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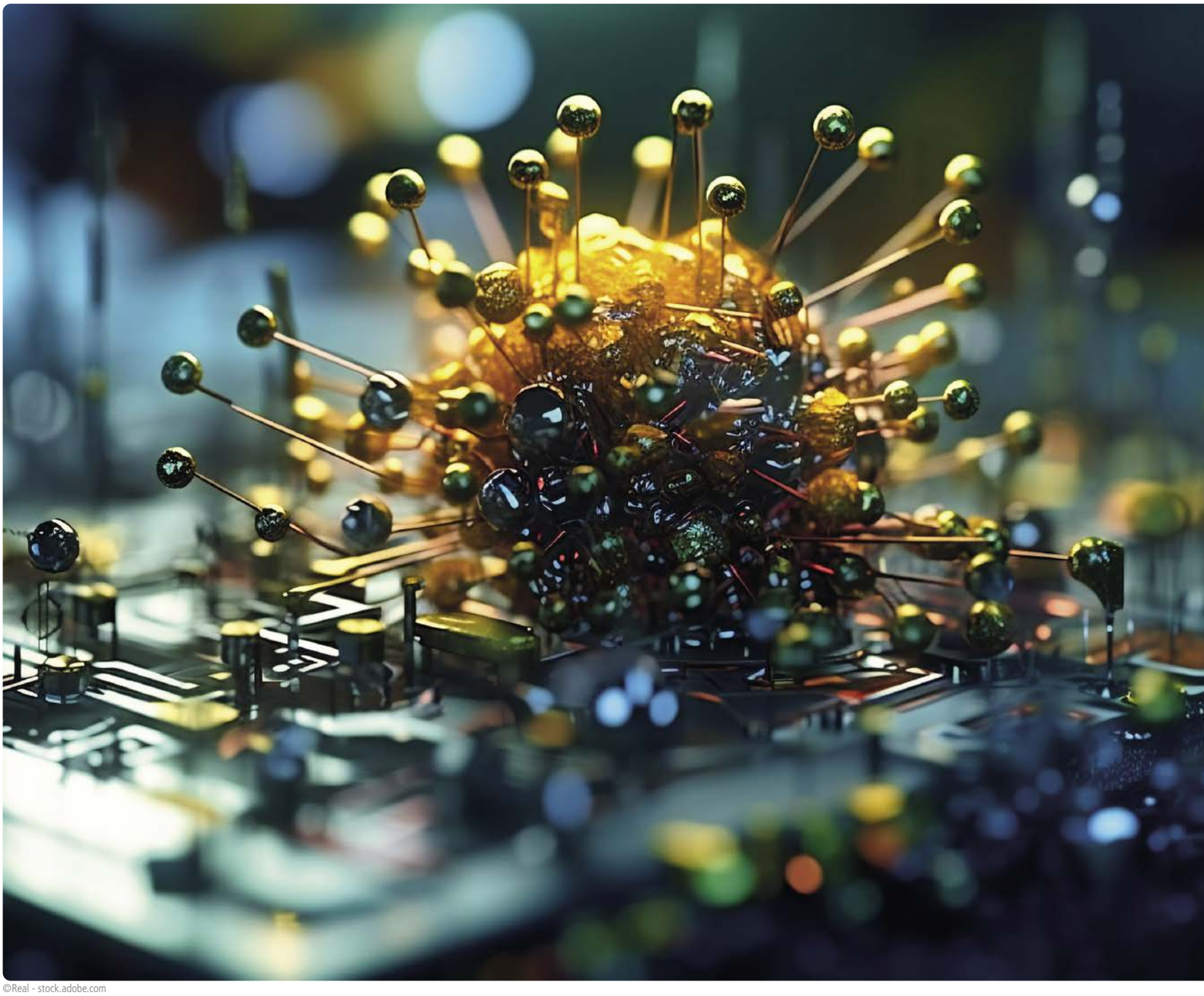

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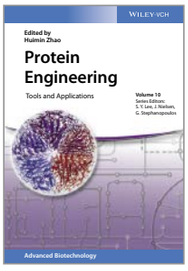

