ARKEMA INNOVATIVE MATERIALS FOR A SUSTAINABLE WORLD

INNOVATIVE

2021 Annual and Sustainable Performance Report


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CONTENTS

The world is experiencing a wave of profound and rapid change, and people have high hopes for the future. Around the globe, action is being taken to address social, environmental, climatic and economic challenges, to make our world a better place.

Deeply committed to the world of specialty materials, the women and men of Arkema are driven by their technological know-how and innovative spirit.
Materials science is our shared passion. It enables us to create new materials, develop promising solutions, and help shape the future we want:

By addressing current and future challenges with high-performing, innovative materials;

By using our expertise, our diversity, and the talent of our employees to help our partners and customers in their search for sustainable performance;

By acting as a responsible industry leader who places climate issues and natural resource management at the heart of its actions;

By cultivating open dialogue with our stakeholders to better meet their expectations.

This is what unites us at Arkema. We reconcile social progress and environmental transition with economic development. And thanks to our innovative materials, we are riding this wave of change toward a more sustainable world.

ARKEMA

INNOVATIVE MATERIALS FOR A SUSTAINABLE WORLD

“Our development is focused on high-growth **technologies that are firmly rooted in sustainability.”**

Thierry Le Hénaff, the Group’s Chairman and Chief Executive Officer, looks back at 2021 and the beginning of 2022. We remain confident, despite the geopolitical context of the war in Ukraine causing some uncertainty.

What are your thoughts on the past year?

In 2021, we achieved record financial performance and continued to progress in line with our 2024 roadmap. At €9.5 billion, our revenue increased by more than 25% compared to 2020, while our EBITDA, at over €1.7 billion, and our margin of 18.1%, reached historic highs, despite a complex environment, marked by the impact of the health crisis and very high inflation in raw materials and energy. These results were only made possible thanks to the outstanding work and determination of the Arkema teams, to whom I would like to offer my sincere thanks.
Our performance in 2021 therefore confirms the relevance of our long-term transformation strategy and marks the beginning of a new era of growth for Arkema.
In the context of the post-Covid economic recovery, we have achieved strong organic growth, demonstrating the strength of our unique Specialty Materials offering which is based on our three complementary segments: Adhesives, Advanced materials and Coating Solutions.

“In 2021, we achieved record financial performance and continued to progress in line with our 2024 roadmap.”

In 2022, the geopolitical context of the war in Ukraine is affecting our economies. What might the consequences be for Arkema?

Firstly, like many, I am deeply concerned by this tragedy and the fate of the Ukrainian people suffering the consequences of the war and in many cases being forced into exile. Arkema decided to make a donation to UNICEF, which works on the ground to help children and their families.

We do not have an industrial base in Ukraine, Russia or Belarus and this area accounts for less than 1% of our sales, with 65 employees based in Russia. Of course, we will be keeping a very close eye on how the situation develops.

In terms of our activity as a whole, during the first months of the year, global demand remained relatively strong, but with some slight variations according to market and region. Our growth this year will be further driven by our innovation with regard to major societal trends. One of our priorities at the start of this year is our ability to pass on the sharp increases in raw materials and energy and to cope with disruptions in supply chains.

This year promises to be similar to last year in terms of the troubled operational environment, but we remain confident and are ready to adapt. We believe that 2022 will be another very good year, as presented in our guidance, which forecasts an EBITDA comparable to last year on a consistent, and replace basis in Specialty Materials.

How did Arkema’s profile evolve in 2021?

The product portfolio continued to evolve toward Specialty Materials, both through organic developments and our M&A activity. Following the completion of the sale of our PMMA business (Altuglas International) and the acquisition of Ashland’s performance adhesives, nearly 90% of Arkema's sales are now generated in specialties. We have come a long way since our initial public offering in 2006, when the Group generated €5 billion in revenue, mainly through Intermediates. We are thus on track to achieve our ambition of becoming a 100% Specialty Materials player by 2024, with revenue in excess of €10 billion.

Will you continue to make new acquisitions in 2022 and beyond?

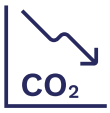
Today, we have a solid balance sheet with a net debt ratio of approximately 1.7 times EBITDA, after the acquisition of Ashland’s adhesives. As a result, we have the financial capacity to continue to make small and medium-sized acquisitions across our three segments. Our acquisition strategy is to target high-quality assets that enable us to accelerate our development in high-growth technologies, with a strong focus on sustainability. We plan to make three or four small acquisitions this year. >>

25%

Increase in revenue compared to 2020.

€750 M

Industrial investments made in 2021.



-38%

Our greenhouse gas reduction target for 2030 (compared to 2015).

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You changed your visual identity at the end of 2021 and adopted a new signature. What was the reasoning behind this?

Indeed we did. We felt that it was the right time to change our visual identity and thus fully reflect the evolution of Arkema's profile toward Specialty Materials. This has seen us become better aligned with our strategic vision which is based on materials science and the growing demand for sustainable solutions from our customers. Our new blue and green logo and our signature "Innovative materials for a sustainable world" embody this positioning and our response to environmental, climatic, energy, economic, and social challenges.

What sustainability-related applications are you working toward?

We have established very interesting positions in several areas with high growth potential, including batteries, 3D printing, more environmentally-friendly paints, lightweighting, bio-sourced materials used in green mobility, housing, consumer goods, water treatment, electronics, and sport. Hydrogen is another example of an area in which we see exciting opportunities for some of our materials.
Of course, to capitalize on all these new opportunities, the power of our innovation and the quality of our R&D are paramount. Consequently, we are now aiming for revenue of €1.5 billion from our five innovation platforms between 2019 and 2030, compared to €1 billion as previously announced.

What is your vision for 2024 and beyond?

There will be many sources of complexity and uncertainty over the coming years. The health context, geopolitical tensions, energy issues, access to talent, technological disruption, and the return of inflation are all issues that will require the Group to be agile and exercise caution. But I have full confidence in Arkema's future. We have the right strategy, a balanced positioning, talented and highly-engaged teams, and world-class technological expertise.
The Group will continue to grow thanks to the many opportunities available to us to support our customers in their quest for sustainable performance. To keep up with this growth, we made over €750 million in industrial investment in 2021. We have committed to new projects that will shape the future, such as a 50% capacity increase for PVDF (polyvinylidene fluoride) in China and France to serve the battery market, where we aim to generate €1 billion in revenue by 2030.
This year we will start up our polyamide 11 (PA11) bio-plant in Singapore, the largest industrial project ever undertaken by the Group, and a PA11 powders plant in China in 2023. A hydrofluoric acid plant will be commissioned in the United States this year and at the end of 2023, a production unit for 1233zd, a new generation of fluorospecialties with minimal impact in terms of emissions.
We will double our photocurable

"The Group will continue to grow thanks to the many opportunities available to us to support our customers in their quest for sustainable performance."

resins capacity in China for the electronics and renewable energy markets. Lastly, in France, we are also in the process of increasing our capacity for Pebax® elastomers - used in sports shoes and consumer goods - by 25%. All of these projects will have a positive impact on the Group's environmental footprint.

Your CSR ambition has never been stronger and more visible. How is Arkema progressing?

In 2021, we were very active in terms of Corporate Social Responsibility. It is at the heart of our strategy and our employees' priorities. For example, we have considerably expanded our portfolio sustainability assessment program, which measures the percentage of sales that contribute significantly to the UN Sustainable Development Goals. Secondly, we have accelerated our initiatives for a circular economy by increasing the share of revenue covered by a lifecycle analysis. Last year we acquired Agiplast, a high-performance polymer recycling specialist and a long-standing partner of Arkema. Furthermore, in line with the announcement at the beginning of 2020 of an ambitious climate plan to reduce the Group's greenhouse gases by 38% by 2030 compared to our 2015 baseline, we had already reduced our emissions by 34% at the end of 2021.
We are thrilled to see these achievements and this progress being recognized: we are now included in the CAC 40 ESG Index, which features the 40 largest companies listed in Paris with the best ESG practices. We have improved our ranking from 6th to 3rd place out of the 114 DJSI World chemical companies and have also consolidated our strong rankings from many non-financial rating agencies.

This year, you incorporated the concept of inclusion in Arkema's values. Why?

Since its initial public offering in 2006, the Group has been built on a foundation of strong values - solidarity, performance, simplicity and empowerment - that shape our corporate culture. These are not empty words for us, these values underpin our human relationships, our management, and of course our development.
In 2021, I wanted to add the value of inclusion to these four historical values. For me, the company has an important social role to play and inclusion is key because it recognizes the importance of tolerance, acceptance of difference, and the value of diversity. Everyone must feel that they have a place at Arkema, regardless of their origin, gender or profile. Diversity and inclusion go hand in hand, and Arkema must be exemplary in this area in order to realize its ambitions and reach its full potential.

If you were to give a candidate two reasons for joining the Arkema adventure, what would they be?

We are an international company whose growth is based primarily on sustainable innovation and which addresses outstanding human, industrial, commercial and environmental challenges. The Group's culture is based on authentic values and our employees are convinced of the strength of our vision and strategy, as evidenced by our regular engagement surveys. We offer a respectful, stimulating work environment and varied and empowering career paths. We are a company where employees feel good and give the best of themselves, as illustrated by the Group's growth over the past 15 years. If I were talking to a candidate, I would simply say: Join us, we will help you grow, and channel your talent and enthusiasm into an exciting project, based on our belief in the need for a sustainable world. ■

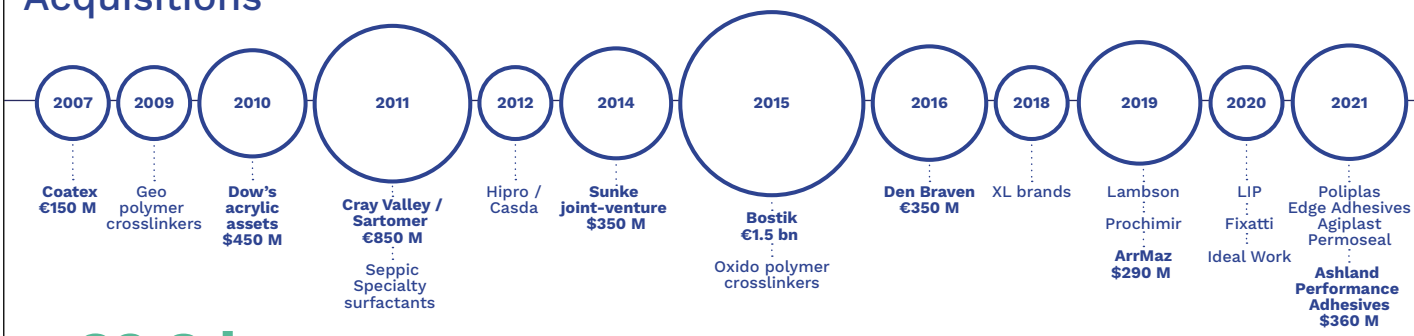
A successful transformation **to take us to 2024 and beyond**

Arkema is confident that the demand for innovative and sustainable materials will continue to grow in order to meet new societal needs linked to environmental and ecological awareness. As a result, the Group has been comprehensively transforming its profile since its creation to focus on specialty materials and the challenges of sustainable development.

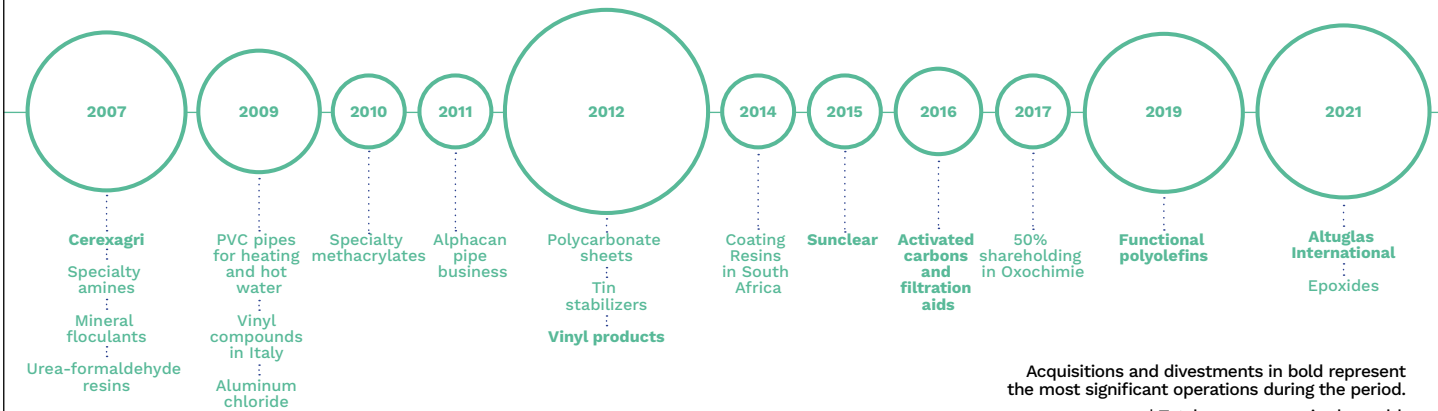
1 We have carried out acquisitions and divestments to further our transformation

The active management of its portfolio has been a strong driver of Arkema's transformation, in particular with the major acquisition of Bostik (€1.5 billion in revenue) in 2015 and the development of its Adhesives segment, as well as the strengthening of its presence in the high value-added downstream activities of its Coating Solutions segment. At the end of 2021, all of these transactions represented revenue of approximately €4.8 billion in terms of acquisitions and €2.8 billion in terms of divestments.

≈ €4.8 bn Acquisitions*



≈ €2.8 bn Divestments*



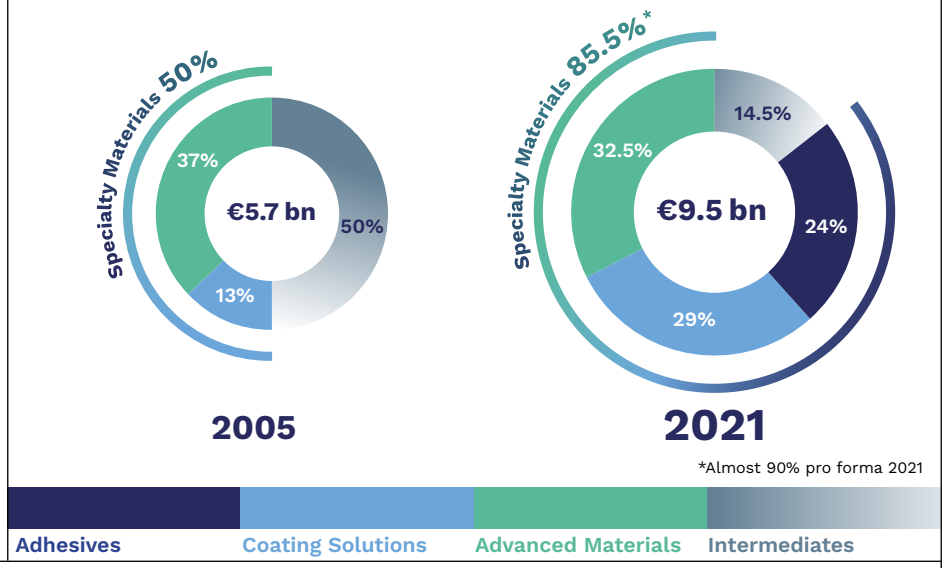
Acquisitions and divestments in bold represent the most significant operations during the period.

* Total revenue acquired or sold.

We have managed our portfolio so as to refocus on specialty materials - which now represent 90% of our portfolio - and to consolidate three additional business segments with a unique market offering to address the issue of using more sustainable materials.

Over the last 17 years, we have increased our revenue by 40%, thanks to our acquisitions and our dynamic organic growth.

REVENUE BY BUSINESS ACTIVITY

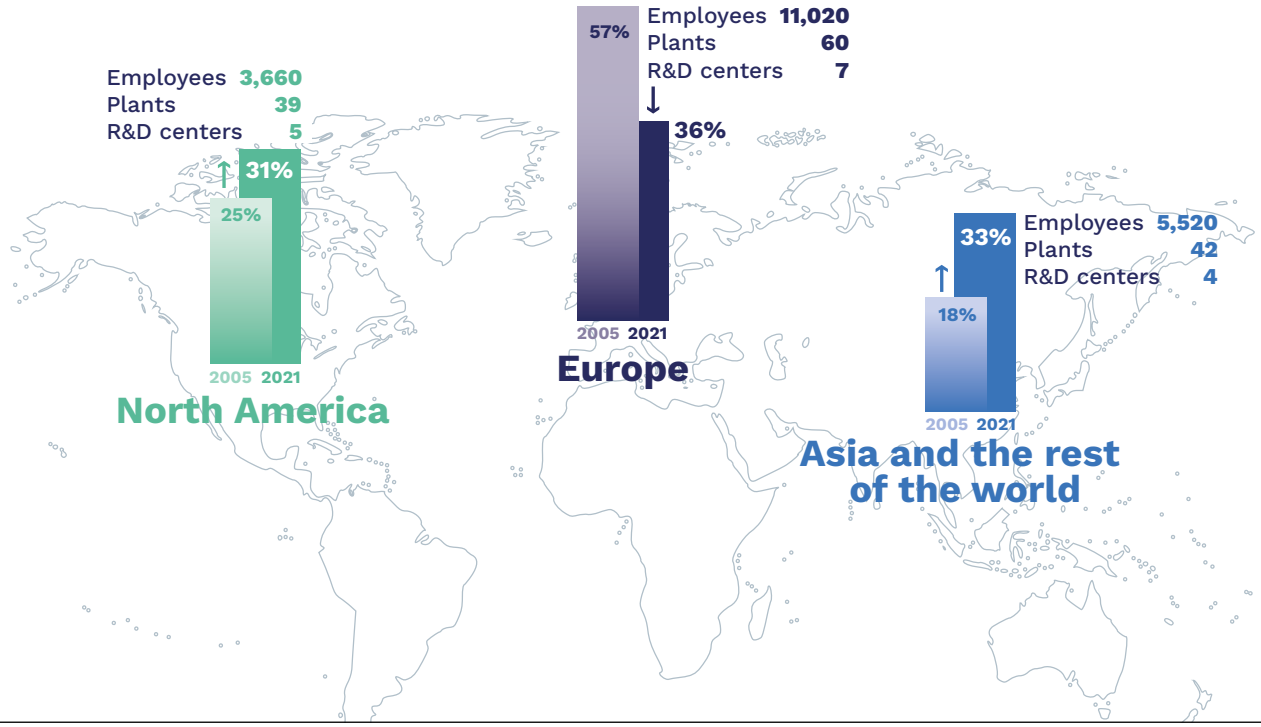


2 We have rebalanced our global presence

With revenue increasing from €5.7 billion in 2005 to €9.5 in 2021, Arkema has continued to grow and invest in developing regions. Over the past 17 years, the Group has sought to strategically balance its activities between Europe, Asia and North America.

Today, thanks to its policy of targeted acquisitions and major industrial investments, the Group is more international than ever, taking advantage of the momentum in high-growth areas.

REVENUE BY REGION



3 We have focused our R&D on five platforms to meet the challenges of sustainable development

In a world characterized by strong trends such as growing urbanization, the scarcity of resources, climate change and new technologies, Arkema has focused its research efforts to ensure that solutions are tailored to the expectations of its customers. This research, reviewed regularly, has led the Group to the definition of **five innovation platforms** that are clearly aligned with the United Nations' Sustainable Development Goals, including a new innovation platform dedicated to the management of natural resources. This includes bio-based, recyclable solutions and water management solutions.

