racing (EVR), a professional motor racing team competing in Formula E – the world’s premier all-electric motor racing competition. Through this innovative partnership, we are exploring new solutions that can support the automotive industry’s transition to electric vehicles (EVs).**

The EV revolution is a major opportunity for us. There is an urgent need for materials and technologies that can maximize the sustainability value of EV technology. From lightweight car chassis that consume less energy to vehicle components, such as tires or brake pads, that offer higher levels of durability and recyclability. The most exciting advancements are taking place on the high-end racing circuit – this is where pioneering innovations such as seat belts and antilock braking systems first appeared before they were adapted for everyday passenger cars.

### A living lab where innovation happens

Our partnership with EVR is the perfect space for Teijin Group to put its R&D expertise to use. Unlike other Formula E competitors, EVR has no affiliation with specific

car brands or original equipment manufacturers (OEMs). Its primary motivation is to meet the goals of the Paris Climate Accord by helping to accelerate the energy transition through new technologies. There are clear synergies with our company’s sustainability ambitions – so, when EVR approached us to sponsor its 'Race Against Climate Change' initiative, it made perfect sense. The racing track is a giant living lab where we can test new solutions, for example using driving simulators. We are also able to identify untapped user needs and new areas where our solutions can potentially add value. Our work with Formula E opened the door to an exciting collaboration with OMP Racing, a leading motor racing equipment manufacturer. Together, we have developed an ultra-light aramid-based racing suit – the

first innovation of its kind for more than 20 years – that delivers a 30% weight saving.

### Shaping a new automotive future

In EVR, we have a sparring partner who, like us, likes to push technology to its limits. EVR tells us what advancements would be most beneficial to the car – this insight is gold dust for our automotive innovation programs. Right now, a new, third generation of Formula E car is being developed in preparation for the 2022–2023 season. We are working with manufacturers to explore ways to make the vehicle as sustainable as possible. These cutting-edge solutions will eventually filter down to the wider automotive market, so we have an opportunity to shape the direction of a major industry!”





Impact case

# Arming our partners with information for a transparent aramid chain

**In 2020, our sustainability and marketing teams worked to develop the first yarn and pulp eco-datasheet: a fact-based overview of the environmental profile of an aramid product. The first eco-datasheet, for Twaron®, was launched in February 2021, offering a comprehensive overview of the environmental aspects of our material and its sustainability advantages.**

The eco-datasheet includes the most recent calculation of the carbon footprint of Twaron®, measured in CO<sub>2</sub>-equivalent units. Users also receive clear information about the product's recyclability as well as its compliance with current chemicals industry regulation and other leading environmental standards and assessments. Our eco-datasheet will be regularly updated to account for changes to our sustainability profile.

## **Building a more transparent and informed aramid chain**

This customer-focused initiative is a key sustainability milestone for the aramid industry – one that directly supports our ambition to create a more transparent, informed, and empowered aramid value chain.

Customers and end-users can easily download the eco-datasheet from the Teijin Aramid website. With this information at their fingertips, they can better understand the environmental impact – and benefits – of using our aramids.

This allows them to make informed decisions about their product development and educate their own customers on the ecological profile of aramid-based solutions.

At Teijin Aramid, we see open communication about the environmental impact of our products and services as a critical step in the journey toward a fully sustainable and circular aramid value chain. The launch of the eco-datasheet goes hand in hand with our wider efforts to drive transparency and accountability across the aramid chain, including the [Customer Benefit Model \(CBM\)](#).





Impact case

# Calculate the energy and emission savings of using Twaron® with our easy online calculator

With their low weight and excellent durability, the ecological and economic benefits of our aramids have long been known. As well as a reduced environmental impact, they bring financial advantages to customers and end-users: applications that last longer and consume less energy. In recent years, we have been working with our value chain partners to accurately quantify these benefits using our [Customer Benefit Model \(CBM\)](#).

Teijin Aramid began developing the CBM in 2011 with the support of Professor Gabriel Lodewijks, at that time Professor at Delft University of Technology, and his students. Step one was to demonstrate by means of mathematical modeling and detailed calculations that it was possible to quantify the benefits of aramid-reinforced conveyor belts. Since then, Teijin Aramid colleagues have worked with other parties, to further develop the model.

## Working with customers to quantify their savings

Today's CBM is an independently certified software-based model that quickly calculates the potential energy savings of Twaron® during the raw material and use phase of aramid-based applications. The resulting environmental and economic impacts are measured against those of

standard materials, such as steel, to provide customers with a clear like-for-like comparison. By working with customers and prospects to better understand aramid and its benefits, we aim to strengthen the value proposition of our technology – and amplify our positive contribution to industries and society at large. Working together, we will accurately quantify the possible savings, something we can do for many applications.

## Conveyor belts

The calculated savings are often substantial: in a typical use case, switching to a Twaron®-based aramid carcass in a mining conveyor belt can reduce energy consumption by up to 25% compared with a traditional steel-cord carcass. Using this calculation as a starting point, the CBM

considers the electricity mix in the country of operations and CO<sub>2</sub>-equivalent intensity, respectively, using the latest data from the International Energy Agency (IEA). The application owner can therefore calculate the potential CO<sub>2</sub> reductions when switching from steel-cord carcass to aramid carcass in both tons and monetary terms.

## Sharing our model

The CBM is available online free of charge. Filling in the calculator only takes a couple of minutes and provides a clear first impression of the potential savings. By making our knowledge and this model readily available, we hope more application owners will see the potential of aramid and switch to a more sustainable solution.