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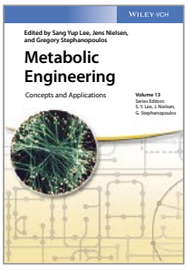

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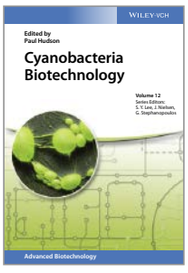

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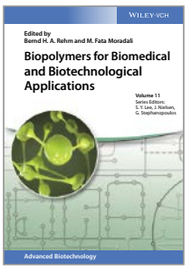

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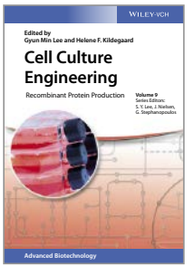

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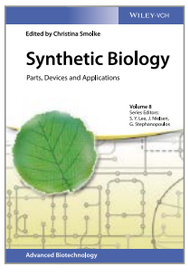

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Navigating Uncertainty in the Biopharma Market

2022 Offered Little Relief to Struggling Biopharma Companies After the 2021 Market Downturn

Biopharma companies are facing funding challenges in 2023 as interest rates rise and investors are becoming more risk adverse. There is hope on the horizon, say some analysts, while others project a prolonged slump due to inflation and global instability. Established pharmaceutical companies are often seen as safer investments, with larger developers expected to perform well in 2023, especially if litigation threats against drugs like Zantac disappear. However, concerns about revenue gaps continue for big companies like GSK and Sanofi, and their strategy and leadership will be closely monitored in the coming months.

Lower valuations may be an asset to acquirers in 2023, but IPOs and venture funding is anticipated to be slow. To combat valuation struggles, clinical successes are critical for the biopharma sector this year. Potential areas for this are respiratory syncytial virus, Alzheimer's disease, and cancer. It is expected that regulation approvals increase after the 2022 slump, according to Evaluate Omnium.

Evaluate Omnium, a specialized analysis and consulting firm focused on pharmaceutical and biotech matters, has published an industry outlook in its latest report, Evaluate Vantage 2023. This study offers valuable insights for company managers, industry professionals, and investors alike, providing essential information for navigating the complex landscape of the healthcare and biopharma sectors.

2023 Pharma Forecast: Drugs and Companies

Next year's pharmaceutical market is set to be dominated by mAbs (monoclonal antibodies) and vaccines, with Merck Sharpe & Dohme (MSD)'s Keytruda, a mAb cancer treatment, leading the way with an expected $3 billion in new sales. Uncertainty remains regarding the impact of Covid-19 on the industry. Two diabetes drugs to watch are Ozempic, which is forecasted to have strong sales growth, while supply issues pose a threat to Lilly's newly launched Mounjaro. Competition between best-selling drugs and fulfilling demands will influence the market.

Pfizer's Comirnaty and Paxlovid are expected to keep the company at the top of the prescription drug sales in 2023, outpacing MSD's Keytruda. This dominance may not last long though, with the projected decline in demand for Covid-19 products. Novo Nordisk and Lilly both are seeing growth from their diabetes and obesity agents. Smaller companies such as CSL, Daiichi Sankyo, and Grifols are also expected to make an impact. AstraZeneca's ranking is boosted by their success in oncology and their acquisition of Alexion with their fast-growing Ultomiris, a mAb autoimmune treatment.

Alzheimer's, Antibodies, and Challenges Ahead

Next year, one of biopharma's focuses will be on Alzheimer's disease as Eisai and Lilly race to bring their antibodies to market. Lilly's Donanemab is awaiting their pivotal trial readout expected mid-2023, but uncertainties remain around FDA approvals and reimbursement. Uncertainty is also on the horizon for predicting demand and securing reimbursement for gene therapies like Duchenne from Sarepta and Roche, a muscular dystrophy treatment. Respiratory syncytial virus vaccines are another product with potential opportunity this coming year, with GSK and Pfizer in the lead. The progress of Apellis's geographic atrophy treatment should also be closely observed, given its additional data filings with the FDA, which delayed its progress by three additional months.