OUR R&D AT A GLANCE

+1,600
researchers

16*
R&D centers located in Europe, Asia and North America
* including the R&D center of our Ashland acquisition

2.6%
of our revenue is devoted to R&D

222
patents filed in 2021, 90% of which relate to sustainable development and our five innovation platforms

15%
of our sales come from products that are less than five years old

“Our sustainable innovation dynamic should enable us to generate €400 million in additional sales in 2024 and up to €1.5 billion in 2030.”*

Armand Ajdari took over the Group's R&D Department at the beginning of January 2022. He talks to us about his vision for innovation, firmly rooted in the major challenges of sustainable development and linked to a vast ecosystem of innovators from the academic world and in business.

*compared to 2019

Boosting our R&D **through partnerships**

What challenges do you foresee as Arkema's the new Head of Research & Development at Arkema?

A.A.: I am very honored to take up this position after my many years in R&D at Saint-Gobain. There is great responsibility associated with this role. For me there is one main challenge: to develop solutions that offer high performance and sustainability to our markets. The Sustainable Development Goals are on everyone's mind and mean a lot to me personally. Arkema is working hard in these issues. We are living in a time of extraordinary acceleration with many opportunities. In order to take advantage of them, we need to be responsive and efficient, and to this end, our R&D must pay attention to what is going on in the world, in order to detect trends in our target markets and our key technologies as early as possible.

This requirement is echoed by the new prize to be presented by the French *Académie des Sciences* in partnership with Arkema, isn't it? (see text box)

A.A.: This sustainable materials prize is a way of promoting our name and highlighting our ambition vis-à-vis the academic world. It is first and foremost an incentive and a mark of recognition for researchers whose passion is aligned with our materials science projects focused on sustainable development. This sponsorship is also a way to build relationships with high-level scientists for partnership opportunities, with a view to creating a pool of talented partners to improve our capacity for innovation.

How do you plan to preserve the spirit of open innovation that was so important to your predecessor Christian Collette?

A.A.: We live in a fast-changing world, where it is essential to make connections before you even really need them. We need to build relationships in our own value chain, with our customers and suppliers, but also with start-ups, SMEs and the academic and university world, among others.

Arkema and the French *Académie des Sciences* launch a prize for innovation in chemistry for sustainable materials

At the beginning of 2022, Arkema joined forces with the French *Académie des Sciences* to launch this prize, which is intended to reward scientists for scientific breakthroughs in the field of sustainable materials, i.e. materials whose life cycle and use will lead to major environmental benefits. This prize will be awarded every year at a ceremony at the *Académie*'s prestigious premises in Paris, and carries a cash prize of €25,000.

Open innovation involves approaching every problem by asking: are we open enough, who could help me better identify the problem and find a solution as quickly as possible?

In which areas will Arkema be investing most?

A.A.: In line with its brand signature, Arkema primarily invests in its five strategic R&D platforms linked to sustainable development. Our contribution to the emergence of new materials and technologies for energy is key, as in the case of electric and hydrogen batteries, for example. Another key area is the responsible use of resources, circularity and reducing our carbon footprint. We develop both the products and processes that make this happen. In addition to these platforms, performance solutions play a role in a number of growth markets, often combined with proposals offering an environmental benefit. There are so many opportunities that it is important to prioritize and mobilize our resources in the areas that promise to have the most impact and value. For this, we benefit from a range of complementary technologies, whether in materials, adhesives or coatings. One of Arkema's strengths is positioning itself as a “premium one-stop-shop” for its customers.

4 We are rolling out three ambitious CSR programs

Market demand for sustainable, virtuous solutions is accelerating. The evolution of business models to integrate a sustainable aspect is a considerable field of opportunity and innovation for Arkema, which has committed to three highly-structured programs for its development strategy.

Update with Virginie Delcroix, Head of Sustainable Development and Noël Zilberfarb, Corporate Sustainable Offer Manager.

“We are doing a lot of work in our plants worldwide and in 2021, we recorded excellent results in terms of reducing water consumption, improving energy efficiency and boosting waste recovery.”

Virginie Delcroix,
Head of
Sustainable Development

1. Circular economy: a source of opportunities for Arkema

At the heart of its value chain, Arkema operates in several ways to optimize its resources and enable the recyclability of its products. Firstly, as Virginie Delcroix, Head of Sustainable Development, points out, *“through the widespread action we are taking in our plants around the world. I am thinking specifically of the excellent results achieved in 2021 in terms of reducing water consumption, improving energy efficiency and boosting waste recovery.”*

More broadly, Arkema plays a leading role in its entire value chain, and in particular with its customers, in designing materials and solutions that contribute to the circular economy: by choosing renewable or recycled materials, reducing the amount of material used, the separability of materials and components, their degradability, their ability to be recycled themselves, or their capacity to facilitate the recycling of the end products in which they will be incorporated. The issue of end-of-life products - and their recyclability - is now considered as part of their ecodesign, which involves the entire value chain, especially suppliers.

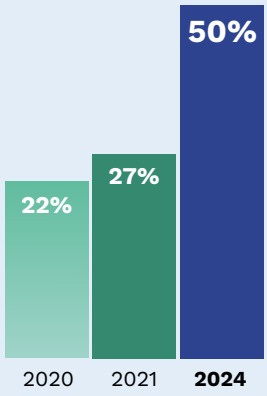
Arkema can act on many aspects of the circular economy thanks to its wide range of technologies and materials such as its polymers, additives and adhesives. *“Many industries are currently developing so-called single-material systems, with different components that need to be compatible and recoverable as part of the same recycling process. For example, Bostik is actively working on this, and last year introduced a grade of laminating adhesive for the flexible packaging market, compatible with polyolefin recycling processes, which is a first on the market. This is a telling sign of the protean aspect of the circular economy.*

Noël Zilberfarb,
Corporate Sustainable Offer Manager

“As producers of specialty materials, we cannot piggyback on existing recycling channels such as those for glass, paper or polyethylene. We need to invent our own channels.”

CIRCULAR ECONOMY AND SUSTAINABLE RESOURCE MANAGEMENT

Percentage of sales covered by a lifecycle analysis



As a specialty chemist, we have an important role to play with regard to all these features,” explains Noël Zilberfarb, Arkema’s Corporate Sustainable Offer Manager.

Our bio-circular policy is a response to high market expectations. It is expressed through the constant increase in the number of our solutions produced from plant sources. Arkema is a pioneer in this field with its Rilsan® polyamide 11 derived from castor oil, a real success story in a wide variety of applications. Our bio-sourced offering extends to many other solutions (specialty surfactants, resins for decorative paints, epoxy plasticizers, hot-melt adhesives, etc.)

Beyond technological innovation, we must also come up with new organizational processes to recover the material, sort it, rehabilitate, purify it and reuse it. An approach to which Arkema contributes, according to Noël Zilberfarb: *“As producers of specialty materials, we cannot piggyback on existing recycling channels such as those for glass, paper or polyethylene. We need to invent our own channels. This is a strong commitment within our High-Performance Polymer business line, which acquired Agiplast in 2021, a company that specializes in the recycling of specialty polymers to enable our customers to engage in circular channels.”* ■

-9%
Reductions in water consumption between 2020 and 2021 (i.e. 104 million m^3 instead of 114).

-15%
Reduction in net energy purchases compared to 2012, fully in line with the target of 20% by 2030.

40%
Percentage of waste (material or energy) recovered in 2021, compared with 35% in 2020.

2. ARCHIMEDES: to evaluate and develop a portfolio of increasingly sustainable and virtuous solutions

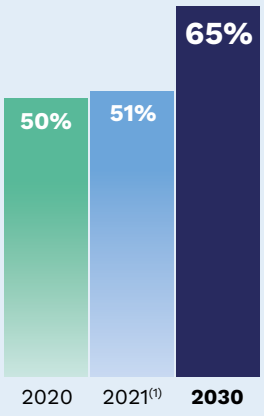
Aligning the entire Arkema offering with the United Nations' Sustainable Development Goals (SDGs) is the objective of the ARCHIMEDES program, our Portfolio Sustainability Assessment. An ambitious project that requires methodology and rigor, as explains Noël Zilberfarb, Arkema's Corporate Sustainable Offer Manager: *"For the past three years, we have been evaluating our solutions portfolio from a sustainability perspective, integrating the entire value chain, and taking each product into account in its various applications and geographical presence. This systematic analysis enables our business lines to evolve their portfolios by accelerating innovation and sales of virtuous solutions. The Group's goal, by 2030, is to ensure 65% of our sales represent 'impACT+' solutions, which contribute to the SDGs and do not pose significant health or environmental risks. During the assessment, if a risk is identified for a solution, we define an action plan, such as the development of alternatives or even substitution."* The ARCHIMEDES program is consistent with the aim of developing "Safe and Sustainable-by-Design" products and solutions, as promoted by the European Green Deal. *"Societal expectations and regulatory changes insist that we develop solutions that are safe, both for people and for the environment, and that contribute to a low-carbon economy and responsible resource management,"* says Virginie Delcroix, Arkema's Head of Sustainable Development. *"Arkema is deeply committed to this way forward. It is clearly one of our top priorities."* ■

"By 2030, we aim to ensure 65% of our sales represent 'impACT+' solutions, i.e. contributing to the SDGs and not posing significant health or environmental risks."

Noël Zilberfarb,
Corporate Sustainable Offer Manager

ARCHIMEDES PROGRAM: TOWARD AN INCREASED POSITIVE IMPACT

Percentage of sales contributing significantly to the UN Sustainable Development Goals



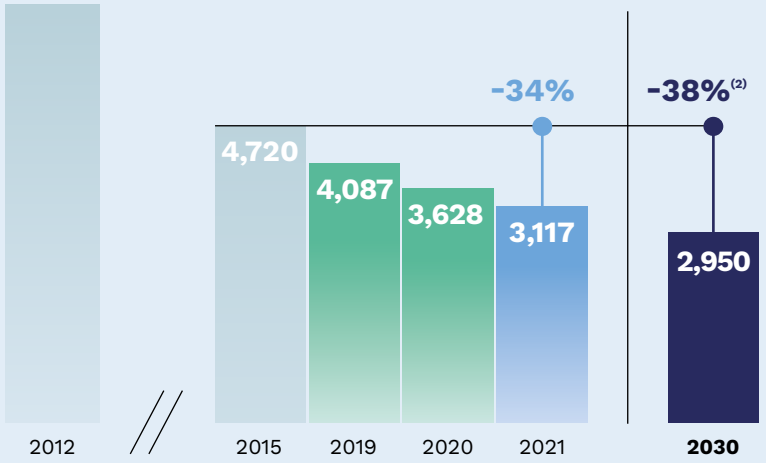
(1) Sales portfolio sustainability assessment on 85% of sales assessed in 2021 and 72% in 2020.

3. Climate Plan: doing more for the climate

In line with the Paris Agreement, Arkema is contributing to the global effort to limit global warming below 2°C above pre-industrial levels, by 2100. The Group is committed to an ambitious climate plan, with a target of reducing its absolute greenhouse gas (GHG) emissions by 38% from its 2015 level by 2030, regardless of the growth of its activities.

This implies the constant improvement of production processes, the decarbonization of energy sources, and a specific policy of optimizing energy efficiency. *"We significantly reduced our GHG emissions in 2021 and increased our efforts to engage our suppliers in setting ambitious climate targets,"* says Virginie Delcroix. *"Indeed, we must think about and act for the climate on the entire upstream-downstream value chain."*

ARKEMA CLIMATE PLAN:
A COMMITMENT ALIGNED WITH THE PARIS AGREEMENT
(absolute greenhouse gas emissions)



Science Based Target is well below 2°C
In kt of CO_2 equivalent
(2) Target for absolute GHG emissions (scopes 1 & 2 + ODS) vs 2015

In addition to continuous improvement and innovation in manufacturing processes, achieving the objectives of this climate plan requires the continuation of energy sourcing efforts and the priority consideration of the carbon issue in all investment decisions (acquisitions, construction and unit extensions). Each of Arkema's business lines is expected to contribute to this evolution, with the end goal of reducing the carbon footprint of our products and, in turn, that of our customers.

A collaborative approach is key, both the climate and the circular economy. *"These issues require exploring outside of the usual frameworks and defining new processes,"* emphasizes Arkema's Head of Sustainable Development. *"The Group therefore works together with its customers, its suppliers, in consortia, with universities and all essential partners to develop innovative and competitive technical solutions."* ■

"We significantly reduced our greenhouse gas emissions in 2021 and increased our efforts to engage our suppliers in setting ambitious climate targets."

Virginie Delcroix,
Head of Sustainable Development

BELIEF #1

Thanks to our specialty materials, electric vehicle batteries are already performing better and are more sustainable.

CARBON-FREE MOBILITY

Transport: **a new electric age**

The global market for electric motors doubled in volume between 2020 and 2021. And this is just the beginning: buoyed by ever-more proactive policies to respond to the climate and energy crisis, in Europe, North America and Asia, electric and hybrid vehicles are expected to account for 15% of sales by 2025 and 32% by 2030.

They could make up the majority of global mobility within a decade. All major manufacturers and OEMs are committed to this revolution, as is the Stellantis Group, which announced that 100% of its sales in Europe and 50% in the United States will be electric by 2030. Improving the energy efficiency of electric motors and their range, optimizing resources and reducing the carbon footprint of vehicles are some of the major challenges of this decade. A technological revolution in which Arkema intends to play a key role: its recognized expertise and unique portfolio of high-performance materials make it a true contributor of solutions for accelerating the transition toward this new electric age. >>

32%

Expected market share of electric vehicles in 2030.

(2021 Deloitte report)

Li-ion batteries: the solutions and vision of a leading materials producer

Arkema has a long history of world-leading R&D in the development of electric mobility, offering an unrivaled range of materials that improve the performance of today's batteries and prepare for the next technological breakthroughs.

INSIDE THE MODULES AND THE PACK

❶ Coating of the bus bar:
RILSAN® OR KEPSTAN®, RELIABLE SOLUTIONS

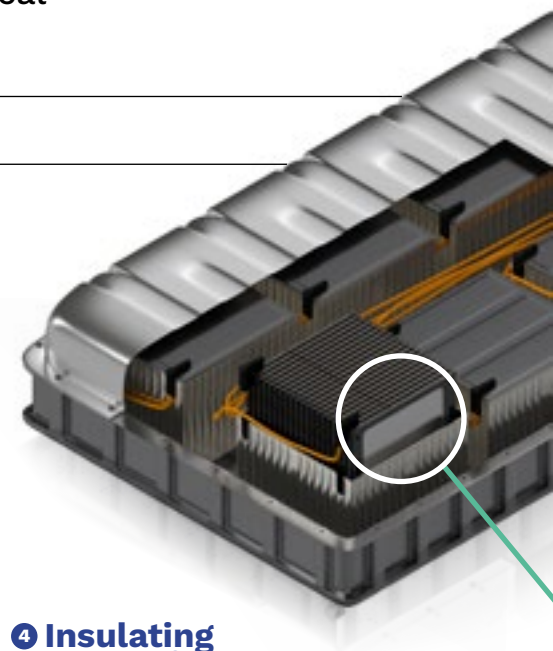
To coat copper connectors (bus bars) that connect the cells together, the Rilsan® polyamide 11 in fine powder offers thermal stability, fire resistance and electrical insulation, tried and tested by an increasing number of manufacturers. As fire-resistance standards become increasingly stringent in some countries, Kepstan® PEKK can withstand 500°C for over 5 minutes and now offers an alternative for this application.

❷ Cooling:
STAYING ONE STEP AHEAD

Rilsan® Polyamide 11 is a proven solution for protecting cooling circuits and already accounts for a substantial volume of sales, with strong growth potential for 2030. In the medium term, however, immersion cooling (where the entire battery is filled with a heat-absorbing liquid) could be required by some manufacturers - a technological change anticipated by Arkema's R&D which is preparing specific formulations using dielectric fluids.

❸ Glues and adhesives:
ADVANCED SOLUTIONS FROM BOSTIK AND SARTOMER

Within a battery, many adhesive functions are used to ensure that there is lasting adhesion between the cells and with the battery pack under demanding conditions. Bostik has made this sector a strong focus of its innovation policy and is developing advanced structural bonding and sealing solutions (gap fillers), which are in the process of being qualified in various gigafactories. Arkema also offers specialty methacrylate resins under the Sartomer® brand, which provide structural adhesives with exceptional strength and flexibility. These future technologies, specially adapted to the structural bonding requirements of batteries, allow for robust, long-lasting attachment capable of absorbing vibration and thermal expansion.



❹ Insulating coatings for batteries:
UV RESINS ON THE WAY

With the emergence of electric mobility, new levels of performance are required for battery-related coatings. UV-curable solutions are attracting the interest of manufacturers due to their instant drying time and ease of application, key factors for industrial efficiency. With its flagship range of Sartomer® UV resins and additives, Arkema is developing high-performance solutions for this application (electrical insulation, chemical resistance and impact resistance), while avoiding emissions of volatile organic compounds. ■

€1 bn

Arkema forecasts €1 billion in battery sales by 2030.

+40%

The average range of electric cars has increased from 211 km in 2015 to 350 km in 2021, an increase of 40%.

Global Electric Vehicles Outlook 2021 report, International Energy Agency

AT THE HEART OF THE CELL

❶ Electrodes and separator film:

SUSTAINABLE GROWTH FOR KYNAR® PVDF

A critical material in Li-ion batteries, PVDF (polyvinylidene fluoride) performs essential functions to protect the separator film (between the anode and cathode), where it provides safety and increases the life of batteries. It also binds active particles to the cathode to improve energy efficiency in the cells. Arkema is now one of the main producers of PVDF under the Kynar® brand, for which it has been developing specific grades for 25 years. Arkema is achieving long-term, double-digit annual growth in this market, and is gaining more momentum by further strengthening its presence in both production and R&D across the three main regions responsible for the future of electric mobility: Europe, North America and Asia. The Group has therefore decided to increase its production capacity of Kynar® PVDF in China to 50% for 2022 and to achieve a 50% increase in the capacity of its factory in Pierre-Bénite (France) by 2023.

❷ Carbon nanotubes Graphistrength®:

A BIG ADVANTAGE FOR ELECTRODES

Arkema is one of the world's few producers of carbon nanotubes. Added in small quantities to the cathode, they significantly improve electronic conductivity by helping the flow of electrons to the anode, thus reducing battery charge time.