Circular economy

# Building a circular economy alongside our partners

We are breaking free from the linear 'take-make-dispose' production model. There are two strands to our circularity ambitions. First, we aim to replace our current monomer feedstocks with sustainable alternatives. Second, we want to maximize the recovery and reuse of used aramids from end-of-life applications as a base material for producing new fibers. Our objective is a more circular – and economically sustainable – operating model which uses an extensive [▶ toolbox of technologies](#).

## Accelerating the inflow of used aramids

To accelerate the controlled inflow of recycled aramid into our production processes, we are taking steps to recover more of our products at the end-of-life stage. In 2020, we actively introduced circularity into our customer relationships and began developing a more formalized process to recover used aramid material.

We present our customers with a unique, three-point business proposition: as we offer our high-quality products, we also demonstrate the environmental and economic advantages of our aramids over the product lifetime via our [▶ Customer Benefit Model \(CBM\)](#). And we offer to take back the used aramids at a cost-benefit to the customer. In return, we can help our customers drive their own sustainability ambitions: they receive a circular product with a lower environmental footprint and a ready-made solution for their waste. This helps us to increase our used aramid inflow, connecting to our sustainability ambitions.

This new approach is made possible by close cooperation between Teijin Aramid teams. Our sales and marketing colleagues are involved in every discussion and our eco-profile team collects relevant data to show the ecological benefits for the customer. Our procurement and logistics teams also play a key role to embed so-called take-back agreements into contracts.

Scroll down to  
read more

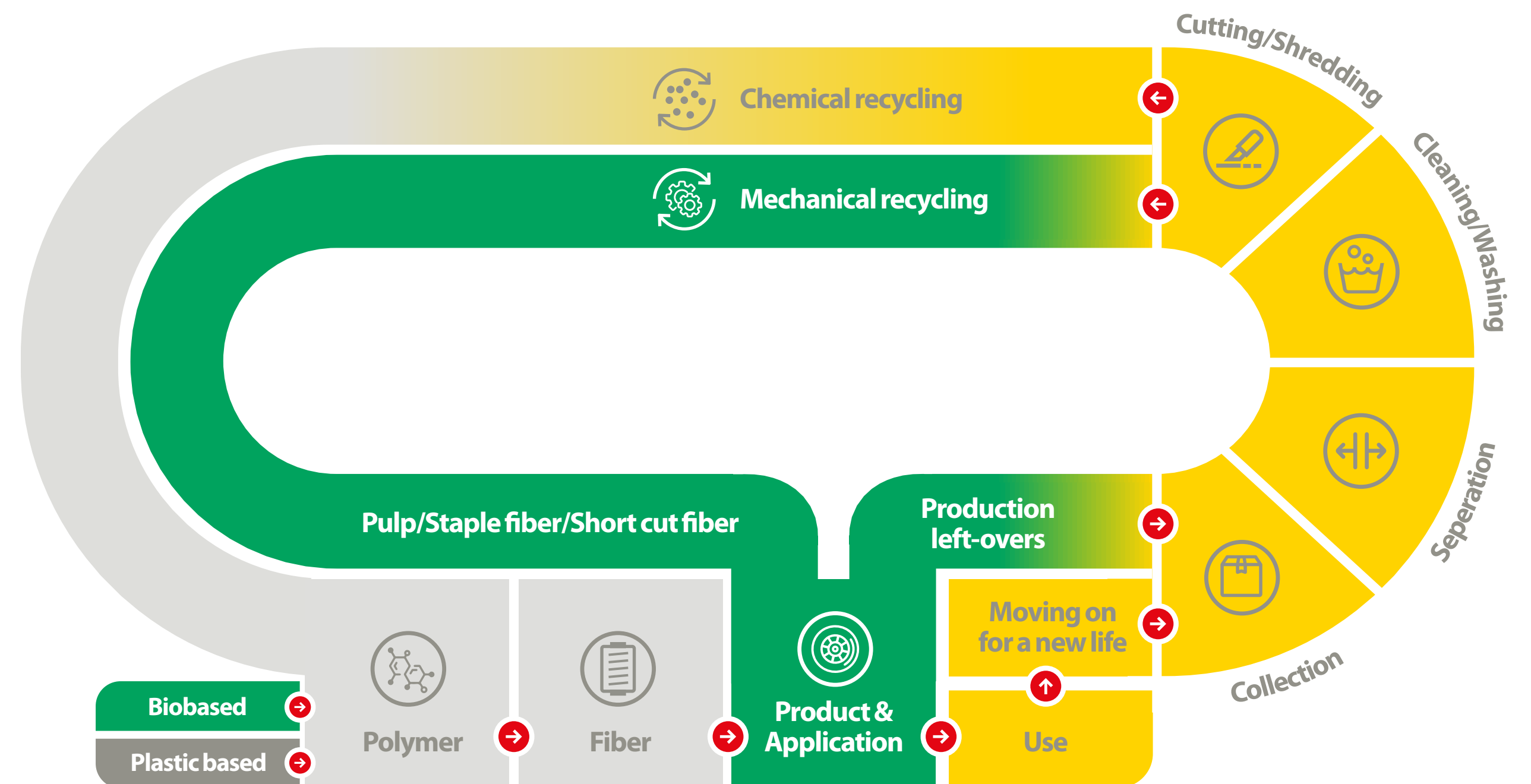


### Expanded recycling capabilities and local partnerships

We aim to process as much end-of-life material as possible. Teijin Aramid's R&D teams are developing a toolbox of advanced recycling methods to extract used aramid in greater quantities and from a wider range of applications.