For projects already filed with regulators generating buzz, two novel anitbody-drug conjugates from Daiichi Sankyo are highly anticipated. A pivotal readout for one, Datopotamab deruxtecan, which Daiichi Sankyo partnered with AstraZeneca on, is expected this year. Talquetamab, an FDA Breakout Therapy in 2022, is another one to watch as J&J filed in December 2022 for its use for relapsed or refractory multiple myeloma. Karuna's schizophrenia and Alzheimers treatment KarXT, secured a rare win in 2022 and should be filed for approval mid-year after Phase 3 clinical trials. FDA green light for clinical trials of Intellia and Regeneron's NTLA-2001 is still awaited as caution around gene-editing projects persists. Despite concerns of its anti-Tigit mechanism,

Roche and MSD's mAb triagolumab remains of interest in 2023.

FDA Drug Approvals Rebound in 2023

Evaluate Omnium predicts a rebound in novel drug approvals this year, following the dip from 2022. This is reassuring as it indicates the recent FDA approval slowdown may be a temporary phenomenon. The focus this year is expected to be on stricter accelerated approvals, similar to what was seen in 2022 compared to previous years. Smaller pharmaceutical companies may face struggles as confirmatory phase 3 trials need to be in progress before accelerated approval can be deliberated. Changes to this pathway have developed where recent user fee reauthorization omitted extensive changes to the process. Despite this, advocates may push for reforms of the process further in the coming months.

Stock Market Hurdles: War, Interest Rates, and Reform

The industry is expected to continue being affected by issues such as the war in Ukraine, rising global interest rates, and concerns about drug price reform in the US. Last year's mid-term elections in the US resulted in a discordant government, which impacts industry expectations for changes to the Inflation Reduction Act (IRA). Cash conservation efforts, portfolio prioritization, job cuts, and deals fueled by fear may hit many in the industry, particularly smaller companies. Concerning the stock market, some analysts believe the US biotech market has hit its bottom, while others anticipate further declines throughout 2023. This indicates potential challenges to those companies struggling with financing.

IPO Market Dips, Biotech Outlook Uncertain

The IPO (initial public offering) market, often a proxy for investor interest for high-risk enterprises, saw a downturn for biotech in 2022. Only 16 drug developers went public on western exchanges, with half raising over $100 million. This significant drop from previous years is forecast by some to continue in 2023, while others expect an uptick in offerings this year. Only the biotech Aelis Farma went public in Europe in 2022, although this low for the European market is not expected to continue. With the US looking to recover first, potential European-based companies are likely to turn to Nasdaq for their IPOs.

The past IPO market from 2020 and 2021 is often blamed for the underwhelming performance of recent biotech IPOs, but the downturn of the market overall also plays a factor. The 2022 market fared well; however, small deals dominate and many struggle to maintain their valuations post-float. The number of IPOs is expected to remain low until larger raises gain traction. The type of companies that receive investor support this year will be an important trend to follow, as the effect of the IRA on biotech versus small-molecule investments unfolds. The IRA disparity is blamed by some companies for the reprioritization of certain assets, potentially shifting the market towards biotech. Investors claim to have changed their valuation assessments accordingly. In the Evaluate Vantage Report they have split recent IPOs by technology type to help monitor this trend.

VCs Brace for Biotech Challenges

The venture capital (VC) world will face further challenges this year due to the ongoing biotech bear market. The closure of the IPO window impacted private financing, with crossover investors retreating and traditional VC facing exit struggles. In 2021, 16% of venture-backed companies received multiple rounds of financing, but last year we saw that number drop to 5%. The average number of financing rounds before going public or acquisition should also be watched. It is expected that acquisitions and mergers will predominate as the IPO window is nearly closed. Businesses will likely have to wait longer for buyouts like in 2022, where an average of nearly four rounds of investment was needed before a deal.

Biopharma Deals: Big Expectations, Mixed Results

In 2022, the biopharma merger and acquisition (M&A) landscape did not deliver the anticipated punch, but Horizon Therapeutics has confirmed initial interest from big players such as Amgen, Johnson & Johnson, and Sanofi. The estimated valuation of Horizon could be $25–30 billion, making it potentially the largest biopharma deal since AstraZeneca's 2020 acquisition of Alexion. Evaluates report highlights Horizon, Biogen, and Vertex as desirable targets for this year. Despite hopes for a bigger year than 2022, most expect similar trends of decent mid-sized transactions and deals driven by desperation. Due to low valuations, more companies may face the choice of giving up or selling out, leading to potential reverse mergers and collaborations between contract firms and biotechs. A Seagan buyout looks more unlikely as its stock returns to levels seen before rumor of MSD's interest. Biogen is also a potential target for acquisition due to its Alzheimer's program, with Lilly being the only big pharma with another Alzheimer's competitor close to market.

