CHEManager INTERNATIONAL

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Circular Economy
Collaboration Models for Chemical Companies, Circular Plastics Products, Transforming Waste into Fuel, Sustainable Innovation

Distribution & Logistics
Risks & Chances in Chemical and Pharma Supply Chains, Added-Value Chemical Distribution, Predictive Logistics

Innovation
Biodegradable Packaging, Virtual Chemical Syntheses, Polymer Brush Coating Technology, Predictive Simulation Models

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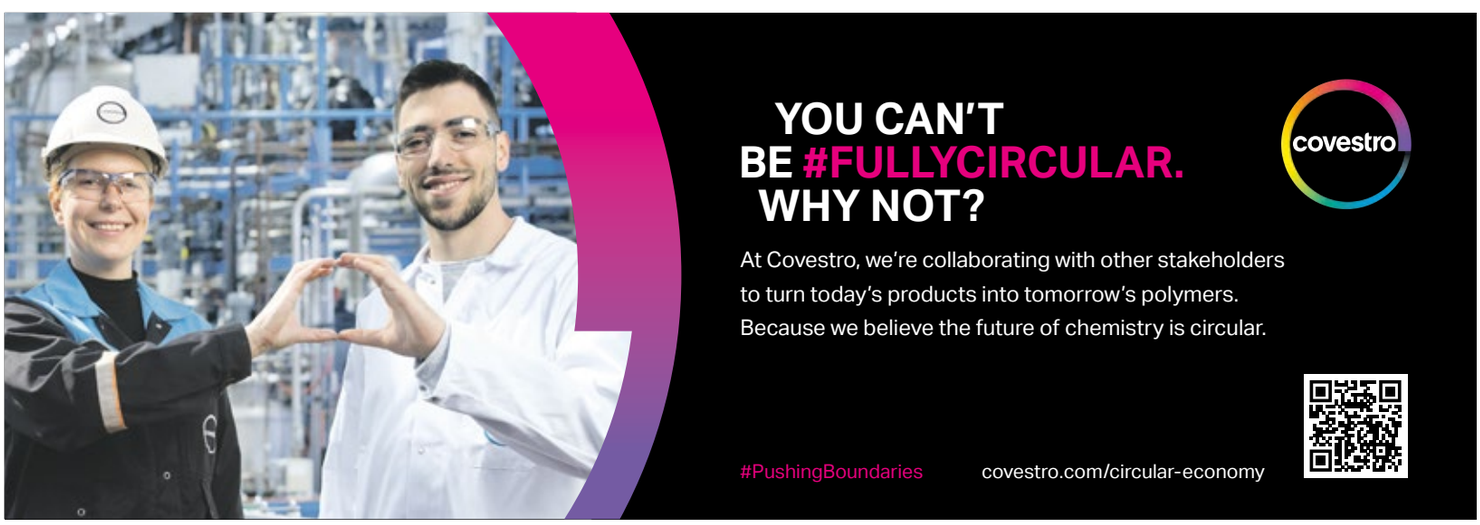
Innovation Pitch

Innovation



No Time to Stand Still

To Succeed in the Circular Economy, Chemical Companies Must Quickly Build Alliances

The collection and processing of growing chemical product waste streams increases the need for companies to reorient and integrate new business areas. The shift requires intensive cooperation along the value chain and across industries. There is little doubt that the chemical industry plays an essential role in establishing the circular economy model and closing loops. The time is now for chemical companies to (re-)define their role as non-traditional opportunities and players emerge.

Collaboration is key to addressing the challenges. There are models already taking shape which demonstrate how chemical companies can have a bigger impact and grow at the same time.

Serious Targets, Serious Opportunities

The circular economy is here to stay, with exciting opportunities for the chemical industry to stand out. In the long run, demand will increase; global brand owners have made pledges to their customers and need to make good on promises in the not-too-distant future which will require enormous volumes of recycled materials.

The recently published research report "Winning in the Circular Economy" evaluates the potential for the chemical industry and backs up why brands are making bold moves: 81% of consumers expect to buy more environmentally friendly products in the next 5 years. Targets for reducing greenhouse gas emissions and replacing fossil resources are serious, in Europe and around the globe. Investor preferences are following suit: access to capital will become increasingly costly for companies who fail to put serious sustainability measures in place and enable circularity downstream. For an overview of the circular economy drivers cf. fig. 1.

The business case is here, too. While, compared to fossil materials, scale will always remain a challenge for secondary raw materials, there are already chemical waste streams like polyethylene terephthalate (PET) with clear break-even economics. For several further plastic waste streams, such as polystyrene (PS), low-density polyethylene (LDPE) and polypropylene (PP), there also appears to be good potential based on how market prices for secondary raw materials compare to their virgin alternatives.

The downstream enablement for circularity bears further sizeable volume and value potential. In the EU, about 51.2 million t of plastics were consumed in 2018, but only 29.1 million t of plastic waste were collected that year. In the absence of disruptions, Accenture expects plastics consumption to grow to 60.5 million t by 2030. Over the long-term, demand will be growing, and incremental demand driven by downstream enablement for circularity means that one can expect additional volume as a result.

Michael Ulbrich, Accenture Strategy

Considering all chemical products — not just plastics — and integrating numerous assumptions, Accenture expects consumption to grow from 139 million t in 2018 to 180 million t in 2030 (fig. 2), along with an increase in average unit value from €1,770 per ton to €1,960 per ton. By 2030, circular economy-driven incremental growth represents a €50 billion value upside potential.

No doubt, the transition to the circular economy triggers a wide range of challenges that the industry needs to address. For companies this means re-evaluating target product portfolios and adjusting business strategies to build trust with consumers and capture new opportunities, shifting capital investments from linear to circular material assets, developing and reorganizing for circular capabilities across the organization and testing new business models.

What is abundantly clear is that companies won't be able to achieve this alone — partnering across the traditional value chain will be crucial. And here is where things get interesting: with collaboration at its core, circular value chains open opportunities for chemical producers to go beyond making and selling molecules. If ever there was an exciting time for the chemical industry, it's now.

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Above All, Forge Alliances

While the end-state of the circular value chain remains open-ended, none

of today's players have the capabilities and experience needed to meet what is required on their own. It's important for companies to embed their collaboration approach into their circularity strategy and quickly build cross-value chain pilots. As the industry landscape changes and chemical companies define their roles, different value chain collaboration models are emerging.

Collaboration Model 1: Chemical company and waste manager cooperation

Some chemical and waste management companies have started to establish joint frameworks and infrastructure for economical recycling processes. The waste managers contribute a sufficient and reliable waste supply with the needed composition and quality for economical recycling processes. In this model, the chemical companies provide the necessary knowledge for the manufacturing technology to use the recyclate or to set up and develop a chemical recycling process. For example, one of the largest plastics, chemicals and refining companies in the world and a global leader in sustainable resource management have founded a 50:50 joint venture for a premium mechanical recycling facility in the Netherlands with capacities of 25,000 t/y of polypropylene (PP) and 35,000 t/y of high-density polyethylene (HDPE); their objective is to expand to 100,000 t/y in 2020. In this way, the resource management company aims to expand its recyclate production to 600,000 t/y. The chemical company profits from the recycling process, which otherwise would threaten its offer of virgin feedstock-based plastics and is in position to ensure high quality of recyclate for its customers.

"Circular value chains open opportunities for chemical producers to go beyond making and selling molecules."

Collaboration Model 2: Chemical company and waste manager partnership, joined by a chemical recycling technology provider

Some chemical companies are taking their relationships with waste management companies a step further with joint development agreements which bring in new technology providers for chemical recycling. For example, a global styrenics supplier is working with start-ups to test chemical recycling solutions for PS, each company adding their expertise to the process. Within one joint development agreement, they are using the manufacturing of the styrenics supplier to process styrene monomers. Those were yielded by a patented chemical recycling technology belonging to a company producing chemicals from recycled plastics.

A similar agreement has been made with another company in the field of plastic recycling. This company provides styrene monomers to the styrenics supplier in order to polymerize food-grade PS for food packaging. Two U.S.-based facilities with capacities of 50-150 t/d of PS are being planned.

Collaboration Model 3: Cooperation between chemical company, converter, brand owner and waste manager

This emerging type of cooperation brings together expertise in material properties, product manufacturing and product requirements. The established supplier relationships in the value chain continue to exist, the shift is the inclusion of a waste manager as a raw material supplier. For example, in a joint development project several companies from different industries such as consumer goods, packaging producers, chemicals and

Continued Page 6 ▶

Can we eliminate plastic waste?

DOW®

Plastic waste is a problem. And we are going to fix it. How? First, by getting help from our industry friends who also want to #EndPlasticWaste. Ensuring no waste – plastic or otherwise – gets in our environment. We're finding new after-use opportunities. We're cleaning up our ocean. We're improving waste management. Plastics benefit our lives in so many ways. And we can't let it go to waste. It's time to change the conversation. To change our planet.

How can you help? #DontWaste

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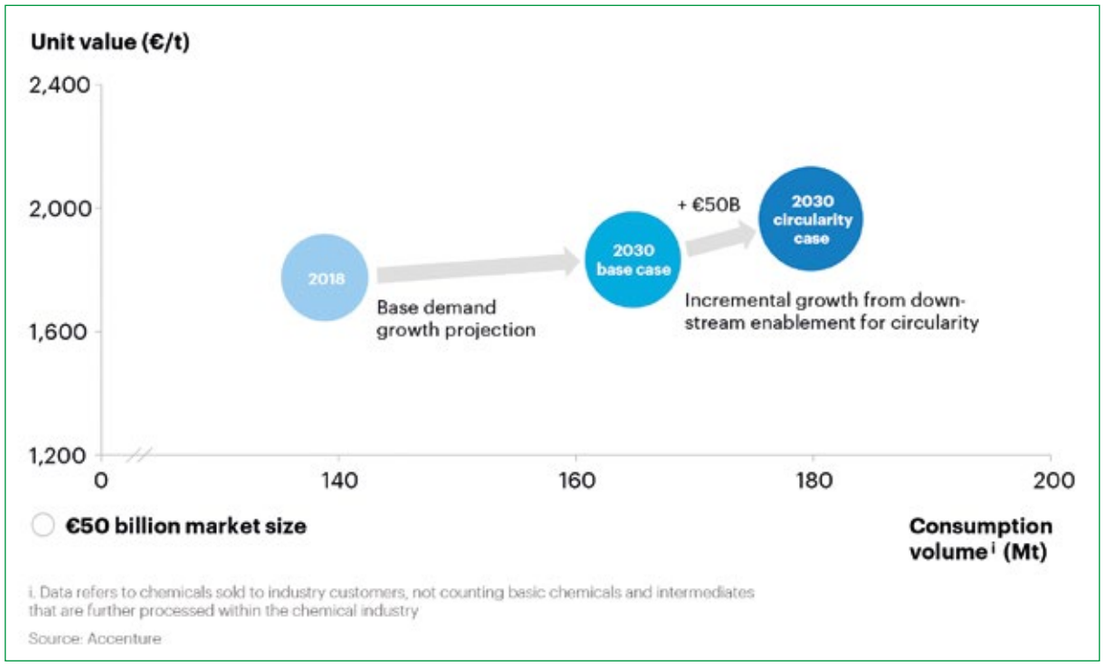

Figure 1: Drivers of circularity

recycling are working together and testing a process to recover complex, multi-layer packaging to gain virgin feedstock-like materials for packaging. In a pilot test, recycled LDPE was used for flexible detergent packaging.

Collaboration Model 4: Direct chemical company and brand owner collaboration

Here, the chemical company's material property design and production capabilities are combined with the application requirements and product manufacturing of the brand owner. For example, a chemicals company and a sportswear manufacturer have been working together for several years on the European Commission-supported Sport Infinity Project with the objective of developing a textile-reinforced composite for infinite recycling loops. The material itself — which is shredded after use and mixed with virgin material and fiber from alternative waste streams — is reprocessed into a new shoe. There is a similar arrangement between a chemical manufacturer and a computer technology company where recycled carbon fibers with specific material properties are used as the composite materials for making computers.

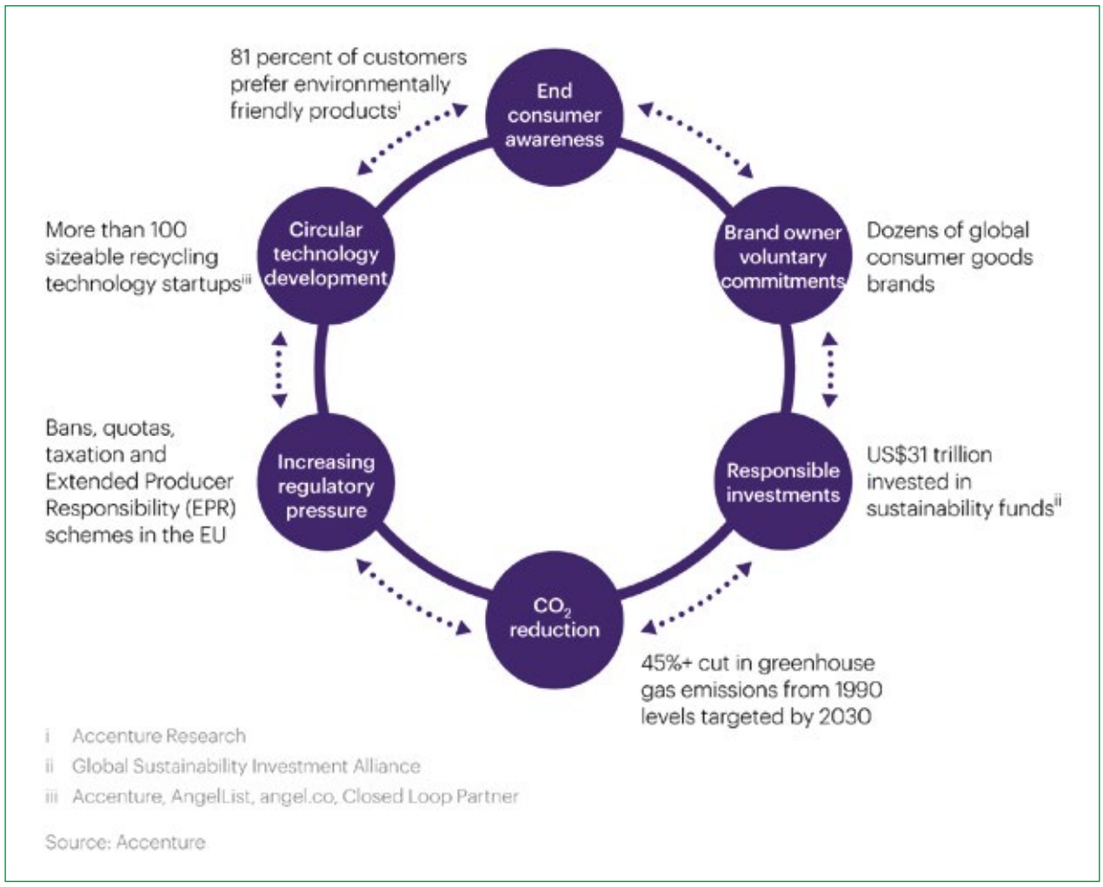

Figure 2: EU27+UK chemicals consumption across all products: volume and unit value projection 2018 – 2030

Collaboration Model 5: Direct cooperation of a start-up and waste manager with a brand owner

In this model, the traditional chemical producer is bypassed and the cooperation between large brand owners and start-ups forms a new competition for established players. For example, a global beverage company is helping to finance a chemical recycling start-up to build its first 10,000-t/y-recycling-plant for colored and contaminated PET. The start-up also works with a consumer goods manufacturer to supply food-grade recycled PET (rPET) with plans to build a recycling facility.

"The transition to the circular economy triggers a wide range of challenges that the industry needs to address."

Conclusion

Most chemical companies are now recognizing the importance of adapting to the circular economy as they are partly pivoting and partly being pushed in this direction. Companies cannot do this in isolation and will need to be decisive on their role and how to put this in place. The opportunities for value-chain collaboration for specific combinations of an end-of-life material as well as the suitable recycling technology and application for the resulting recyclate are nascent. It is important that companies find their sweet spots quickly. Those who stand still too long may find themselves standing alone.

Michael Ulbrich, Managing Director, Chemicals and Natural Resources Practice, Accenture Strategy, Frankfurt, Germany

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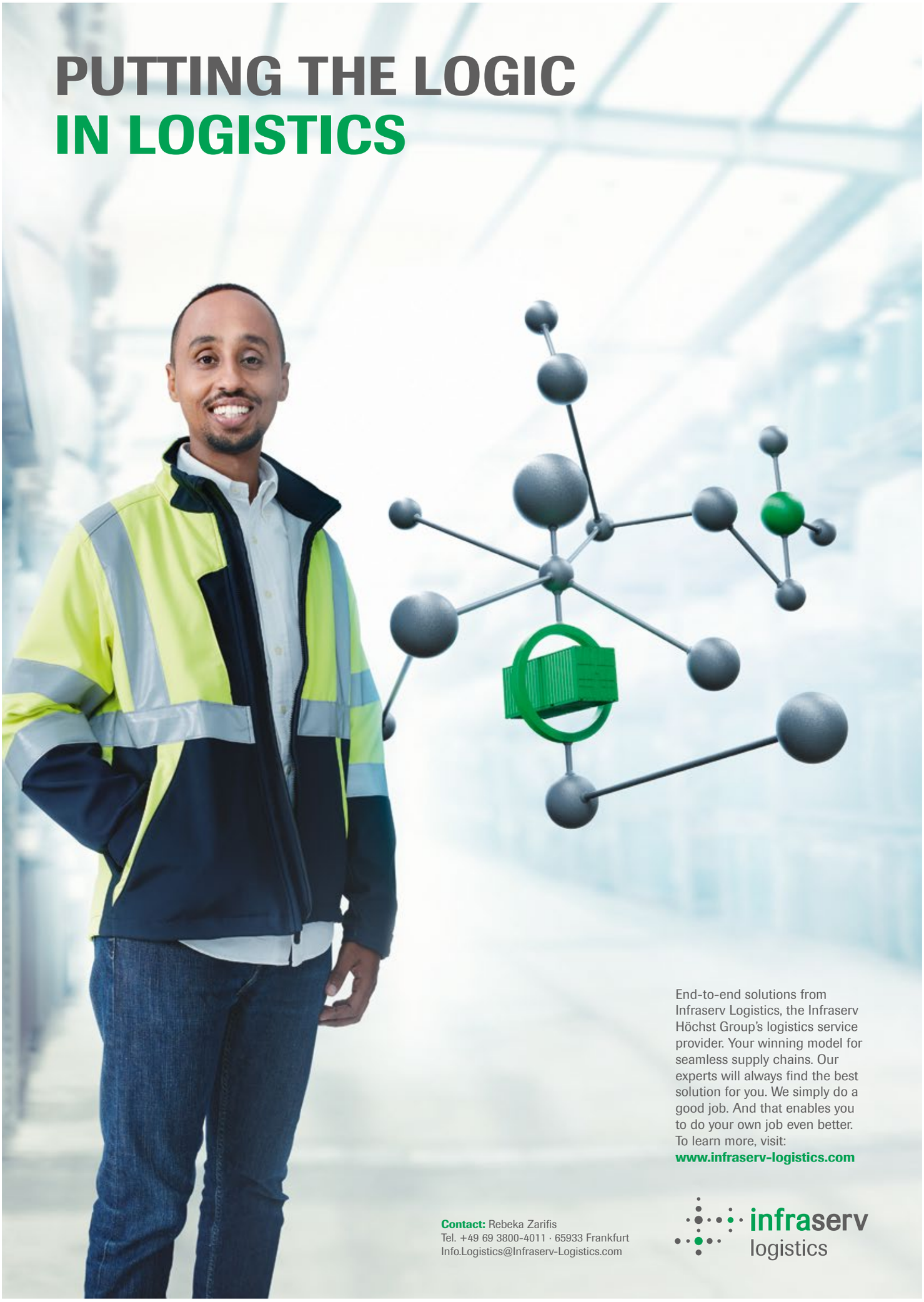
PUTTING THE LOGIC IN LOGISTICS



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The Age of Circularity

Renewable and Recycled Products Preserve the Benefits of Plastics while also Tackling Climate Change

Plastics have come under increasing criticism. In March last year, the European Parliament passed a law on the abolition of single-use plastics, which the British ‚Guardian' called a "declaration of war on plastic waste". Greenpeace speaks bluntly of "climate killer plastic".