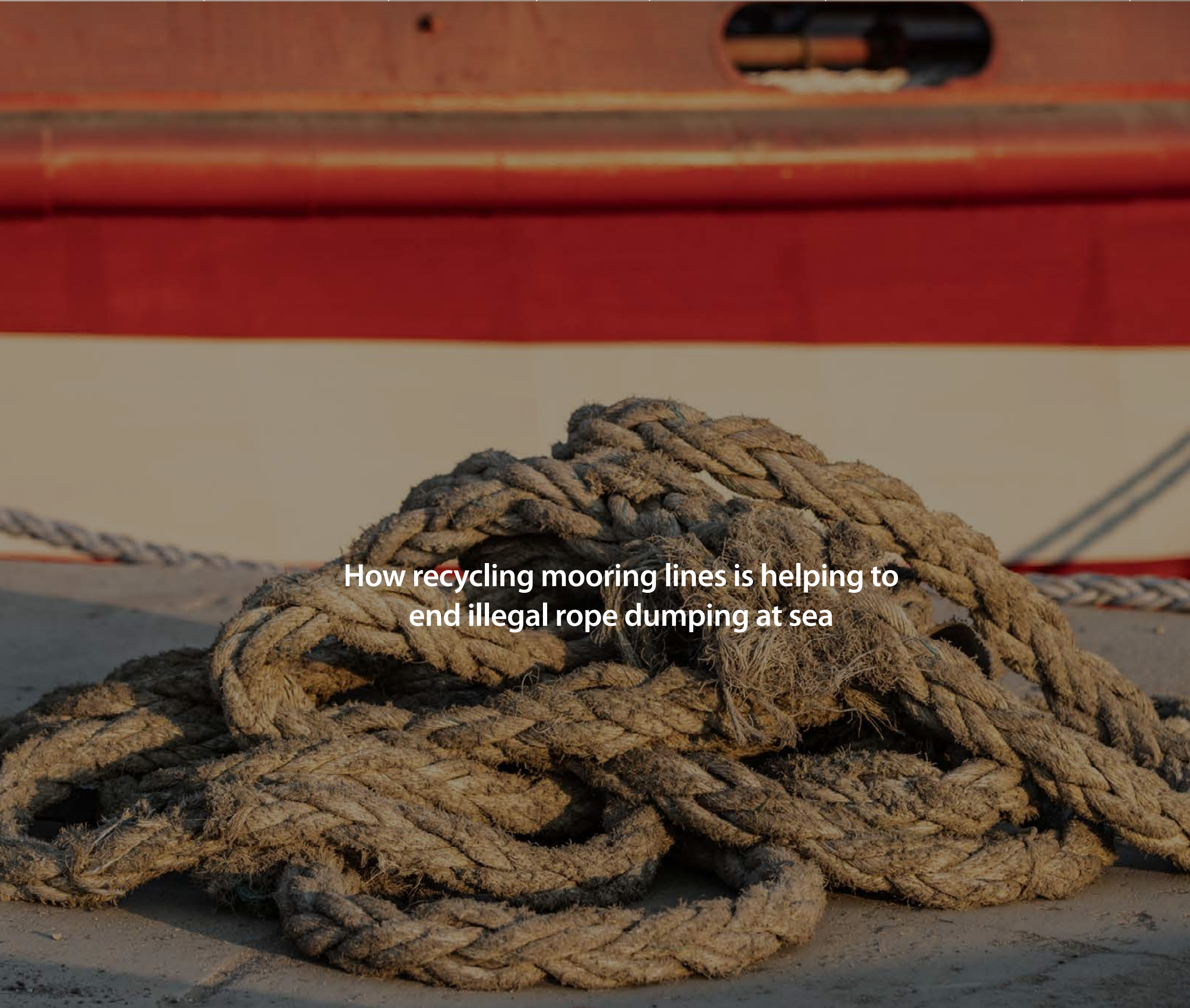
As well as researching the right techniques, optimizing the upstream value chain is an important step to be able to maximize the input of recycled materials. This represents new challenges: for example, used materials are often contaminated with other materials and or chemicals.

When recovering our materials, the first step is to separate the aramid fibers from the rest of the product and, if required, to clean the separated aramid product. Since collection, separation, and cleaning are not core competences of ours, we are working closely with local partners.