While Evaluate's Vantage 2023 Report points to hopes for improved conditions in the biopharma industry in 2023, challenges such as funding difficulties, regulatory uncertainties, and market fluctuations are expected to persist. Biopharma companies will need to navigate these hurdles, focus on clinical successes, and closely monitor the changing landscape of the industry to thrive in the coming year. (cs)

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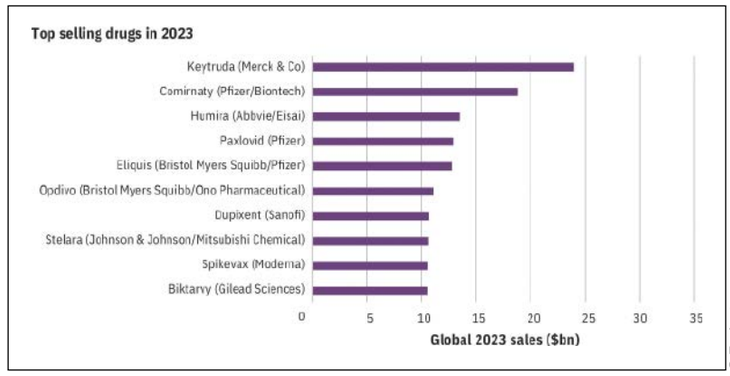
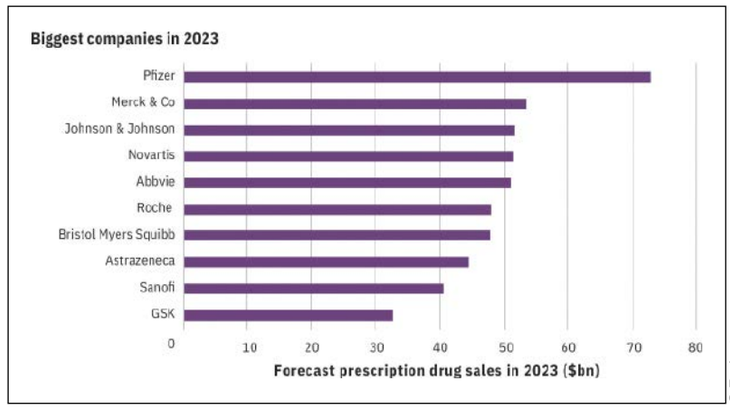
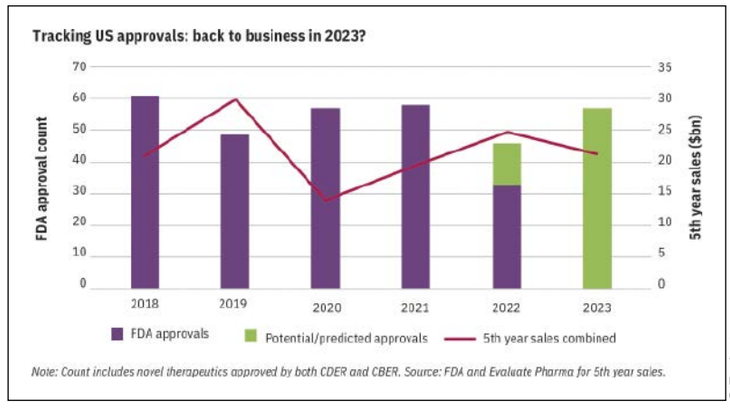


Top selling drugs in 2023; global 2023 sales ($ billion)



Biggest companies in 2023, forecast prescription drug sales in 2023 ($ billion)



Tracking US approvals: back to business in 2023? FDA approval count and 5th year sales ($ billion) 2018–2023

Small Particles with a Big Impact

Challenges and Implications of the EU Regulation Defining Nanomaterials

Nanomaterials consist of differently shaped tiny particles no larger than one hundred nanometers. As nanomaterials exhibit various promising technological properties, modern particle technology includes promising applications such as printable electronics for the energy sector, or biomedical sensors for the pharmaceutical or medical health industry to name a few. Therefore, particle product design is an enabling technology relevant for many sectors, such as chemicals, consumer products, foods and beverages, health, energy, and the environment.