❸ Electrolyte salts Foranext®:

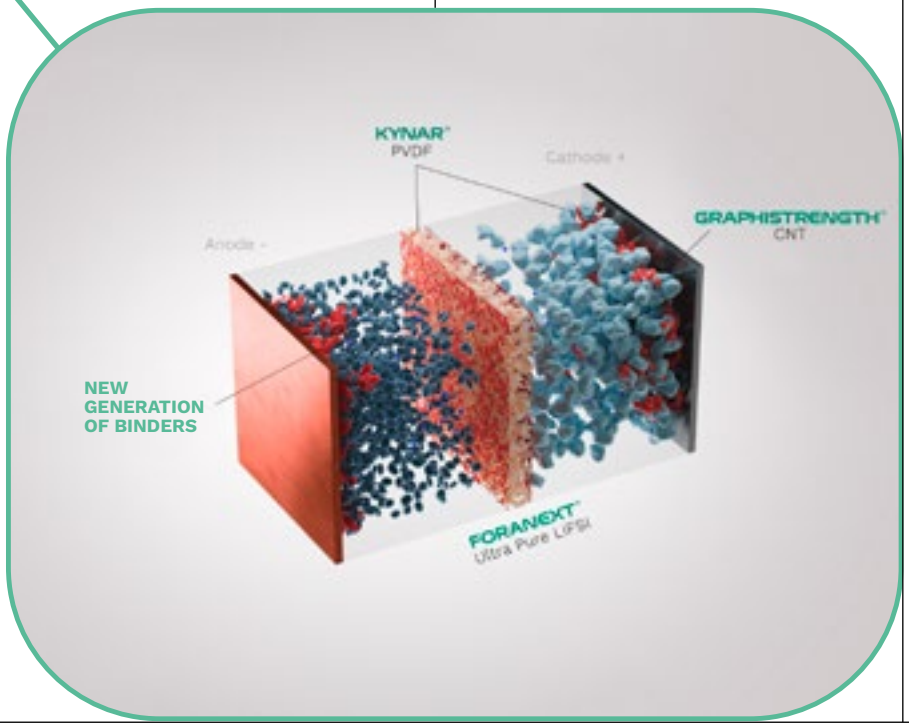
A STATE-OF-THE-ART SOLUTION FOR HIGH-VOLTAGE BATTERIES

Higher battery voltage is a significant market trend that increases the requirements for the electrolyte salts used in each cell. Arkema anticipated this need by investing for several years in the development of an ultra-pure LiFSI electrolyte salt, which offers higher conductivity than current solutions, enabling reliable performance in cold weather and reduced charging time. Arkema has also developed a LiTDI additive used in electrolyte formulations to increase their durability. This breakthrough technology will be marketed in 2023.

❹ Innovative binders

FOR THE ANODES OF TOMORROW

The next generation of Li-ion batteries will incorporate a graphite/silicon anode for which current binders have limited performance. For this emerging technology, which could take the lead by 2030, Arkema is developing specific grades of binders, based on newly patented resins, thus creating significant potential for growth. ■



Center of Excellence dedicated to batteries: **a major asset for Arkema's innovation strategy**

The inauguration took place on November 19, 2021, and was attended by Thierry Le Hénaff, Chairman and CEO of Arkema, as well as numerous customers and partners. The Group has opened a new Center of Excellence dedicated to batteries for clean mobility at its research center in Pierre-Bénite, France. This multi-technology and multi-product space is entirely geared toward developing advanced materials and processes for the batteries of the future. Called Christian Collette in memory of the Group's Head of Research who died in 2021, this center benefits from state-of-the-art equipment, including a dry room, an electrode manufacturing line and a pilot line dedicated to the preproduction of the next generations of electrolyte salts. Arkema's teams, in collaboration with their academic and industrial partners, are addressing a range of short-term and medium-term technological challenges: binders for next-generation active materials (high-nickel or high-manganese), silicon-enriched anodes, high-voltage batteries and "solid-state" batteries. ■

60%

Manufacturers currently manage to recycle up to 60% of the weight of a battery.

Institute for Sustainable Futures (ISF), University of Technology Sydney, Australia

VERKOR

With Verkor, Arkema is investing **in the French battery ecosystems**

Arkema contributed several million euros in 2021 to the fundraising of French company Verkor, which plans to develop high-performance, low-carbon batteries. Through this investment, which falls under the technology partnership, the Group intends to contribute its expertise and materials solutions to a highly innovative project, which will strengthen the battery ecosystem in France and Europe. The French start-up, which has brought together major players such as Renault Group, EIT InnoEnergy, Tokai COBEX and Schneider Electric at its Grenoble innovation center, has just announced the construction of a next-generation gigafactory, which is expected to become operational in 2023, in France near Dunkirk. From 2025, this plant will produce 300,000 batteries, equivalent to 50 GWh. Verkor will use these to equip a million electric vehicles, including the famous Alpine built in Dieppe by Renault Nissan. ■

300,000

The number of batteries, i.e. the equivalent of 50 GWh, that the new Verkor plant in Dunkirk will produce from 2023.

End of battery life: now is the time to prepare

With the rapid development of electric mobility comes the issue of what to do with batteries when they come to the end of their serviceable lives. Arkema has made this major environmental issue a key criterion in its innovation policy. In conjunction with the Virtucycle™ Recycling Program (see p.36), the Group is developing recovery and recycling processes for Kynar® PVDF contained in batteries. The first step, which consists of separating the various materials that make up the battery after crushing, involves hydrogen peroxide, of which Arkema is a major producer. Bostik's adhesive solutions also play a key role in this process: they must ensure the long-lasting adhesion between the battery components while also allowing them to be detached and separated at the end of their lives. An important aspect to highlight: The LiFSI electrolyte salts developed by Arkema to support the boom in high-voltage batteries can be recovered and reused through a competitive process already patented by the Group, a major advantage. ■

BELIEF #2

We have faith in the rise of hydrogen and bio-sourced jet fuel. Our solutions contribute to the development of these new fuels.

CARBON-FREE MOBILITY

Hydrogen, an asset in the making **for carbon-free mobility**

Hydrogen fuel cells, not yet commonly used in engines, will have their role to play in post-oil mobility options, alongside all-electric vehicles. Arkema has anticipated this shift, developing materials and solutions that are already contributing to improving the industry's performance and business model.

The Hydrogen Council estimates that six million hydrogen tanks could be produced worldwide every year after 2030. For several years now, manufacturers like Renault and Hyundai have been marketing hydrogen cars, while local governments have launched experimental bus lines. Yet the sector still only accounts for a marginal share of global mobility. *“The basic technologies for fuel cells, storing and transporting hydrogen, are essentially ready”* explains Jean-Paul Moulin, Materials Science Director at Arkema R&D. *"The key issue now is how to produce fuel in a carbon-free way.”* While 96% of the hydrogen currently being used comes from the reforming of fossil-based methane, renewable, water-electrolysis production lines have yet to become economically viable. This is the subject of considerable global research and development efforts, fueled by the benefits that hydrogen, not as a source but as a “carrier” of green energy, would bring (see box p. 24). >>

>>

Complement with all-electric engines

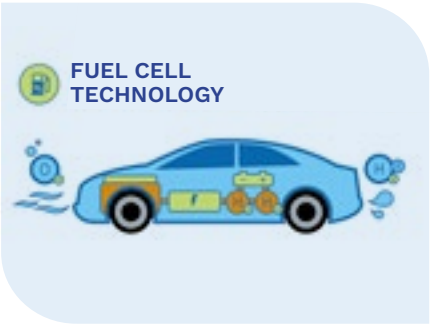
Considering the challenges of post-oil mobility, which will require the best use of all available levers, hydrogen must take advantage of the development of green electricity networks and find its place alongside all-electric engines. *"These two approaches are very complementary in their uses,"* says Jean-Paul Moulin. *"Hydrogen has a higher energy density than batteries, which means greater autonomy and much faster refueling times – it only takes a few minutes to fill up."* Fuel cells are therefore better suited to vehicles covering long distances, such as commercial vehicles, trucks, coaches, trains and even boats.

Arkema is working hand-in-hand with the hydrogen industry to rise to the challenge

This is the prospect being opened up by manufacturers and OEMs with expertise in high-performance materials, including Arkema, who are investing in this technology: *"We are closely monitoring progress in the industry and are already developing a set of dedicated solutions that will contribute to improving the performance and carbon footprint of hydrogen vehicles,"* emphasizes Jean-Paul Moulin. From tank shells to fuel cell exchange membranes, hydrogen mobility can rely on Arkema's materials and ideas to write the future. ■

Fuel cells, a renewable electricity carrier

Within a fuel cell, the oxidation of hydrogen on an electrode generates voltage. A hydrogen car is therefore an electric vehicle whose energy reserve is embedded in the form of hydrogen. However, to produce hydrogen in a carbon-free manner, via water electrolysis, renewable electricity is needed. So hydrogen is not an energy source, but a "carrier" that converts electricity into a format that can be stored more easily. This characteristic makes it a very fitting option to support the development of so-called intermittent renewable energies (solar and wind), the production of which is not always in line with what is required – when a peak in production occurs at a time of low consumption, the surplus can be stored as hydrogen fuel and used later, for "zero-emissions" mobility, for example.



6 million

The number of hydrogen tanks that could be produced worldwide every year after 2030, according to the Hydrogen Council.

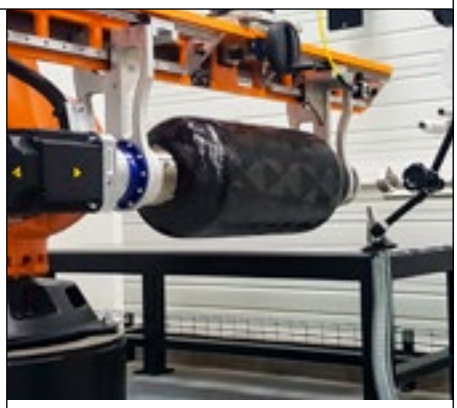
Hydrogen: Arkema solutions **on the starting blocks**

Rilsan® polyamide 11, Elium® thermoplastic resin, Kynar® PVDF and advanced piezoelectric materials: Arkema is rising to the challenges of hydrogen vehicles and is creating solutions that will contribute to the growth of a new carbon-free mobility.

Elium® composite tanks: **manufacturing gains and recyclability**

For the high-pressure storage (700 bar) of on-board hydrogen, current tanks are made of a composite based on thermoset resin (epoxy), which must be cured for several hours after winding. Elium® liquid thermoplastic resin, combined with carbon fibers, offers the same strength properties with much better industrial efficiency.

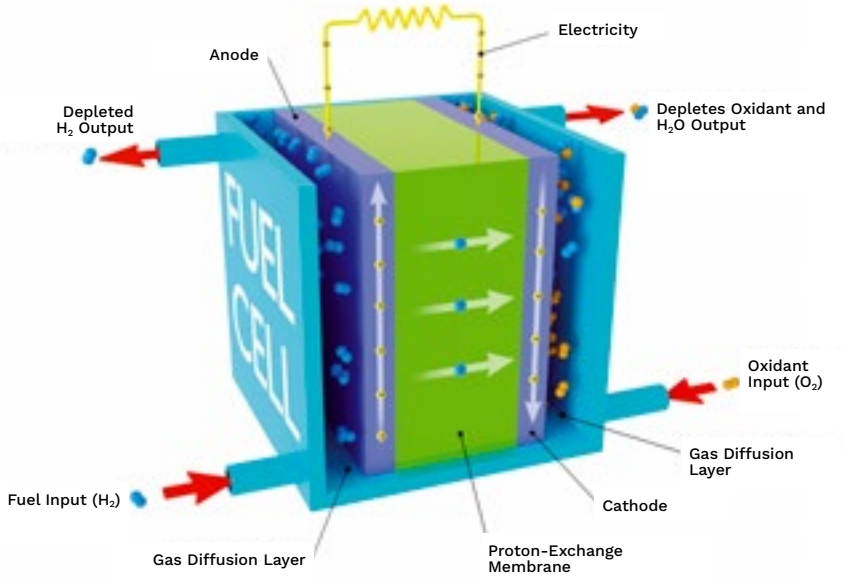
Its polymerization under the effect of UV is carried out during the winding process, saving considerable time and energy. This technology, which could see its first applications for light vehicles on the market in 2023, also offers excellent recycling possibilities for composite tanks at the end of their life, while thermoset resins are still very hard to recover. ■



— **TANK PROTOTYPE**
made of carbon fibers combined with Elium® resin cured by UV radiation.

700 bar
A hydrogen tank must resist pressure of up to 700 bar, which is the equivalent of 713 kg per cm^2.

Kynar® PVDF: core chemical properties **at the heart of batteries**



A true agent for charging electric vehicle batteries (see p.18), PVDF is also a key component of fuel cells. Due to its high electrochemical stability, it plays an essential role as a binder in the formulation of the graphite double pole plates that serve as a current collector, ensuring the cooling and transportation of gases. Arkema already sells significant quantities of its Kynar® PVDF for this application.

The Group is also developing functionalized Kynar® grades with properties including advanced proton conduction, temperature stability and chemical degradation resistance. These will boost the performance of the exchange membranes, which conduct protons within the battery, within the next four to five years. ■

Electroactive polymers: **the safety advantage for tanks**

The fluorinated electroactive polymers of the Piezotech® range, sensitive to shocks, deformations and acoustic vibrations, open up prospects for innovation with high added value for the safety of hydrogen vehicles. Used to form sensors embedded in the composite layer, they can provide a continuous monitoring function for the condition of hydrogen tanks, which also allows manufacturers to size the structure as accurately as possible with regard to safety issues, generating raw material savings. Arkema expects the first launches of this application, which is still in the R&D stage, to be within the next three to five years. ■

Rilsan® polyamide 11: **bio-sourced solutions for the liner and for winding**

Rilsan® polyamide 11, a 100% bio-sourced high-performance polymer, has the qualities required to form the interior liner of high-pressure tanks. Impermeable to hydrogen, resistant to cold shocks (the tank temperature may drop to -50°C in the event of rapid depressurization), barely affected by temperature variations and easy to work with, including for large parts (tanks for trucks, for example), it is already being used by several manufacturers. Within the next two or three years, it will also offer a next-generation solution for the production of carbon fiber composite tapes pre-impregnated with Rilsan® fine powder, making it possible to form a tank shell that also acts as a liner by hot winding. It is an excellent choice for manufacturers as it does not need to be cured after winding and requires less carbon fiber (the main cost factor for tanks) than epoxy with the same resistance. ■

Aviation
DMDS helping green **fuels take off**

As aircraft manufacturers and governments seek to reduce the carbon footprint of air travel, the use of bio-kerosene is booming. Its production involves new refining processes in which DMDS, an additive derived from sulfur chemistry, of which Arkema is the world leader, plays a key role.

By 2030, the aviation industry will see the share of renewable fuels in its total energy consumption increase twofold. This shift, encouraged by regulations like the RED II directive in Europe, requires the use of conventional kerosene plus bio-fuels and now also the development of "green kerosene", which is wholly derived from biomass. Like Total's La Mède facility in France, since 2019, more and more refining plants are being converted to produce these next-generation fuels. DMDS (dimethyl disulfide) performs an essential function in this chemical process. *"Bio-refineries use catalysts to deoxygenate the vegetable oils from which bio-kerosene is made,"* explains Francis Humblot, Business Development Manager for Oil & Gas in the Arkema Thiochemicals business unit. *"Our product, injected at the right time into the reactors, causes the surface of these catalysts to activate."*

— **BIO-BASED FUELS** will double their share in aviation fuel consumption by 2030.

Global demand to grow 15% by 2030

Demand for this specialty additive, recognized across the globe for its efficiency and already vital in the oil industry, will surge worldwide due to the rapid growth of bio-kerosene: *"We expect that in 2030, DMDS consumption in this market will be equivalent to that of the traditional refinery market and will contribute to a 15% increase in DMDS consumption globally",* says Guillaume Legouis, DMDS Global Business Manager at Arkema. The Group, the undisputed world leader in the supply of DMDS, with two production sites in Kerteh (Malaysia) and Lacq (France), is of course aiming to support this growth. Its Carelflex® service offering, which enables it to ensure the safe *in situ* injection of DMDS into refineries around the world by a team of Arkema experts, is already successfully supporting the main producers of bio-kerosene. ■

No. 1

With two production sites, in Malaysia and France, the Group is the world leader in the supply of DMDS.

BELIEF #3

We are constantly innovating to achieve better performing, bio-sourced and more environmentally friendly paints and coatings.

SUSTAINABLE PAINTS AND COATINGS

Resins and additives, a leading offering **for more sustainable coatings**

Interior decoration, boats, construction, automotive, touchscreens, packaging, industrial timber, metal infrastructure and more: the coating sector covers a huge range of applications and meets demanding and varied aesthetic, functional and regulatory specifications.

Arkema is one of the world's leading players: its vast portfolio of materials - resins and additives - provides manufacturers of paints, varnishes and lacquers with solutions that meet market expectations, increasingly driven by energy and climate challenges. *"Our role is to support the transformation of the coating sector by focusing on four major aspects: phase out of hazardous substances, the quest for bio-sourced raw materials, development of more efficient and sustainable technologies and the evolution of application processes toward greater industrial and energy efficiency",* explains Hélène Pernot, Sustainable Offer Manager Coating Solutions at Arkema.

Our four main areas of improvement explained. >>

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❶ Phasing out hazardous substances:

STAYING ONE STEP AHEAD OF REGULATIONS

Phasing out hazardous substances (HAPs*, heavy metals, volatile organic compounds, etc.) is a critical issue in the coating sector, driven by increasingly stringent regulations. An underlying trend that is driving Arkema's entire Coatings offering: the Group anticipates the implementation of new standards to offer its customers, manufacturers of paints, varnishes or lacquers, a wide range of solutions that comply with the highest health and environmental standards, beyond regulatory requirements. Its proven expertise in solvent-free (aqueous, powder and UV-curable resins) and high-solid resins technologies also makes it one of the world's leaders in reducing the use of volatile organic compounds in coatings.

* Hazardous Air Pollutants.

❷ Bio-sourced solutions:

FOR COATINGS WITH A LOWER CARBON FOOTPRINT

The search for alternative feedstocks based on renewable or partially recycled materials is one of the main areas of focus in Arkema's policy for reducing the carbon footprint of coatings. In the context of decorative paints and lacquers, this has led to the Synaqua® range of alkyd resins, which have a high content of bio-sourced materials: from 42% to 96% of total carbon, depending on grade, mainly from paper byproducts. For photocurable specialty coatings, Arkema offers UV Sarbio® resins, based on renewable raw materials. Synaqua® and Sarbio® products have been awarded the USDA* label, which certifies their bio-sourced content. In the context of specialty additives (modifying the fluid behavior of formulations), the Group has proven reference products in this field, with the Crayvallac® ranges (80% based on castor oil derivatives) for marine paints and construction sealants, and the Coapur™ range, which will introduce new bio-renewable raw materials based thickeners for aqueous paints. In 2021, the Group also initiated a "mass balance" sourcing approach for its acrylics sector (see box opposite).

* US Department of Agriculture

96%

Some of our paint resins contain up to 96% bio-sourced raw materials.

❸ A unique combination

OF TECHNOLOGIES GEARED TOWARD SUSTAINABILITY

The Group is one of the few companies to have invested simultaneously in all four current coating technologies, for which it has world-renowned solutions aqueous resins, such as the Encor® Flex range and Kynar Aquatec® emulsion used for cool roofing applications (see p. 33); high-solid resins, which are diluted in application (in the context of industrial coating); powder resins, increasingly used in hyper durable industrial coatings; and photocurable resins to achieve greater durability and a high-end coating finish. This unique combination enables the Group to provide more sustainable and innovative solutions in the most dynamic segments of the market.

❹ Application processes:

A DRIVING FORCE FOR PERFORMANCE AND ENERGY EFFICIENCY

In the context of industrial coating, a key driver for optimizing the consumption of resources and energy lies in the advancement of application processes among end customers. Arkema is a key player in these transformations, thanks to its portfolio of innovative materials and the support it offers to compounders and appliers in terms of implementing them. Its high-solid resins combine lower transport costs with better industrial efficiency during application; its powder resins, like Reafree® polyester resins, are characterized by their low baking temperatures. Finally, its photocurable resins represent a breakthrough technology for industrial coating with considerable time and energy savings compared to conventional processes (see p. 32).