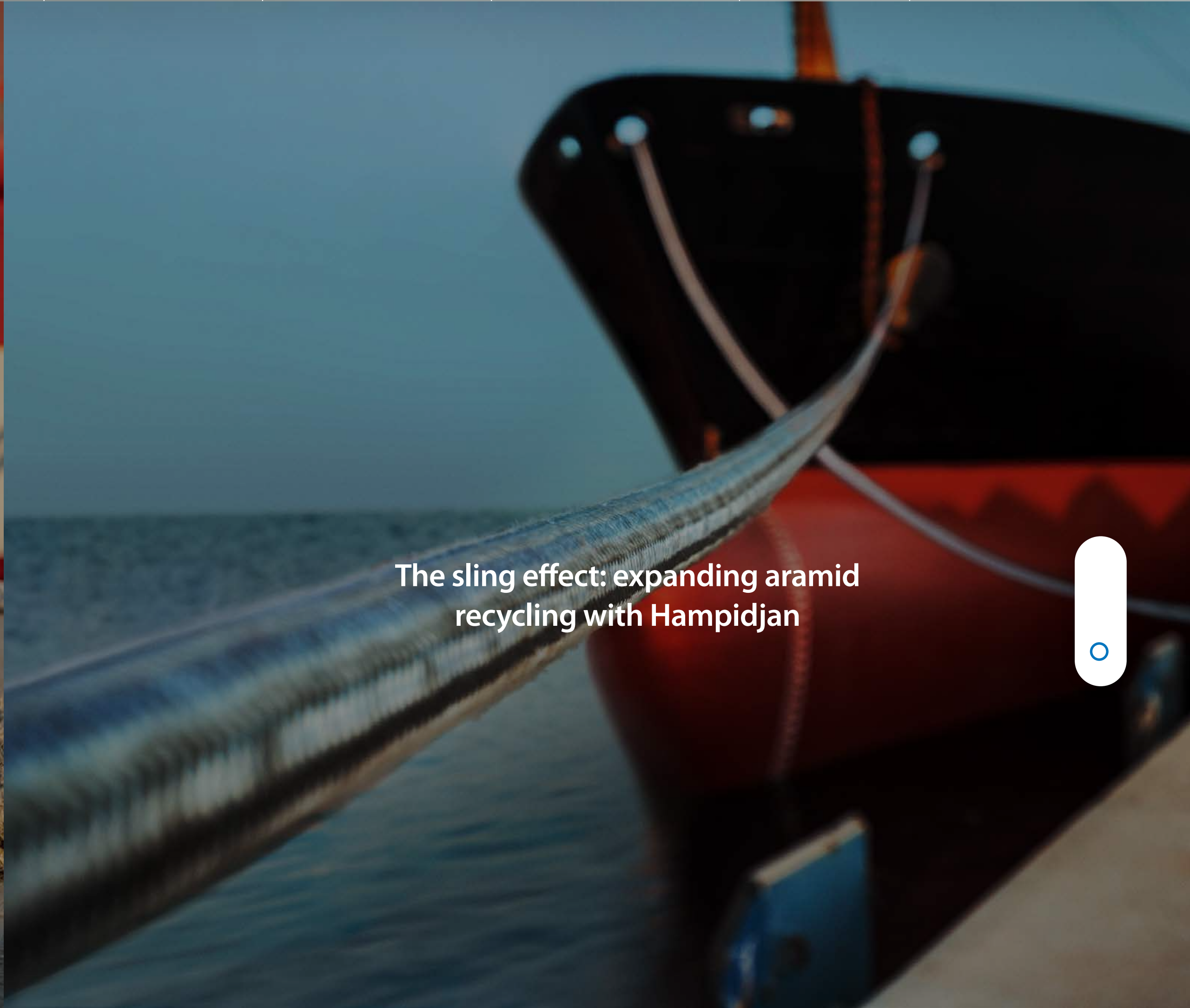


Scroll down to  
read more





How recycling mooring lines is helping to end illegal rope dumping at sea



The sling effect: expanding aramid recycling with Hampidjan





## Impact case

# How recycling mooring lines is helping to end illegal rope dumping at sea

**Marine waste is a serious and fast-growing problem. By 2050, the plastic floating in our oceans is expected to outweigh the combined mass of fish and other marine life. Mooring lines – typically made from non-recyclable synthetic fibers– are a big part of the problem. Lines are often dumped at sea after rupturing or at the end of their life. Others are incinerated or landfilled, which releases harmful greenhouse gases (GHGs).**

### A recyclable solution that minimizes waste

We are helping to shape a more sustainable and circular maritime industry by the development of aramid-based mooring lines that can be collected after use so that they can be recycled. With Twaron®-based mooring lines, at least 95% of the rope carcass (everything but the rope covers) can be recovered at their end-of-life stage. The aramid fibers salvaged from the mooring line are then reprocessed for use in new applications.

### Closing the chain – and adding value

Pulp made from recycled aramid has a positive impact along the aramid value chain by reducing the need for new (fossil-based) aramid production and the emissions this creates, by limiting the GHG emissions and natural resources involved in creating new aramid feedstocks. In fact, we estimate that every kilogram of used aramid that can be recycled saves 4kg of potential CO<sub>2</sub> emissions.

Aramid fibers recovered from mooring lines can be repurposed for use in a wide range of applications. For example, using pulp from recycled aramid fibers in brake pads reduces waste and can be used in a range of automotive applications, offering a more environmentally friendly option to harmful substances such as asbestos. We are pleased to be making a valuable contribution to a cleaner planet – across air, land, and sea.





## Impact case

# The sling effect: expanding aramid recycling with Hampidjan

**Making our customers an integral part of our recycling program enables both parties to reduce their carbon footprint and drive circularity. Teijin Aramid communicates its commitment to this way of working by presenting customers with a declaration of safe recycling: all aramid material returned to us at end of use will be safely and efficiently recycled into new applications and will not be used for any other purpose.**

## A powerful partnership built on circularity

This approach is at the heart of our partnership with Iceland's Hampidjan, a world-leading supplier of high-end lifting equipment. The company's philosophy is to live in harmony with nature and to select suppliers who help it achieve its sustainability goals. Teijin Aramid and Hampidjan have been innovation partners since 2017. Together, we have developed the Twaron®-based TERRA Sling: the world's first 100% recyclable heavy-lift sling for offshore and onshore construction. At the heart of our collaboration is our mutual commitment to collect and reuse end-of-life slings wherever possible.

## Benefits along the chain

As a favored supplier to shipping customers and other heavy industries, Hampidjan is an important driver of this recycling program. We organize the recovery of end-of-life TERRA Slings from end-users, enabling Hampidjan customers to solve their waste problem. The used products are then sent to our regional recycling centers where the aramid is extracted. Converted to aramid pulp, it is used in a range of applications, such as automotive brake pads, reducing the need for virgin raw materials. Our calculations show that using recycled Twaron® saves about 4kg of CO<sub>2</sub> equivalent over the product lifecycle of each sling. As a result, Hampidjan customers can lower their carbon footprint while also minimizing their waste. What began as a partnership between two companies is helping to improve sustainability and recyclability across multiple industries, cutting a path toward a fully circular aramid chain.