In the European Union, all nanomaterials are covered by the same rigorous regulatory framework that ensures the safe use of all chemicals and mixtures, i.e., the REACh and CLP regulations. In 2022, the European Commission revised the definition of nanomaterials in a new recommendation, which supports a uniform EU regulatory framework and aims at aligning the legislation across various sectors. The revised definition of the term "nanomaterial" is deemed to be very technical and is defined as follows: A nanomaterial is a natural or manufactured material consisting of solid particles either on their own or as identifiable constituent particles in agglomerates. Moreover, 50% or more of these particles in the number-based size distribution are in the size range below 100 nm including particles with an elongated shape, such as rods, fibers or tubes, or plate-like particles.

In this article, we summarize the impact of the revision of the definition of nanomaterials on companies and their business processes. We highlight which sectors must deal with challenges arising from the new recommendation such as the translation from technical definitions into the business context. One particular challenge includes the reclassification of well-established materials (such as a specific product variant of titanium dioxide, which has been reclassified as non-toxic) as toxic due to its reclassification as a nanomaterial without any change in the product. This is in particular difficult to address as the exact determination of the particle size distribution of a particle ensemble remains challenging and highly depends on the measuring principle. Finally, future possibilities are highlighted together with our partner LUM GmbH, who is active in the development of measurement principles and devices to address the topic of nanomaterial classification directly at the core.

Particle Technology and Nanomaterials Across Various Industrial Sectors

Modern particle technology plays a key role in various sectors such as

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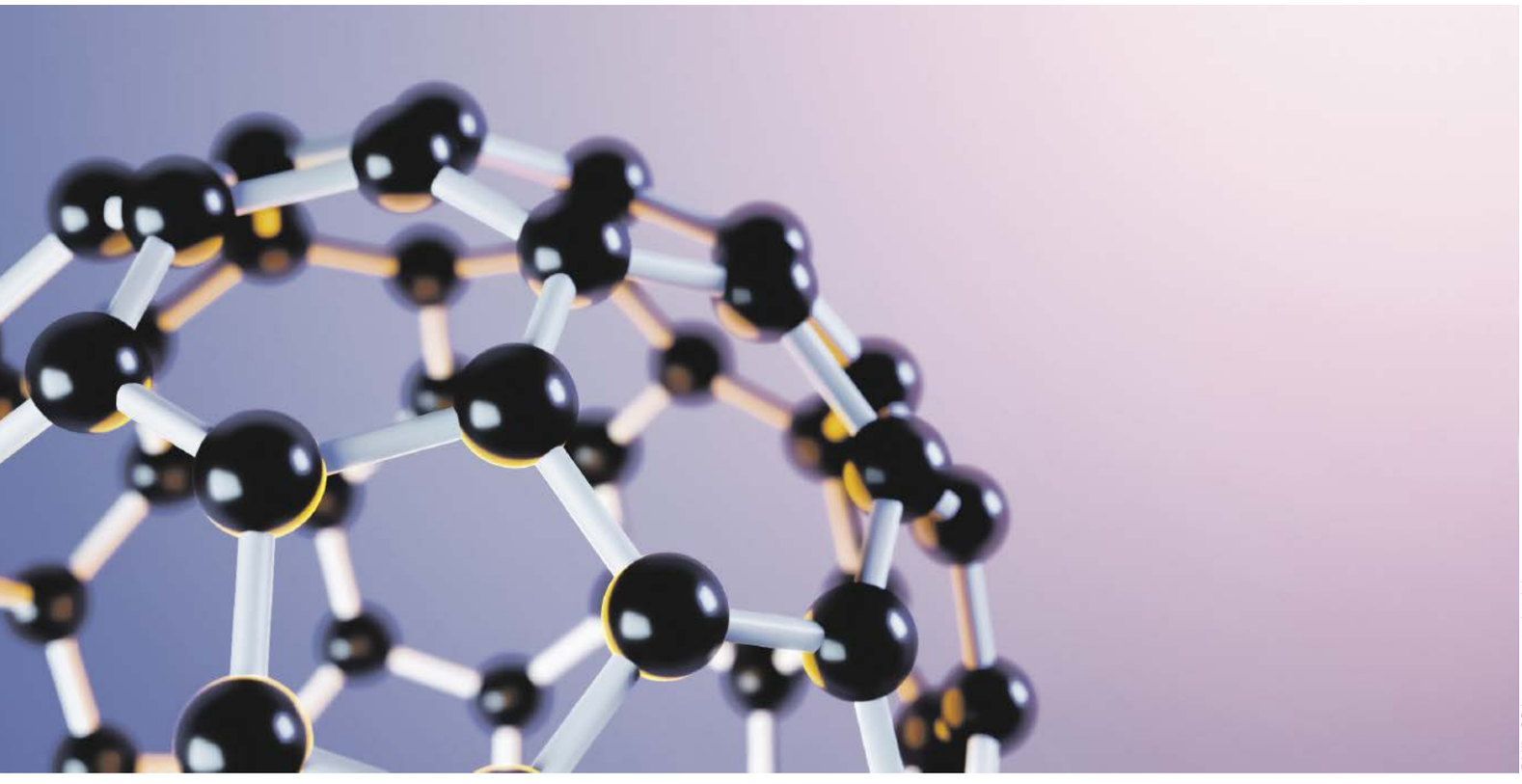