Mass balance: **more sustainable sourcing for the acrylics industry**

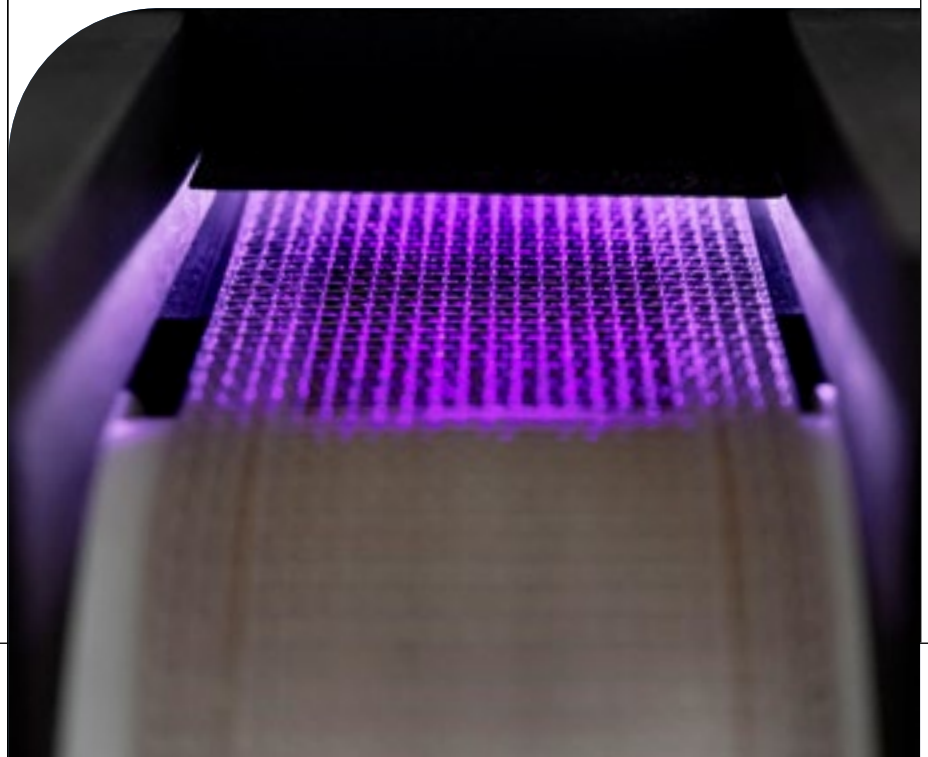
Partly replacing fossil resources with bio-sourced raw materials without changing the process or industrial tools is now possible thanks to the mass balance principle, or the "bio-attributed" approach. This process allows us to attribute this element of natural resource to our end products through certified traceability throughout the value chain and to gradually increase the share of renewable carbon in production. Advocated by the Ellen MacArthur Foundation, it is an emerging approach that Arkema will adopt in 2022 for its acrylic acid line, an essential raw material for many of the Group's coating solutions, such as resins and additives.

UV resins and powders: **“zero solvent” on the rise**

With its proven UV-curable resin and powder resin offerings, Arkema has two key advantages in offering “zero solvent” alternatives on the coating market, covering a wide range of applications.

UV resins: **saving time and space**

Floors and furniture, automotive parts, packaging for cosmetics, modern PVC flooring, consumer electronics: the specifications for coating (varnishes, paints and lacquers) need to be highly resistant and offer a high-end finish. For all of these applications, Sartomer® UV resins are an established solution of choice, formulated and applied by means of a completely volatile organic compound-free process. These resins dry instantly under UV light (compared to several hours for more conventional coatings), resulting in significant savings in time, energy and space: a line of paint 100 meters long can be replaced by a machine a few meters long. A new technology for which Arkema is a global leader, with more than 300 products in its portfolio, truly functional “bricks” that enable manufacturers to meet their customers’ expectations. ■



Powder resins: less is more

At the same time, in its range of Reafree® polyester powder resins, Arkema has another “zero solvent” solution that has been adopted by an increasing number of customers in the industrial coating sector. This technology does not require diluents for its application and therefore does not generate atmospheric emissions. In addition, it offers exceptional performance in terms of durability: with more than 90 products, the Reafree® range is used in many applications ranging from household appliances, such as refrigerators and washing machines, to metal garden benches and a wide range of marine and industrial equipments.

Arkema is investing in R&D to develop these technologies of the future, as explained by Chris Miller, Head of R&D for the Coating Resins business unit: *“Our global network of dedicated laboratories enables us to develop new solutions for innovative formulations that are less energy intensive. They provide ‘super-durability’ and can help companies across the value chain improve overall performance.”* ■

Cool roofing:
Kynar Aquatec® emulsion, the agent that protects white roofs

A coat of reflective white paint with a top coat of Kynar Aquatec® emulsion provides an environmentally friendly and economical alternative to installing air conditioning, now backed by French authorities.

15%

Cool roofing generates savings of around 15% on the energy bill of buildings.

More roofs on large shopping centers and logistics warehouses, particularly in Europe, are adopting cool roofing to bring the temperature of buildings down during periods of warm weather. *"In 2022, 400,000 m² of additional roofs will be covered in France by our partner Cool Roof France"*, announces Bertrand Dinelli, High-Performance Polymer European Market Manager at Arkema. Approximately 15% on the energy bill of buildings can be saved, thanks to the combination of a white aqueous paint and a transparent anti-UV overcoat of Kynar Aquatec® resin, which increases its ability to reflect solar radiation and protects it from mold and dirt for nearly 20 years. *"Our coating also enables the roof to self-clean when it rains, much like an oilcloth, while providing a seal that prevents the release over time of residues from the undercoat"*, emphasizes Bertrand Dinelli.

Government recognition

This solution has been approved since 2021 by the ATEE (French Energy Environment Technical Association), the body that manages energy saving certificates in France: a major step forward, which will enable developers to benefit from government grants to switch to cool roofs. This recognition could also be awarded in other European countries, such as Spain and Italy. Moreover, Arkema's Encor® Flex acrylic emulsion, sold in the United States for roof coatings, is an undercoat that is perfectly tailored to use with Kynar Aquatec® emulsion. ■

BELIEF #4

The future of our high-performance polymers will include more bio-sourcing and recycling.

BIO-CIRCULARITY

High-Performance Polymers, **bio-circular factors**

Bio-sourced raw materials, low-carbon applications and a focus on sustainability, recovery and recycling of materials: these are the three pillars of the bio-circular concept designed by Arkema, under the acronym ABC (“Advanced, Bio-based, Circular”), the central area of focus of its innovation and growth policy in the field of its High-Performance Polymers.

This approach relies largely on the Group’s expertise in the production of polyamides derived from 100% castor, an inedible plant grown mainly on arid lands in India. It offers the benefit of being harvested twice a year, while polymers from petroleum rely on a resource that takes more than a million years to form. As the world’s largest buyer of castor oil, Arkema has invested in the Pragati program (see box on next page) over the past five years to support thousands of Indian castor growers yield more responsible, less water-and fertilizer-intensive crops. In 2021, the Group also acquired Agiplast, a specialist in polymer regeneration. Beyond the sustainability and performance of its polymer range, Arkema therefore intends to invest in the entire value chain of its polymers, from sourcing to recycling. >>

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A. Advanced:

SOLUTIONS FOR THE FUTURE IN THE FACE OF ENVIRONMENTAL CHALLENGES

Rilsan® polyamide 11, Rilsamid® polyamide 12, Kynar® PVDF, Kepstan® PEKK: *"The Group's high-performance polymers firstly share the common purpose of serving applications with a long service life and making major contributions to the global innovation effort to address major climate and energy challenges"*, explains Charlotte Herdt, Global Sustainability Program Manager for Arkema's High-Performance Polymers business unit. This fundamental aim is notably reflected in the growth of electric (p. 17) and hydrogen mobility (p. 23), in the race to create lighter components in the transport sector (from Rilsan® polyamide 11 to Kepstan® PEKK), and also in the soles of technical sports shoes.

B. Bio-based:

THE SEEDS OF SUSTAINABLE GROWTH

With more than 70 years of expertise in castor chemistry, Arkema has created in Rilsan® polyamide 11 a veritable global standard for high-performance bio-sourced polymers. *"While petroleum-based equivalents use a raw material that takes thousands of years to form, castor beans are harvested several times a year by farmers"*, confirms Charlotte Herdt (see box opposite). A truly decisive argument: Arkema's various polyamide 11-based materials (Rilsan® 100% bio-sourced, Rilsan® Clear 40 to 60% bio-sourced, Pebax® Rnew® 30 to 98% bio-sourced) are experiencing growing success in a range of applications. The Group supports and anticipates this demand by developing a next-generation production capacity in Singapore which will increase the global availability of polyamide 11 by 50% (p. 63).

No. 1

Arkema is the world's leading castor oil processor.

C. Circular:

FROM RECYCLING POLYMERS TO ECO-DESIGN

Arkema has made recyclability the backbone of its high-performance polymer innovation policy. The Group's commitment accelerated in 2019 with the launch of the Virtucycle® program, which aims to develop recovery and regeneration loops, mainly for Kynar® PVDF and Rilsan® polyamide 11. A key milestone was reached in 2021 with the acquisition of Agiplast (see next page). At the same time, the Group has been raising awareness and supporting its customers and industrial partners through its sales teams and a team of "bio-ambassadors". *"It's about identifying sources of recyclable materials, particularly in our customers' factories, and working together with them to design recovery schemes adapted to each situation"*, says Charlotte Herdt. *"We are also increasingly working with them to apply the principles of eco-design: reducing the number of materials, the chemical complexity, and thinking, right from the design stage, about the recovery and recycling possibilities at the end of their life."*

Arkema acquires Agiplast, **a polymer recycling specialist**

With the 2021 acquisition of Agiplast, a pioneer and world leader in the regeneration and compounding of high-performance polymers, Arkema added a major asset to its bio-circularity policy. The Italian company, which has been a partner of the Group since 2019 as part of the Virtucycle® program, has developed recognized expertise at its factory in Cremona (Italy) over the past 20 years. Recycled volumes are now found mainly in the production "drops" of various industries, such as the automotive and sports equipment sectors. Once the sources have been identified, Agiplast organizes their recovery and takes care of their recycling. *"An essential part of the activity is waste treatment: identification, separation, cleaning and purification, before crushing the materials"*, explains Fabrice Chopinez, Head of Recycling at Arkema. *"Regeneration is then carried out according to different processes, depending on the type of polymer and the properties concerned."* Armed with this expertise, Arkema introduced its first grades of partially-recycled Kynar® PVDF and Rilsan® polyamide 11 into its portfolio: *"These materials, grouped under the Virtucycle® brand, incorporate a given proportion of recovered material whilst offering the high level of performance demanded by our applications"*, confirms Fabrice Chopinez, who announced significant sales at the start of 2022. ■

In Gujarat (India), renewed success for the Pragati program

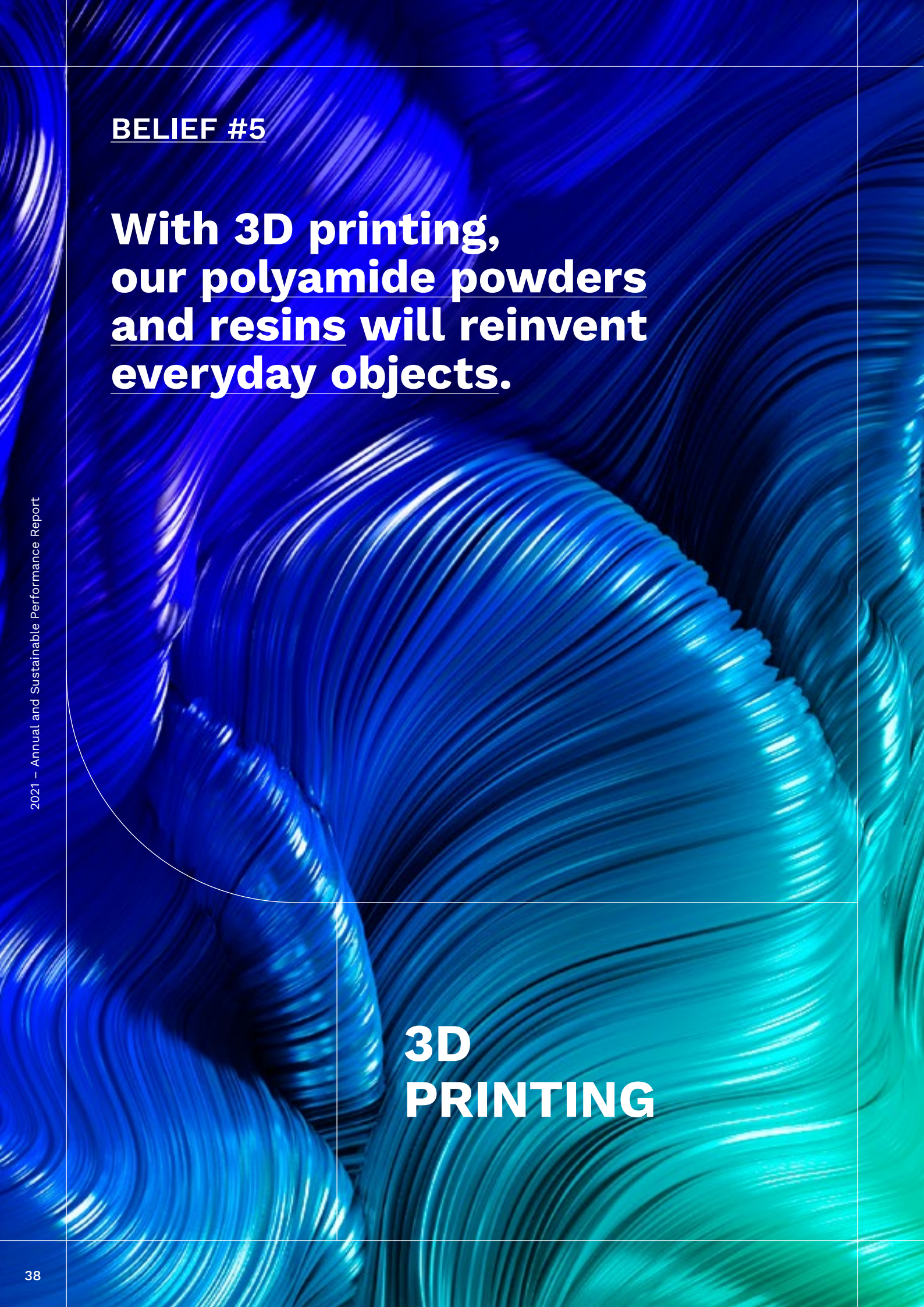
Arkema, the world's largest buyer of castor oil from which Rilsan® polyamide 11 is made, gets its supplies, among others, from thousands of smallholder farmers in Gujarat, India, who are part of the Pragati ("progress" in Hindi) program. *"We guide them in using good farming practices, which improve yields by optimizing the necessary resources"*, explains Charlotte Herdt. Launched in 2016, this certification scheme, which brought together over 5800 producers at the end of 2021, will be further extended in Gujarat and other areas in order to meet the projected growth of the polyamide 11 market. The cultivation of castor, a plant which is perfectly suited to arid lands, requires few inputs and little water. Its production does not compete with food crops and does not lead to deforestation. ■

Greenfib, bio-circularity and innovation made in France!

French company Greenfib markets a range of 100% bio-sourced and recyclable performance materials, combining Rilsan® polyamide 11 with mineral powders (talc, oyster shell powder) and vegetable flour (wood, cane) from sustainable sources, all located in France. This exemplary bio-circularity approach, serving various applications and processes from injection to 3D printing, was notably put into practice in 2021 in the manufacture of OxO eyewear, distributed by Écouter Voir. ■

80%

of the world's production of castor beans comes from India, representing about 1.2 million tons annually.



BELIEF #5

With 3D printing, our polyamide powders and resins will reinvent everyday objects.

3D PRINTING

3D printing: **life-changing solutions!**

The rise of 3D printing technologies, increasingly used for mass production, is driven by the development of high-performance materials that provide new options to designers.

Arkema, with nearly 25 years of experience in 3D printing, is one of the world's leading 3D printing companies. Its unique portfolio of solutions, fine-tuned through connections with manufacturers of printing machines, printing software publishers and their customers, covers all additive manufacturing technologies. For consumer applications, two families of materials specifically address the expectations of designers: the UV-curable liquid resins in the Sartomer N3xtDimension® ranges, as well as the Rilsan® Invent polyamide 11 grades, suitable for powder bed sintering (or laser sintering). Playing a complementary role, they give substance to a wide variety of objects and designs, many of which are already part of our lives: health, jewelry, sports, cosmetics, 5G and eyewear to name a few.

Our materials for 3D printing are found in many everyday applications, details of which are presented in the following pages. >>

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– Materialise and Arkema:

A COMMON VISION FOR BIO-SOURCED FRAMES

The Belgian company Materialise, one of the world's leading manufacturers of 3D finished products, is working with Arkema to develop an innovative approach on the eyewear market by taking advantage of the unique properties of Rilsan® polyamide 11 to manufacture frames. Easily adjustable, perfectly compatible with for prolonged skin contact, strong and lightweight, the 100% bio-sourced polymer also offers aesthetic and styling qualities (option to experiment with the surface finish to give it slight transparency or the opposite for strong colors), that are unique on the market. The flexibility of the additive manufacturing process is particularly relevant for eyewear brands and opticians, Materialise's main customers: it offers them the option of increasing the number of models without causing storage problems and enables them to reduce to just a few weeks the time needed between designing a frame and making it available in the catalog.

– Dental health:

UV-CURABLE RESINS, THE SECRET WEAPON OF CLEAR ALIGNERS

More discreet and comfortable than metal braces, clear aligners offer an increasingly appreciated alternative for people undergoing orthodontic treatment. These transparent mouthpieces, of which 20 to 30 can be produced during treatment, are thermoformed by the dental technician using a mold tailored to the patient's teeth at time T. N3xtDimension® UV-curable resins are highly recognized by leading industry players in the manufacture of these molds, which are 3D printed using an intraoral scanner. They provide an exceptionally smooth surface appearance, minimizing the need mold adjustment, and excellent definition to obtain the precise shape of the patient's teeth.

– 3D printing:

A UNIQUE WAY TO MAKE JEWELRY

The exceedingly high spatial definition and perfectly smooth surface finish of the parts obtained by 3D printing using Arkema N3xtDimension® UV resin solutions make it a material of choice to revolutionize the traditional technique of lost-wax casting in which the jeweler sculpts their design by hand. This time, the shape of the jewel is printed in 3D resin, forming the model on which a plaster mold is made. The resin is then burned, creating an empty space in which the metal of the future jewel is cast. This innovative approach offers exceptional freedom of design, an ability to truly customize jewelry, while ensuring faster and more reliable production thanks to the 3D printing of a burnout resin. It is being adopted by a new generation of jewelry designers who work from a screen, offering unparalleled freedom of design, especially when creating intricate details. This technology for jewelry is already used in mass production in Asia.

30%

Annual growth of the global 3D printing market. The Global Industry Institute forecasts that it will represent $28 billion in 2028.

– 5G technology

IS EVERYWHERE, AND IT IS (AT LEAST A LITTLE) THANKS TO ARKEMA!

Initially limited to the densely populated urban areas of city centers, 5G now extends to more remote areas. This gradual roll-out requires the signal emitted by 5G antennas to be better directed: to concentrate the waves over longer distances, lenses made up of complex shapes with particularly good surface resolution and advanced dielectric properties are required. A demanding specification and a challenge that the Arkema teams rose to by developing specific UV resins for the 3D printing of lenses with the lowest dielectric loss on the market for this advanced application. An application that is invisible to the general public but essential for the interconnectivity of today and tomorrow!