Performance per production location

## Local reporting on a global scale

Teijin Aramid has an extensive global network of sales offices and agents, enabling customers all over the world to optimally benefit from our products and knowledge. Our head office is located in Arnhem, as is our central R&D department. Our Twaron® production facilities are located in Delfzijl, Emmen, and Arnhem. This appendix presents all local facts and figures.

In addition to detailing our performance at a company-wide (Twaron®) level, we also report on the performance of our production locations a local level. If you have any questions regarding this data, feel free to contact us by email ([info@teijinaramid.com](mailto:info@teijinaramid.com)).

Scroll down to read more

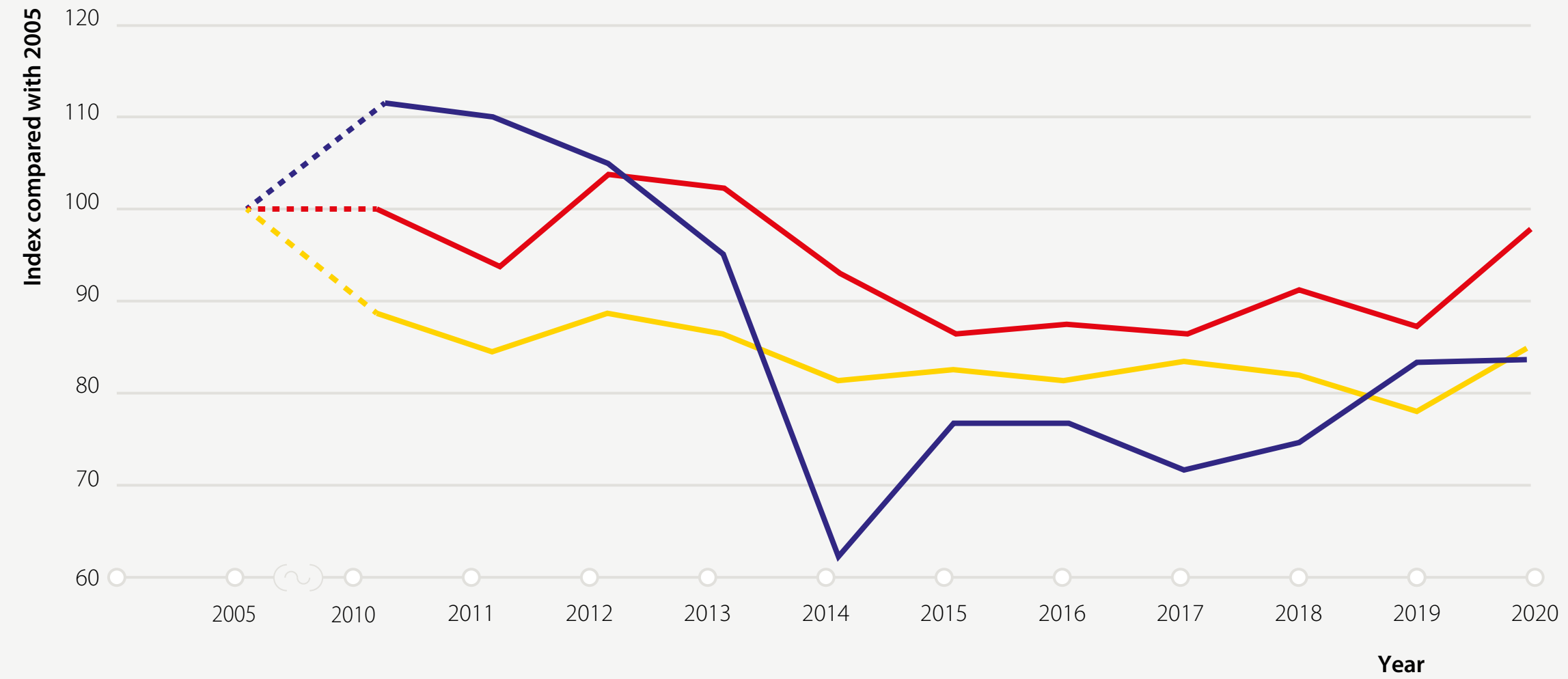




**Energy Efficiency Index**

We express our energy consumption by means of the Energy Efficiency Index (EEI). This is the total energy consumption per ton of manufactured product per site, compared with our reference year, 2005.