Such rhetoric suggests that plastics are generally an evil that one has to get rid of sooner rather than later. This narrative is not only harmful to the plastics industry but also means that the important role of plastic products in everyday life is overlooked, and so hinders the development of even better solutions.

Of course, there are undeniable problems, especially in the post-use phase of plastics, and there are good arguments against products that offer very limited added value in relation to their environmental footprint — such as the disposable plastic bags at the fruit counter.

But that's only one side of the coin. The other shows the unique contribution that plastics make to the preservation of food, for example, or to the safety and health of millions of people every day. And yes, plastics even contribute to the fight against climate change by, for example, making vehicles, airplanes and transported goods lighter and thereby reducing fuel consumption.

It would therefore be desirable to have a constructive discussion that focuses on how we can continue to use and develop the unique abilities of modern plastics in the future, without neglecting the problematic aspects that need to be addressed.

Two key words are central to such a debate: sustainable raw materials and circular economy. Combined and consistently thought through to the end, these two aspects address almost all current criticisms of conventional plastics, from the consumption of finite resources to the waste issue in the post-use phase.

Mercedes Alonso, Neste Corporation

Creating the Necessary Conditions

Successfully developing a circular economy to improve the sustainability of plastics essentially depends on three pillars.

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Technology

Innovative technologies form the basis for comprehensively establishing more sustainable, circular plastics. This applies to the raw materials, their processing, and the collection and reprocessing of used products.

Some of these technologies are already in existence and can be used commercially. The renewable raw material that Neste produces primarily from waste and residues in a patented refining process is one example. Polymers based on it can be used as a drop-in solution within the existing infrastructure for plastics production, even in sensitive areas such as food packaging or medical products.

Other technologies are on the way to market maturity, such as the chemical recycling of plastic waste that cannot be recycled mechanically. Commercial-scale applications will not only help to achieve recycling goals but will also significantly expand the raw material base for new, more sustainable products.

"It would be desirable to have a constructive discussion that focuses on how we can use and d evelop the unique abilities of modern plastics."

Yet other processes are still in their infancy or will only be developed in the future. For example, Neste is working on solutions that should enable the processing of other types of renewable raw materials. One example is the 'power-to-X' technology, which produces a petroleum substitute based on renewable hydrogen. Another option is the processing of municipal solid waste.

In addition, there are innovative approaches in product development such as 'design for recycling'. These range from more robust plastics with a longer service life to reduce the amount of waste, to the deliberate reduction of complexity in packaging, making it easier to recycle.

Social Initiatives

Sustainable, circular solutions serve a social need that is being articulated ever more clearly. This means joint social efforts are needed to help related concepts gain traction.

A current example of this is the European Plastics Pact. Initiated by the governments of France and the Netherlands, the project aims at creating a 'public-private coalition' in order to establish a circular economy for plastics. More than 80 countries, companies, associations and NGOs across Europe contributed to the wording and signed the pact on March 6, 2020. This initiative demonstrates how entrepreneurial, political and social ideas and energy can be brought together to advance sustainable solutions.

Cooperation

The complex challenges of a circular economy on a technological, procedural and regulatory level require new forms of cooperation. Industry players and actors in the scientific, political and social arena alike must develop a willingness to collaborate even in previously unfamiliar constellations in order to gain a holistic view of the overall problem and to develop the most promising possible solutions.

Neste has been successfully practicing this approach for years in the field of renewable fuels. Likewise, when it comes to renewable and circular polymers, we are in constant exchange with a wide range of established corporate partners in the recycling industry, specialty chemicals, plastics processing and branded goods, as well as with research institutions, start-ups and regulators. It is clear that the plastics industry faces common challenges that no single party can solve on its own.

Acting Pragmatically and Optimistically

The plastics industry is on the threshold of a new era — the age of circularity, where products are based on circular value chains and made from renewable and recycled raw materials. The technical, political and social conditions for progressing on this path are encouraging.

"The two aspects 'sustainable raw materials' and 'circular economy' address almost all current criticisms of conventional plastics."

However, this development is not a sure-fire success. There is fundamental resistance to plastics in general. Technological hurdles must be overcome and questions regarding the handling of raw material requirements have to be answered.

Last but not least, whether we will be successful depends on the attitude with which we as an industry approach the problems. In my view, the following three aspects are particularly important.

First, an open mindset: there will be no single technology that magically solves all the problems. Different challenges and conditions will require different approaches. We should therefore give various options a chance, testing and evaluating them while always keeping our eyes open for even more innovative possibilities to come.

"Sustainable, circular solutions serve a social need that is being articulated ever more clearly."

Second, pragmatism: let's not wait for perfect, flawless solutions, but start making use of what is already available. Ultimately, it is always about replacing fossil oil with more sustainable alternatives. Sure, there may be cost issues to be addressed and ever more extensive testing desirable, but time is running out. Renewable solutions have shown that their use can dramatically reduce greenhouse gas emissions over a product's life cycle compared to fossil alternatives.

Third, optimism: Our best response to current criticism is contagious confidence, which will almost inevitably lead to innovative, still better answers. My firm belief is that, in the context of the climate and environmental debate, renewable and circular plastics are not a problem, but an important part of the solution.

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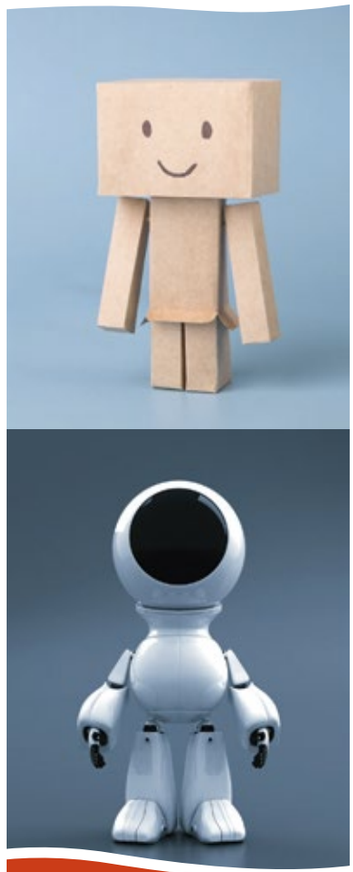

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More about us

Turning Trash to Treasure

Growing Demand for Clean Fuels and Renewable Chemicals Triggers the Transition to a Circular Economy

We have all heard the adage: one man's trash is another man's treasure. Flea markets, rummage sales and even today's online materials exchanges are all based on the trash-to-treasure concept. Yet not all trash is so readily reused or recycled.

Despite all the efforts and programs introduced to recover materials that can be recycled or composted, more than 50% of the 2 billion t of trash generated around the world each year is still landfilled, creating environmental problems and producing methane emissions that are 25 times more harmful than CO_2.

As society produces ever more trash, and climate change happens seemingly before our eyes, the world needs disruptive innovation to turn every kilogram of waste we generate into something of higher value — and to do so cleanly and economically.

Moving from a Linear Economy to a Circular Economy

Collective efforts and new technologies are helping to divert more garbage from landfills and incineration. Among the new solutions are advanced thermochemical technologies such as the one developed by Enerkem, a Canadian company that transforms waste into high-value biofuels and renewable chemicals. Some 20 years ago, Enerkem's founders developed and deployed a technology that uses an abundant resource available everywhere — urban waste otherwise destined to landfill or incineration — as feedstock to produce renewable chemical products that find their way into everyday goods, including biofuels, paints, cleaning solvents and glues.

This innovative technology is based on an integrated chemical recycling process that converts carbon-rich solid materials into a clean and stable synthetic gas. This gas is then turned into liquid value-add products using catalysts. In less than 5 minutes, non-recyclable trash (mixed waste stream traditionally destined to landfill or incineration) is converted into methanol and ethanol and becomes a sought-after treasure — chemicals that can be used as low-carbon transportation fuels or as renewable chemicals to green our everyday products (fig. 1).

Peter J. Nieuwenhuizen, Enerkem

Demand for Clean Fuels and Renewable Chemicals is Real and Growing

While governments are developing policies to address the need for

Enerkem's facility in Edmonton, Alberta, is the world's first full-scale plant using waste to produce advanced biofuels.

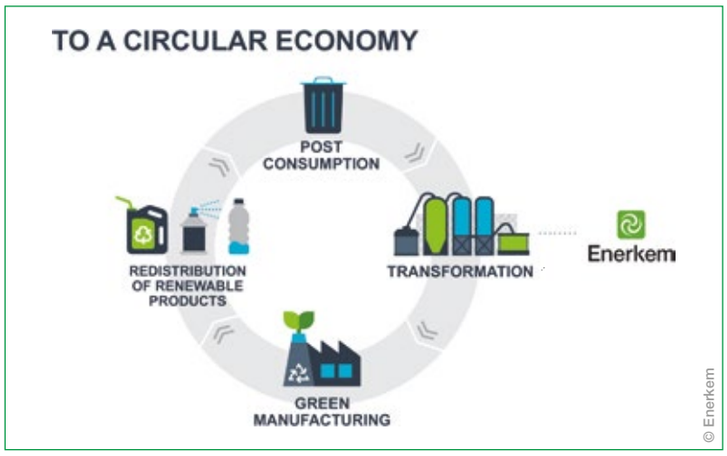

Fig. 1: Concept of the circular economy and Enerkem

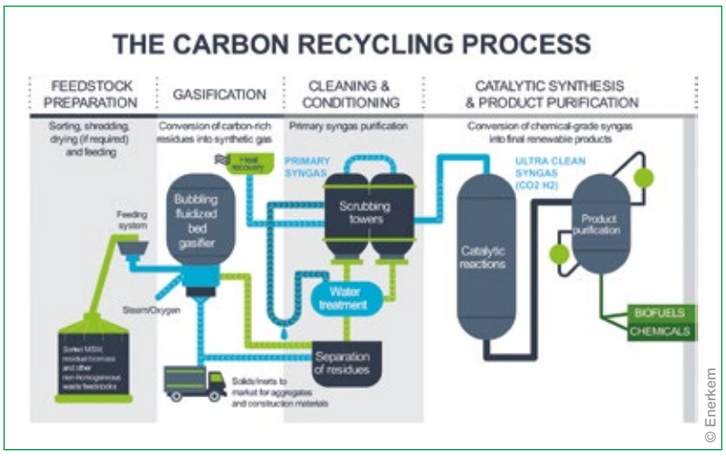

Fig. 2: Overview of the Enerkem technology

more sustainable energy, including low-carbon transportation fuels, global consumer goods manufacturers are also putting pressure on leading chemical manufacturers to replace hydrocarbon-based products with renewable chemical alternatives to meet the demand of their own customers.

Demand for renewable transportation fuels and chemicals is significant and global. Governments worldwide are mandating the use of renewables in the conventional fuel pool. According to Biofuels Digest, 65 countries had renewables targets or mandates in 2019. Ethanol is the most popular biofuel around the world. It is a biodegradable alcohol that replaces a portion of the gasoline used to fuel cars and serves as an oxygenate given its high-octane level. Producing ethanol from non-recyclable waste not only reduces greenhouse emissions in the transportation sector, it also reduces the volume of waste being landfilled or incinerated and complements upstream waste management activities such as recycling and composting.

"Society needs disruptive innovation that turns problems into clean and effective solutions."

At the same time, retail product manufacturers are looking for solutions to green their products as well. One of the key elements in reducing the carbon footprint of everyday products is to use renewable chemicals as ingredients. Using waste as a feedstock for the production of chemicals rather than fossil sources does just that and is a way to reduce the footprint of products and to transition from a linear economy to a circular one. It's yet another example of the trash-to-treasure model at work.

From Idea to Commercial Reality

Back in 2005, an emeritus university professor and PhD in chemical engineering together with his visionary son launched a cleantech start-up to pursue what was then idea distant dream. Turning household waste into a valuable raw material is no small undertaking, and what many believed to be near-impossible to achieve has since turned into a disruptive technology that has led to the world's first waste-to-biofuel company, Enerkem.

Developing and implementing an industrial technology innovation to take on some of the world's most pressing environmental issues — waste disposal and low-carbon transportation — was no easy task. Ensuring proper financing throughout the growth phases, building a sound business model and a solid IP strategy while establishing strong relationships with project partners were considerable challenges that any entrepreneur would find overwhelming. These could not be overcome without an engaged and experienced team giving their all to build and operate the first commercial plant of its kind and to develop an efficient modular manufacturing infrastructure for constructing future plants. One thing that became abundantly clear in the process — a new industrial revolution, that of circularity, has begun — and it's being driven by cleantech innovators.

Transforming Waste into Advanced Biofuels

Today, Enerkem's facility in Edmonton, Alberta, is the world's first commercial facility of its kind to use municipal solid waste to produce renewable methanol and ethanol. At full capacity, the facility will transform 100,000 dry tons of household trash annually to produce a synthetic gas and convert it into advanced low-carbon transportation fuel. This is enough to fuel over 450,000 cars on a 5% ethanol blend in the fuel pool. The facility is not only helping decarbonize the transportation sector, it's also helping the City of Edmonton reach its goal of increasing its waste diversion rate to 90%. The advanced biofuels produced by Enerkem help reduce greenhouse gas emissions by 60% and more when compared to fossil fuel production and landfilling.

"Demand for renewable transportation fuels and chemicals is significant and global."

With waste volumes continuously growing and compounding global climate and economic challenges, society needs disruptive innovation that turns problems into clean and effective solutions. Technologies like those of Enerkem are proving that even non-recyclable trash can become treasure. Combined with the vision of municipal leaders committed to concrete action to develop tomorrow's economy, these innovations are also key to creating sustainable prosperity and growth for all.

Peter J. Nieuwenhuizen,
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Circular Economy

Exciting Opportunities for the Chemical Industry

The chemical industry is on the threshold of a new era — the age of circularity, where products are based on closed-loop value chains and made from renewable or recycled raw materials. The technical, political and social conditions for progressing on this path are encouraging. However, this development is not a sure-fire success. Whether it will be successful depends on the attitude with which the key players along the value chain approach the problems. The shift requires intensive cooperation along the value chain and across industries. There is little doubt that the chemical industry plays an essential role in establishing the circular economy model and closing loops. The time is now for chemical companies to (re-)define their role as non-traditional opportunities and new players emerge. The circular economy is here to stay, with exciting opportunities for the chemical industry to stand out! These are excerpts from our feature articles published in this issue (see previous pages).

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CHEManager asked industry experts from well-established players along the chemical/plastics value chain to share their opinions on challenges and opportunities of the circular economy. We proposed to discuss the following aspects:

- Public criticism of our industry in the context of the climate and environmental debate.
- Alternatives to the circular economy approach.
- Ways to support the circular economy concept.
- Challenges that have to be overcome on the way to a circular economy.

Read the insightful answers of the experts here.

Recycling Plastics into New Raw Material

Martin Jung, President of Performance Materials, BASF

Currently the key basic steps of chemical production produce substantial greenhouse gas (GHG) emissions. To address GHG emissions, we will pursue breakthrough technologies and utilize renewable energy while focusing on increased processes and energy efficiency. Our Carbon Management R&D program has a project that reduces CO_2 emissions from steam cracking by up to 90% using electrification of exothermic processes such as the steam cracker.

As a plastic producer, BASF aims to contribute to a better use of plastics as plastic is a valuable resource that can provide benefits to our society if handled appropriately at the end of its life.

Plastic pollution is a multifaceted challenge which calls for well-orchestrated efforts from consumers, businesses, partners in the entire value chain and policymakers. Genuine impact can be made with an infrastructure to collect and process plastic waste, a regulatory system that supports the process, and motivated people who change their disposal behavior.

As a founding member of the global Alliance to End Plastic Waste (AEPW), BASF is dedicated to advance solutions to eliminate unmanaged plastic waste in the environment. Some examples include recycling TPU from worn-out shoes; scaling our ChemCycling project quickly where we transform mixed plastic waste into valuable products; producing engineering plastics from post-consumer recycled carpets or recycled PET bottles.

BASF covers substantial parts of several plastic value chains from monomers to polymers and their formulated specialties including a broad portfolio of plastic additives. This offers numerous opportunities to close circles of a different size, utilizing our expertise mainly for chemical recycling. Our ChemCycling project, for instance, is to build closed circles to recycle plastics into new raw material. We are developing a recycling process of polyurethane foams while looking to increase the use of new bio-based monomers. Collaboration with a partner to develop solutions for plastics traceability and circularity as well as the investment in a carbon recycling company — all these are prime examples that demonstrate we put this concept into action across the entire value chain.

Various Approaches to a Plastics Circular Economy

Jens Schuermann, Manager of Segment Marketing and Technical Solutions, Biesterfeld Plastic

We use our technical expertise to advise our international customers and suppliers and help them to develop innovative solutions. Thanks to our extensive product portfolio, we can influence the design of new applications and we pursue an integrated approach to ensure their recyclability. As a signatory to the UN Global Compact, we believe that every product is still of value after its primary use.

Developing concepts and technologies that enable plastics to be reused after their primary use is an area in which all industry sectors are working hard. However, given the sheer variety of the associated challenges, the result won't be a single patent formula.

Currently there are two main solutions: mechanical and chemical recycling. Today our partners are focusing more on mechanical recycling, i.e. the collection and processing of assorted raw materials or waste materials which cover the whole plastics pyramid, from standard polyolefins to recyclable high-performance polymers.

This is where our consulting services come in. We work with our partners to develop solutions tailored to a given application. On a case-by-case basis, we evaluate what costs and benefits need to be taken into consideration from an economic and environmental perspective and how they can be optimized.

Essentially, the separation and reuse of materials gets more difficult the greater the number of materials used is. Thus, it could be advantageous, to develop products from a single polymer base or from related materials if this makes them easier to recycle. The processing method used (e.g. multi-component injection molding) and subsequent processes such as optimized joining techniques also need to be considered.