– Soles, orthopedics:

AS CLOSE AS POSSIBLE TO THE PATIENT'S BODY SHAPE

In orthopedics, the requirement is for both customized designs and lightweight, resistant materials that are suited to prolonged contact with the skin: a specification that the combination of 3D printing and Rilsan® polyamide 11 meets perfectly. Arkema's bio-sourced polymer is increasingly used for the additive manufacture of orthopedic soles, based on patient imaging, by innovative podiatry specialists, such as the start-up X-Feet. The company Invent Medical, a French pioneer in 3D printing technologies for prosthetic and orthopedics, has also made Rilsan® polyamide 11 a prime asset in its fully-customized solutions, from soles to face masks and cranial remodeling orthotics for babies.

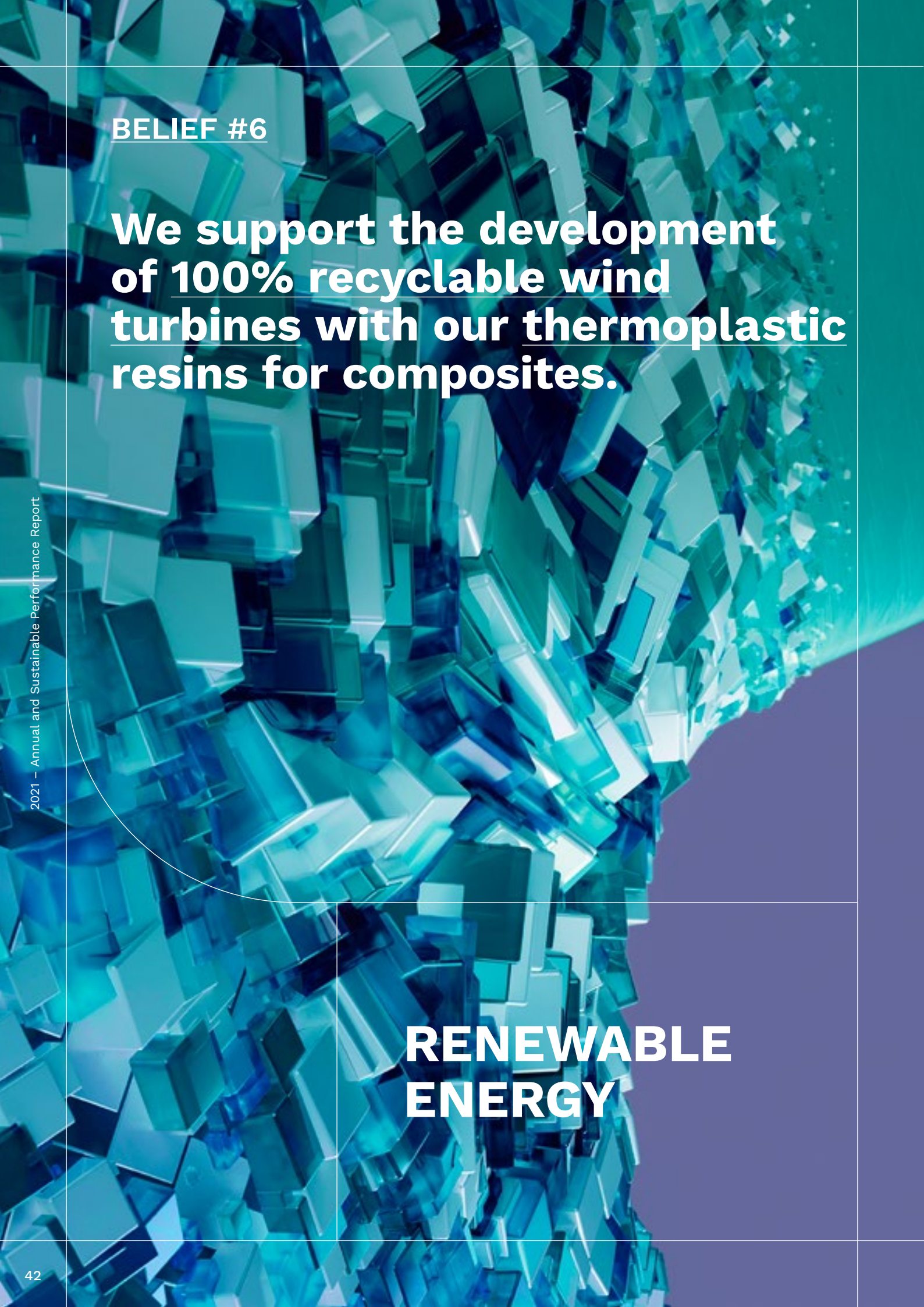
– Mascara and cosmetics:

WHEN 3D PRINTING MAKES LIFE MORE BEAUTIFUL

It is one of the immense success stories of Rilsan® polyamide 11 in the world of cosmetics: millions of Chanel's Revolution and Volume Stretch mascara wands, printed by Erpro3D Factory, a French specialist in high-volume 3D printing, have already been produced. Their unique design, which incorporates microcavities that allow unparalleled comfort and speed of application, makes them stand out. More widely, 3D printing with Rilsan® powders is becoming increasingly successful in a variety of applications, particularly at Albéa, global leader of cosmetic packaging and perfume bottle stoppers: in this sector where new bottles are designed in quick succession, additive manufacturing is an asset for unlocking creativity and acts as a key driver for reducing time to market.

Sporting goods: customized to our body shape

Sports performance is a matter of training, talent and often materials! In the fast-growing sporting goods market, Arkema high-performance materials and the opportunities for innovation and customization offered by additive manufacturing have already come together to produce many success stories. The bio-sourced nature of objects produced with Rilsan® or Pebax® Rnew materials is an additional factor of choice, increasingly sought after by consumers. This is the case for the sneakers from iAM footwear, whose "lattice" sole structure delivers unique lightweight and energy return qualities, or for the customized cycling helmets from London company Hexer, the internal structure of which is printed in Rilsan® polyamide 11 based on the shape of the customer's skull. Other OEMs opt for UV resins, also used in the 3D manufacture of honeycomb textured running shoe soles, which can only be achieved by photocrosslinking, or parts that take advantage of the soft surface aspect and elasticity of N3xtDimension® UV solutions, such as helmets, handlebar grips and high-end saddles with a "lattice" structure, also referred to as "honeycomb".



BELIEF #6

We support the development of 100% recyclable wind turbines with our thermoplastic resins for composites.

RENEWABLE ENERGY

Wind energy rises to the challenge **of recyclability**

Along with other renewable energies, wind power will play a key role in the energy mix for decades to come. This increasingly competitive energy sector is growing, but in order to be truly sustainable, wind power must rapidly find a solution to one major challenge – how to efficiently recycle blades at the end of their life.

93 GW: the wind power industry installed this amount of new capacity worldwide in 2020, the best year in history, despite the pandemic. At the end of 2020, the world's wind farms totaled 743 GW, or more than 1.1 billion tons of CO_2 avoided each year, equivalent to the annual emissions of South America. This growth is being driven by China and the United States, which together account for 75% of new facilities. Supported by proactive public policies and improved energy efficiency, this development is expected to continue.

According to estimates from the Global Wind Energy Council, the pace of new facilities is set to reach 280 GW annually to help achieve the goal of keeping the average temperature rise “well below 2°C” by 2050.

The growing problem of blades reaching the end of their lives

The success of this sector is, however, suffering a setback that could tarnish its environmental record in the short term – with the first wind turbines installed 20 years ago reaching the end of their lives, the issue of >>

>>
managing decommissioned units is becoming increasingly pressing. While 85 to 90% of the mass of the turbines (the steel mast, the concrete slab and so on) is recycled satisfactorily, how to manage the end-of-life blades remains a problem for the current models made of composite, combining a thermosetting resin (mainly epoxy) and glass or carbon fibers. Fiberglass blades can potentially be ground to provide fuel for the cement industry, but carbon fiber blades cannot currently be reused and end up being buried.

Elium® resin opens up a new era

To break this impasse and build a truly circular sector, thermoplastic materials, which can be melted down and reused with their properties intact to produce a new blade, represent a very solid prospect. This is what Arkema offers with its Elium® liquid resin, which, in combination with glass fibers, produces a composite material that is both lightweight, high-performance and infinitely recyclable. This breakthrough innovation is now at the heart of industrialization programs being implemented by the world's largest wind power and recycling companies. ■

Between 15 and 20%

Annual growth of the world's wind turbine fleet.

(Global Wind Energy Council)

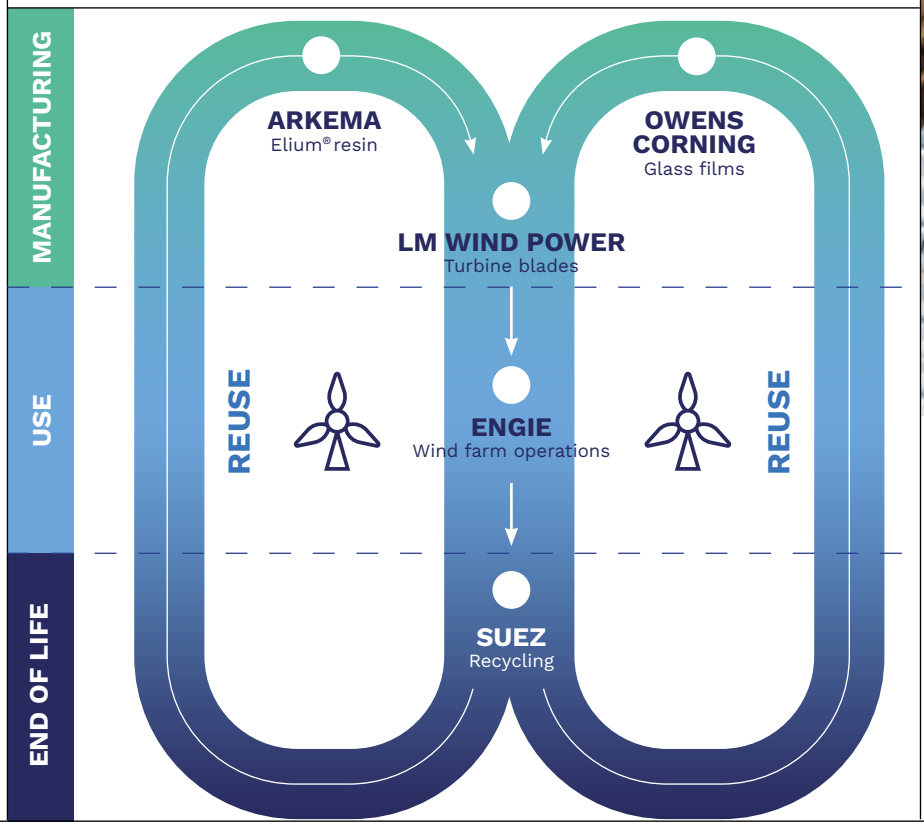
Elium® composite recyclable blades: **final steps before industrialization**

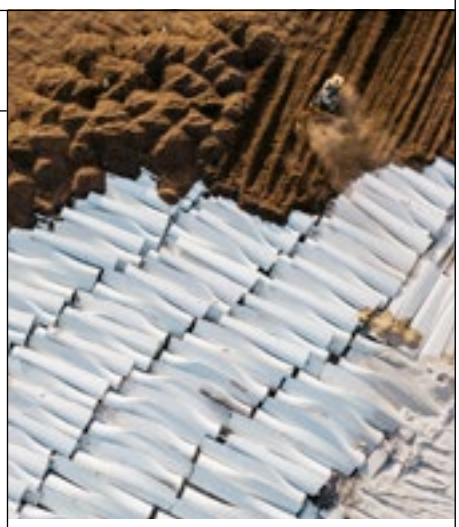
After 10 years of development in collaboration with the largest players on the world market, Arkema is en route to success with truly circular wind power thanks to the decisive contribution of Elium® resin-based composite materials to the manufacture of 100% recyclable blades. In the context of one of its most advanced partnership programs, the Zebra project in France, the Group is going through the validation stages for its manufacturing and recycling processes. The first 62-meter blades were produced at the end of 2021 and the first commissionings are planned for 2024.

Elium® liquid resin, in combination with glass fibers, has all the necessary properties to form a composite that is perfectly suited to the manufacture of wind turbine blades. It combines lightness, mechanical strength and durability, at a price comparable to the epoxy thermosetting resins that currently dominate the market. The fact that it can be used at room temperature and its short curing times unlock significant industrial and energy gains compared to current epoxy composite-based processes. Above all, it enables easy depolymerization via heating, allowing for the full recovery of blade materials at the end of their life, thereby facilitating truly recyclable turbines. This is unique in the world. *"To give substance to this extraordinary potential, the challenge is all about establishing industrial processes for manufacturing and recycling and validating their technical and economic feasibility"*, explains Guillaume Clédat, Head of Elium® Development. *"We have been working on it for several years, through a variety of co-development programs involving leading partners – wind turbine manufacturers, wind farm companies, recycling operators and research laboratories."*

— THE FIRST BLADES
62-meter Elium® resin blades were produced in 2021 as part of the Zebra project.

LIFE CYCLE OF AN ELIUM® RESIN WIND TURBINE BLADE –
Zebra project partners





— LANDFILL SITE
in the United States of wind turbine blades made of non-recyclable composite materials.

Zebra project: the first 62-meter blade

One such industrialization program is the Zebra project, launched in September 2020 after a major effort to bring together partners representing the entire wind power value chain. For a 42-month period, alongside Arkema and glass fiber manufacturer Owens Corning, it is mobilizing the world's leading manufacturer of wind turbine blades LM Wind Corner (a GE subsidiary), the wind farm operator Engie and the world leader in recycling SUEZ. *"The laboratory research phase on the properties of the composite (fatigue strength, resistance to bending, tensile strength, compression strength), confirmed that our material meets all the technical requirements of a turbine blade",* says Guillaume Clédat. In December 2021 and January 2022, after several prototype models, the partners reached a milestone in validating the manufacturing process by building the first two life-sized blades made of Elium® composite (62 meters long, 6 tons of resin). A larger model, intended for offshore use, will also be produced at the end of 2022. Beyond these iconic achievements, the project aims to validate the technical-economic equation of the sector as a whole: *"We are developing a process that will allow resin and glass fibers to be fully recycled and then reused in the manufacturing process",* explains Guillaume Clédat. A complementary line of work involves recovering the production process waste. While the Zebra project will run until mid-2023, Arkema anticipates that the first Elium® composite turbine blades will be commissioned in 2024. Now more than ever, the fair winds are blowing! ■

BELIEF #7

Our adhesive solutions have a major role to play in helping recycle the various elements of transportation.

INDUSTRIAL ADHESIVES

Transport and mobility: **Adhesives, environmental performance factors**

The race to achieve lightweight, low-carbon engines and materials, to ensure recyclability... Transportation is changing in the face of the energy and environmental crisis. Innovative adhesive solutions play a major role in this development. Interview with Benoît Perrier, Mobility Director at Bostik's Durable Goods business unit.

OEMs and vehicle manufacturers are in a race for innovation to ensure mobility that is less resource-intensive. How do your adhesives help?

Benoît Perrier: Assembling a vehicle requires hundreds of different bonding solutions, all with various specifications to be met. So the transformation underway in the world of mobility represents a huge field of innovation for our adhesives, which must make these changes possible and indeed accelerate them. Hence the search for a lightweight solution, which is a fundamental trend, involves using new materials, particularly composites, which pose new challenges in terms of bonding. Likewise, the development of electric engines requires demanding assembly functions, especially with regard to batteries.
The bonding processes must be technically efficient by integrating new functionalities such as heat dissipation and fire resistance, but they must also be efficient on an industrial level. Application time and energy costs are key criteria >>

>> for our customers. More broadly, analyzing the life cycle of adhesives is now a key focus, from the environmental footprint related to sourcing, to compatibility with recycling schemes.

At the same time, the transport sector is recording ever higher expectations in terms of driver and passenger comfort...

B.P.: Yes, this is the other key trend, focused on customer experience. Again, there are major implications for our adhesives. For example, reducing noise and/or vibrations involves adding textiles, which require highly durable, material-friendly adhesives. The increase in onboard electronics, particularly in electric cars, also creates a need for precision bonding, similar to that found in the consumer IT sector.

How does Bostik, the world's third-largest adhesives company, position itself in this rapidly changing market?

B.P.: We're one of the only players in the world able to offer value-added solutions across all technology families (see box) mobilized by the automotive (original equipment and repair), public transport, rail, marine and aerospace markets. Our innovation policy, which relies on targeted acquisitions, also allows us to develop cutting-edge technologies in highly differentiated specialty hotmelts in certain key areas. We sell our products to OEMs, as well as directly to the major vehicle manufacturers, to whom we also offer our expertise. They sometimes consult us very early on in their projects, to translate their functional specifications into technical specifications. ■

Benoît Perrier,
Mobility Director at Bostik's Durable Goods business unit.

Four major adhesive technologies for transport

— STRUCTURAL ADHESIVES – LOAD BEARING
Super robust, these two-component reactive adhesives (polyurethane, methyl-methacrylate, epoxy etc.) replace the mechanical fixings used in applications required to withstand a very high load over time. This fast-growing segment represents an estimated global potential of €3.5 billion across the mobility market.

— FLEXIBLE ADHESIVES – ELASTIC BONDING
For assembling two parts with different thermal behaviors (e.g. bonding a windscreen to the bodywork), these adhesives, often moisture-reactive and single-component, have the flexibility to absorb the differential expansion of the two materials. Bostik is the world leader in sealing modified polymers, a technology that offers excellent environmental and adhesive properties on different types of materials.

— ASSEMBLY ADHESIVES FOR FLEXIBLE MATERIALS
These are used to assemble textiles, carpets and flexible coatings. Applications include automotive passenger compartments, where durability and an absence of odor and volatile organic compounds are essential. Hotmelt adhesives are a solution favored by OEMs here.

— ADHESIVES FOR ELECTRONICS – ENGINEERING ADHESIVES
These cyanoacrylate adhesives are "dotted" on the assembly lines of GPS, onboard computers and other embedded electronic devices using robotic arms. Small quantities, but high added value!

Adhesives for **sustainable mobility**

Water sports:
AN ADHESIVE COMPATIBLE WITH COMPOSITE RECYCLING

Brunswick Corporation, a recreational boat manufacturer, has partnered with Arkema to produce boats whose structural parts and hull, made of Elium® composite, will be fully recyclable at the end of their life and reintroduced into the manufacturing process. This project benefits from Bostik's expertise thanks to their development of a methyl methacrylate structural adhesive used for assembly and compatible with the Elium® resin recycling process. Not only does this adhesive make it easier to recycle composite parts, but 70% of the raw materials that make up the glue are also fully recyclable.

Alfa Romeo 4C:
FLEXIBLE ADHESIVES FOR A SPORTY RIDE

The bodywork of this Italian manufacturer's signature model incorporates lightweight composite parts assembled with carbon and composite components using specific grades of Bostik's sealing modified polymers flexible adhesives.

Bumpers:
REPAIR, DON'T REPLACE!

Reducing the carbon footprint of transportation also means extending the life of the equipment – especially the most heavily used equipment, such as the bumpers. Since 2019, Bostik has offered a two-component polyurethane adhesive dedicated to repairing cracked bumpers: it enables the functional strength of the part to be restored without any visual damage. This is state-of-the-art technology which is increasingly popular with specialist distributors in Europe.

Carpets and polyester coatings:
ADHESIVES SUITABLE FOR RECYCLING

End-of-life vehicle floor mats and interior coatings are an important source for polyester recycling schemes. The adhesives used to assemble these components must still be compatible with the overhaul processes and not affect the properties of the recycled polyester. This is one of the advantages of the specialty hotmelt technology in which Bostik is the world leader.