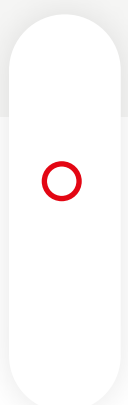
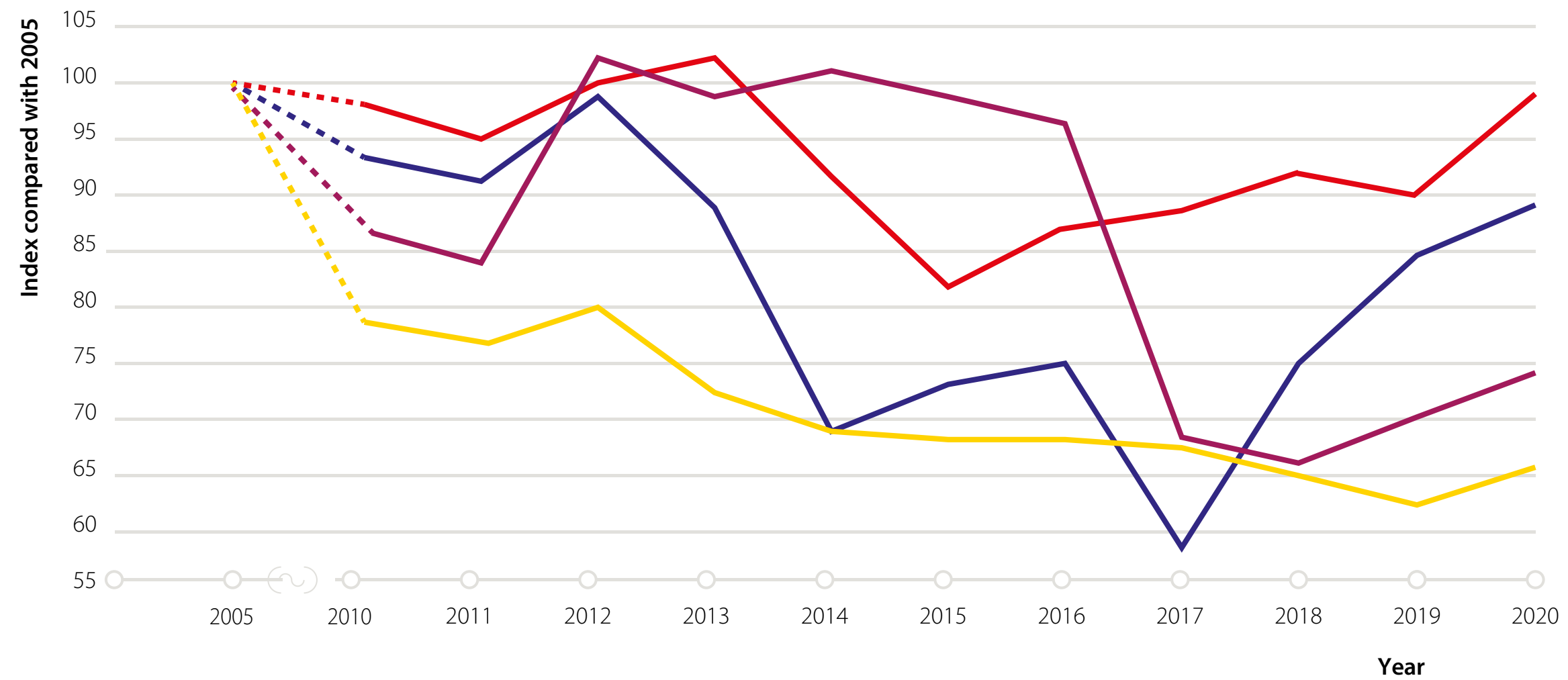
- EEI Delfzijl
- EEI Emmen
- EEI Arnhem



**Water Consumption Index**

We express our water consumption by means of the water consumption index per location. This is the total water consumption per ton of manufactured product per site, compared with our reference year, 2005.

- Index Delfzijl
- Index Emmen - yarn
- Index Emmen after treatment
- Index Arnhem