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printable electronics for the energy sector, biomedical sensors for the pharmaceutical or medical health industry and consumer products for foods and beverages. From the industrial perspective, nanomaterials are comprehensive materials produced or manufactured for various fields of application. Among the many different products, such as carbon nanotubes, silica, copper and aluminum oxide, titanium dioxide (see left panel of Fig. 1) is one of the most prominent examples and a widely applied particulate product in the chemical industry, especially in the construction sector. Further examples include dispersion in paints, solid catalysts and surface coatings. The application of titanium dioxide is frequently discussed in the context of nano toxicity.

Apart from the industrial point of view, modern particle technology gains a lot of attention from the research and development perspective. While applications such as sensors for medical devices development based on gold-silver nanoalloys (exemplary depicted in the right panel of Fig. 1) are developed from the synthesis point of view, methods for the particle characterization has gained significant importance as the product relevant potential of (nano-)particles directly depend on the physical properties of the respective parties, such as particles' size, shape and composition, as can exemplary be seen in the right panel of Fig. 1 and was further highlighted in a review article in the scientific literature.

"Highly accurate and high-throughput particle characterization techniques are one key aspect in the field of nanomaterials."

In the context of definition of nanomaterials, certain EU laws require adequate data collection, a thorough risk assessment, as well as labelling of particulate products. This aims to inform customers and consumers of the presence of nanomaterials in products.

In summary, even though modern particle technology triggers innovation, some challenges remain which are discussed and initiated in the context of regulatory frameworks within the EU.

In this article, we highlight the implications of changes of the EU regulations and to detail the direct relationship between meeting the EU regulations of nanomaterials and developing comprehensive particle characterization techniques. Therefore, the next paragraph summarizes the status of the regulations on nanomaterials across the European Union. Finally, we comment on the technical challenges of particle characterization and future possibilities in this area together with our partner LUM.

Regulations on Nanomaterials Within the European Union

The REACh and CLP regulation ensure the safe use of chemicals and their mixtures while enabling competitiveness within the chemical industry. Under REACh, the burden of proof is placed on each company, hence the safe application of each chemical must be demonstrated to ECHA by producing companies in the European market. Conclusively, changes within the regulatory framework of nanomaterials have a di-