Since not all waste streams are recyclable, industries are focusing a great deal of effort on chemical recycling solutions. This involves transforming plastic waste into raw materials and/or monomers, which can then be turned into polymers of the same quality as prime plastics.

In our active role in plastics value creation, we are committed to environmental, economic and social sustainability. You can read more about our commitment in our annual sustainability report.

Driving the Chemical Industry towards a more Sustainable Future

Christian Kohlpaintner, CEO, Brenntag Group

The Circular Economy approach is an important driver to rethink the production, usage and end phases of products. It is needed to reduce waste and to reflect the scarcity of resources. It is thus an essential element to drive the chemical industry towards a more sustainable future.
Brenntag as the leading chemical distributor connects an enormous number of producers and users of chemicals. Therefore, Brenntag will play an active role towards a circular economy. We do this already to some extent as we sell and promote reused as well as recycled chemicals (e.g. acids and solvents) and recycled plastics. By doing so we help our customers to reduce waste, extend the lifetime of products, and improve the ecological footprint.
For a stronger move towards a circular economy we see different challenges, like the scarcity of certain recycled materials in high quality, or strong price competition with virgin materials and also regulations which make it difficult to use reused or recycled materials for certain applications.

Collaboration with Partners and Prioritization of New Technologies

Christian Haessler, Global Circular Economy Program Lead, Covestro

To address global challenges such as climate change, resource depletion and the needs of a growing world population, a systemic change of our economy and ways of value creation are necessary.
It is essential to find and implement sustainable practices to stop environmental pollution and the overexploitation of the world's increasingly scarce resources to be able to meet these challenges. At Covestro, we are convinced that a transition to a circular economy is the right answer.
As a raw materials manufacturer, we play a key role in enabling circular solutions for a broad range of industries, from electronics, to health care, construction and mobility.
Mimicking nature as a blueprint for the circular economy, we are focused on integrating renewable resources into our production processes and developing innovative recycling pathways for our materials. To realize this, we work closely and exchange with various actors: our customers and suppliers, research institutes as well as totally new players in the value cycle. Our goal is to ultimately move away from fossil-fuel resources by introducing a supply of alternative raw materials.
With our breakthrough in using CO_2 as a resource for polyurethane applications — our product cardyon — we have proved that circular solutions are economically and environmentally viable. Ultimately, we also aim to develop innovative energy-efficient technologies to convert materials at the end of their lifetime back into their building blocks and use them again as a raw material source in production.
In order to deliver on the challenge of recycling, we are putting our brightest minds to work to develop new solutions which bring those technologies to the market in a fast and efficient way. We are confident that in collaboration with partners and by prioritizing new technologies, we can lead our industry towards a circular economy.

For Recycling to Be Successful, it Must Be Economically Viable

Anno Borkowsky, Member of the Board of Management, Lanxess

The chemical industry has substantially expanded its production volume during the last 30 years. At the same time, energy consumption was reduced by about 15% through increasing efficiency, innovation and technological upgrades. Also, greenhouse gases have been reduced by 48%. We need to continue on this path and Lanxess is fully aware of its responsibility in this regard. We support the transformation towards a sustainable, resource efficient and carbon neutral economy with its activities and products. We have therefore declared to become climate neutral by 2040, and already today, our products enable climate-friendly solutions for new mobility and other technological areas.
Another key issue in this regard is the circular economy concept, to which the chemical industry can make significant contributions, e.g. by implementing reverse reaction processes that allow "chemical recycling". We are intensively working on respective projects. But chemical recycling is only economically feasible under certain conditions. Here, politics must create the right framework. Effective incentive systems for the transition from the use of primary feedstock to recycled feedstock are needed. In particular, chemical recycling should be promoted to the same extent as mechanical recycling. For recycling to be successful, it must be economically viable. And last but not least, processes need to be developed in cooperation with all stakeholders involved in the value networks.

Designing for Recyclability Requires Innovative Approaches

Lucrèce Foufopoulos, Executive Vice President Polyolefins, Innovation & Technology, Borealis

Collection, waste management and innovation are key factors in closing material loops on the way to a circular economy. In order to stop marine littering, the focus needs to be on collection and waste management. We know that many items that are leaking into the environment today are perfectly recyclable but unless we can collect them, the recyclability & technological advancement will be in vain. To reduce leakage of waste and plastic waste and accelerate the transition of our industry towards a more circular one, we need to focus on collection and waste management. We need collection systems with incentives to make them work. Collecting the plastic is the essential first step in building a circular economy. Collecting in the right way is critical to clean streams of inputs into recycling infrastructure, and is thus a strategic component of the circular economy. Production and use of plastics do not inherently cause pollution. It is the lack of collection that creates pollution, not the plastic itself. It is therefore paramount we address with speed and focus the waste collection issue to develop towards a true circular economy of plastics.
Innovation is just as crucial in closing the loops. Borealis is creating value with its new plastics recycling technology brand Borcycle, which can be used to manufacture high-

quality compounds made of recycled polyolefins. One Borcycle grade launched last year contains 80% rPO and can be used for visible appliances parts. Innovative approaches are also required if designing for recyclability is to become the default mode. Again here, Borealis is working with its value chain partners to penetrate the EverMinds mind-set of recycling, re-use, and design for circularity.
On another level, Borealis has invested in state-of-the-art upgrades of our own recycling plants, including Wildon, Austria in 2019, where we increased our recycling capacity by 60%. We are also excited about our ReOil collaboration with OMV, which is advancing the chemical recycling of post-consumer plastics.
In essence, in order to allow our industry to accelerate its conversion towards a more circular industry and address the plastic waste issue, the following key issues will need to be addressed:

- The right kind of collection system that is efficient, low cost but also effective in feeding circularity.
- The right kind of recycling - to minimize environmental impacts and to produce high quality, high value outputs.
- The right kind of demand from the market, with the appropriate pricing for clean, recycled content.
- The right economics for collectors, recyclers and for customers of recycled materials.

Leading Efforts to Find the Feedstocks of the Future

Marco Jansen, Circular Economy & Sustainability Leader in Europe & Asia, Braskem

We are now entering a crucial phase that will determine how plastics can respond to our societal and environmental needs. We know the scale of the challenge ahead of us, and it is up to us to find ways to deliver innovative and sustainable materials that can meet the demands of our customers, the public and policy-makers.

Developing and bringing "I'm green" to the market was one of the first steps Braskem made on our journey towards the circular economy. It was 10 years ago — perhaps before the concept was as mainstream as it is now — that we launched our bio-based polyethylene. The revolutionary idea was to replace the conventional fossil-based building block, with a plant-based alternative.

As a company operating in that space between raw material sourcing and the brand owner, Braskem can play a fundamental role in developing a new and more responsible approach. I see our role as follows: to lead efforts to find the feedstocks of the future. This vision is something I call a "low carbon circular economy" — resource efficiency primarily determined by our ability to reduce or even eliminate a product's carbon impact. We're combining sustainable biosourcing with increased use of post-consumer material, so that we can offer our customers a range of materials that achieve the twin goals of, one, fighting climate change, and two, increasing recycling.

That's why we have set out to develop plastic recycling technology, mainly by working with partners. Braskem has agreed to work with a number of market leaders to develop advanced recycling techniques, and last year we ran successful initial trials of pyrolysis oil — derived from plastic waste feedstock — in one of our Brazilian crackers.

Chemical Distributors Enable Circular Economy

Robert Späth, CEO, CSC Jäklechemie

Circular Economy goes hand in hand with the global sustainability goals and became a key issue of EU politics recently. Chemical distributors as essential links in the supply chain deal with this topic since quite a while — long before it became so popular. If we look to the commodity business in Germany, there is a deposit return scheme for the packaging of chemicals. This, founded in 1996, established a closed loop for all drums, IBC's and other packaging of liquids to enable multiple use. The reuse of packaging is one aspect of Circular Economy.

Many distributors like us are certified waste management companies and establish an important link in the recycling of chemicals. They offer the logistics to take back and collect used solvents or other chemicals for the recycling industry. In addition, distributors provide innovative business models like chemical leasing that strongly support the recycling aspect of the Circular Economy. If we look to the specialties business, there is a rising demand for renewable feedstock from our customers. Our task as chemical distributor is to find innovative new products that meet these expectations and promote them in the market. For example, there are coating hardeners whose carbon base is derived mainly from renewable raw materials. I see all these activities under the umbrella of the global Responsible Care initiative to improve health, safety and sustainability. As a result, chemical distributors enable Circular Economy.

Partnerships Along the Value Chain Are Crucial

Bettina Siggelkow, EcoCircle Program Manager, Clariant

For answering the challenges of CO_2 reduction and the scarcity of resources, the circular economy approach is inevitable. Circularity hereby should value plastic waste as raw material. This includes the full waste hierarchy, supporting reduction of plastic waste as well as recycling. Combining circularity and sustainability offers new product and business opportunities through a broadened scope of product properties.

Clariant offers products along the full plastic value chain, including mechanical and chemical recycling. To support the reduction of plastic waste, our experts support the development of concentrated product solutions, e.g. for home care and cosmetics. For reusing packaging Clariant additives increase the plastic lifetime, e.g. through light stabilization. Other additives support to increase the usage of recycled polymers from mechanical recycling, by keeping product properties and processing efficiency during the conversion. And finally, for dissolution and chemical recycling Clariant's processing aids can be used in the purification steps.

Within Clariant we have defined circularity as one of the pillars of sustainability, with EcoCircle as the corporate initiative to enable a circular plastics economy. We can jointly develop, with our customers, new solutions by product expertise as well as using Clariant's experience in agile innovation management techniques for co-creation. As we believe in the transformation towards a circular plastics economy, partnerships along the value chain are crucial and Clariant's expertise in leading such partnerships will support the required change. Through joint development of new products, the primary focus on the intended use can be extended to additional advantages in their behavior within and beyond the end-of-use phase.

At the Forefront to Deliver a More Sustainable Future

Maurits van Kolck, Group Director Regulatory, Quality and Sustainability, IMCD

The chemical industry is at the forefront of making their value chains both sustainable and circular. Developments in this area are increasing at an unprecedented pace.

IMCD plays an important role in the value chain for a wide range of raw materials, half fabricates, and formulations. The basis of our business model is that we can supply to the majority of the SME market, promoting the products of our suppliers to a much broader audience than they would ordinarily be able to themselves.

This enables us to introduce a circular approach and achieve a deeper market penetration, ranging from large to very small customers. We are then able to influence the use of these products across the wider, more fragmented economy. Our unique position allows us to contribute directly towards our partners' efforts to become more sustainable.

We see the challenges for maintaining a healthy industry and environment in the future. However, we also see great potential and an industry that is galvanized to make a real difference. If we can also align with other sectors (like governmental, manufacturing, and waste processing), I personally believe the chemical industry will be at the forefront of a movement to deliver a more sustainable future.

Driven by the Transition from a Linear to a Circular Economy

Carsten Larsen, Managing Director, Dow Nordics, Commercial Director Plastic Circularity EMEA & APAC, Dow

Modern society has come to rely on plastic's social and economic benefits. But plastic's low-cost, everyday presence in our lives means we take it for granted and it is often thoughtlessly discarded, resulting in the global plastic waste issue we face today.

As one of the world's biggest plastics manufacturers, we are responding to the plastics waste challenge. We believe our future license to operate depends on ensuring that all parts of our portfolio are driven by the transition from a linear to a circular economy.

Helping this become a reality requires action at every stage, from manufacturing to stimulating new markets for recovery. We are constantly developing new initiatives to ensure plastics' value is retained throughout its lifespan. We know we can have most impact in five key areas.

Designing with recyclability in mind: We are providing innovative design solutions that help brand owners deliver on their sustainability commitments by ensuring plastics are both functional and easier to recycle at end of life.

Mechanical recycling: We are improving the quality of recyclate from flexible packaging and last year launched Agility CE — a pivotal milestone in our journey to incorporate a high percentage of post-consumer plastic waste into our product offering, without sacrificing quality.

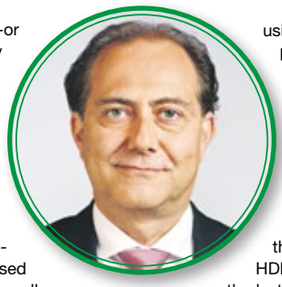
Feedstock recycling: The process of breaking down mixed waste plastics into their original form to manufacture new virgin polymers. Last year we announced a new partnership with Fuenix Ecogy Group and launched our first product made from pyrolysis oil feedstock.

Renewable feedstocks: Our partnership with UPM BioFuels is turning waste residue from paper pulp production into naphtha to produce bio-based polyethylene (PE).

Bridging solutions: We are working to find interim solutions to remove plastic waste from the environment in emerging economies, while advancing the circular economy where we can in the long term.

Need of a Changed Consciousness when Dealing with Materials

Jürgen Rietschle, Managing Director, Bodo Möller Chemie



This is not about an either-or solution, but about many components that should prevent to avoid the increasingly larger waste flows. The circular economy should play an essential role here. However, I consider it inevitable to think about the recyclable material plastic. I see an opportunity in a more needs-based production without surplus, smaller series provided with a higher value that is also perceived by the consumer. We need a changed consciousness when dealing with materials. Here, 3D printing could play an essential role towards a positive change. This is only one reason why we have decided to invest more in this market. We must wait and see to what extent the coronavirus will keep changing consumer behavior in a lasting way after the crisis. When consumers take it for granted that all substances and materials are available at all times, it makes them inferior in their minds. The crisis has taught us to reconsider taking things for granted. I think that the industry has gone much further in many things than is the case with consumers and politicians. There are numerous sustainability projects when I think, for example, about using CO_2 as raw material for plastic production or the increasing importance of the high-quality processing of recycled materials.

We keep checking our portfolio to adapt it further to market conditions, focusing on polymer compatibilizers in order to recycle them better, and on recycled HDPE compounds. Likewise, for the last 10 years, we have been noted experts in the additivation and stabilization of thermoplastic recycling materials. With our additives, we influence oxidative processes so we can make an important contribution to a part of the circular economy.

The biggest challenge is still in the material flows themselves, as they have come to a halt due to the corona crisis. In order to close the material cycle, it is necessary in many cases to switch to mono- instead of multi-materials. Part of conscious recycling is when those materials with good recycling characteristics are already considered during manufacturing. In order to better identify and track the flows of materials, digital solutions are necessary. Inefficient situations must be avoided to enable the circular economy to have the necessary future horizon.

Industry is the Key to Driving forward Sustainability

Holger Hoecker, Head of Safety, Strategy & Controlling, Evonik

One thing is clear: Plastics and other products manufactured by the chemical industry make an important contribution to climate protection. They help to use energy and other resources efficiently, for example, in transportation, where lightweight construction reduces fuel consumption, and in foam-insulated building facades, which improve energy efficiency. Without high-performance polymers, it would not be possible to build durable wind turbines, which make a key contribution to the energy mix. In view of the public debate about sustainability, waste avoidance and the use of resources, the idea of a circular economy is gaining importance.

At Evonik, our expert circle on the circular economy is working on specific and sustainable solutions. For instance, our specialists are undertaking a quantitative evaluation of the circularity of selected Evonik products. We use the material circularity indicator developed by the Ellen MacArthur Foundation and Granta Design to assess the potential circularity of selected products. In addition, we use life cycle assessments to evaluate the environmental impact of our products. The results support the sustainability analysis of our business.

Moreover, as a specialty chemicals company, our R&D is looking at solutions for mechanical and chemical recycling. That includes recycling both plastics and rubber. In this context, we are also looking into the feasibility of chemical recycling of PET plastics. Researchers at Evonik and Siemens are jointly exploring options for the use of CO_2 as a production input.

Taking nature as their model, their research included looking closely at photosynthesis. By combining electrolysis and fermentation processes, they have developed a carbon-based technology that uses green electricity to generate valuable chemicals. This technology is currently being tested in a pilot plant as part of the Rheticus project, which receives funding from the Federal Ministry of Education and Technology (BMBF). In the future, this innovative technology could be installed wherever carbon dioxide is generated. CO_2 would then play an important part as a starting product in the chemical industry, analogously to photosynthesis in the natural world. We are convinced that industry is the key to driving forward sustainability, environmental protection, and the circular economy. And that is in the interest of society and would benefit us all.

Improved Possibilities for Recycling of Plastic Waste

Andreas Holzner, Global Head Business Unit Special Additives, Baerlocher

The plastics industry is facing perhaps the greatest changes in its history — driven by an increasing adoption of the circular economy approach. This trend is propelled by increasingly stricter global regulations and a growing consumer awareness for sustainability and the environment.

As a result, the plastics industry is seeking new technologies which will allow recycled plastics to enter new applications, or significantly increase the content of recycled polymers in existing products — but this is not as easy as it sounds. For example, recycling the film fraction of post-consumer plastics presents an obstacle. Even with careful raw material preparation in a modern recycling facility with state-of-the-art equipment, the end-product may only be suitable for simple applications. The problem is the reprocessing, requiring melt filtration through fine filters to get rid of contaminants. There the high temperature inflicts so much damage to the polymer that it is left with very poor film blowing properties. To avoid this, it is key to re-stabilize the recyclate to protect the polymer.

Sustainability has always been an issue for Baerlocher — we played a formative role in the transition to Ca-organic PVC stabilizers. It is hence only logical that we devote our innovative strength to the recycling sector as well. During last year's K show, the company was able to present several case studies. Leveraging Baerlocher's Baeropol T-Blend Resin Stabilizer, KNF Flexpak, a US packaging manufacturer, can now run 100% recycled film using post-industrial polyethylene film, helping to improve sustainability and reduce costs. The technology resolved issues of variable film quality by preventing gels, bubble instability and haze. In a live demonstration at the exhibition grounds, plastics processor APK and Erema, a recycling equipment manufacturer, showcased how adding Baeropol T-Blend stabilizer to low-value consumer film waste on the Erema Intarema TVEplus film recycling line can upcycle this material into a product suitable for film blowing.

Driving Sustainable Practices to Protect our Natural Resources

Kevin Norfleet, Senior Program Manager, Engineered Materials Sustainability, Celanese

As a global producer of basic chemicals as well as engineered materials and performance polymers, Celanese's wide product portfolio covers most critical industries and applications essential for everyday living. We see sustainability and promoting a circular economy as a core part of our strategy and our future and so are honing our focus on three key areas: bio-based feedstocks, increased recycled content and materials designed for end-of-life versatility. By preventing the disposal of valuable materials and reducing the amount of new raw materials used in our environment, we can contribute to decreasing GHG emissions as well as waste. As a leader in engineering thermoplastics, our strongest focus in our circularity programs is on producing high-quality materials made entirely or partially from recycled content, but we also offer many products with bio-content. Customers increasingly want solutions with recycled or renewable materials but also need to maintain high standards for performance and reliability. Celanese is committed to helping meet those needs.