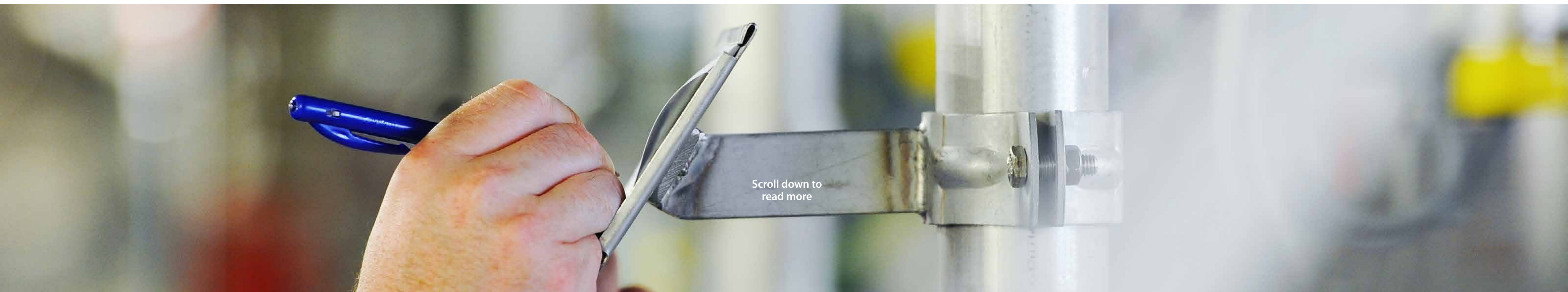
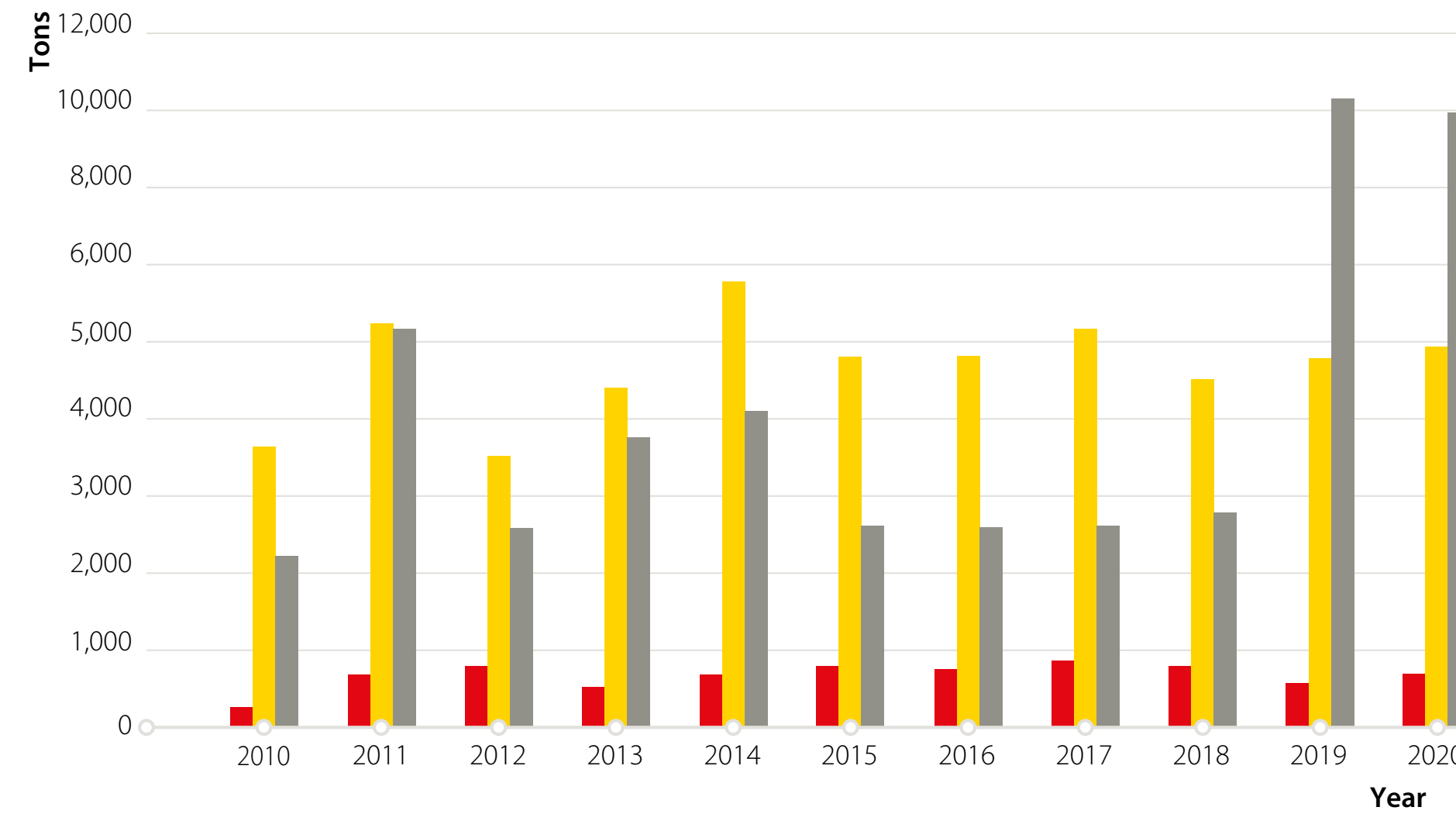




**Waste**

Despite our closed loops, all our production plants still produce waste. Where possible, this waste is recycled. Non-recyclable waste is incinerated with heat recovery. Waste that cannot be incinerated is sent to landfills.

- Landfill total
- Incineration total
- Recycled total



Scroll down to read more





Emissions to water	Location	2014	2015	2016	2017	2018	2019	2020
Component (in tons)								
Chemical Oxygen Demand (COD)	Delfzijl	57	60	48	61	51	67	39
	Emmen	5.1	4.5	5.8	5.4	5.2	5,0	4.0
	Arnhem	14.9	7.0	6.1	6.1	6.1	6.0	8.0
Total Nitrogen	Delfzijl	5.1	5.6	4.6	5.6	5.1	6.2	5.5
	Emmen	0.5	0.4	0.4	0.4	0.4	0.4	0.4
	Arnhem			0.2	0.1	0.5	0.5	0.35
N-methylpyrrolidone	Delfzijl	1.7	2.1	1.9	2.2	2.4	2.9	2.2
	Arnhem	0	0.2	0.2	0.1	0.3	0.4	0.25
Sulfate	Delfzijl	54	49	46	50	48	47	38
	Emmen	226	237	231	253	246	258	212
	Arnhem	70	57	49	67	62	41	46

Emissions to air	Location	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Component (in kg)												
Polymer dust and other particulates	Delfzijl	999	884	1,148	1,143	1,070	991	1,029	1,450	1,695	773	1141
	Arnhem	52	17	15	8	8	2	36	2	13	80	80
Tetrachloromethane	Delfzijl	103	145	301	81	184	677	145	132	44	48	41
N-Methylpyrrolidone (NMP)	Delfzijl	149	146	251	513	871	624	436	852	517	517	253
	Arnhem						6	10	<0.1	<0.4	<0.5	<0.4
Aniline	Delfzijl	81	23	26	21	20	20	20	50	42	22	22
Dichloromethane	Delfzijl	1,059	1,609	1,051	1,839	894	366	800	315	360	261	372
Freon 507	Emmen	490	49	0	245	147	98	245	294	98	245	150
	Arnhem					0	20	0	85	70	50	0
Nitrogen oxide (tons)	Delfzijl	11	12	11	11	12	9	8	10	9	11	11
	Emmen	1	2	2	2	2	2	2	2	2	2	1
	Arnhem	1	1	1	1	0.7	0.4	0.4	0.9	0.9	1.2	0.9