Paint varnish:
HIDE BUBBLES TO SAVE RESOURCES

The painted bodywork of cars is covered with a coat of varnish which protects the paint from damage. But sometimes small bubbles form when applying this top coat, creating a visual flaw: the manufacturer then has to return the entire part to the paint shop, which results in over-consumption of energy and resources... unless it can simply perform a touch-up. For this purpose, Bostik has developed a UV-activated adhesive which, when applied, makes the defect invisible without affecting the protective properties of the varnish.

€3.5 bn

On the mobility market, structural adhesives represent global potential estimated at €3.5 billion.

Our future starts today

Reports on three major projects for Arkema in 2022 that will contribute significantly to our growth. Go to the United States to discover our innovative industrial project with Nutrien. Take off with Bostik, which continues to grow, especially with the consolidation of Ashland’s performance adhesives. Visit our new integrated polyamide 11 factory in Singapore, the largest industrial project in Arkema’s history.

P. 56
Nutrien, an innovative partnership

P. 58
Bostik, pushing the boundaries

P. 62
Singapore plant,
our largest industrial project

Nutrien provides a safer and greener source of supply for our **polymers and fluorogases**

Access to hydrofluoric acid through traditional mining sectors remains increasingly volatile, so the partnership forged in the United States between Arkema and the fertilizer manufacturer Nutrien is a game-changer. The precious raw material is obtained from an existing industrial product, by means of an innovative process, with low emissions and without water consumption.

Commissioning is scheduled for April 2022. At its industrial complex in Aurora (North Carolina), dedicated to the production of phosphate fertilizers, the Canadian group Nutrien will produce 40,000 tons of hydrofluoric acid annually, intended for the Arkema plant in Calvert City (Kentucky). This is the culmination of an exemplary industrial project, and is a landmark achievement: it is one of the very first units in the world (and the first in North America) to produce this strategic raw material, not from fluorspar mines, but as a coproduct in the production of phosphate fertilizers: hydrofluorosilicic acid (HFSA).

$150 million investment

"For those working in fluorine chemistry, access to hydrofluoric acid is a key issue", emphasizes Christophe Villain, Managing Director of Arkema's Fluorogas business unit. *"It is the basic reagent for fluorogases (HFC and HFO), but also for the Kynar® PVDF that we produce in Calvert City."* However, supply via the traditional sector, consisting of extracting small amounts of fluorine from large quantities of rocks, has become problematic due to growing demand and increasing price volatility.
In its search for an alternative source, Arkema has for many years been investigating a specific innovative process developed under license, which allows hydrofluoric acid to be obtained from HFSA. Some pilot projects are already in progress in China.
In 2018, Arkema then approached Nutrien, which was also interested in this new process. The two parties reached an agreement in early 2020: Arkema will put $150 million into financing the construction of the processing unit, the group's largest investment in 2021.

Long-term commitment
The plant was built by Nutrien, in close partnership with Arkema. The 40,000 metric tons of hydrofluoric acid that it will produce each year are essentially reserved for the Arkema plant in Calvert City. Both parties have gained from this groundbreaking project, which was completed on a very tight schedule. While Nutrien has found a sustainable and valuable outlet for its HFSA production, Arkema has acquired a major asset to support the development of its markets in North America. *"Aurora's production will cover all of Calvert City's needs for the coming years",* says Christophe Villain. *"We have therefore secured our supply of raw materials over the long term, at a stable and competitive price, to support the development of 1233zd (fluorogas with very low greenhouse effect) and the growth of our Kynar® PVDF, in the areas of water filtration and electric and hydrogen vehicle batteries."*

The environment also comes out on top
In addition to the economic and industrial success, this achievement stands out in terms of its impact on the environment. *"The big advantage of the new process is that it is based on a material that already exists on the market, whereas the traditional process consists of extracting fluorspar from the ground, then treating it using processes that consume a lot of water and energy in order to transform it into hydrofluoric acid."*
At Nutrien, 40,000 metric tons of hydrofluoric acid will be produced without water consumption and without any waste water discharge: all the water used in the process is recycled. Comparative analyses carried out by Arkema also show that the process implemented at Aurora emits around 95% less volume of greenhouse gases (CO_2, SO_2 and NOx), than the conventional process, for the same quantity produced. Finally, the carbon footprint of the transport component is also better. Aurora's hydrofluoric acid will be transported in block trains to Arkema's plant in Calvert City, 1200 kilometers to the west, whereas the previous supplier shipped it from Mexico. The project as a whole offers further proof of Arkema's ability to constantly reinvent its production methods, and to offer its markets solutions for the future that fully meet the United Nations' Sustainable Development Goals. ■

40,000
The Canadian group Nutrien will produce 40,000 tons of hydrofluoric acid annually.

-95%
The new process emits around 95% less greenhouse gases.

"Arkema has a major asset to support the development of its PVDF and fluorogas markets in North America"

Christophe Villain,
Managing Director of the Fluorogas business unit

Bostik continues **its growth strategy**

“We’re building a global leader in high-performance adhesives.”

Vincent Legros
Chief Executive Officer of Bostik

Following the acquisitions of Prochimir in 2019 and of LIP, Fixatti and Ideal Works in 2020, Bostik finalized the consolidation of US Ashland’s Performance Adhesives business in 2021. Arkema’s large subsidiary acquired in 2015 has the means to achieve its ambitions, in synergy with the Group’s growth strategy. Interview with Vincent Legros, Chief Executive Officer of Bostik.

The list of companies acquired by Bostik in recent years was further expanded in 2021, notably with the Ashland acquisition. What criteria do you use to select these acquisitions?
Vincent Legros: Some allow us to increase our market share, especially in regions where we don’t have much presence. This was the case, for example, with LIP, the Danish leader in tile adhesives and floor preparation solutions, of which our acquisition in 2020 has been a major asset in our development in the Nordic countries’ Consumer & Construction markets. Other operations are based on the acquisition of technologies, such as with Fixatti where we gained specialist hotmelt know-how, or, most recently in early 2022 when we bought PMP, the Chinese specialist in very high-precision adhesives for the electronics markets. We’re targeting key technologies with high growth potential and we’re leveraging our global presence to help internationalize them.

How does the acquisition of Ashland’s Performance Adhesives business fit with this strategy?
V.L.: In this case, we’re acquiring both market share and world-class technology. With revenue of $360 million and high levels of profitability, Ashland Performance Adhesives has recognized

“The global adhesives market grows 4% per year”

brands in the US along with a wide range of solutions in the fields of pressure-sensitive adhesives and structural adhesives. It represents a major step forward in our development strategy.

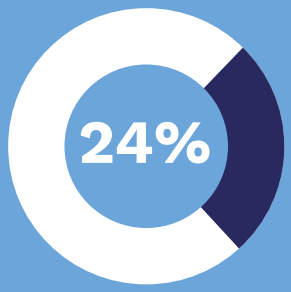
What’s the long-term aim of this acquisition policy?
V.L.: Bostik is a leader in high-performance adhesives, demonstrating strong growth, high profitability and a global presence in industry and construction. We’re currently number three or four in the world, with a market share of approximately 4%. But there’s still plenty of potential for growth: the glues and adhesives sector is highly fragmented with a lot of small and medium-sized players, including some very high performers. Our aim is to maintain organic growth of 3 to 4% per year over time, and 10% including acquisitional growth.

How does the synergy with the Group’s other business activities tie in with this strategy?
V.L.: Operating within Arkema is a huge asset, beyond the financing capabilities that it gives us. It’s a considerable lever of growth in terms of geographical presence, market access, as well as technology and know-how. We’re developing more and more relationships with our colleagues in the Coating Solutions and High-Performance Polymers divisions. These may be in the form of direct collaborations for a given solution, for instance the Elium® resin in wind power (see next page) or more broadly in the form of commercial and applications synergies. We share many customers and we’re committed to bringing them innovative and sustainable solutions. ■

BOSTIK in figures

16
acquisitions in 5 years, two of which are major:

- **Dutch company Den Braven** in 2016 (revenue of €350M)
- **US Ashland's Performance Adhesives business** in 2022 (revenue of $360 M)



24% of Arkema’s revenue in 2021

€2.28 bn
in revenue, up 33% since 2015

70
production sites

50
number of countries in which Bostik has a commercial presence

6,600
employees

The technological gems behind Bostik's growth

As the leader in performance adhesives, it has built its success in each of its markets on a range of key technologies with high growth potential. Examples include adhesives for recyclable wind turbines, photocuring adhesives, pressure-sensitive adhesives, cure-in-place gasketing and recyclable packaging.


1

Wind turbine blades:
EXTREME MECHANICAL STRESS, PLUS RECYCLABILITY

The development of a 100% recyclable wind industry sector, of which Arkema is one of the great creators, is also a challenge in terms of adhesives. As part of the Zebra industrialization project (see p. 44–45), Bostik developed a methacrylic adhesive with innovative properties for assembling the two long components that make up an Elium® wind turbine blade. It ensures a super secure fixing that lasts at least 20 years (temperature range of between -30°C and 70°C, extreme mechanical stress at the end of the blade), while offering proven compatibility with the resin recycling processes developed by the Group and its partners.

Photocurable adhesives...
EVEN FOR OPAQUE PARTS

Among the range of photocurable adhesives where exposure of the resin to UV radiation triggers the "setting" by polymerization, Bostik has a technology unique to the world. It allows this process to be used even for opaque objects by exposing the thin layer of resin from the side. A "gem" offered across different chemistries, for different applications: from the consumer "fix & flash" range, sold in DIY stores with a little UV lamp, to 3D layer-by-layer printing of carbon fiber parts.

Pressure-sensitive adhesives:
GREATER PERFORMANCE, FEWER SOLVENTS

Pressure-sensitive adhesives (PSA) - stickers and rolls of adhesive tape are common examples - are also widely used in industry and construction. Bostik has acquired a major asset in this domain with the purchase of Ashland, which has a unique portfolio of technologies that ensure long-term adhesion in demanding conditions, for example, the assembly of roof sealing membranes or attaching the headliner to the metal bodywork in the automotive industry. All with fewer and fewer volatile organic compounds: the new generation of PSA developed by Bostik replaces solvent glues with innovative solutions, activated by humidity or UV.

UV cure-in-place gasketing:
HIGH-PRECISION SEALING

Some industries, such as watchmaking and information technology, require bonds with very complex geometry, ensuring a perfect seal while allowing (unlike with glue) dismantling. For these delicate applications, Bostik has an unrivaled technology: cure-in-place gasketing. A liquid adhesive is deposited on the receiving part, in the desired form, by a robotic needle; exposed to UV, it sets to form an elastic seal less than 0.2 mm thick. Amazingly


2


3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— **1. WIND TURBINE BLADES**
Methacrylic adhesives are used to join the two parts that make up a blade.

— **2. PHOTOCURING ADHESIVES**
Bostik owns a technology unique in the world in the family of UV curable adhesives.

— **3. PRESSURE-SENSITIVE ADHESIVES**
Adhesives triggered by pressure – such as rolls of sticky tape – are used in industrial applications, especially in car interiors.

— **4. UV CURE-IN-PLACE GASKETING**
Very popular in electronics, our liquid adhesives enable highly precise and perfectly sealed bonds.

— **5. PACKAGING GLUES**
Bostik glues help to facilitate the recycling of polyethylene packaging (PET), paper and cardboard.


5

precise and used for example in the manufacture of Samsung waterproof watches (dismantlable and therefore repairable) and for assembling aerials or sensors in the electronics industry.

Packaging adhesives: AHEAD OF THE GAME FOR RECYCLABILITY

Across the huge market for packaging adhesives, the ease of recycling materials by sector (paper/cardboard, polyethylene, PET, etc.) is currently the decisive issue. Bostik is pursuing a proactive policy to minimize the number of materials and the use of additives or inks, without sacrificing the functional performance of its adhesives. And this has had considerable success in its solutions portfolio. It includes the first polyurethane glue for flexible polyethylene packaging to obtain Recyclass certification, and the first Plastic Sense-certified adhesive for recycling resealable PET trays. ■

The Singapore plant **an industrial achievement**

Construction of the Jurong Island plant in Singapore, announced in 2017, will be completed by mid-2022. With this exemplary industrial project, Arkema has signed the largest investment in its history and has increased the worldwide production capacity of polyamide 11, its fully bio-sourced high-performance polymer, by 50%.

The timetable was ambitious and yet it is on the way to being met despite the pandemic. The Jurong Island integrated bio-refinery in Singapore will produce its first tons of the amino 11 monomer and polyamide 11 in the summer of 2022. The culmination of this highly strategic project for the Group (see following pages), which increases the global availability of its famous bio-sourced polymer by 50% thanks to a next-generation industrial tool, is exemplary for several reasons. *"For the first time we are producing amino 11, a monomer from castor oil, and its polymer polyamide 11, on the same site",* notes Erwoan Pezron, Managing Director of the High-Performance Polymers business unit, who has supervised the construction of the plant on the ground.

Industrial integration and synergies

This integration across the value chain of castor chemistry is a major factor in industrial efficiency. It is supported by process innovations on some key steps in monomer

synthesis and significant synergies with the Jurong Island industrial platform. *"The presence of multiple suppliers and world-renowned chemists on the island ensures direct access to different raw materials"*, says Erwoan Pezron. *"Likewise, the proximity of Air Liquide has enabled us to successfully integrate steam, the plant's main source of energy. This is a good example of circular economy because we utilize the waste steam, the by-product of another process, allowing us to significantly reduce the site's carbon footprint."* The core raw material, castor oil produced for Arkema by farmers in Gujarat in India, will be delivered by boat directly to the factory doors.

Two years of an extraordinary construction site

The construction of this 12-hectare complex, including 8 hectares for production units, is in itself an industrial feat, especially in the context of the Covid-19 pandemic. *"At the beginning of April 2020, as we were preparing to begin piling for the foundations, the Singaporean authorities announced a strict lockdown, which of course complicated our operations"*, confirms Erwoan Pezron. Nevertheless, the project was able to forge ahead thanks to the commitment of local teams and the support of the authorities in Singapore, with a delay of only three months on the initial schedule. As many as 1,750 people were working on-site, with the support of the engineering company Wood. Work included assembling 27,000 pieces of piping and laying approximately 1,000 km of cables.

150 employees recruited and trained

A major hiring and training program was carried out at the same time. The site will employ approximately 150 Arkema staff members (and some 50 sub-contractors), 90% of whom had already been recruited by mid-February 2022. *"The staff will be composed mainly of Singaporeans and Malaysians, as well as a few expatriate positions to continue the transfer of skills during the early years of operation"*, details Erwoan Pezron. The Group is committed to welcoming and retaining this highly skilled workforce - the world's best-engineered plant is worth nothing without talent to bring it to life! ■

50%

This strategic Group project increases the global availability of its famous bio-based polymer by 50%.

1,750

The worksite had up to 1,750 people on site to assemble 27,000 pieces of piping and lay 1,000 km of cables.

€450 million

The total amount invested by Arkema in the construction of its Singapore plant, as well as in downstream polymer capacities in China. To finance this investment – the largest in its history – the Group successfully listed its first green bond, for an amount of €300 million.

Polyamide 11 boosts **Asian growth**

Simultaneously high-performance, 100% bio-sourced and recyclable, polyamide 11 is now more than ever in step with the current major issues of sustainability and circularity. Arkema is the world's only producer, through a family of products marketed under the Rilsan®, Rilsan® HT, Rilsan® Clear, Rilsan® fine powders and Pebax® RNew® brands. By increasing its global production capacity by 50% through its Singapore bio-refinery, the Group is able to meet the expectations of five strategic markets, with growth largely happening in Asia.

Mobility/Transport

Rilsan® polyamide 11 contributes in several key ways to the advent of cleaner mobility. In particular, it offers an alternative to metal and rubber for various structural parts of vehicles, notably in the form of composite bands loaded with carbon or glass fibers, offering manufacturers a bio-sourced and recyclable solution in their race to make vehicles lighter. It is also increasingly used in demanding applications such as the fuel lines of plug-in hybrid vehicles, as well as in new electric vehicle battery cooling lines (see p. 18). In the medium term, it appears to be well positioned to contribute to the rise of hydrogen vehicles. Its high resistance to cold shocks (up to -50°C) makes it a particular material of choice for hydrogen tanks.

Consumer electronics

In this market that is constantly innovating, very few materials offer both the expected high level of performance and the renewable nature of a plant-based raw material. Rilsan® Clear polyamide 11, formulated to give it specific properties such as high rigidity and flawless transparency, is becoming increasingly popular for dozens of niche applications including structural elements in cell phones, folding screens and watch parts. With the boom in 5G technology, the low dielectric constant of some Rilsan® grades makes it a solution of choice for certain smartphone components that require such "transparent" materials.

Sporting goods

Sporting performance is often associated with talk of equipment and materials performance. In this huge market whose growth, especially in Asia, is driven by the rise in living standards, Rilsan® polyamide 11 and especially Pebax® RNew®, a combination of a thermoplastic elastomer and polyamide 11 blocks, offer lightness, flexibility, impact resistance and/or energy restitution to many items. These include soles and structural parts for soccer and running shoes, ski boots, anoraks and so on. Their bio-sourced nature is a feature that is increasingly in demand from end consumers and that is promoted by manufacturers.

Specialty coatings

Many fine powder grades of Rilsan® are used as specialty coatings for a wide variety of technical applications. One of these is the manufacture of dishwasher baskets, a market with strong organic growth in Asian markets, which will be a major outlet for Arkema's new downstream production unit at its Changshu facility in China. Production there is scheduled to start in 2023. Rilsan® fine powders are also used for coating metal parts, such as water pipe fittings, and for the chemical and electrical isolation of bus bars that connect cells inside electric vehicle batteries.