With experience and expertise across most end-markets, Celanese is helping customers meet complex material requirements with grades containing recycled or renewable content in the most cost-effective ways possible. Through those product efforts as well as other advancements, we are able to renew and restore materials through all phases of our production. From 2013 to 2018 we reduced our solid waste intensity by 35% with over 40% of total waste recycled; reduced our greenhouse gas intensity by 28%; VOC intensity by 29% and global energy intensity by 15%.

By establishing an ESG Council driving our environmental, social and governance commitment, Celanese continues to drive sustainable practices to protect our natural resources while helping our partners and their customers to do the same.

Note: Numbers are estimates and may be based on assumptions.

Circular Economy Is not a One-Size-Fits-All Solution

Thorsten Harke, CEO, Harke

The circular economy approach certainly is a good idea in some areas but of course not a one-size-fits-all solution. We have to be careful in certain cases, not to waste more energy and resources by circulating products, than we save by it, which would be counterproductive. In some of these cases a thermal utilization by waste-to-energy could be a more rational alternative.

As distributor and hence "transaction cost specialist" our role is per se to minimize the consumption of resources and hence the environmental impact in the sale and distribution process. We achieve this, by combining many products form different producers to a larger portfolio for our customers and hence reduce visits and shipments by combination synergies.

Furthermore, the environmental aspect is playing an important role when we consider adding products to our portfolio. Our strategy is to constantly expand our product lines with sustainable (from renewable resources), recyclable and/or recycled products and raw materials.

As internationally acting distributor, we deliver a wide range of plastic raw materials and products all over Europe, Russia and Turkey, of which a growing number are already either made from renewable raw materials, are recyclable or produced as or from by-products or from recycled raw materials.

Examples range from our Green Mantra product range of specialty polymers and synthetic waxes made from recycled plastics, our Q-Milk beads, produced from waste of the milk industry as substitute for micro plastics, over a larger range of oleo chemicals, solvents and polyols produced out of natural and therefore renewable raw materials. Furthermore, plastic products like films and containers that dissolve and/or are biodegradable, this way reducing plastic waste. In addition, we take back plastic waste from our customers in order to refeed it into our production process of plastic products like films.

Besides the high logistics costs and bureaucratic burdens for returning used material for recycling, especially in international trade, one big challenge is the still lacking acceptance and willingness to use recycled materials, due to partly higher costs of the recycled raw materials, technical and visual challenges and/or optical or qualitative compromises. Furthermore, the productivity sometimes can be a problem due to e. g. a worse melt flow rate. Yet we consult our customers how to adapt and optimize production processes accordingly.

Circular Economy Is Programmed into our DNA

Ansgar Pohl, Executive Officer, & CEO, Regional Headquarters EMEA, Mitsubishi Chemical

Circular economy is directly programmed into our company's DNA by our vision of KAITEKI, which strives for the sustainable well-being of people, society and our planet Earth. That vision influences our whole company culture as well as technologies, products and solutions we develop for our customers. The circular approach and circular technologies will decide upon the future availability of our resources. It is the ideal way to do business and will be paramount for the sustainability of all industries, not only for the chemical industry.

As Mitsubishi Chemical we are placing an emphasis on three cornerstones: the use of bio-based and bio-degradable materials, the mechanical and chemical recycling of materials and solutions designed for recyclability.

Our bio-sourced portfolio includes many materials, both bio-based and biodegradable. This is complemented by our recent cooperation with Lactips, a company that promotes a bio-sourced, biodegradable and even water-soluble solution providing a response to the issue of micro-plastics ending up in the oceans.

The acquisition of the Swiss Minger Group which offers superior proprietary recycling technologies for engineering plastics illustrates our cornerstone of recycling. It will allow us to establish an integrated business model for engineering plastics including collection and reuse, hence contributing to the realization of a recycling-based society.

Last but not least we are convinced that only a joint approach of the whole industry will ensure success for the circular economy approach.

That is why we collaborate with partners and support many alliances, e.g. we act as a member of the Executive Committee for the Alliance to End Plastic Waste (AEPW) and we are part of the Ellen MacArthur Foundation's Circular Economy 100.

Finding Innovative Solutions to Create a Circular Economy

Mark Vester, Circular Economy Leader, SABIC

At SABIC, we are helping to avoid plastic from becoming waste. Our vision is that plastic remains in the value chain to be reused and remade into new products and does not end up in our environment or landfills.

We are committed to finding innovative solutions to create a circular economy and close the loop on used plastic. We have already started making this a reality. Just over a year ago, we became the first in the industry to implement an investment project for the feedstock recycling of used plastic back to the original polymer. We recently launched our TRUCIRCLE portfolio and services for circular solutions that enable our customers to produce more sustainable products. Since then, we have helped several of our partners to successfully launch products using our circular solutions, most of which are already available on supermarket shelves.

Whilst we believe we can play a crucial role in closing the loop, no company can address these issues alone. We need to collaborate with players across the entire value chain and reshape our society, industry, frameworks and governing structures. We also need to encourage people globally to view plastic as a material which is on loan from the value chain. In doing so, we'll create the right conditions to become truly circular.

This challenge has created fertile ground for groundbreaking innovations to enable this change. We now have new collaborations on the horizon that build on our TRUCIRCLE portfolio and will help to make our value chain a more circular one. We must continue to work together to transform everything we do and the way we do it, so we can all work together towards a sustainable, circular future for our business, our people, and the planet.

Circular Economy Means more than just Recycling Waste

Auguste Willems, Executive Board Member, Wacker Chemie

I am convinced that a circular economy on a global level is necessary to cope with the environmental challenges we are facing, such as the limited availability of natural resources and maritime littering, just to name two examples. In my opinion, there is no alternative to closing economic loops and turning „linear" material flows into cycles, enabling as much recycling as possible. However, we can only exploit these potentials with a comprehensive understanding of how to recycle waste and conserve resources as effectively as possible. We also need reasonable regulation which fosters technological openness and innovation. And last but not least, we need renewable energy at competitive prices for reducing the industry's carbon footprint globally.

However, circular economy means more than just recycling waste. We need to look at the entire lifecycle of a product, including the materials used for manufacturing. The chemical industry is an important enabler in this respect. Our contribution here is more than just making our production processes more efficient and reducing waste and emissions by closing loops and reusing by-products. Our materials also enable innovations and technologies which significantly enhance the sustainability of products avoiding overall net emissions tremendously.

To initiate new ideas and grasp new opportunities, we started a program called Wacker Sustainable Solutions. The goal is to find out how our materials are able to optimize lifecycles of everyday products. The program has a long-term character of course, but already now, after a short period of time, we were able to identify and start a number of projects. For example, increasing the share of biobased and renewable raw materials in our products — be it polymer binders or silicone fluids — helps to effectively reduce the carbon footprint in a wide range of industries. And there is more to come. By 2030, nine out of ten products in our portfolio will be at least neutral or even better than neutral when evaluated according to generally valid sustainability standards. This will be a significant milestone in our roadmap and on our path towards CO_2 neutrality in 2050.

CHEManager INTERNATIONAL

DISTRIBUTION & LOGISTICS

Distribution
Chemical Distributors are Added Value Partners in the Supply Chain

Logistics
Chemical and Pharma Supply Chain Trends, Real-Time Data Visibility

Sustainability
Companies Strive for a New Responsible Way of Doing Business

WILEY

The Chemical Distribution Industry

An Added Value Partner in the Supply Chain

In today's competitive global market, chemical distributors face not only growing compliance demands and have to deal with digitalization and cyber security issues, but also strive to increase their significance in the chemical value chain and adapt their business models to a changing market environment. CHEManager asked Dorothee Arns, FECC's Director General, about the current market trends, challenges facing the sector and the organization's vision for the chemical distribution industry's future.

Dorothee Arns, FECC

CHEManager: Mrs Arns, what, in your opinion, are the most important short- and long-term challenges facing the sector?

Dorothee Arns: Right now the top priority everywhere is to cope with the impacts of Covid-19, for example managing the existing uncertainties, adapting to the so-called "new normal", protecting staff from infections while resuming operations safely, reconstructing interrupted supply chains, monitoring inventories and cashflow developments.

Fortunately, the overwhelming majority of distributors in Europe were operational over the past months and without infections. Especially in our business sector diverse product portfolios, thorough market know-how, supply chain excellence and the agility to respond quickly to emerging challenges and dynamic situations are key to success. This has helped us a lot to weather the storm. Nevertheless, the full impact of economic lockdown measures on our sector and others will become fully visible only over the coming months, and presumably the picture will be as diverse as the distribution sector itself is.

Actually, the Covid-19 experiences are not so far away from the generic challenges chemical distributors are faced with: it starts with services of the future and the added value that distributors can bring in comparison to direct sales, also by proving supply chain excellence at all times, while application segments and required services get more and more diversified.

Secondly, it is digitalization. Home offices and virtual team meetings are just one facet of it, but as we have seen over the past weeks the demand for stable, integrated, reliable, (cyber-) safe solutions along the whole value chain is strongly increasing. This trend will affect distribution significantly, because we are centrally placed in the middle of all supply chain functions and deal with all industrial segments. As regards mid- and long-term challenges, all aspects of sustainability – above all the circular economy – will have a major impact on chemical value chains in Europe and the way we do business. And last but not least, distribution has to rise to the challenges of the demographic change. This means that the question of how to attract and retain young talent is also high on the agenda.

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Do you think that supply chains will be organized differently in the future as a result of the current Coronavirus pandemic?

D. Arns: That's a good question, and its ultimate answer will certainly also depend upon the time it takes to restore the usual supply chains, which suffered from interruption due to the pandemic.

I could well imagine a bigger push towards diversification in all aspects, not only attempts to find a sound balance between local/regional and global sourcing and selling, but also a scrutiny of all current supply chain channels and logistics solutions in use, plus – especially from the distributors' perspective – a potential extension of application segments covered. This might also lead to more strategic alliances in the future.

In the past 10 to 15 years, the supply chains of all industrial segments have become globally optimized and, hence, very vulnerable to protectionist tendencies. In this context, it was a somewhat traumatizing experience to see how quickly most of the EU Member States closed their borders in March and early April without coordination – let alone consultation – with their neighbors and despite the guarantee of a single European market. This aggravated the already tense supply situation in many parts of Europe by interrupting major value chains to the detriment of all and, thus, lively demonstrated the essential value of free trade. Hopefully, this will be considered in future decisions and in the current EU-UK Brexit negotiations.

Additionally, digitalization in the sense of integrated electronic supply chain solutions will certainly move up even higher on the agenda.

One of FECC's objectives is to support its members to manage the digital transformation of the industry. Which are the biggest challenges caused by the ongoing digitalization and how can they be tackled?

D. Arns: Indeed. The pandemic has also vividly showcased the value of digital solutions, especially when it comes to quick, always up-to-date, reliable, flexible and contactless processing of orders, deliveries and many other supply chain functions, including inventory management and cashflow monitoring.

Since distribution is ideally placed at the core of all supply chain operations – like customizing blending, formulating, packaging, warehousing, R&D, recycling – and covers all segments, while combining production, distribution and international trade, we consider ourselves to be best suited for piloting all kinds of innovative, digital solutions in close collaboration with our value chain partners.

In this respect, associations like FECC can enhance their crucial role, especially when it comes to elaborating industry-wide standards and testing new innovative solutions for their community with internal and external partners in the framework of legally sound governance and compliance rules. With this in mind, the FECC Board has decided already a couple of months ago – well before Corona! – to open up our membership criteria to take also all kinds of value chain partners on board in the pursuit of joint targets, such as digitalization and sustainability.

Especially but not exclusively for small and medium-sized enterprises, without huge IT departments, the various standards applied in different segments/countries/process steps, and the resources needed to ensure and maintain high data quality as well as effectuating the necessary updates in regular intervals are a big issue. At the same time, the safety and confidentiality of data needs to be ensured, all the more so when granting value chain partners access to own systems.

FECC also wants to drive responsible care and sustainable development. Which role do chemical distributors play in the chemical/plastics value chain and how do they support the circular economy concept?

D. Arns: Well, as distributors we are used to the ongoing requirement to constantly prove our value-adding supply chain services and special market know-how to our principals, customers and other supply chain partners. Since our margins are usually smaller than in direct sales, we must strictly apply resource-efficiency as overall guiding principle and important element to safeguard our competitiveness. Moreover, many of our member companies are family-owned businesses, which think from generation to generation and are strongly rooted in their individual neighborhoods, which means that you have to respect all types of sustainability requirements to be accepted – even better: well reputed – by local stakeholders.

Consequently, the successful scouting of market trends plus thorough know-how about present and potential customers is part of our business model, while we are fully committed to all principles of sustainability. This is why we also whole-heartedly co-signed the EU Commission's initiative Circular Plastics Alliance.

Our pledge is to use our market know-how to "connect the dots" in the chemical and plastic value chains to facilitate new, innovative solutions and applications for these chains in general, as well as for recycled plastics in particular, to enhance sustainability and circularity. What helps us here is that our customers range from large multinationals to small start-ups with new solutions, in some cases even outside the chemical sector.

From this perspective, we see the circular economy as an opportunity to enhance our agile role in the new circular business models.

As already mentioned, the race for young talent will intensify in the coming years. How do you plan to attract young people to the sector?

D. Arns: Well, first of all we need to explain our sector and the wealth of activities it offers more thoroughly, especially how agile, fast-moving, intriguing and diverse it is. What we just discussed on the circular economy topic will help everyone in distribution to make a real difference in contributing to solve the societal mega-challenges of the future. Here we will have compelling stories to tell young people in search of a purpose.

Besides this, the distribution sector offers highly qualified and well-paid jobs with life-long learning opportunities, a high level of responsibility from the first day in the company and a very heterogenous, agile environment. Distribution is an international business in midst of production and trade, with many different supply chain functions – real diversity everywhere, in the true sense of the word. If this message is delivered fully and passionately, I am sure it will attract young people to this sector.

What is your vision of the future of the chemical distribution sector? Do you think that the role of chemical distributors in the chemical value chain will change?

D. Arns: Sustainability in general and the circular economy in particular boost a further diversification in the chemical value chain in all aspects, such as chemical raw materials, sourcing per se, a further segmentation, globalization versus or complemented with regional supply chains, logistics processes, etc.

Agility in combination with a thorough market know-how about future applications and potential customers is needed more than ever before, enriched by the ongoing trend of big producers striving to simplify their business models, also for cost reasons. ‚Solutions' are needed rather than ‚mere sales'. I am confident that all this can be an opportunity for distributors.

www.fecc.org

Read the complete interview on
www.chemanager-online.com/en

Global Chemical Leasing Award 2021

FECC is an official sponsor of the Chemical Leasing Award 2021. This Award from UNIDO – the United Nations Industrial Development Organization – has been created in partnership with the governments of Germany, Austria and Switzerland. It aims to acknowledge best practices and innovative approaches related to chemical leasing and performance-based business models for the sustainable management of chemicals. Companies and individuals can submit their applications until Dec. 15, 2020 to ChemcialLeasing@unido.org.

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A New Responsible Way of Doing Business

Azelis Has Made CSR and Sustainable Innovation an Integral Part of its Business Model

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In 2018, for the first time, Azelis was awarded the EcoVadis Gold rating, making the Antwerp, Belgium-based company the first specialty chemicals distributor to receive this award. In 2020, Azelis joined the global Together for Sustainability (TFS) initiative and was awarded the EcoVadis Gold rating for the second time in a row. Asked by Michael Reubold, Maria Almenar, Azelis' group Safety, Health, Environment and Quality (SHEQ) and Sustainability Director, explains the importance of both milestones for the company and its relationships with principals and customers.

CHEManager: Ms. Almenar, how has the importance of SHEQ aspects changed in the chemical industry within the past 20 to 30 years, and how has it impacted corporate cultures?

Maria Almenar: In the early eighties, concerns arose over chemical products and their health, safety and environmental impact after chemical accidents occurred such as the major derailment of a train which carried chemicals and explosives in Mississauga, Ontario, Canada, in 1979, and the gas leak incident in Bhopal, India, in 1984.

The train accident in Canada was at the origin of the development of the Responsible Care program, launched in 1985 by the Chemical Industry Association of Canada. Today, Responsible Care is a global, voluntary initiative developed autonomously by the chemical industry for the chemical industry, and it stands for the improvement of health, safety and environmental performance.

Since the creation of RC, we have witnessed an evolution and increase in health, safety and environmental regulations such as the Globally Harmonised System of Classification and Labelling of Chemicals, GHS, developed in 2000, and REACh, created in 2006.

Being a global distributor, Azelis has a strong product stewardship policy in order to ensure that our products are compliant with global legislation and that information is provided through the entire supply chain to ensure the safe handling of chemicals and minimize risks to the environment.

Next to GHS and REACh, ISO standards were developed to support SHEQ by providing practical tools to set up SHEQ management processes and certify management systems. These ISO standards have certainly been very helpful for our management processes.

Today, the term 'sustainability' encompasses these efforts and a lot more.

M. Almenar: Yes, the term 'sustainable development' appeared for the first time in 1987 in the Brundtland report and since then we have seen an increasing number of players get involved in this area; from scientific institutes, NGOs and governments to companies and consumers.

Issues that humanity is facing like climate change, resource scarcity, environmental degradation, pollution, poverty, and social inequality are now being addressed in different agreements and frameworks, such as the ones created at COP 21, and the United Nation's Sustainable Development Goals, SDGs. With these frameworks, governments have not only set clear goals but also defined a structure that companies are now using to implement processes to accelerate success. Governments and corporations are increasingly working together in the same direction.

As governments will have to deliver and meet their targets in a timely manner, this could give rise to additional legislation in the fields of climate-related disclosure, energy efficiency, air quality and CO_2, and climate risk management. Companies, on their part, will have to review their strategies to cope with these new legislations and incorporate more risk management. Companies now have a strategic choice between being part of a well-planned transition or being subject to more disruptive transition. At Azelis, we have chosen to be part of the group of progressive companies that are planning the transition and are leading this historical change.

What is Azelis' mindset regarding safety, health, environment and quality, and sustainability? What are the pillars of your Corporate Social Responsibility, CSR, agenda?

M. Almenar: Azelis has long been committed to Responsible Care & Responsible Distribution, but being a global distributor, we quickly noticed our scope had to be much broader. We created our Corporate Social Responsibility program in 2015, following the Paris Agreement on climate change and the 2030 Agenda for Sustainable Development by the UN, and it is based in the UN Global Compact initiative and ISO 26000 and Global Reporting Initiative.

This program comprises 26 KPIs based on four pillars: resources and environment, people, fair business practices and sustainable procurement. This is now helping us to further optimize our existing processes and fair operating practices, as well as obtaining a more resilient supply chain as a result of a good due diligence process and risk management.

How do you rate SHEQ and sustainability aspects — and more precisely the TFS membership and the EcoVadis Gold rating — for your relationships with suppliers and customers?

M. Almenar: We are very excited to have joined 'Together for Sustainability'. With our membership, we will strengthen our position as a leading innovation service provider towards our customers and suppliers. It will also provide more visibility towards existing and potential partners and will certainly open up a plethora of opportunities.

Furthermore, having received the EcoVadis Gold rating for the second time in a row is a wonderful recognition of our group-wide efforts and commitments to implement the same high standards for our CSR performance across all regions in which we operate.