“In addition to detailing our performance at a company-wide (Twaron®) level, we also report on the performance of our production locations a local level”



# Impact cases: Making a difference

Energy efficiency

Raw materials

Impact on chain

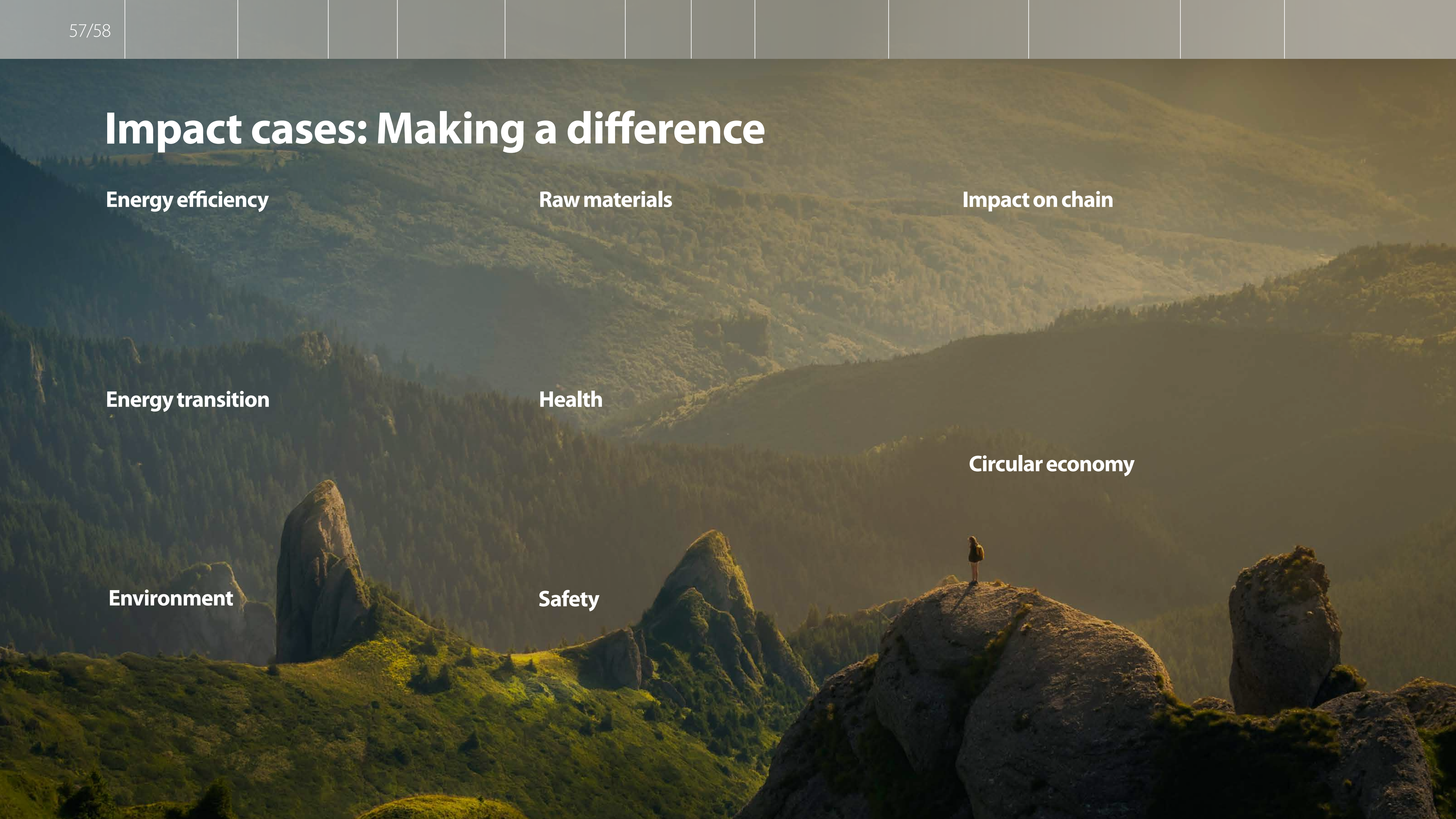
Energy transition

Health

Circular economy

Environment

Safety





## Be sure.

To us, everything connects. Every choice we make and every step we take as individuals, as a whole, leaves a mark. Now and in the future. That's why we aspire to shape a better future for generations to come.

Sustainable thinking and acting matter deeply to us - we continue to meet the needs of society today, without compromising the future. Through inventive thinking and smart collaborations, we challenge ourselves to improve our high-performance products and processes. Every day we contribute to developing sustainable solutions that create new value and reach beyond ourselves – for the present, for new generations, for our planet, and for you.

Let's think sustainable.  
Let's connect.  
Be sure.



### For more information

Please email us at:  
[sustainability@teijinaramid.com](mailto:sustainability@teijinaramid.com)  
or visit  
[www.teijinaramid.com](http://www.teijinaramid.com)

ta-8.1-20192606-en

Disclaimer: this data reflects our best knowledge at the time of publication. The content is subject to change as a result of new developments. It only contains a selection of the properties of the product(s) and is meant for commercial use only. Teijin Aramid gives no warranties and does not accept any liability regarding (i) the fitness of the products for any particular use, (ii) the correctness, completeness and usage of the information, (iii) the usage of the products (iv) or any infringement of any (intellectual or industrial) property of a third party. All intellectual property rights regarding this publication are the property of – or are licensed to – Teijin Aramid. Without our prior written consent, the reproduction and publishing of (parts of) this publication is prohibited.

**Twaron® Technora® Teijinconex® Endumax®**