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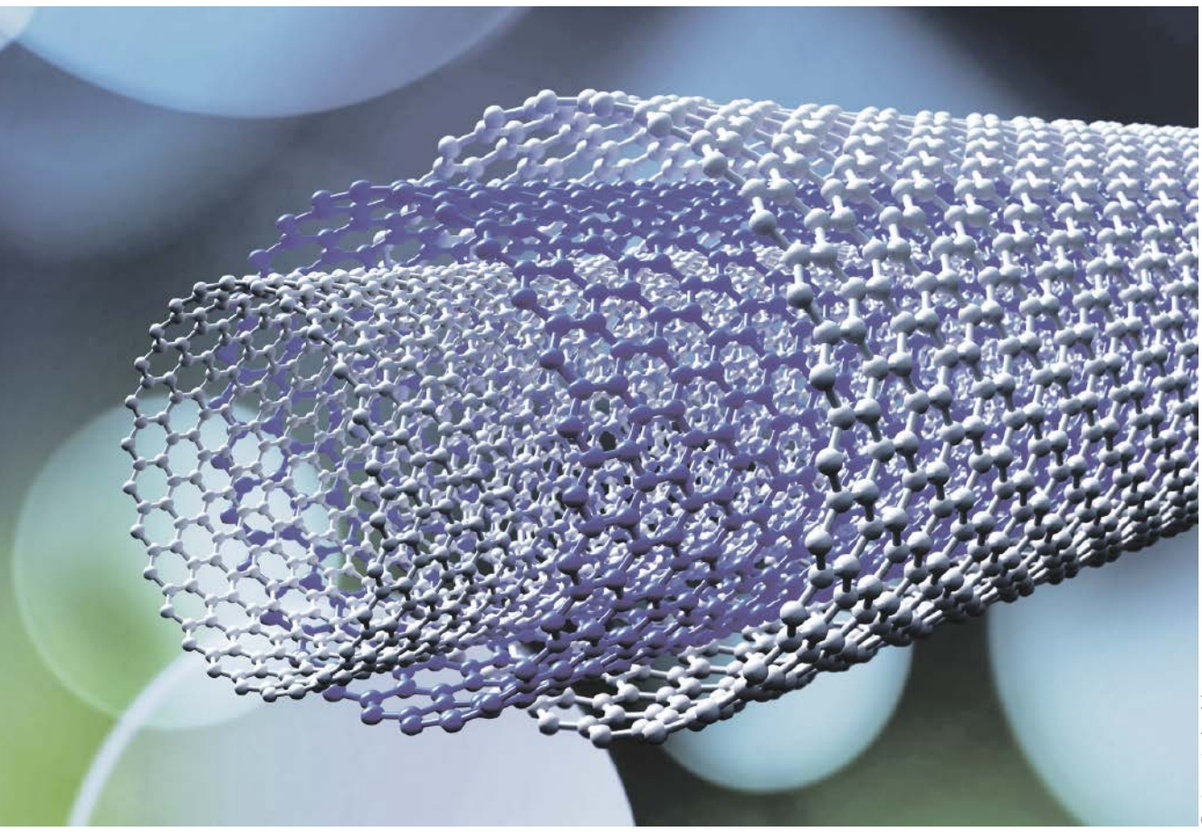

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rect impact on various companies throughout the entire chemical industry across the entire European Union. As clear guidelines from the regulatory perspective pave the way for advancements and technical developments, an aligned legislation across various sectors will be key for the way forward. Most EU legislations (e.g. REACh, Biocidal Products Regulation, Medical Devices Regulation) and some national legislation use the common definition from Commission Recommendation 2011/696/EU, while the food and cosmetics sectors still relates to an individual definitions of nanomaterials. Since 2020, legal requirements under REACh are applied for manufacturing or importing companies of nanomaterials and particulate products which are considered nanoforms. These requirements address specific reporting obligations which are related to the REACh regulation. In 2022, the definition of nanomaterials was revised with a new recommendation by the European Commission, which aims at supporting a uniform regulatory framework throughout the European union as a deliverable of the Chemicals Strategy for Sustainability. The update refers to the previous recommendation 2011/696/EU taking into account the progress from the scientific community. Notably, 2011/696/EU clearly states that a nanomaterial is considered "a natural, incidental, or manufactured material containing particles." However, in order to evaluate whether or not a solid powder, i.e. particles or dispersions must be considered a nanomaterials in order to meet the compliance criteria, the technical definition as well as the impact from different particle characterization strategies must be taken into account.