We are convinced that CSR and sustainable innovation should continue to play an integral role in our business model. We see the growing importance of sustainability in the business decisions of our suppliers and customers as well; it has become a new norm or standard, a new responsible way of doing business.

With our growing global presence and expanding number of suppliers, we must have robust programs in place for our due diligence processes. TFS can help us with this, and this support through our membership is certainly valued by our partners.

So, the CSR performance is not only a 'nice-to-have,' but almost a prerequisite of your partnerships with principals and customers?

> *"We see the growing importance of sustainability in the business decisions of our suppliers and customers."*

M. Almenar: Absolutely. We fundamentally believe that it is not an option any longer to just continue doing what has always been done. No company operates in isolation, and — as both individuals and corporate leaders — we are all very much aware of the climate change, depleting resources and an ever-increasing global population.

Being faced with all those changes simply does not leave any other option but to steer our activities towards sustainable solutions. It is an obligation towards future generations to find a sustainable way on how we utilize the available resources the world has to offer. We strongly believe that sustainability will become the standard — it will become a 'must-have', an integral and critical part of a license to operate, and hence not so much a differentiator any longer.

Which segments of the chemical industry or manufacturing industries are driving this trend?

M. Almenar: When it comes to sustainability, all industries are very much concerned and involved in improving standards. We observe that many of our partners are working towards developing sustainable product management procedures and methodologies to assess the impact of their products in the environment, and how their products help in reducing energy consumption or improve recycling.

In general, we are seeing more demand to distribute ingredients coming from sustainable sources or shift away from chemicals with identified health hazards.

The role of chemical distributors — in the past decades — has changed from being traders to being innovation service providers. And innovation today means improving sustainability along the supply chain. How does Azelis support its suppliers and customers in this regard?

Maria Almenar, Azelis

M. Almenar: As a distributor, we have a privileged position between suppliers and customers, which gives us the ability to cascade our customers' requirements — including sustainability — to our many suppliers and leverage our partnerships with both our suppliers and customers to further develop their sustainable product offering. This structure puts us in an ideal position to maximize customer satisfaction on sustainability.

To cater for this sustainable product demand, our application labs strive to offer sustainable innovations and concepts, and we consider the green principles of chemistry when we develop product formulations. By offering the right ingredients and demonstrating innovative formulations created by our lab technicians, Azelis works together with its customers to make our future greener and cleaner.

We believe that working and thinking together for more sustainable solutions can only strengthen relationships with our business partners who are equally responsible and equally dedicated to preserving resources for future generations.

www.azelis.com

Change at an Unprecedented Pace

Pharmaceutical Logistics in North America

Pharmaceutical logistics in North America is more dynamic now than ever. Logistics executives are addressing increases in special handling requirements along with heightened cost pressures with innovative approaches to logistics management. And pharmaceutical logistics in the United States is big business. With slightly less than 330 million people, the United States represents less than 5% of the total world population, but, depending on the statistics referenced, the United States comprises over one third of the total global spend on pharmaceuticals.


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The $1,200 per year per capita spend on pharmaceutical products in the US is about 30% more than the next highest per capita spender, Switzerland, and about twice as much as Italy and France (Statista). As a result, regulators and healthcare advocates are taking notice.

The Politics

The US government continues to debate instituting pharmaceutical price controls like those used by other countries but, so far, no new bills have been passed regarding pricing reform. The current administration has recommended approaches to allow Americans to legally and safely gain access to lower priced medicines from abroad but those approaches continue to meet resistance.

All in all, Americans continue to struggle with paying the highest prices in the world for the pharmaceutical products they need. No matter what the perspective is, the fact remains that the North American pharmaceutical market is the largest in the world with the United States leading the way.

The Scale

The structure of pharmaceutical distribution in North America is driven by the different geographic and population density profiles of the three major North American countries — the United States, Canada and Mexico. While North America technically includes 23 sovereign Nations, the US, Canada and Mexico dwarf all other countries by both population and land area, accounting for over 80% of the North American population. (Note: For this discussion, while geographically part of the North American tec-


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tonic plate, Greenland is considered within the European continent)

Canada is one of the least densely populated countries in the world. Even though the population is small, only the US and Switzerland spend more per capita on pharmaceutical products than Canada. Mexico, approaching 130 million people, falls just outside the 10 most populous countries in the world but spends very little on pharmaceuticals, less than a quarter of what the US or Canada spends.

If the pricing scenario stays the same in the United States, Canada and Mexico, the volume of pharmaceutical sales will likely continue to expand based on population growth and the aging populations in those countries. To the North American pharmaceutical logistics professional shifts in channel operations and product flows are of more importance than the macroeconomic effects driven by political agendas.

The Distribution Structure

Canada and Mexico combined represent less than 15% of the volume and spend of pharmaceutical products in North America. Most of the activity regarding North American pharmaceutical distribution revolves around the United States. Over the last 20 years, mergers and acquisitions have been commonplace across the pharmaceutical supply chain. Pharmaceutical manufacturers, wholesalers, retailers and hospital systems have all consolidated, eliminating operational redundancies and driving economies of scale.

No matter what the size of the pharmaceutical manufacturer, nearly all pharmaceuticals are distributed through one of three major wholesale distributors — McKesson, Cardinal Health and AmerisourceBergen. These three behemoths not only dominate the pharmaceutical industry in the US, they are all within the largest 20 of all companies in the country. McKesson, for example, ranks 7th on the Fortune 500 list, 30 spots higher than the largest diversified pharmaceutical manufacturer who ranks 37th on the list. These three all have immense distribution networks with dozens of warehouses and specialty facilities scattered throughout the country to accommodate nearly every pharmaceutical distribution need and to facilitate next day (or better) delivery for the majority of their customers. In total, these three companies control well over 90% of the pharmaceutical distribution market in the United States.

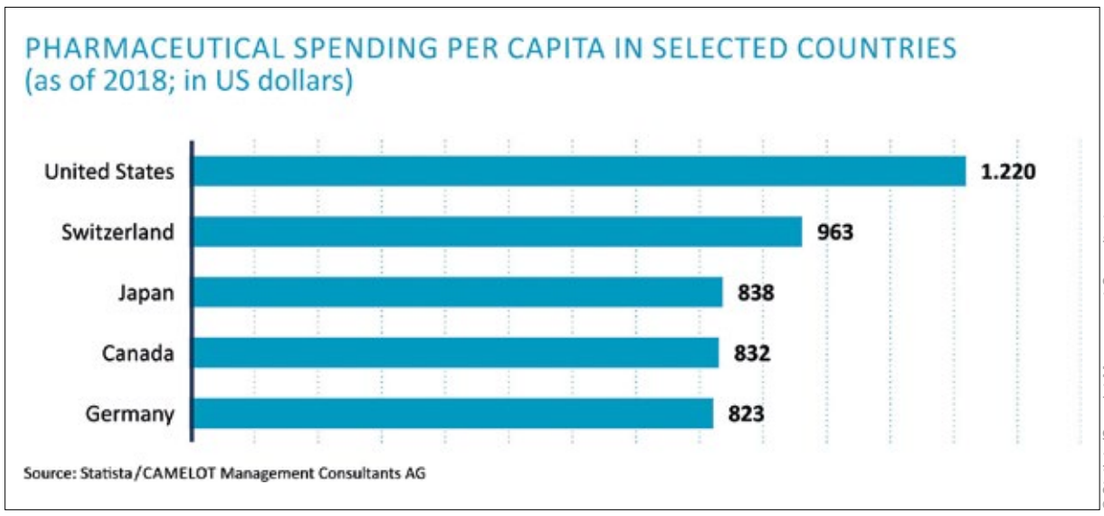
Similarly, the large pharmaceutical retailers continue to consolidate. Twenty years ago, there were dozens of regional pharmacy chains in the United States and many mass merchants, grocers and independent pharmacies existed. Today there are essentially two pharmaceutical focused retailers — CVS and Walgreens. In 2018, the Walgreen's Boots Alliance, owner of the Walgreen's chain in the US, completed the acquisition of the third largest pharmaceutical retailer, Rite Aid. Even so, Walgreen's remains 2nd behind CVS which controls almost a quarter of the retail pharmaceutical prescription market in the United States. The other larger retail pharmaceutical channels include the remaining large mass merchants, grocers, mail-order pharmacies and hospital systems, all of which have been consolidating as well. In 2016, CVS took over the pharmaceutical retail activity within Target, the 2nd largest US mass merchant behind Walmart. Overall, more than 70% of pharmaceutical retail is controlled by just 10 companies.

"The North American pharmaceutical market is the largest in the world."

Shifting Handling Requirements

Specialty handling requirements for pharmaceutical products is becoming less and less "special". Gone are the days when simple tableted or capsuled products dominated pharmacy shelves waiting to be counted out by pharmacists, hopefully well ahead of the years long expiration dates printed on their bottles. The growth in biologics has driven the need for more and more temperature-controlled capacity and much more sophisticated temperature monitoring. Shelf lives are becoming dramatically shorter and "designer" drugs are being made for specific individuals. The increasing complexity of pharmaceutical product characteristics is no different in North America than it is in other parts of the world. To some extent, the large population and high use of new products with specialty

Continued Page 24 ▶



The United States comprises over one third of the total global spend on pharmaceuticals.

handling requirements leads to some economies of scale, especially considering the geographic expanse of the continent and related climate diversity.

Shifting Regulatory Requirements

A major initiative underway in the United States relates to the tracking and tracing of pharmaceutical products driven the Drug Supply Chain Security Act (DSCSA) which was made law in 2013. These new regulations had a 10-year implementation timeline involving licensure, product verification, serialization and traceability. Companies across the supply chain have been working to comply with the regulations which require "lot level" traceability all the way through the dispensing pharmacy by the end of 2020. By 2023, the pharmaceutical supply chain is charged to operate with an inter-operable system at the unit level. Companies have been able to comply with the regulations to date for the most part as requirements have focused on lot level traceability through the distributors.

2020: a Defining Year for Cannabis

In 2018, Canada nationally legalized medical and recreational cannabis. In the United States over 30 states have legalized cannabis either completely or with various restrictions even though national/federal restrictions still exist. The layers to cannabis legalization are complex as state restrictions for growing, distributing and selling cannabis products vary. Federal restrictions generally prohibit the shipment of cannabis products across state lines and federal banking laws dramatically limit funding and investment options for companies operating within the cannabis supply chain.

The momentum for further legalization at the federal level, however, is clearly building. Hemp was previously classified as a controlled substance under the umbrella of all cannabis products in the Controlled Substance Act of 1970. The new legislation dictates that hemp cannot contain more than 0.3% THC, the psychoactive chemical within cannabis products. Federally, any cannabis product with more than 0.3% THC is still deemed a controlled substance. The new law generates and protects research regarding hemp-based products.

"'Lot level' traceability all the way through the dispensing pharmacy is required by the end of 2020."

From an operational perspective, changes to logistics systems due to cannabis-based products could be far reaching in the future. Potential effects range from cannibalization of existing over the counter and prescription medicines to completely new treatments based on the 500 or so unique chemical compounds that exist within cannabis plants.

An Ever-changing Environment

Just 25 years ago, logistics in the pharmaceutical arena in North America was relatively straight forward. Products were dominated by chemically produced, stable small molecule compounds requiring limited attention beyond security and expiration date management. Logistics costs were relatively insignificant, usually much less than 1% of the sales cost, and products had longer shelf lives so distribution channels were flush with inventory and leveraged basic warehousing, transportation and handling processes.

Today, pharmaceutical logistics in North America is dramatically different and changing at an unprecedented pace based on a plethora of influences. The foreseeable future for pharmaceutical logistics in North America is expected to remain dynamic, challenging and loaded with procedural, technological and operational innovations as logistics processes and structures adapt to growth and dramatically increased complexity.

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The Digital Transformation of Supply Chain Management

Supply chain management is under increasing pressure from several challenges, such as pressure to increase overall efficiency and manage a more complicated vendor mix, respectively.

According to the recent report „The Digital Transformation of Supply Chain" from Lux Research, this has sparked a flurry of innovation, with hundreds of companies developing digital tools to address aspects of every segment of supply chain management — planning and forecasting, purchasing and procurement, inventory, warehousing, transport, and supply chain platforms. The report, authored by Jonathan Melnick and Katrina Westerhof, finds that warehousing and transport have the most innovation activity, while digitization of supply chain platforms will facilitate highly dynamic processes that will shift priorities in planning and forecasting and beyond.

"Supply chain management challenges come from all directions; upstream, internal, and downstream," says Melnick, Director of Research at Lux. "Companies are facing internal pressures to be more efficient, integrated, and agile and to meet new consumer expectations of increased visibility into products. This is causing a shift in how vendors are evaluated and sourced to meet those expectations.

Traditionally, companies would source preferred vendors at the expense of efficiency and transparency. As more data around vendors and their products become available, digitalization gives companies greater insight into better and more dynamic vendor selection. This is enabling sourcing on demand, where new vendors are brought in rapidly, reducing trust and long-standing established vendor relationships. Digitalization is being used in purchasing and procurement in two key ways: to understand product quality and detect genuine vs. counterfeit products, and to lower transaction costs through increased pricing visibility.

The authors of the report predict that multiple variables, such as supplier risk, lead time, and variability, will work together to create a dynamic pricing market.

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Information is Key!

B2B Portal and Business Newspaper
for executives in the chemical and pharmaceutical industry

High-level Chemical Logistics

Evaluating the Performance of Logistics Service Providers and Chemical Distributors

As an independent system of uniform third party assessments, SQAS — Safety and Quality Assessment System —was initiated to evaluate the performance of logistics service providers and chemical distributors. Furthermore, it serves a more reliable partnership between logistics service providers and the chemical industry. In the network of logistics specialist Dachser, 27 branches have already been SQAS assessed. Recently, the San Sebastián location in Spain has joined them.

The Spanish chemical industry continues to grow. For last year, the Spanish trade association FEIQUE forecast a revenue increase of 2.6% to €67.6 billion for chemical products. Spanish chemical companies generate about 60% of their revenue abroad. This makes them an important driver of Spain's export industry.

It's wide of the mark to say that all chemical products are dangerous goods. However, when Dachser Iberia introduced its own dangerous goods system on the Iberian Peninsula about 5 years ago, it put itself in a very good position to support this growth in Spain's chemical industry. Independent parties like to confirm that the Dachser Chem-Logistics industry solution offers considerable expertise. After recently going through the SQAS assessment procedure for logistics services, the San Sebastián branch has joined the list of Spanish locations as an SQAS assessed company.

High Transparency

SQAS started out as a joint initiative by chemical companies and the European Chemical Industry Council (CEFIC) to develop a transparent process that ensures logistics providers adhere to the highest standards regarding quality, safety, the environment, and social responsibility. This involves having independent experts assess the companies using a standardized questionnaire.

Back in 2016, Dachser Barcelona became the first branch in Spain to go through an SQAS assessment.

"The SQAS assessment is particularly important for us as the local chemical industry needs a strong and reliable logistics partner especially for export. The most important export countries for our customers in the chemical sector here are Germany, France, Italy, and Poland," explains Antonio Garrido, team leader External Assessment & ADR European Logistics at Dachser Iberia in Madrid. Exports account for around 23% of total revenue with chemical products in Spain.

Garrido adds that successfully getting through an SQAS assessment is a challenge. The central element is a detailed questionnaire divided into several general topics: management system and responsibility, risk management, human resources, as well as performance analysis and management review.

High Standards

At Dachser's head office in Kempten SQAS expert Nicole Sommerlatte and her team support the preparation and completion of the assessment in the European branches, including San Sebastián. "This guarantees that we never lose sight of business practice and that any improvement potential we identify can always be transferred to other branches," states Sommerlatte.

This also means that the in-house aims are often set even higher than those of the independent auditors. All reports have to be renewed regularly: Therefore, ten reassessments were conducted in 2019 and six more are planned for this year, along with two first assessments.

Altogether, 27 branches have already been SQAS assessed in Dachser's European network, with no differences between regions. The most important effect of such a special evaluation is that it improves in-house controls and processes. With appropriate training in improved processes, employees can carry out their tasks safely and deliver better quality. And that applies to downstream service providers as well. Garrido acknowledges: "SQAS implementation is another way for us to reinforce our position as preferred partner for companies in the chemical industry." (sa)

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Milestone for Transparent Cooperation

Michael Kriegel, Department Head of Dachser Chem-Logistics, gives some insights about the relevance of SQAS for both sides — the chemical industry as well as the logistics provider. CHEManager editor Sonja Andres asked the questions.

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Michael Kriegel, Dachser

CHEManager: Mr. Kriegel, what does SQAS mean in detail?

Michael Kriegel: Back in 1994, Europe's chemical industry created SQAS — a milestone for transparent cooperation with logistics providers. Based on a single standardized questionnaire for the whole of Europe, it paves the way for sound partnerships with the chemical industry. It is undisputed that the chemical industry places higher demands on its logistics providers than other industry segments, especially in terms of quality and safety. I see SQAS as the entry ticket for a logistics company to begin working with the chemical industry.

For us, SQAS doesn't simply mean completing a one-time audit; it's rather a philosophy, a daily standard that we consistently live by in the company. Three years after a site's initial audit, a reassessment is conducted. It's much more challenging to demonstrate that something you've already implemented is still in effect than it is to achieve a certain standard once, which is what makes SQAS valuable for Dachser.

Why did Dachser choose to audit branches all over Europe?

M. Kriegel: Almost 40 chemical companies throughout Europe are members of the SQAS Service Group. A valid SQAS assessment is a requirement for working with them. If, after winning a tender, a logistics provider cannot present such an assessment, the contract will stipulate that they must arrange for an audit to be performed within a certain period of time.

15 years ago Dachser recognized that SQAS was a way to present its existing uniform standards transparently to the outside world. In the past, Dachser has always been able to implement the requirements quickly and successfully. The development of our European SQAS sites shows this very clearly. In 2010, for example, we had 14 branches assessed according to SQAS Transport Service. Today that number has grown to 27 branches in eight European countries. In addition, three of our sites have been assessed according to SQAS Warehouse. We achieved above-average results in all assessments. One way to tell how much importance the company attaches to this topic is the fact that they created an own central head office position to coordinate and support the audits together with the branches.

A good example of how quickly and successfully audits can be implemented is Dachser Iberia. In 2013 the long-standing joint venture partner was acquired and integrated into the European network. After the successful implementation of our own dangerous goods organization, we had the first branch in Barcelona audited according to SQAS Transport Service in 2016. Since then, two more successful assessments have followed on the Iberian Peninsula.

What are the benefits for chemical companies choosing a logistics service provider with SQAS?

M. Kriegel: Thanks to SQAS, all companies in the chemical industry can be sure that their logistics provider delivers very high standards of quality, environmental management, health, and safety, and that it is committed to living up to its corporate social responsibility. And that the provider regularly proves this in accordance with a standardized European framework.

Moreover, companies that are also a member of the SQAS Service Group not only have the opportunity to read up on all the assessment details at any time, but they can also take part in the assessments in person to see for themselves how high the standards are. That's really the most transparent and effective way to evaluate a logistics provider.