1

3D printing

The additive manufacturing market is growing at an annual rate of 30%, beyond prototyping, to many small and medium series applications. Arkema is deploying an unrivaled portfolio of solutions based on the complementarity of its high-performance polymers. Rilsan® polyamide 11, well-suited

2

3

4

5

— **1. MOBILITY/TRANSPORT**
Polyamide 11 is an alternative to metal and rubber for structural parts in vehicles

— **2. CONSUMER ELECTRONICS**
The transparent grade of polyamide 11 is used for smartphone components, foldable screens and watch parts

— **3. SPORTING GOODS**
Pebax® Rnew® elastomer provides lightweight, elastic performance for athletic shoe soles

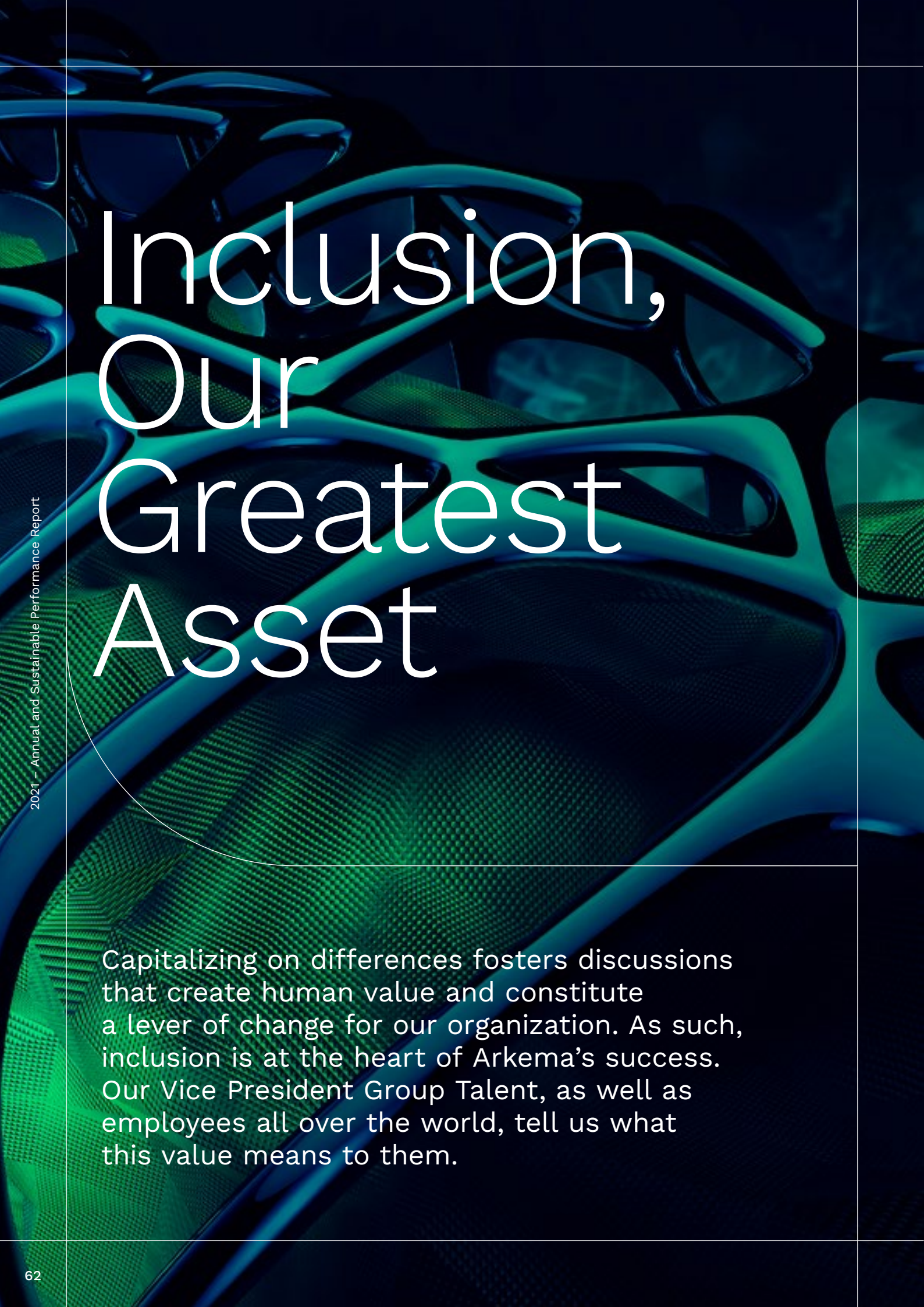
— **4. SPECIALTY COATINGS**
In its fine powder version, polyamide 11 is used for ultra-resistant coatings, including dishwasher baskets

— **5. 3D PRINTING**
Polyamide 11 powders are increasingly used to manufacture mass-produced items, such as eyewear

to laser sintering technology, offers mechanical strength and durability for the rapid manufacture of custom-made shapes, in areas such as eyewear and bicycle helmets adapted to the cyclist's body shape (see p.40 and 41). ■

"The commissioning of our Jurong Island bio-refinery, which increases our global amino 11 production capacity by 50%, marks a major step forward in our strategy to develop bio-sourced polymers based on polyamide 11. In addition to Marseille, we now have a second production plant for the monomer, which is a strong guarantee of business continuity for customers who rely on our supplies. As for its location in Singapore, it suits our desire to 'serve the region from the region'. This additional capacity will be mainly directed toward Asian demand, where we expect organic growth in our existing markets and the development of new applications, driven in particular by the appeal of bio-sourced solutions. We foresee that, over the coming years, this overall growth in demand will be around double the region's GDP growth."

Olivier Poyet, General Manager Specialty Polyamides



Inclusion, Our Greatest Asset

Capitalizing on differences fosters discussions that create human value and constitute a lever of change for our organization. As such, inclusion is at the heart of Arkema's success. Our Vice President Group Talent, as well as employees all over the world, tell us what this value means to them.

Mélanie Jourdain
VP Group Talent

Why have you added inclusion to the long-standing values on which Arkema bases its strategy?

Mélanie Jourdain: solidarity, responsibility, performance and simplicity are the four core values that have formed the basis of the Group's culture since its inception, as well as our management of human resources. This year, we wanted to add inclusion to these values, coupled with the notion of diversity, because expectations on this subject are growing, across society and, of course, within Arkema, along with our actions concerning our environmental impact. For me, the social role of the company is obvious, and inclusion is a great source of human enrichment for our teams. Diversity and inclusion go hand in hand, and we work hard in our recruitment process and in our career management to make our employees feel included and happy in their role, whatever their profile, origin or background. A company where employees feel secure, recognized, listened to and included allows them to give the best of themselves. This is where inclusion is a key value, in order to support our talent, on an international level, to retain people and thus expand the Group with men and women keen to engage.

Are there indicators to measure our progress in terms of diversity and inclusion?

M. J.: We monitor two indicators in particular: gender balance - the percentage of women - and diversity - the percentage of non-French employees - in senior management and leadership roles. We also conduct regular internal surveys, particularly on engagement, which are an opportunity to ask employees if they feel included, if they've already found themselves in a discriminatory situation, if they don't feel they have access to the same opportunities etc. Measuring this sense of inclusion is essential to enable us to then work on specific action plans.

When it comes to gender balance, what are your goals?

M. J.: We want to promote the role of women and ensure they can access positions of responsibility. This is already the case at the highest level, but we still need to do more. We're aiming for 30% of senior management or leadership roles to be held by women by 2030. At the end of 2021, the figure was 24%. This is already very encouraging but it takes time to build these pools of women, support them and train them. The dynamic we create will also benefit intermediate levels of responsibility and all women within the Group.

Does equal pay form part of inclusion?

M. J.: It's an integral part of the action plans enshrined in the Diversity and Inclusion charter that we're developing. The Group is strongly committed to measuring pay gaps, with a clearly held principle of equal work, equal pay. We focus not only on gender equality, but also on difference in the wider sense, whether this relates to social origin, nationality, culture, age, experience, physical condition, family situation etc. Every employee must feel that they benefit, without bias, from equal access to career and development opportunities. We're not trying to erase the perceived differences in a team so that everyone looks the same, but rather to draw the best from each person's profile by relying on collective intelligence. ■

Inclusion - **How it affects them**

Yong-Sheng, 45, lives near Changshu in China. A mechanical engineering and automation graduate, his professional career is impressive and varied. It all began in 1998 when he was involved in the construction of the Changshu site, after which he was recruited by Arkema as Director of Infrastructure and Maintenance Supervision. He then progressed steadily to take on the role of managing a facility with nearly 400 employees in 2019. Investment, a positive attitude and a sense of leadership... Yong-Sheng has all the qualities that Arkema looks for when moving its staff between roles. ■

Yong-Sheng,
Facility Manager, China

Celine remembers the day that a HR manager in Paris asked her what her dream would be. *"To become a facility manager"*, she replied. *"If I hadn't been asked the question, the idea of taking on such responsibility would never have occurred to me. Arkema pursues a real policy of bringing talent to the fore."* First recruited in the late 1990s as a chemist to set up the Changshu laboratory, she has held various other positions since, including HSEQ Manager, Production Manager, SAP Project Manager, Facility Manager. Now the HSEQ Director for Asia, she would like to inspire other young women to rise through the ranks. ■

Celine,
Health, Safety, Environment and Quality Director for Asia, China

“The engineering sector remains male-dominated but this doesn’t cause me any problems at work.”

Sharifah,
Process Engineer, Malaysia

Malaysian-born Sharifah is 26. After graduating as a Process Engineer from ENSICAEN (the national school of engineering and research) in Caen, she completed her internship at Arkema and was offered a permanent job in Malaysia. *“As a Process Engineer, I work under the supervision of a Senior Engineer to monitor processes and help solve problems. It’s stimulating and also challenging. Working in a factory requires safety and security management, which are aspects of the job that my studies didn’t prepare me for!”*

But in her working relationships, the key word is calmness. *“My colleagues are very helpful and always remember that I’m just a young graduate. Of course, by the end of the day my head is bursting with information as there’s so much to learn! But I feel supported by the management team and the people around me. And, I’ve just been offered training in project delivery. It’s very rewarding.”*

Being a woman in a male-dominated environment is not a problem for her. *“Firstly, because I’m the only girl in my family so I’m used to living with my brothers in a male environment, and, more importantly, because I know that Arkema has firm rules and robust policies that protect us from discrimination. The engineering sector remains male-dominated but this doesn’t cause me any problems at work.”*

As a Muslim, Sharifah wears the traditional headscarf, again without any apprehension. *“In Malaysia, Islam is the main religion and it’s common to wear a headscarf. However, some of my friends have to take theirs off for work. Arkema lets me choose, which is great. I just have to make sure I wear a cotton scarf to avoid any kind of fire hazard, and it must be knotted simply so it can be taken off quickly.”*

Sharifah is looking to the future with enthusiasm and confidence, supported by the HR team which is *“always willing to find a practical solution to any request.”* She is extremely committed and preparing for an international career – and why not! She even plans to spend a few years at Arkema France. Nothing would make her happier than to go back to France, *“to relive the simple things that I enjoyed, like going to the bakery in the morning and buying a croissant!”* ■

“I’ve never come across discrimination in my professional relations.”

Maryetta,
Facility Manager, USA

“I started my career in 1995 as a Production Operator, on a rotating 12-hour shift system. *With a degree in microbiology, I was responsible for the control desk, collecting samples and taking care of problem-solving and labeling. After 25 years at Arkema, I was promoted to Facility Manager two years ago.*

My progression has been gradual. With experience, I became more aware of my abilities and started to perform management duties, before being appointed as Security Manager. In order to progress further, I went back to school and obtained an MBA in supply chain management. I owe my position to a HR process. One day a Facility Manager contacted me and said: ‘How would you feel about becoming Facility Manager?’ Chemical companies usually promote mainly chemical engineers, but Arkema has a different policy; the Group considers skills above all and endeavors to advance all kinds of talent. From Production Operator, I became Facility Manager! I never forget that in my family, I’m the only one who's gone on to higher education; my mother was a caretaker and my father was a truck driver.
At my level, being a woman in a male-dominated environment could have been a personal challenge. But this hasn’t been the case, and I’ve never had to report any problems in my professional relations. During discussions with other Facility Managers, I feel completely at ease and I've never had to complain about any type of discrimination. Arkema is doing a great job of promoting women to senior positions and, more broadly, promoting diversity. As an African-American, I’ve always been treated equally. I’ve never felt that I had to work 200% to be properly valued. In meetings or discussions with colleagues, I’m comfortable saying what I think, and I feel that my opinions are considered and respected.

When I look at the people in an Arkema meeting room, I realize that we have a broad range of experiences, types and backgrounds. We often joke that we’re like a little family, but it’s the truth!” ■

“The Simulation Recruitment Method worked for me as you don’t need to have a qualification or experience in chemistry.”

Florian,
Manufacturing Operator,
France

“I’m 29 and a Manufacturing Operator. *My career path is a little out of the ordinary. After seven years working for KS Services, a sub-contractor responsible for kegging at the Arkema plant, I sent an application to HR, who directed me to the Simulation Recruitment Method (SRM) offered by the Employment Center. I’d never heard of this. The Employment Center first invited me for a preliminary interview, followed by practical tests to assess my suitability for this type of work. They went well.*

After an interview at Arkema, I received on-site vocational training and mentoring for six months, which helped me learn the ropes. I was awarded a permanent position as an Operator June 2021. This method worked for me as you don’t need to have a qualification or experience in chemistry. I now have a professional baccalaureate in industrial maintenance.

SRM gives everyone an opportunity. On my course, for example, there was a young lad who was a seasonal worker and another who was a baker. The profiles are varied. The employment opportunities are more extensive. I really like what I do and enjoy my relationships with the teams, even though there are constraints with shift work. But ultimately, I’ve never had so much free time. And I know that I can still develop and become multi-skilled and learn other tasks in another building. I feel supported and encouraged.” ■

“It’s the quality of human relations and the richness of our differences that bring us closer together.”

Samir,
Manufacturing Operator, France

“I started playing football in my home town of Arles, like a lot of kids, and it really took me places. I moved to clubs all over France before signing a professional contract with Nîmes Olympiques in 2013.”
Samir has achieved his goal, and as a center forward, he knows how to score them. But the career of an elite footballer is short lived. *“As a professional, I made a good living but not enough to retire quite so young.”*

Playing amateur football again in the Fos Division d’Honneur, he came across Sport Society. This association, which has partnerships with companies including Arkema, supports athletes in navigating a smooth transition out of professional sport. *“Sport trains us without discrimination and teaches strong values such as solidarity and the drive to achieve, which fit in well with corporate expectations”*, says James Strauss, former footballer and now one of the association’s managers, who suggested to Samir that he train as an operator in the chemicals sector. *“I discussed it with other athletes who’d gone down this road and they told me all about the job and the opportunities for progression, and convinced me to do a Certificate of Professional Qualification (CQP) through vocational training at the TotalEnergies Oleum Center in Martigues. Life opens the doors that we least expect!”*, says Samir, now 34 years old and married with two children, who is now employed as an Operator on a permanent contract at the Arkema plant. *“It’s a complete U- turn, but there is some common ground with football: you have to work together to win, and in the factory, if you don’t all head in the same direction, you don’t meet your production goals.”*

Samir’s colleagues know all about his unusual journey. *“I can talk about what I used to do, it’s easy, they love football. And when I saw that Arkema had sponsored the women’s Division 1, I thought that was fantastic. For me, both in the factory and on the field, it’s the quality of human relations and the richness of our differences that bring us closer together.”* ■

Audrey,
Engineer, France

"I joined Arkema in 2017, before being diagnosed with ankylosing spondylitis, *a degenerative autoimmune disease with fibromyalgia. It took a while before I was ready to start the RQTH (Recognition of Disabled Worker Status) process with the public bodies. I needed some time to accept my situation and recognize that I needed help. Well-informed and supported by Arkema HR, I finally completed my RQTH application in 2019. This support has been crucial in enabling me to improve my well-being at work.*

I've benefited from new equipment such as an electric desk which lets me work standing up to relieve my pain. I've also been given more flexibility in my working hours and have facilities available to me for business trips. I'd also like to say that I've been really fortunate in having exceptional managers who have been kind and understanding, illustrating the value of inclusion that we're talking about today. They made adjustments for me even though I wasn't yet officially recognized as a disabled worker. My department's team is amazing. Nobody has ever made me feel that I'm different. I had to tell them not to worry and that I'd let them know if there was a problem. You have to learn to communicate. My illness is obviously unfair and painful, but once you accept that, life is much better. In fact, I'm not Audrey, the person with a disability who needs to be handled with kid gloves. I'm just Audrey, the colleague they bug with incessant demands. True happiness (she laughs)!" ■

Arkema, at the top of the HR 2021 rankings

In 2021, Arkema ranked highly on four HR leaderboards of international and French magazines and institutes. These rankings reflect how well our employees, work-study students and trainees perceive their company. They're also an indication of what the Group is doing to establish itself among the best in terms of talent management, promoting women, diversity and inclusion.

Forbes

For the last five consecutive years, we have featured in the Forbes list of the World's Best Employers: whereas last year we were 259th out of 750 companies, we ranked 102nd in the 5th edition of Forbes 2021. We are also ranked 8th out of 54 French companies on this list. The survey was carried out among 150,000 employees in 58 countries working for multinational companies and institutions. Participants were asked to assess their willingness to recommend their own employer to their friends and family, and to rate their satisfaction with their employer in terms of overall image, economic footprint, talent development, gender equality and social responsibility.

Capital

Within the list of the 500 best employers in France compiled by Capital magazine, Arkema features in the Top 20 and is recognized as the best-perceived employer in France's Oil and Chemical sector. This excellent ranking by our employees underlines our commitment to a high quality working life, diversity, gender equality and the wealth of the roles we offer.

Trainees choose mycompany

Finally, for the third time, Arkema has been recognized by HappyIndex® Trainees 2022 France as the company where trainees and/or work-study students are the most motivated and happy in their work! Arkema ranks 2nd in the category "Companies with 200 to 499 trainees and/or work-study students per year."

Shareholder information

Snapshots of 2021

Acquisitions, awards for our CSR initiatives, investments in the electric battery and 3D printing sectors, planned increases in capacities and other highlights: here's an overview of our main news to give you a taste of the Group's achievements during the year.

JANUARY

BOSTIK BOLSTERS ITS FAST-SETTING, HIGH-PERFORMANCE ADHESIVES BUSINESS

Bostik invests up to 51% and $11 million in CMC (Crackless Monomer Company), a joint venture with the Taiwanese company Cartell Chemical Co, a specialist in cyanoacrylate solutions. CMC will specialize in the development of high-performance adhesives for the electronics, medical equipment and DIY markets.

FEBRUARY

ARKEMA LAUNCHES ITS START-UP CONNECT PROGRAM

This program invites start-ups from all over the world that are specializing in advanced materials to enter into an exclusive R&D partnership with Arkema in order to benefit from the Group's assistance and technological experience.

FEBRUARY

LAUNCH OF THE CYCLON, THE FIRST 100% RECYCLABLE RUNNING SHOE USING RILSAN® POLYAMIDE 11

Arkema worked closely with the Swiss sporting goods manufacturer On to design this totally innovative running shoe, the first 100% recyclable shoe made entirely from polyamide 11, our bio-sourced material derived from castor seeds.

FEBRUARY

NEW ACQUISITION IN THE BRAZILIAN ADHESIVES BUSINESS

Bostik reinforces its presence in the Brazilian construction adhesives market with the acquisition of Poliplas (revenue of €10 million in 2020), a leader in hybrid-technology mastics and adhesives.

FEBRUARY

INCREASE IN KYNAR® FLUOROPOLYMER PRODUCTION CAPACITY IN CHINA

Arkema will increase its production of PVDF fluoropolymers at its Changshu site by 35% in 2022 in response to strong demand in the lithium-ion battery sector.

MARCH

ARKEMA JOINS THE PARIS STOCK EXCHANGE'S NEW CAC 40 ESG® INDEX

The CAC 40 ESG® brings together the 40 companies that demonstrate the best Environmental, Social and Governance (ESG) practices. It highlights the Group's commitments and successes over several years in the quest for a sustainable economy.

MAY

BOSTIK EXPANDS ITS RANGE OF HIGH-PERFORMANCE ADHESIVES IN THE UNITED STATES

Bostik acquires Edge Adhesives Texas (revenue of €12 million in 2020), which manufactures innovative adhesive solutions in the field of hotmelt adhesives and pressure-sensitive adhesive tapes for the residential building market.

MAY

CIRCULAR ECONOMY: ARKEMA ACQUIRES AGIPLAST

Agiplast is a leader in the recycling of high-performance polymers, in particular specialty polyamides and fluoropolymers. Through this acquisition, Arkema will be able to offer a full service to customers in terms of materials circularity, addressing growing market expectations in this field.

JUNE

Arkema successfully holds its first Digital Coating Days

The schedule for this innovative two-day event included a live television program hosted by a journalist in the presence of Arkema leaders and experts from the Coatings industry, followed by a series of webinars focusing on our range of high-performance resins and additives and Arkema's innovations in coatings. Almost 2,000 customers took part.

JUNE

ARKEMA INVESTS IN 3D PRINTING SPECIALIST ERPRO 3D FACTORY

ERPRO 3D FACTORY is a French company founded in 2017 that specializes in large-series additive manufacturing. The company has already produced more than 19 million parts, most of which are made from 100% bio-sourced polyamide 11 powders. This 10% stake will allow us to develop new applications for our powders.