Chemical Companies and their Logistics Service Providers

Safety & Quality Assessment for Sustainability (SQAS) is a system of uniform third party assessments to evaluate the performance of logistics service providers (LSPs) and chemical distributors. SQAS assessments cover quality, safety, security, environment and CSR (corporate social responsibility). The SQAS assessment reports allow chemical companies to evaluate their logistics service providers according to their own standards and requirements.

SQAS, managed by CEFIC, the European Chemical Industry Council, is a key element of Responsible Care in logistics operations.

Chemical companies use the SQAS system in support of the risk management of their logistics activities as part of product stewardship. The reports provide a good insight in the strengths and weaknesses of their (potential) service providers. The assessment reports can help chemical companies in their selection processes of new service providers and for the ongoing evaluation of the standards and performance of existing cooperations.

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WHEN IT MATTERS

Predictive Logistics Era is Happening, Now!

Demand for Real-time Data Visibility is Poised to Rocket

Change is happening this very minute in the logistics industry. Why? Quite simply, because shippers are under enormous pressure from their customers to provide accurate real-time visibility data on shipments from pick-up to delivery.

Armed with live logistics data, smart factories can plan just-in-sequence supply chains, warehouses feeding every sector of human activity, such as the chemical and pharmaceutical industries, can improve productivity by up to 30%, and retailers will be able to better provision supermarket shelves. Every sector of the business spectrum in the coming smart, live data era will profit.

Avista Oil is a perfect example. The base oil and lubricant manufacturer aims to differentiate from competitors through better customer services by providing live shipment data. It obtained real-time visibility of 70% of shipments within a week of onboarding the platform with carriers.

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© sixfold

Armin Tüll, Sixfold

”Sixfold is the future of data distribution in the supply chain,” says Manfred Himmelbach, Avista Oil’s Head of Group Logistics at a carrier workshop on onboarding the Sixfold platform. ”Our customers have high demands and expect real-time information about their orders and if there are any delays.”

In the past, shipping logistics from A to B was all about pen-and-ink planning with dispatchers reliant upon a set of well-trodden trade routes. Now the logistics industry is beginning to get smart.

Optimizing Shipments

According to consultancy firm Bain, shippers with optimized distribution networks can expect up to 10% increases in margins. However, the majority of businesses still think of their supply chains as costs rather than as tools to drive added value and increase efficiency. The cost mindset has to change. By moving goods in an optimized way — improving route and shipment efficiency — manufacturing plants can decrease high levels of inventories while improving operational efficiency.

Three issues still need to be addressed: reducing shadow IT and information silos, breaking free from “old school” planning, and ditching the spreadsheet.

Of these issues, perhaps the most important is ditching the spreadsheet. Not only do logistics planners contribute to information silos by producing plans in Excel, they also counteract the mindset of open, transparent workflows so crucial to success in the modern supply chain. Indeed, this type of workflow is emblematic of the organizational structures that result in shadow IT and silo decision-making, both of which

make a forward-facing and future-oriented supply chain virtually impossible. Under these conditions, businesses get caught up in a cycle of planning based on past events instead of future predictable events, and then scramble to react to unforeseen breakdowns.

Predictive Logistics Era

Smart logistics is beginning to shape a more advanced conception of the logistics value stream with predictive delivery platforms being integrated into traffic management systems. It marks the dawn of the "predictive logistics era" where supply chain management and smart technology predicts delays of shipments in transit ahead of time, enabling planners, even autonomous machine processes, to adjust production schedules to meet changes in delivery schedules.

As predictive shipments accelerate, the global value chain will become more complex, relying on advanced predictive algorithms and the integration of more and more connected elements. The supply chain will become smarter and leaner, offering a more adaptive and agile environment.

"Smart logistics is beginning to shape a more advanced conception of the logistics value stream."

The predictive logistics era will allow more data to be circulated more quickly over networks. It will be indispensable for helping to propel autonomous vehicles, large-scale Internet of Things (IoT) and drones. Other logistics-specific applications such as fleet management and predictive maintenance will benefit and drive greater efficiencies in the supply chain.

In the predictive logistics era, parcels in trailers will be embedded with their own sensor tracking data such as humidity and temperature. Shippers will then be able to implement infrastructure monitoring, process automation, smart metering and real-time fleet management.

"The supply chain will become smarter and leaner, offering a more adaptive and agile environment."

Large carriers and freight forwarders will be the first to benefit from logistics predictive technologies allowing them to track assets in real time, make informed decisions by detailed data streams and to better engage with customers.

Sixfold's predictive logistics platform is already beginning to transform Europe's supply chains as customers enter the smart shipments era and transform their business economics in the process. It also enables shippers to better engage with their customers and become more customer-centric.

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The Risk of Dependency

Resilience and Political Implications: Current Pharma Supply Chain Model on Trial

In recent decades, outsourcing of production steps, especially to Asia, has been one of the most important trends in manufacturing strategies in both the European and the US pharmaceutical industry. This resulted in a significant dependence on Asian suppliers. In an interview David Francas, professor for Logistics and Information at Heilbronn University and managing director of the Healthcare Supply Chain Institute, Germany, gives a closer look at the global pharmaceutical supply chain and at methods to calculate risks and chances. The interviewer was Sonja Andres, CHEManager.

CHEManager: Mr. Francas, do you expect the current outbreak of Covid-19 will cause a long-lasting impact on the pharma supply chain?

David Francas: First, the significant demand changes, like the surge in demand for paracetamol, and temporary supply shortages, like APIs from Asia, are likely to result in a bullwhip effect that will cause imbalances in supply chains over the next nine to 18 months. Second, decision-makers in politics and business are already starting to question whether they could have been better prepared for this crisis. It is very likely that this will result in a critical review of the design principles of global pharmaceutical supply chains. The calls to move production of active pharmaceutical ingredients — or APIs — back to Europe are first examples of this upcoming discussion.

Especially in pharmaceutical manufacturing the global complexity of the supply chain has increased substantially in the past years. Can you please illustrate this complexity? Where is its highest impact on the supply chain?

D. Francas: Over the past decades, consolidation of production sites and outsourcing of production steps were major trends in manufacturing strategies. In particular, API manufacturing has maintained a firm position as the most outsourced area for drug manufacturers. Since one API supplier often delivers to multiple pharmaceutical companies, issues at this level may have widespread effects on drug supply. Especially, the fact of India and China being a prime location for API manufacturing is a subject of intense debate. National authorities and other stakeholders question more and more the resilience and political implications of this supply chain model.

Looking at the general supply of medicine, how do you estimate the resulting dependence?

D. Francas: Data from Europe and US authorities confirm a significant dependence on Asian suppliers. For example, 40% of API manufacturing facilities that serve the US market are located in India or China. Unfortunately, there is no detailed information available about the type and volume of APIs being produced in Asia for the US or European market — a matter of fact also admitted by the American FDA. Several industry reports indicate that the true dependence on Asian suppliers may be even higher: They state that up to 80% of APIs used in Europe or the US comes from China and India. From a risk management perspective, the high concentration of API production in one region comes along with higher supply chain vulnerability. This fact has been confirmed by the temporary shutdowns in China during the coronavirus outbreak, which sparked severe fears of global drug shortages.

David Francas, Department of Transportation and Logistics, Heilbronn University

Did these dependences cause negative impacts already on production and supply of APIs in the last couple of years?

D. Francas: Drug shortages have become a global phenomenon and are recognized to affect all health systems. Though several shortages are reported to be caused by issues with API supply, there is no clear empirical proof yet that outsourcing has substantially contributed to this trend. However, some facts may suggest that there is a connection. Before the coronavirus outbreak, manufacturing quality issues in India and China had been subject of concern. In fact FDA data from 2019

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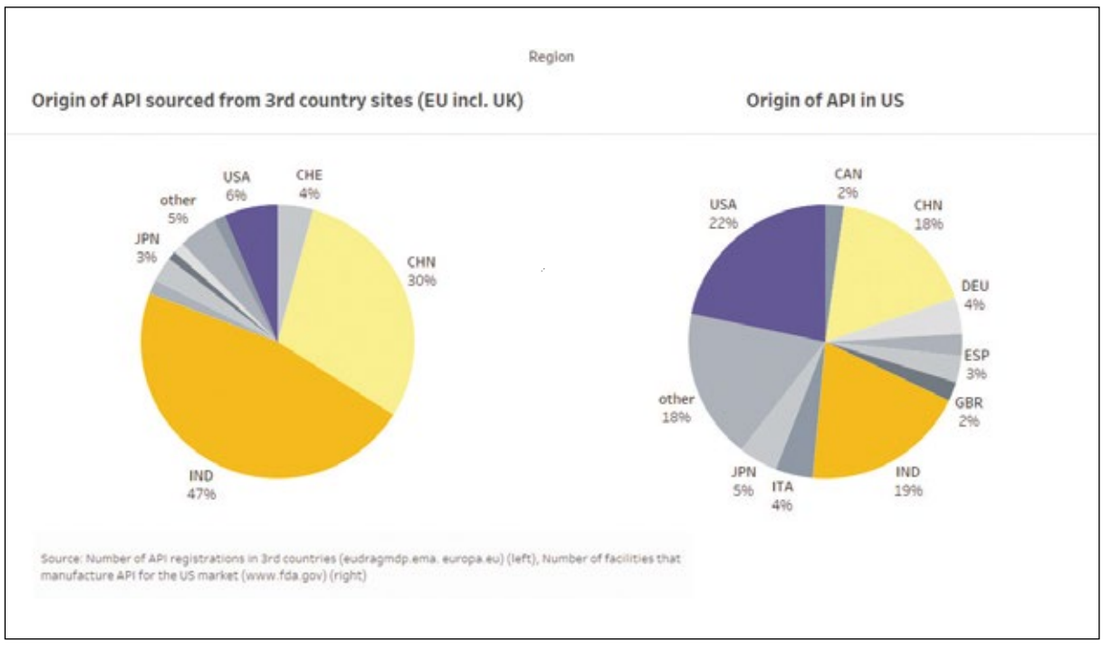

Fig. 1: Number of API registrations in 3rd countries serving the EU (eudragmdp.ema. europa.eu) (left), number of facilities that manufacture API for the US market, www.fda.gov (right)

show that India has the poorest rate of FDA inspections with acceptable outcomes (83%) — much lower than China (90%), the US (93%), and EU (98%). A case in the year 2018 shows the impact of such quality issues. Contaminations found in drug ingredients manufactured by API manufacturer Zhejiang Huahai Pharmaceutical caused worldwide product recalls of Valsartan.

How do you estimate China's and India's part as API delivering countries — today and in the future?

D. Francas: It is worthwhile to note that India with its generic drug production also heavily depends on Chinese manufacturing of APIs and intermediates; several sources estimate that India imports nearly 70% of its APIs from China. The basis for China's and India's domi-

Continued Page 32 ▶

Secure Solutions for Temperature Sensitive Logistics

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nance in API and other key ingredients in drug production are labor and other cost advantages that are not likely to diminish that soon. Moreover, especially China benefits from a strong chemicals industry and substantial scale advantages in production. Given these cost advantages and the considerable investment cost for moving API production back to the USA or Europe, it seems very likely that China and India will remain key suppliers of APIs in the next years.

Can you give us a more detailed insight into supply chains of European and North American pharmaceutical production?

D. Francas: In general, we see that primary API manufacturing is often done in Asia while secondary manufacturing, and packaging in particular, tends to be closer to the local or regional markets. For example, only 22% of the API manufacturing sites that serve the US market are based in the US, in contrast to 64% of the (secondary) manufacturing sites. Though much of the public attention focuses on the high share of API production in Asia, the high concentration of manufacturers also warrants critical analysis. In Germany, around 530 drug substances are classified as essential medicine; almost a fifth of them are attributed with an increased supply risk since only one authorization holder, or only one manufacturer, or only one active substance manufacturer is available. Risk and supply chain theory clearly suggests that those supply chains are much more vulnerable to disruptions.

Is it possible to counteract the shortage of general pharmaceutical ingredients and APIs without risking an extreme increase in the price of medicines? Would methods like predictive und prescriptive analytics be helpful?

D. Francas: Increasing prices for generic drugs, national drug reserves, and reshoring of API production are frequently discussed measures to reduce shortages and secure national drug supply. The truth is, however, that any of these measures would likely increase directly or indirectly healthcare costs. As is also acknowledged by national authorities, there is a general lack of detail data and empirical studies that thoroughly explain key drivers of drug shortages. Understanding those drivers and the development of appropriate decision support systems would be important to better guide decision making. In this way, analytics could certainly help.

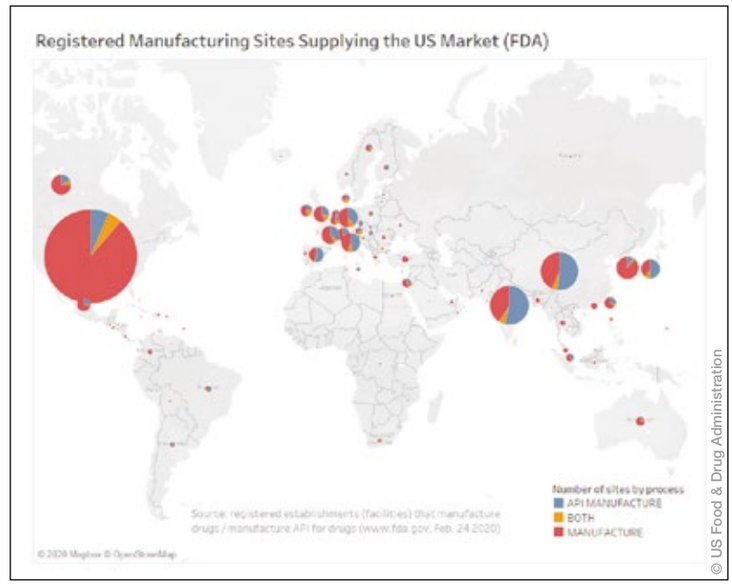

Fig. 2: Number of facilities per country which manufacture drugs that are commercially distributed in the US or offered for import to the US

How can pharmaceutical companies protect themselves against risks in the supply chain?

D. Francas: Structural risk mitigation levers in a pharma supply chain are dual or multi-sourcing, agile capacity, and risk inventory. Furthermore, choosing the right risk mitigation measures requires effective planning. The commonly used deterministic, i.e. scenario-oriented, planning logic is hardly capable of adequately accounting for risk and uncertainty. Our own research confirms that prescriptive analytics such as stochastic or robust optimization can help companies to better manage supply chain risk. For example, we developed an optimization approach for biopharmaceuticals that takes demand variability — forecast errors — and shelf life risk along with supply chain cost into account when determining lot sizes and inventory levels. Case studies with companies show both significant cost savings and risk reduction compared to standard planning approaches.

> *"It is very likely that China and India will remain key suppliers of APIs in the next years."*

Finally, what actions should be taken to improve resilience of the supply chain?

D. Francas: While the above-mentioned risk mitigation levers are generally well understood, there is a need for better end-to-end metrics and supply chain planning. Because historical data on rare events such as the coronavirus outbreak are limited or non-existent, their risk is hard to quantify using traditional models. As a result, many companies do not adequately prepare for them. Our research shows that novel metrics like time-to-survive and time-to-recover can help companies to better assess their risk exposure. We recently developed E2E Risk Guru, a software that uses prescriptive algorithms to simulate optimal reactions to failures and optimize risk mitigation strategies based on these metrics. Using data from ERP and planning systems, E2E Risk Guru creates a digital twin of the supply chain planning environment. For example, this allows for finding weak links in the supply chain and optimizing risk inventory or other measures considering multiple risk scenarios simultaneously, like failure of API supply and failure of bulk production at the same time.

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INNOVATION PITCH

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Creating the AI-Powered Future of Chemistry

Polish Start-up Bridges the Gaps Between Chemistry, Technology and Business

Molecule.one leverages artificial intelligence (AI) to design novel chemical syntheses. As a response to the outbreak of the Covid-19 pandemic, the Warsaw, Poland-based start-up has set out on the mission to accelerate the process of creating medicines. Piotr Byrski and Paweł „Maxus" Włodarczyk-Pruszyński, who have known each other since high school and worked together for the last 10 years, created the first Molecule.one technology prototypes. They were joined by Paweł Łaskarzewski and Stanisław "Stan" Jastrzębski, who added their business acumen and AI expertise to the team skill-set. The founding team explains their motivation, current situation and next steps to develop the company.

Paweł Włodarczyk-Pruszyński, Stanisław Jastrzębski, Paweł Łaskarzewski and Piotr Byrski (from left to right), Molecule.one

CHEManager: What inspired you to found a company?

Piotr Byrski: While studying medicine, we saw many people suffering from untreatable diseases. That prompted us to ask ourselves two questions. Firstly, why designing a new drug must take so long. Secondly, what can we do — with our chemical and mathematical education — to solve this problem?

How did such a noble idea come to life?

Paweł Włodarczyk-Pruszyński: During our studies, together with Piotr, we were invited as consultants to a research group operating at the Institute of Organic Chemistry in Warsaw. A group of chemists worked there on an attempt to automate the synthesis of chemical compounds. It was the team in which we were consultants that later created the platform and software, which uses chemical knowledge and a database to predict the methods of synthesis of organic compounds. After cooperating for some time, we decided to work on our own idea, using solutions from the artificial intelligence field.

P. Byrski: Their solution gave good results, but unfortunately it is impossible to maintain a system based on hand-coded rules in the long run. Maxus and I thought that this was not a forward-looking approach. Chemistry is developing very dynamically, with new compounds and new types of reactions appearing. We wanted our model not only to apply what it had in the set, but also to have some creativity.

Combining math and chemistry skills allowed us to consider the perspectives of both users and software developers.

And what happened next?

Paweł Łaskarzewski: Then we met. After initial talks with pharmaceutical companies, I realized that the demand for such a solution is huge. Companies have been gathering information for years about the reactions they carry out in their laboratories and had a lot of unused data. We had an idea for a world-class AI tool that could predict if a chemical reaction could be carried out and how. From the beginning, our goal was to create a solution that could learn and be able to draw conclusions based on previously performed experiments.

After this analysis, I decided to help them from the business side, to raise capital, promote and support building high-class technology. In 2018, when the first investors appeared, we began building the system. Sunfish Partners, a VC fund based in Berlin, Germany, invested in our company. We have also filed a patent application in the US, where the largest number of pharmaceutical companies is located. We intend to open a company there.

What are your next steps in technology and business development?

Stanisław Jastrzębski: In terms of technology, we are constantly optimizing our machine-learning algorithm in order to improve the quality and the confidence measures of our predictions. Furthermore, we are increasing the performance of our solution. Although we can already analyze 10,000 compounds per hour, we are working to go beyond that. In addition, we aim to make our interface more convenient for our customers. In terms of business, we are planning to raise some funding this year. While continuing to work with our existing customers, we are also seeking to expand our customer base.

Molecule.one is supporting the efforts of scientists and researchers around the world to discover a drug against Covid-19.

P. Byrski: Yes. Recently, we have achieved a significant technological milestone, which enables us to plan and evaluate chemical synthesis for multiple compounds at once. This is useful for early stages of drug discovery, when lots of options need to be kept open. A couple of months ago, when the coronavirus crisis started to spread, we wondered how we could support the development of drugs against SARS-CoV-2. Given we are the only technology platform to perform synthesis planning for thousands of molecules per hour, we realized this was where we could bring value. Therefore, we decided to grant free access to our synthetic accessibility screening (SAS) capabilities to every team involved in developing potential treatments and cures for Covid-19.

Personal Profile

Piotr Byrski is a Doctor of Medicine and holds a B.Sc. in Chemistry and Mathematics. A laureate of multiple national and international science competitions, he previously was a board member at Collegium Invisibile, an academic NGO.

Paweł "Maxus" Włodarczyk-Pruszyński, is a Doctor of Medicine and holds a B.Sc. in Chemistry and Mathematics. A silver medal laureate at the International Chemistry Olympiad, the self-taught software engineer has 7 years of experience in day-to-day programming.

Paweł Łaskarzewski managed two successful start-up exits. The former CTO of Absolvent.pl: the 4th fastest growing start-up in CEE in 2016, built a mobile bank from scratch as CTO/COO. and has 20+ years of experience in ICT.

Stanisław Jastrzębski earned a Ph.D. from Jagiellonian University and was a postdoc at New York University. He published highly cited work with scientists in deep learning (Yoshua Bengio, Kyunghyun Cho) and gained industrial experience with Google and Palantir.

Business Idea

Make Medicines Faster

Artificial Intelligence (AI) enables to speed up the process of chemical synthesis and, thus, the development of new drugs. The Molecule.one platform is a type of virtual laboratory where researchers can get a recipe for a given molecule, and then physically create it in the laboratory. In order to generate syntheses, it uses graph neural networks, adapted to the needs of chemistry. Since a chemical reaction is the transformation of one chemical compound into another, both can be saved as one graph.

If a scientist wants to learn how to create a new, never synthesized molecule, then Molecule.one's artificial intelligence will cope with it. AI will look for similar reactions or chemical standards in the data, based on which it will generate a synthesis path — i.e. a recipe for how to do it.

The data is acquired from the US Patent Database. The patent register contains a huge amount of publicly available data from which millions of examples of chemical reactions can be obtained. The correct interpretation of information recorded this way is sometimes difficult and it takes a lot of time to pull out all the important elements. However, the start-up team managed to properly clean this data and today is automatically updating the database with new patents. Molecule.one is also able to clean up other data sources. Entering into a cooperation with a large pharmaceutical company will enable the start-up to connect their internal data sources, so that the algorithms can also take into account their experience and knowledge accumulated over the years.

Using this solution in the pharmaceutical industry can affect the lives and health of billions of people around the world. Automation of the synthesis process enables a much faster launch of new drugs on the market — maybe also a drug for the treatment of Covid-19.

■ Contact details: Molecule.one, Warsaw, Poland
Web address: https://molecule.one

Molecule.one

The Molecule.one team prepares for pitching at the TechCrunch Startup Battlefield contest, part of the TechCrunch Disrupt SF 2019 conference.

Elevator Pitch

All About the People

Molecule.one is a Polish start-up. Founded in 2016 in Warsaw, the company has created the fastest software platform for chemical synthesis based on state-of-the-art artificial intelligence (AI). The start-up wants to lay the groundwork for the automated future of organic chemistry, especially in the pharmaceutical industry.

Milestones

2017-2018
- Proof of the ability to build the system and raise initial interest of 6 top pharmaceutical companies

2019
- Angel investment allowing to accelerate development
- AI achieved first human-level results on a subset of reactions
- Roll-out of a beta version of the software to first users
- Closing of pre-seed venture capital Investment
- Deployment of first AI model to production
- Launch of product at TC Disrupt SF Startup Battlefield

2020
- AI achieved state-of-the-art retrosynthesis results on a public benchmark
- Synthetic Accessibility Score was used by researchers working on Covid-19 drug discovery
- First scientific papers published online

Roadmap

2020
- Confirmation of trials with 10 top pharmaceutical companies
- Significant improvement of interpretability and robustness of AI models used
- First long-term partnership with a top pharmaceutical company

2021
- Prediction of the cost of drugs synthesis using AI with similar accuracy as chemists
- Generation of reaction data and first AI-based predictions based on these data
- Equipment of platform with accurate reaction conditions and outcome prediction

2022
- Decreasing the failure rate of a commonly used reaction by 30%
- Achieving deep chemistry understanding of AI models
- Signing long-term contracts with 3 top pharmaceutical companies

2023 and beyond
- Set-up and operation of own automated laboratory
- Building partnerships with 8 top pharmaceutical companies
- Scaling up data generation pipeline and sales
- Expansion beyond the pharmaceutical market
- Discovery of novel chemical reactions of economic value using self-driving laboratories

By creating the AI-powered chemical synthesis platform, Polish start-up Molecule.one aims to solve the unpredictability of chemical synthesis to enable faster development of medicines.

Contributing to the Circular Economy

Biobased and Biodegradable Solution for Packaging Applications

Cellugy was founded two years ago by a diverse team of young academics and professionals from Spain, Indonesia, Albania, and Denmark. Working together at Aarhus University in Denmark, the idea of developing a material based on nanocellulose as an alternative to plastic barrier coatings arose and grew into a start-up and a first product. Co-founders Isabel Alvarez-Martos and Deby Fapyane talk about their motivation and vision.

The Cellugy team (from left to right): Serena Leka, Deby Fapyane, Isabel Alvarez-Martos, and Paruntungan Sihombing (sitting).

CHEManager: Cellugy was founded 2 years ago. How did it all start?

Isabel Alvarez Martos: One of the co-founders and I met while working at Aarhus University. We shared lab spaces together and many delicious meals. When shopping for food, we found out that both of us are not happy about buying organic food that is wrapped in plastic. From there, the idea of developing a new material from renewable resources to replace the plastic arose. We presented the idea in a university case challenge in the climate category. It was fundamental for us to test public's perception of the problem we had with plastic packaging, but also take on the opportunity to replace it with more sustainable materials.

What does the name Cellugy mean, where does it come from?

I. Alvarez Martos: For a biotechnology company, to succeed, the brand might not have the same priority as the other company matters, however for us, communication of our products comes together with a certain educational value to the general public, in example: on how to treat packaging at the end of life, dependent on the type of material used. Our core technology is the production of nanocellulose using a fermentation process, very similar to the one used to make beer. That's why we named the company Cellugy. It stands for green cellulose.

There are several companies working on materials made of cellulose. What is the USP or differentiating feature of Cellugy?

Deby Fapyane: Cellugy has designed a biomaterial able to replace plastics in several packaging applications, which is completely harmless to the environment. Being made of nanocellulose, our product EcoFlexy can be either recycled in the paperboard stream or home composted, whereas if leaking into the environment it safely biodegrades in a short time, leaving no toxic residues behind. And what is also worth mentioning: the EcoFlexy production emits 94% less CO_2 emissions compared to the production of conventional plastics and at the same time enables a circular economy for hard-to-recycle packaging products.

Which obstacles did you have to master so far during the Cellugy journey?

I. Alvarez Martos: we have applied a step-by-step approach to building Cellugy and developing EcoFlexy. On our journey, we became very agile in the way we initially communicate and partner up with stakeholders throughout the supply chain, and as a result, we could realize many start-up milestones in a relatively short period of time.

On the other hand, fundraising has been a monster task as we aimed at strengthening the technology before going into VC funding. Nevertheless, with the support of different Danish and international funding schemes, and other entrepreneurial programs, Cellugy has been for two years "self-incubated", raising approx. €1 million for developing our MVP and shaping the company's values. Such a commitment is thanks to having 'true-to-the-cause' co-founders and advisors, with the right expertise and experience on technical and business matters.

What have been the most exciting projects so far?

D. Fapyane: For a scientist, international recognition of your work is of great motivation. Cellugy has designed EcoFlexy, a breakthrough biomaterial that receives tremendous attention once people and companies get to know about it. Preparing for the Ocean Plastic Innovation Challenge, by National Geographic and Sky Ocean Ventures, was the most exciting project. The idea of meeting other worldwide start-ups, who are designing advanced materials and new technologies to tackle the plastic waste issue, is thrilling, and the inspiration you get while sharing experiences in such an environment is exactly what you need. We received the runners-up prize in the competition and came home with an investment commitment.

What will be the next steps to develop Cellugy

I. Alvarez Martos: We are working hard to strengthen the core technology and secure partnerships with key players in the packaging market that help us validate our product in their operational environment. By 2025, we expect to have the full protection of our intellectual property, and in addition, we envisage exploring different applications of EcoFlexy such as an eco-friendly reinforcement agent for the construction and automotive industry and an eco-friendly microbead component for the cosmetic and pharmaceutical industry.

Personal Profile

Isabel Alvarez Martos has a B.Sc. and a Ph.D. degree in Chemistry from the University of Oviedo, Spain. During her former academic career, she published 20 original papers including two book chapters and received the prestigious 'Marie Sklodowska-Curie' Individual Fellowship as well as several other research grants from the Spanish Ministry of Education and Science. Her work was developed at the interface between materials science, electrochemistry, and biochemistry.

Deby Fapyane has a B.Sc. degree in Pharmacy from the University of Airlangga, Indonesia, an MSc degree in Environmental Engineering from the Gwangju Institute of Science & Technology, South Korea, and a Ph.D. in Nanoscience from Aarhus University, Denmark. She has published to date 15 publications in international peer-reviewed journals and gained extensive experience in enzyme and microbiology technologies with a focus on environmental applications. Her research has always been commercially oriented and multidisciplinary.

Business Idea

Replacing Plastic with Biomaterial

Cellugy is an award-winning biotechnology company with the objective of designing disruptive nanocellulose materials that enable more readily recyclable alternatives to conventional packaging composed of multiple materials (often including polyethylene, aluminum, and wax). The Danish start-up is introducing their first product EcoFlexy to packaging companies and chemical companies serving the packaging industry and, indirectly, to brand owners. The company's short-term focus is the food industry as one of the major and more challenging sectors contributing to packaging waste.

EcoFlexy has been developed for replacing plastic with biomaterial and showcases the following benefits:

- **Fossil-free:** EcoFlexy is made from renewable resources. The production of nanocellulose from both sugar and agro-industrial waste has been demonstrated.
- **Edible:** The product is made from nanocellulose, a natural fiber that has been 'Generally Recognized As Safe' (GRAS) by the FDA. It is thus edible, will not suffocate sea animals, and is ideally positioned to be used for food packaging.
- **Biodegradable at ambient conditions:** EcoFlexy disintegrates completely within four weeks according to the EN 13432 for home composting.
- **Recyclable in the paperboard stream:** As nanocellulose has the same chemical structure as cellulose in the pulp, EcoFlexy can be recycled alongside cardboard and paper.
- **High oxygen barrier:** The use of EcoFlexy as barrier material allows to extend food shelf-life and preserve freshness while being a mono-material packaging solution.
- **Suitable for the food packaging industry:** In addition to the environment-friendly properties outlined above, EcoFlexy is compliant with EU regulations for food contact materials.

Cellugy is fully aligned with the United Nations Sustainable Development Goals (UN SDGs), responding directly to SDGs 12, 13, and 14 since the start-up tackles several problems at once: the plastic epidemic, food, and agricultural waste production, and the sustainability of packaging.

Next for Cellugy: The team aims at enhancing the society's sense of community, cooperation and participation through circular economy, while facilitating end-of-life management.

- Cellugy, Aarhus, Denmark
  www.cellugy.com

Elevator Pitch

Award-winning Biotechnology

Cellugy was founded in Spring 2018 by a diverse team of young professionals from Spain, Indonesia, Albania, and Denmark. Challenged by the idea that plastic is linked to almost every purchase that we make, and the majority of this plastic is not suitable for recycling; the team focused their energy on developing a distinctive material that is environmentally sustainable and satisfies the packaging requirements. The proof-of-concept and working prototypes of the material named EcoFlexy are being trialed with early industry and knowledge-based partners. Currently, Cellugy is an 80% women-led team moving towards exploiting the opportunities that white biotechnology represents in producing nanocellulose as an alternative to plastic barrier coatings.

Milestones

2018
- Foundation of Cellugy
- R&D and Technology validation on lab-scale
- Top 3 foodtech companies in Europe by TechTour European Venture Contest in Dusseldorf, Germany
- Bootstrapping of the initial financing of 65,000 EUR

2019
- Validation of technology and first proof-of-concept agreements with industrial partners
- Top 10 cleantech start-ups at Nordic Cleantech Open 2018/2019 edition
- Food Innovation Prize of the European Institute of Innovation and Technology (EIT)
- Winner of the Advanced Materials Competition of the Innovation Network for Advanced Materials (INAM) in Berlin, Germany
- Winner of the Global Innovation Summit in China, by InnoEU
- Runners-up in the National Geographic and Sky Ocean Ventures Ocean Plastic Innovation Challenge in Washington, DC, USA

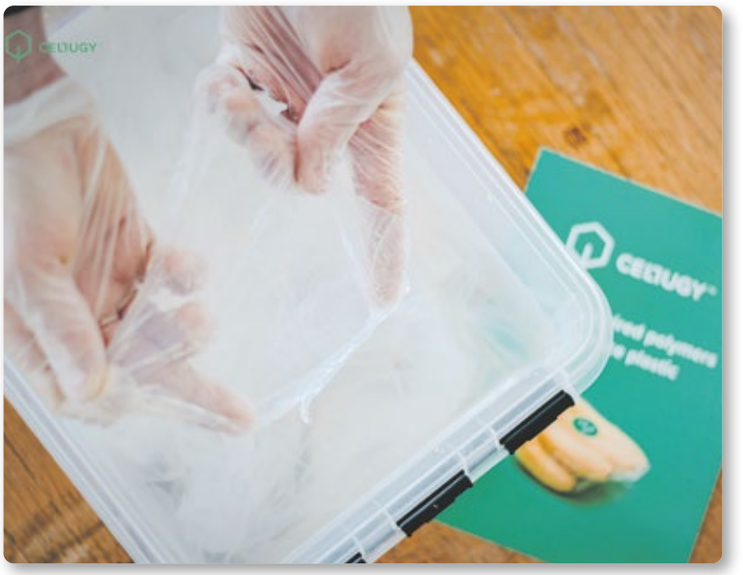
2020
- Sky Ocean Ventures becoming first investor in Cellugy

RoadMap

2021
- Fermentation technology scaled
- Signing with partners to co-develop EcoFlexy-based packaging products

2022
- Market introduction of EcoFlexy
- Pilot plant set-up

Cellugy believes that packaging materials should be made sustainably and designed to return value through a closed-loop system without compromising nature. The team uses nanocellulose to manufacture biodegradable materials.



EcoFlexy is an innovative bio-cellulose material produced by the bioconversion of sugars. Its unique performance allows producers and brand-owners to meet their sustainability goals and contribute to a more sustainable future.

Reshaping Adhesion — and the Industry

Reversible Solution for Superior Plastic Assemblies based on Polymer Brush Coatings

Hybrid assemblies, joints of dissimilar materials, are everywhere — in our smartphones, cars, TVs, dishwashers, in planes and so on. However, in modern products we increasingly rely on plastics, which are intrinsically hard to bond to other types of material — and by using industrial glue for the bonding the parts cannot be recycled easily. Solving this monumental challenge inspired the foundation of the Danish start-up company RadiSurf five years ago. Now finally, the breakthrough reversible, patented solution RadiBond is out on the market. Mikkel Kongsfelt, co-founder and CEO of RadiSurf, takes us on RadiSurf's journey.

Mikkel Kongsfelt, RadiSurf

Personal Profile

Mikkel Kongsfelt is CEO and co-founder of RadiSurf. In 2014 he received a Ph.D. in nanoscience from Aarhus University. Later he supplemented his technical background with the Pasteur program at Harvard Business School and is concluding a part-time MBA in Business Economics at Aarhus University. An entrepreneur by heart, Kongsfelt founded RadiSurf in 2015 together with three leading specialists in the field of polymer brushes, all currently professors at Aarhus University.

CHEManager: Mr Kongsfelt, what makes RadiSurf's adhesion technology so unique?

Mikkel Kongsfelt: RadiSurf's core technology is based on the chemistry of polymer brushes, which is polymer chains chemically bonded to a surface such as a metal, glass or ceramic and free to move in the other end — visualized as a nano-Velcro structure. The free end can be designed to match a plastic material and hence create a direct chemical link between otherwise vastly different materials such as a metal and a plastic. By design our RadiBond technology combines chemically different materials, while traditional glue only works with chemically similar materials.

Because the RadiBond adhesion technology is controlled at the molecular level to create direct chemical bonds between materials, the materials can easily be disassembled again without any contaminations from the "glue" — a critical parameter for the recycling of plastic materials. With this technology, we create truly reversible bonding systems.

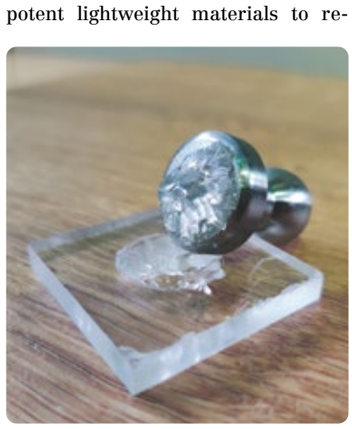
Can you give us an example?

M. Kongsfelt: An example is PEEK, a notoriously challenging thermoplastic, where we achieve bonding to steel comparable to what you get when bonding steel to steel with state-of-the art epoxy systems. In fact, when we pull the parts apart it is the plastic that breaks, not the bond. Cohesive fracture for PEEK — that is amazing, no structural adhesives comes close to that.

You mentioned the recycling of plastic materials being a challenge.

M. Kongsfelt: Yes. We already see a lot of changes in big industries, such as automotive, aerospace, electronics and renewables, where companies need to put increasingly more focus into the life-cycle and environmental impact of their products, such as to avoid plastic and electronic waste at end-of-life.

In the automotive and aerospace industry there is a huge pressure right now to reduce CO_2 emissions, and the simplest path to do that is by reducing weight. Some of the most potent lightweight materials to replace steel are engineering plastics and composite materials. However, then you have the problem with bonding these components to the metal structures in your car or plane — and later disassemble them for recycling. RadiBond already fixes that, whether it is PPS, PEEK, PC, ABS, PVDF or PA material, and is easily integrated into modern assembly lines.



The RadiBond technology combines chemically different materials. The result is plastic-breaking strength even for challenging plastics.

RadiBond enables companies to build better and more sustainable products. Our aim for the future is less plastic and electronic waste in the landfills, less CO_2 emissions from transportation, more range on your electrical car, and consumer products designed to be more durable, longer lasting, and easier to repair or recycle.

How did you come up with the idea behind RadiBond?

M. Kongsfelt: RadiBond is built on the foundation of more than 15 years of research in surface chemistry. It was fueled by challenges proposed to scientists at Aarhus University by some major companies in Denmark. The research led to the basic concept behind RadiBond and was then patented; and RadiSurf was founded to commercialize and further develop this groundbreaking technology that is now covering four patents and is truly scaled for industrial production.