JUNE

A NEW BREAKTHROUGH RANGE OF RENEWABLE PVDF GRADES

The Kynar® CTO PVDF grades will be produced using carbon derived from renewable raw materials - in this case a pine oil derivative - and will be specifically intended for lithium-ion batteries. This innovation reduces the impact on climate change by nearly 20% while also reducing dependence on upstream oil consumption.

JUNE

Arkema recognized by the American Chemistry Council for its polyamide 11

Arkema's commitment to high-performance polyamide 11, 100% bio-sourced from castor seeds and recyclable, has been honored with a Sustainable Leadership Award for Societal Contributions from the American Chemistry Council (ACC). This award recognizes products, processes or initiatives that illustrate a commitment to innovating for a sustainable future.

JULY

ARKEMA ACQUIRES A STAKE IN VERKOR AND ACCELERATES ITS BATTERIES STRATEGY IN EUROPE

Arkema becomes a shareholder and technological partner of Verkor, a French start-up specializing in the production of high performance batteries.

JULY

MEETING THE GENERAL PUBLIC: ARKEMA RETURNS TO THE BIG TOUR 2021

Arkema attends the second edition of the Big Tour organized by BPIFrance. This tour showcasing French business know-how in some twenty locations all over France was an opportunity for nearly 300,0000 visitors to discover the various unexpected ways in which our materials can be used.

SEPTEMBER

ARKEMA RANKED NUMBER ONE OF CHEMICAL SECTOR COMPANIES BY THE AGENCY VIGEO-EIRIS

The Group ranks #1 of the 42 companies assessed in the global chemical sector, and 49th of the 4,952 companies in all sectors, thereby recognizing our strong progress in Corporate Social Responsibility.

SEPTEMBER

ARKEMA SELLS ITS EPOXIDES BUSINESS

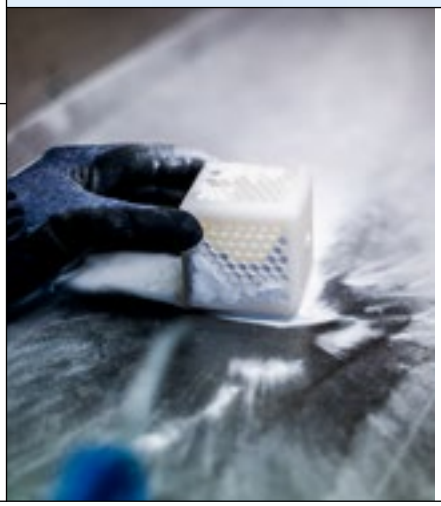
Arkema announces the proposed divestment of its epoxides business to Cargill, a leader in food products and services.

AUGUST

Acquisition of Ashland's Performance Adhesives business in the United States

This acquisition of Ashland's Performance Adhesives business for €1.39 billion was a major step forward in Bostik's long-term ambition for strong growth.

The Ashland business is a leader in high-performance adhesives for industrial applications in the United States.



OCTOBER

A NEW PLANT IN CHINA TO PRODUCE BIO-SOURCED POLYAMIDE 11 POWDERS

In parallel with its major project to increase its global production capacity of bio-sourced polyamide 11 by 50% in Singapore, Arkema announces the construction of a polyamide 11 powders plant at its Changshu site in China. This investment will support the growing demand for advanced, bio-sourced and recyclable materials in Asia.

ARKEMA INNOVATIVE MATERIALS FOR A SUSTAINABLE WORLD

NOVEMBER

Unveiling of our new visual identity

With this new brand identity, Arkema demonstrates its ambition to use its innovation and expertise in materials science to help build a sustainable world. To help share the news, the largest advertising plan since Arkema was founded is launched in France and internationally. Arkema is in the spotlight with 60 inserts in some 30 print media and content on hundreds of display screens at the four largest European airports.

NOVEMBER

ARKEMA RANKS 3RD PLACE IN THE 2021 DOW JONES SUSTAINABILITY INDEX

Arkema has been recognized among the chemicals sector's global leaders in sustainability in the 2021 Dow Jones Sustainability Index (DJSI), improving its ranking to third place in the DJSI World and maintaining its second place in the DJSI Europe.

DECEMBER

ARKEMA DOUBLES ITS SARTOMER® PHOTOCURABLE RESINS CAPACITY IN ASIA

This expansion at our Nansha site will support the fast-growing demand in Asia for cutting-edge solutions in electronics driven by 5G technology, and for renewable energies.

DECEMBER

ACQUISITIONS IN ADHESIVES IN SOUTH AFRICA

Arkema announces the proposed acquisition of Permoseal in South Africa (revenue of €41 million), one of the leaders in adhesive solutions for woodworking, packaging, construction and DIY. Its range of high-performance adhesive solutions will strengthen Bostik's product range in the industrial, construction and DIY markets in South Africa and sub-Saharan Africa.

Governance

THE BOARD OF DIRECTORS

Chaired by Thierry le Hénaff, the Board of Directors determines the Group's strategic orientations and oversees their implementation. It is composed of 14 members, eight of whom are independent directors. It has seven female members, two directors representing employees and one representing employee shareholders.

Thierry Le Hénaff,
Chairman & CEO of Arkema

Jean-Marc Bertrand,
Director representing employee shareholders

Isabelle Boccon-Gibod,
Non-independent Director, representing the French Equity Fund FSP *(Fonds Stratégique de Participations)*

Marie-Ange Debon,
Independent Director

Ilse Henne,
Independent Director

Ian Hudson,
Independent Director

Victoire de Margerie,
Independent Director

Nathalie Muracciole,
Director representing employees

Laurent Mignon,
Non-independent Director*

Hélène Moreau-Leroy,
Independent Director

Sébastien Moynot,
Independent Director, representing Bpifrance Investissement

Thierry Pilenko,
Independent Director

Susan Rimmer,
Director representing employees

Philippe Sauquet,
Independent Director

11 meetings
including one day dedicated to the Group's strategy with an attendance rate of 100%.

92%
meeting attendance rate.

*More than 12 years of presence on the Board of Directors.

To help it carry out its duties, the Board of Directors has set up three specialized committees:

THE AUDIT AND ACCOUNTS COMMITTEE, composed of **Marie-Ange Debon** (Chairwoman), **Isabelle Boccon-Gibod, Ilse Henne** and **Ian Hudson.** This committee ensures the quality of internal control and the reliability of the information provided to shareholders and financial markets.

THE NOMINATING, COMPENSATION AND CORPORATE GOVERNANCE COMMITTEE, composed of **Thierry Pilenko** (Chairman), **Hélène Moreau-Leroy,** Lead Director, **Nathalie Muracciole** and **Philippe Sauquet.** This committee makes its recommendations on the composition of the Board, the compensation policy for corporate officers (including the CEO) and corporate governance best practices.

THE INNOVATION AND SUSTAINABLE GROWTH COMMITTEE, composed of **Victoire de Margerie** (Chairwoman), **Jean-Marc Bertrand, Isabelle Boccon-Gibod, Ian Hudson** and **Sébastien Moynot.** This new committee, created in 2021, is responsible for assessing the contribution of Arkema's innovation and strategy to environmental issues and sustainable growth. Together with the other two committees, it carries out comprehensive reviews on all of the Group's ESG and non-financial issues.

THE EXECUTIVE COMMITTEE

Chaired by Thierry Le Hénaff, the Executive Committee provides operational management as well as the coordination and deployment of the strategy within the Group. This decision-making body gives priority to strategic thinking and performance monitoring, examines important organizational issues, major projects and oversees the implementation of internal control. It is made up of a Chief Operating Officer, five operational and functional general managers and three operational deputy general managers. It meets twice a month.

Thierry Le Hénaff,
Chairman & CEO of Arkema

Luc Benoit-Cattin,
Executive Vice President, Industry & CSR

Bernard Boyer,
Executive Vice President, Strategy

Marie-Pierre Chevallier*,
Senior Vice President, Performance Additives

Marie-José Donsion,
Chief Financial Officer

Richard Jenkins*,
Senior Vice President, Coating Solutions

Vincent Legros,
Chief Executive Officer of Bostik

Thierry Parmentier,
Executive Vice President, Human Resources & Corporate Communications

Erwoan Pezron*,
Senior Vice President, High-Performance Polymers

Marc Schuller,
Chief Operating Officer, Advanced Materials, Coating Solutions and Intermediates

In 2016, a Management Committee was set up to review the operational activity (HSE, business, finance, ESG and operations) and to monitor the Group's projects and major issues. Made up of 25 members, including the Executive Committee's 10 members, six business line directors and three country directors, it meets several times a year.

* These three members report to Marc Schuller.

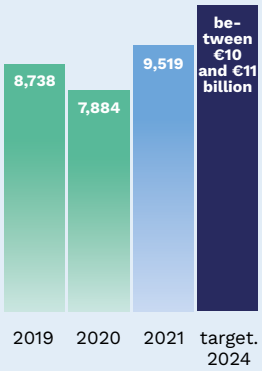
Financial and non-financial **performance**

Arkema strives to drive forward both its financial results and its environmental and societal performance. The Group has set itself ambitious targets in both of these areas.

Exceptional financial **results in 2021**

Arkema's geographical and technological positioning, as well as the diversity of its markets, have enabled the Group to achieve record financial performance in 2021, despite the context of the health crisis and a complex environment.

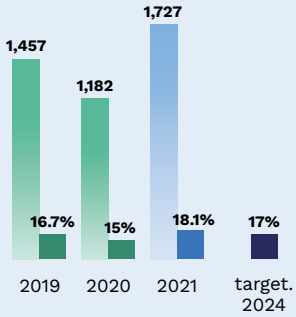
REVENUE
(in € millions)



Revenue increased by 25.9% in 2021 compared with 2020 on a constant scope and exchange rate basis.

2024 TARGET: revenue of between €10 billion and €11 billion.

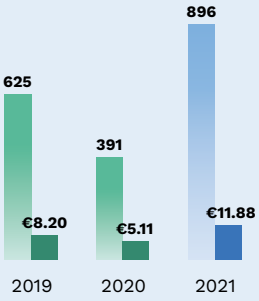
EBITDA
(in € millions)
AND EBITDA MARGIN
(as a %)



EBITDA, at more than €1.7 billion, and the EBITDA margin of 18.1%, reached the highest levels in our history.

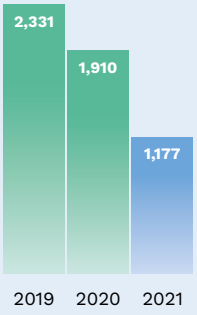
2024 TARGET: an EBITDA margin of 17%.

NET INCOME
(in € millions)
AND NET EARNINGS PER SHARE
(in €)



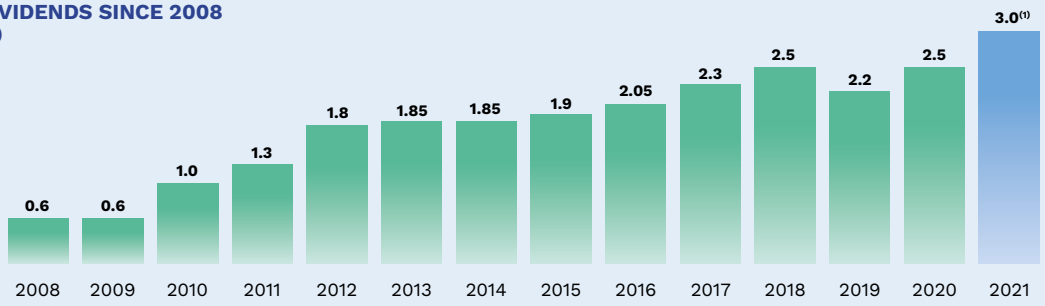
Net income amounts to €896 million, or €11.88 per share.

NET DEBT INCLUDING HYBRID BONDS
(in € millions)



Net debt is falling sharply and stands at €1.177 billion, including hybrid bonds (€700 million), i.e. 0.7 times the year's EBITDA.

RISING DIVIDENDS SINCE 2008
(in €/share)



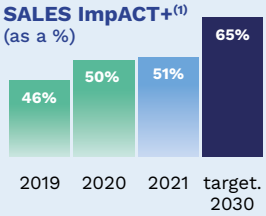
(1) Dividend proposed at the Shareholders Annual General Meeting on May 19, 2022
The dividend is a key component of the Group's shareholder return policy. At the Capital Markets Day on April 2, 2020, the Group reiterated its ambition to gradually increase the dividend, with a target distribution rate of 40% of its profits by 2024.

Continually evolving CSR Indicators

Based on specific indicators and targets, Arkema is striving for continuous progress in its CSR activities through three commitments:
- to deliver sustainable solutions driven by innovation;
- to act as a responsible manufacturer; and
- to cultivate an open dialogue with internal and external stakeholders.

1. SUSTAINABLE PRODUCTS

PROPORTION OF SALES ImpACT+[(1)] (as a %)



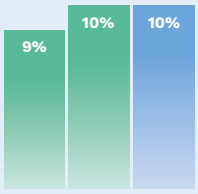
[(1)] The proportion of sales making a significant contribution to the SDGs (ImpACT+) is based on an evaluation of 85% of sales in 2021, 72% in 2020 and 44% in 2018 and 2019.

In order to strengthen its commitment to offering sustainable products, for several years the Group has been evaluating its portfolio of solutions against sustainability criteria.

In 2021, the share of sales making a significant contribution to the UN SDGs (ImpACT+) was 51%.

2030 TARGET:
for 65% of our sales to make a significant contribution to the SDGs

PROPORTION OF SALES FROM RENEWABLE OR RECYCLED RAW MATERIALS

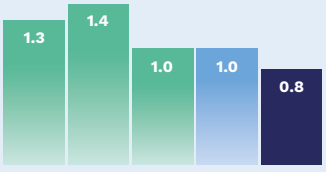


The proportion of sales from renewable or recycled raw materials includes sales based on a content of at least 25% renewable or recycled raw materials in 2021 and 20% in previous years (this threshold change has no impact on the value of the indicator).

2. RESPONSIBLE MANUFACTURING

Safety: two new targets for 2030

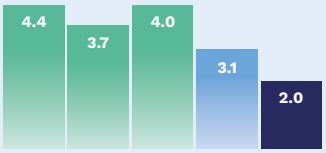
TRIR
(Total recordable injury rate per million hours worked)



The TRIR for 2021 (including accidents among Group personnel as well as workers from contracted firms) came to 1, which is stable compared with 2020. Arkema's TRIR performance is among the best in the chemical industry.

NEW TARGET:
achieve a TRIR of 0.8 by 2030

PSER
(Number of process safety events per million hours worked)



The PSER (Process Safety Events Rate) vastly improved to 3.1 in 2021. A plan is currently being developed to define both technical and human actions to reduce the PSER.

NEW TARGET:
achieve a PSER of 2 by 2030

Climate and environment: four environmental targets for 2030

The climate target is defined as an absolute value of GHG emissions compared with 2015.
The three objectives (Energy, Water and Air) are defined on the basis of intensive indicators called EFPI (Environmental Footprint Performance Indicators), which incorporate changes in the Group's scope of activity and the production of the plants.

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CLIMATE
(Greenhouse gas emissions)

In 2021, Arkema reduced its greenhouse gas (GHG) emissions by 34% compared with 2015.

2030 TARGET:
reduce our GHGs by 38% compared with 2015.

This commitment is in line with the Paris Agreement. This translates into a reduction in absolute emissions of more than 1.7 million tons of CO_2 equivalent, compared with 2015, with the aim of achieving a figure of less than 3 million tons by 2030.

ENERGY
(Net energy purchases EFPI)

In 2021, energy performance improved significantly as a result of measures taken by the Arkema Energy program and the return to more favorable production conditions.

2030 TARGET:
reduce net energy purchases by 20% in EFPI compared with 2012.

>>

WATER
(chemical oxygen demand [COD] EFPI)

In 2021, Chemical Oxygen Demand (COD) was stable and very close to the 2030 target. Efforts are continuing at sites to optimize waste water management.

2030 TARGET:
reduce COD emissions by 60% in EFPI compared with 2012.

AIR
(volatile organic compounds [VOCs] EFPI)

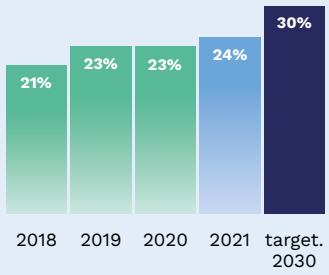
In 2021, VOCs were down, despite the increase in activity. This decrease is mainly the result of the ongoing collection measures and the reliability of treatments, and to a lesser extent, the completion of the PMMA divestment.

2030 TARGET:
reduce VOC emissions by 65% in EFPI by 2012.

3. OPEN DIALOGUE

Employee development and diversity

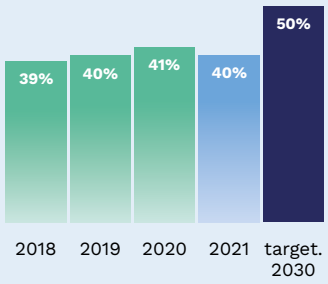
PROPORTION OF WOMEN AMONG SENIOR MANAGEMENT AND EXECUTIVES



In 2021, across the Group, the proportion of women among senior management and executives increased by 1% after an increase of 2% in 2019 compared with 2018.

2030 TARGET:
proportion of women among senior management and executives to be at least 30%.

PROPORTION OF NON-FRENCH NATIONALS AMONG SENIOR MANAGEMENT AND EXECUTIVES

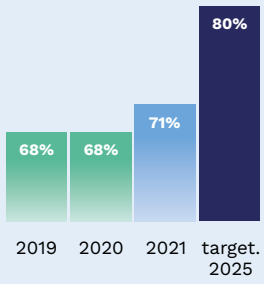


In all countries where Arkema operates, local skills and know-how are preferred at all levels, including within management teams.

2030 TARGET:
proportion of non-French nationals among senior management and executives to be at least 50%.

Responsible purchasing

PROPORTION OF PURCHASES FROM RELEVANT SUPPLIERS COVERED BY A TFS ASSESSMENT



Arkema has participated in the TfS (Together for Sustainability) initiative since 2014. This is an initiative that aims to support social responsibility throughout the supply chain of the chemical sector. Relevant suppliers are those representing at least 80% of the Group's recurring purchases.

2025 TARGET:
80% of purchases made from relevant suppliers to be covered by a TfS assessment.

A PROGRESS INITIATIVE RECOGNIZED BY THE NON-FINANCIAL RATING AGENCIES

Member of Dow Jones Sustainability Indices Powered by the S&P Global CSA

Joined the DJSI World and DJSI Europe indexes in 2020

MSCI

"A" rating since 2017

CDP

In 2021, received a "B" rating for Climate Change and a "B" rating for Water Security

V.E

Listed on the Europe 120 and Eurozone 120 indexes since 2015

Joined the CAC 40® ESG in 2021

ecovadis

Arkema is among the top 1% of the industry's highest rated companies since 2014

ISS ESG

"C+" rating, Arkema ranks in the top decile worldwide

ARKEMA

FOR THE WORLD TO CHANGE, WE MUST CHANGE THE MATERIALS WE USE.

Beginning the journey to a more sustainable world means embracing innovative materials. At Arkema, we offer a broad spectrum of materials essential for the battery ecosystem, as well as solutions that support the development of hydrogen as a fuel. Arkema makes mobility better by ensuring innovation and responsibility always go hand in hand.
Arkema. Innovative materials for a sustainable world.

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