What are the next steps for the company?

M. Kongsfelt: We are currently working with customers in 12 countries to support the implementation of our technology in their products and later into their production line. The final go from these customers and getting it all up and running is certainly top priority in short term, and we hope to get the first applications on the market this year in small volume. Over the next five years we expect to be able to support customers globally in our key markets, starting with electronics, then later automotive, aerospace and healthcare applications. My expectation is that, in about ten years, RadiBond is a globally recognized technology for major manufacturing companies.

Your goals are ambitious; what makes you feel confident to make it to the finish line?

M. Kongsfelt: First, we have made sure to have a solid technological foundation, which since the beginning we have developed in tight collaboration with end users to ensure a good market fit. Our go-to-market plan is formed around these innovative and risk-willing clients to ensure a fast implementation worldwide. Second, we have strong global partnerships to support our technical and business development. However, scaling a material solution to a global market is a huge task, so we are in search of new strong partners and investors to support us for the next three to ten years of growth.

Business Idea

Ready for the Circular Economy

RadiBond is the culmination of almost two decades of research, with a breakthrough finally made in 2018. Moving back more than a decade, researchers at Aarhus University discovered that nanometer-thin layers of polymer brushes, essentially plastic chains tethered to a surface, provided virtually unbreakable adhesion if sufficiently matched to chemically entangle with various plastic chemistries.

From 2015 RadiSurf led on and last year moved the development of this concept to a point that now allows for large-scale commercialization of the revolutionary technology. It is a solution for applying polymer brush coatings on surfaces for direct bonding to plastics, even challenging types such as PEEK, PPS, PVDF and PC — including for thermoplastics used in fiber-reinforced composites for lightweight materials.

RadiBond is efficiently applied as dip, spray or paint-on (the two latter methods are not yet commercialized) in two steps that overall takes down to a few minutes — providing a lasting adhesion layer. To entangle and bond with the polymer brushes, the plastic is simply melted in the interface through traditional welding or molding techniques. Reheating, or dewelding, the interface again resolves the bond and allow for easy disassemble of clean parts for reuse or recycling — ready for the circular economy.

The technology is ready for the market, with a wide range of companies in large markets such as automotive, aerospace, electronics, medical devices and offshore already working with RadiSurf to implement RadiBond in their production line. When implemented, RadiSurf will supply the adhesive chemicals to the customer for use under a commercial license.

RadiBond unique assembly features include:

- Superior strength and durability in plastic joints
- Nanometer-thin, air- and water-tight bonding interface
- 100% biocompatible and biologically safe
- Reversible — incorporation of circular design

- RadiSurf ApS, Risskov, Denmark
  www.radisurf.com

Elevator Pitch

Adhesion by Molecular Design

RadiSurf was founded in 2015, as a spin-off from Aarhus University based on decade-long forefront research in polymer brush technology. At the time, the technology was unmatured and far from being industrially relevant, with hourlong tack times and processing conditions not viable for manufacturing industries.

Through five years, the company has gradually eliminated the technological barriers one by one and is now ready to hit the markets with its first, award-winning, polymer brush-based product, RadiBond.

Polymer brushes are a highly adoptive technology for tuning surface functions, with a tremendous potential to impact both on the industry and society. With the code now broken, RadiSurf has set its aim in developing other polymer brush-based applications — cementing its position as the leading commercial operator.

Milestones:

2015
- Foundation of the company

2016
- Secured seed investment from Borean Innovation for expanding operations

2017
- Moving to new, more spacious headquarters at Risskov, Aarhus

2018
- Most Disruptive Tech Award at EIC event, Hannover Messe
- First product on market with RadiBond (Unisense)

2019
- Best Technology Award at Global Innovation Summit in Chengdu
- Patent submitted for new application process

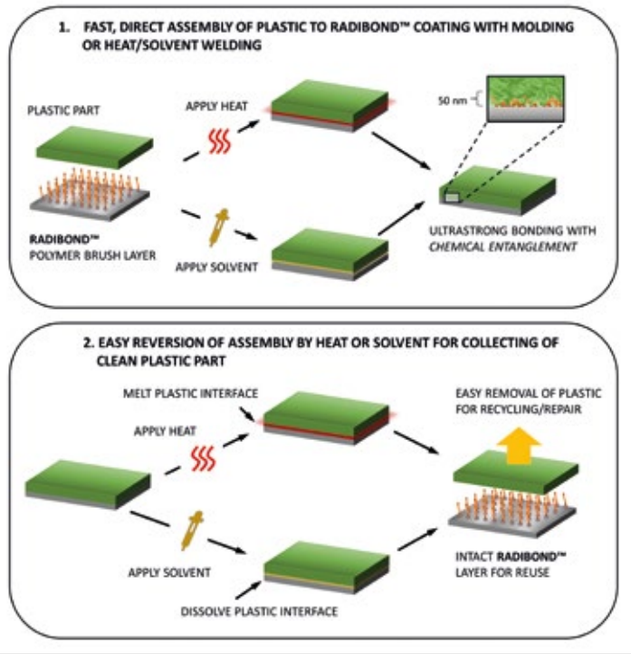
2020
- JX-Nippon Innovation Award
- Accelerated growth in customer pipeline
- 150% growth in revenue, projected 400.000 EUR by year end

Roadmap

2020
- RadiBond industrial adhesives hit the market
- Series A investment round

2022
- First small chemical plant established with 200 t capacity

2023
- Projected first break-even year



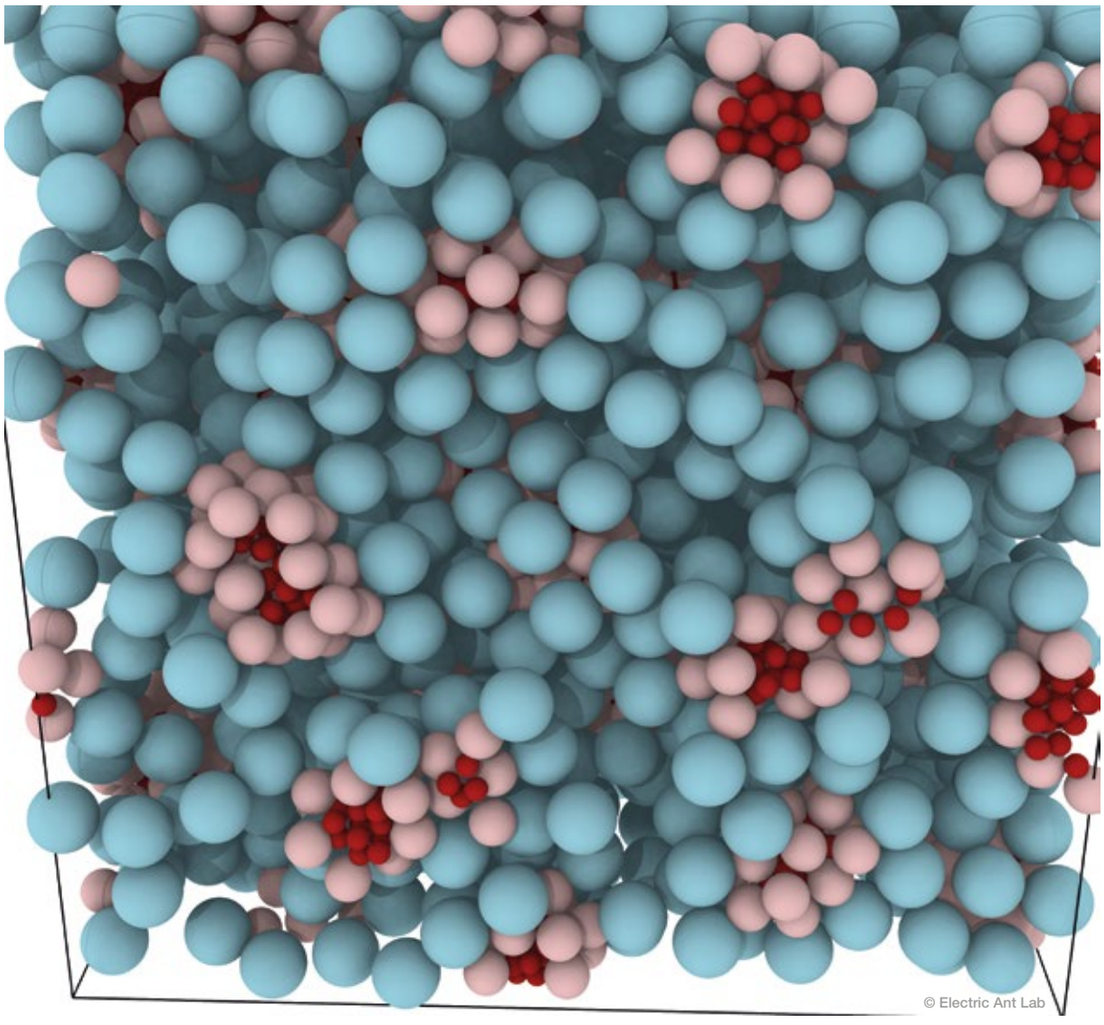
RadiBond is a culmination of 15 years of research for a reversible plastic adhesive. The technology combines chemically different materials, while traditional glue only works with chemically similar materials. On the right: illustrations of the assembly and disassembly procedures of the polymer brush coating technology

Predictive Simulation Models

Virtual Prototyping of Complex Fluids and Flowing Materials

Complex fluids are everywhere. Examples with very specific rheology and transport properties are pharmaceutical components in a mixer, care products, ferrofluids, foodstuff, paint, and slurries. These components come together, due to the laws of physics at the microscale and mesoscale, to form a material with distinctive and sought-after properties. The critical challenge in formulating a complex fluid is how to determine which ingredients to mix, at which proportions, and under which conditions, in order to create a material with desired properties. Advanced simulations are extremely powerful tools to understand, predict, and improve the rheology and transport of complex fluids and their processing. Electric Ant Lab (EAL) is a simulation software company founded in 2015 that works at the forefront of predictive fluid modelling. EAL's scientific mission is to push the boundaries of high-performance computing, and to create new theoretical frameworks for predicting complex fluid physics. These complicated tools are fashioned into a user-friendly cloud-based simulation platform called RheoCube, geared towards non-expert users in both scientific and industrial contexts. Ralf Kempf asked Jurjen van Rees, the company's Commercial Director and one of the two owners, about EAL's service portfolio and his strategy for the further development of its simulation tools and the expansion of the company's global activities.

Jurjen van Rees, Electric Ant Lab



© Electric Ant Lab

◀ Molecules self-assembling into micelles

CHEManager: Mr. van Rees, within five years since its foundation Electric Ant Lab has already established itself as a provider of simulation tools for the process industry. What were the most important milestones in EAL's development?

Jurjen van Rees: The Dutch start-up ecosystem is very well suited for technical and scientific start-ups. The Dutch government has quite a few excellent programs to help tech start-ups bridge that difficult gap from idea to minimum viable product. This ecosystem is especially active in the Amsterdam area where we are located at the Science Park Amsterdam. The University of Amsterdam, where the founder Eric Lorenz came up with the idea for our product RheoCube, is across the street from our office.

Other key milestones were the agreements we made with six early adopters originating from various industries, but all sharing the common chemical R&D component. Companies like Clariant, a well-known personal care company and a leading manufacturer of flavors and fragrances showed their forward thinking

and drive to innovation by supporting Electric Ant Lab so early on in the development of our product RheoCube.

You are developing simulation models for the study of rheology and transport properties of complex fluids. In which industry sectors do such fluids play a role?

J. van Rees: We basically target every industry where complex fluids play a role. The most obvious is the food industry with quite a few very well-known consumer brands. Complex fluids can, for example, be found in the production of ice creams and shelf-life issues in peanut butter. How these foods interact with their packaging over a typical shelf-life time is also crucial to understand. More generally, our target audience is any industry that is developing polymers, coatings, adhesives, paints, specialty chemicals, and all related ingredient suppliers. We even have had successful cases in the oil, gas and fuel-additives markets. As you can imagine, the application is quite broad. So far, we have not been much involved in the pharma, biotech and medical devices industry, but we envision a huge applicability there as well. We already had successes in the prototyping of microfluidic chips with our validated blood-cell model.

> *"Advanced simulations are extremely powerful tools to understand, predict, and improve the rheology of complex fluids."*

What are the benefits of using a simulation software? How can this tool help companies in the sectors mentioned above?

J. van Rees: There is a two-sided answer to that. If you ask the director or vice president of R&D or even the C-level, the answer is time, cost-savings, faster product-to-market times and a match to their digitalization (of R&D) strategy. If you ask the R&D scientists, formulators and process engineers, it's the new insights, visualizations, data analyses and validated explanations and to some extent predictions for behavior of their products, ingredients etc.

To put some numbers to the time and cost-saving argument: the average time spent in the physical labs can in some cases be decreased by 75%. Many experiments that take place in an average industrial R&D lab cover a lot of trial-and-error experiments with the goal of explaining and better understanding physical behavior and phenomena, that occur on the single ingredients level or in creating new formulations of products. This is exactly the scale where our simulations add value.

How detailed can the simulations be? Are interactions at the molecular level also covered?

J. van Rees: We aim to capture all of the molecular and physical interactions that occur within the "micro" to "meso" scales.

The microscale is where atoms and molecules live, roughly on the nanometer length scale, and the pico- to nanosecond timescale. Presently, our simulations begin at the scale of hundreds to thousands of molecules, where reality can be well captured with statistical thermodynamics and molecular dynamics. This is just above the level where explicit quantum mechanical detail would need to be considered.

From there, our simulations go up to the mesoscale, which sits on the microsecond and micrometer time and length scales. Here, our simulations represent a complex fluid as many interacting "blobs" of liquid and/or solid, each containing around 1 million molecules. This is the scale where quantitative predictions can be made about the rheological behavior of the mixture.

The beauty of this is of course that you can turn on or off certain physics. For example, some behaviors of complex fluids can be better explained or understood under zero-gravity circumstances. We can switch that off. We can basically manipulate any physical behavior known to nature within the time and length scales above. The only boundaries to this are in our own development time needed to construct these physical models, and more importantly for our clients: the computational time to run such a simulation.

> *"We basically target every industry where complex fluids play a role."*

The creation of accurate simulation models that reliably represent a product requires detailed input on both physical as well as chemical characteristics. Where does the required data come from?

J. van Rees: Our goal is to provide the greatest predictive power with the least required input of data. Nevertheless, our clients usually have a wealth of information about their products and the components in their products. This data is typically readily available in datasheets, or as experimental data that they have already collected. This data is than added by the user to RheoCube when they create new components like polymers, surfactants or particles. We then help our clients assess the scientific performance of RheoCube for their goals, typically by doing validation simulations on related mixtures found in scientific literature. To help clients in determining these parameters, we work closely together with Van Loon Chemical Innovations (VLCI) which is also conveniently located at the Science Park Amsterdam. If we send them a few examples, we can feed the collected data into RheoCube for our clients.

> *"With predictive fluid modelling the average time spent in the physical labs can in some cases be decreased by 75%."*

Where do the simulation calculations take place? Does EAL provide the necessary hardware or only the software?

J. van Rees: Detailed simulations do require a lot of computational power — there is no way around that. We realize that this is often a significant hurdle for clients to adopt simulation as a tool.

Therefore, we designed RheoCube from the very beginning to integrate with cloud-computing servers from well-known vendors. The simulation code running inside RheoCube makes use of the latest parallelization strategies on multi-core CPUs, as well as GPU parallelization. Our platform also provides estimates on the computing time and costs for simulations.

To add credit to the ground-breaking work of our tech and science team that is led by our founder Eric Lorenz, the capability of running these simulations on cloud-computing infrastructure is really unique to our software. R&D scientists that use RheoCube do not need another PhD in computational physics to use this simulation approach. So, in answer to your question, yes we provide the hardware and the software. Without any local installation. You just need a web-browser.

What is your strategy to further develop EAL's expertise and geographical reach? Are there any specific projects in the pipeline?

J. van Rees: We have yet to contract our first Dutch client, hahaha. But that is mostly a matter of time and will happen eventually. All joking aside, we are currently looking into external financial resources — that is venture capital — in order to focus more on the DACH region, the United States and Canada. Most of our clients are already in these geographical areas, but this really needs more of a local physical presence in order to serve our clients best. Most importantly, at this point in time, we want to expand our client base in these areas in the coming years. You can do a lot of growth-hacking over video-calls, but in the end, you need to see the scientists behind a company like EAL. And vice versa as well. We invest into long-lasting relationships with our clients as they are quite progressive in embedding our solution into their R&D workflow.

> *"Our goal is to provide the greatest predictive power with the least required input of data."*

We definitely have a few ground-breaking projects up our sleeves, but these will be released and presented in due time.

Our main goal is indeed to expand our user base and to achieve our main goal: unlock the power — and all these years of research and development from our talented team and founder — of complex fluids simulations for scientists across the globe.

https://electricant.com

LogiChem

LogiChem, Europe's leading chemical supply chain event, has been rescheduled for September 8-10, 2020, in Rotterdam, The Netherlands. Bringing together 350+ supply chain leaders from the world's largest chemical companies, this is a great opportunity to benchmark your people, processes and technologies with the key chemical supply chain leaders from the world's largest chemical companies, 3PLs and technology providers and to gain practical insights on how to increase end-to-end visibility, drive customer centricity, achieve integrated digitalization and much more. **https://logichem.wbresearch.com**

Chemspec Europe

Chemspec Europe has been rescheduled to take place in Cologne, Germany, on November 11-12, 2020. The event is the key platform for manufacturers, suppliers and distributors of fine and specialty chemicals to showcase their products and services to a dedicated audience of professionals in the industry sector. The product portfolio of this international exhibition covers a maximum range of fine and specialty chemicals for various industries. Excellent networking opportunities and top conferences presenting the latest results of ongoing R&D projects round-off the show. **www.chemspeceurope.com**

CPhI Worldwide

CPhI Worldwide, scheduled for October 13-15, 2020, in Milan, Italy, and co-located events ICSE, InnoPack, P-MEC and FDF, host more than 45,000 visiting pharma professionals over three days. 2,500+ exhibitors from more than 150 countries gather at the event to network and take advantage of free industry seminars. Every sector of the pharmaceutical market is represented under one roof. In 2019, two new podiums will be introduced: Natural Extracts, based in the Natural Extracts zone, with content that covers this segment of the industry; and World of Pharma, which will look mainly at regional trends and updates. **www.cphi.com**

Food & Health Ingredients Europe

Food Ingredients Europe, co-located with Health Ingredients Europe, is scheduled for December 1-3, 2020, in Frankfurt, Garmany. The events cover specialty food ingredients from sensory to functional, as well as processing solutions and services across the whole supply chain and offer industry knowledge across a wide range of conference presentations, exhibitor seminars, new product zone displays, expert innovation tours and much more. More than 21,000 attendees and 1,175 suppliers will be showcasing the latest and most innovative F&B ingredients from all corners of the world. **www.figlobal.com**

Due to the coronavirus pandemic, events may be postponed or cancelled. We therefore cannot guarantee the validity of the dates mentioned here.

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