Technical Point of View and Relationship to EU Regulation

From a chemical engineering point of view, in terms of definition, a nanomaterial is a natural or manufactured particulate product or material, which consists of solid particles or dispersed particles in a liquid either on their own or as identifiable constituent particles in agglomerates. Moreover, nanoparticles are usually associated with a broad spectrum of size, shape and composition, which is illustrated in Fig. 2.

Nanomaterials are by definition particles no larger than 100 nm in one dimension in case the nanomaterial is not spherical. However, nanoparticle ensembles are usually characterized by particle property distributions since it is not possible to quantify the properties by one number only. Therefore, the definition of nanomaterials is further refined according to the following description: A material is considered a nanomaterial in case 50% or more of these particles in the number-based particle size distribution are in the size range below 100 nm including particles with an elongated shape, such as a rods, fibers or tubes, or plate-like particles.

Conclusively, comprehensive particle characterization techniques are key to ensure all nanomaterials are in compliance with European and national regulations. As an example, the increase of toxicity is often associated with a decrease of the particle size for materials such as titanium dioxide. The direct determination of the particle size is a tedious task and often requires time consuming sample preparation and the subsequent use of multiple measurement devices with clear standard operation procedures. Moreover, the direct measurement result must be easily understandable with clear guidelines and criteria for lab reports. One particular example in this area is the reclassification of a well-established product, i.e., a specific product variant of titanium dioxide. Titanium dioxide was considered toxic after classification as a nanomaterial without any change in the product but in the regulation. After rigorous discussions on this topic and the support of comprehensive particle characterization techniques, which was in this case provided by LUM/Dr. Lerche, titanium dioxide has been reclassified as non-toxic. A further example is the case of tricalcium citrate (see right panel of Fig. 3), which is a food additive with a large-scale production. As tricalcium citrate shows a plate like structure on the particle level (see left panel of Fig. 3), it needs to be evaluated whether or not the plate thickness is the key property which must meet the compliance criteria or if an equivalent hydrodynamic sphere must be calculated and needs to comply with the EU regulation. Needless to stay, the product, i.e., tricalcium citrate, as well as the way of production did not change and is a key product in the food and consumer industry associated with a large turnover for certain companies.

„Particle product design is an enabling technology relevant for many industry sectors."

From our point of view, it becomes clear with this example, that highly accurate and high-throughput particle characterization techniques are one key aspect in the field of nanomaterials. Furthermore, the range of nanomaterials reaches across various industry sectors. Therefore, our partner LUM contributes to future solutions by developing particle characterization techniques further with clearly defined standards and standard operating procedures. With this, the topic of nanomaterial classification is addressed directly at the core.

References to this article can be requested from the authors.

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Successful Through Change

How Chemical Distributors Can Successfully Navigate Market Downturns and Transformation Trends

New buzzwords such as polycrisis and permacrisis are increasingly circulating, highlighting that we have grown accustomed to facing multiple crises since the 2000s, including 9/11, the financial crisis, debt crisis, refugee crisis, and the ongoing Covid-19 pandemic. However, the challenge now is that several crises are converging over a longer period, making it more difficult to assess variables such as inflation, energy prices, geopolitics, and the possibility of further pandemics. Recent difficulties faced by individual banks have only added to the existing tensions. Despite the ongoing uncertainty, we can observe a decline in economic growth, greater volatility in supply chains, and a partial reversal of globalization. In this context, "business as usual" is not an option, even for chemical distributors who play a significant role in the global economy.

In recent months, the automotive and manufacturing industries have been primarily focused on "restructuring" and "crisis management" due to rising energy and purchasing costs, as well as changes in sales markets. However, chemical traders and distributors—who are considered to be less vulnerable to price and cost increases and therefore more robust and crisis-proof—have largely been excluded from these discussions. Instead, chemical distributors are increasingly becoming occupied with transformational trends that will contribute towards their development: What do increasing economic pressures from suppliers and customers mean for portfolio management? Do mergers and acquisitions (M&A) still drive growth? What opportunities does the next wave of digitalization measures offer? Do opportunities arise from the trending topic of ESG (Environment, Social, Governance) and from new regulatory requirements? How can the chemical distribution industry attract young and specialist workers to address the impending shortage of skilled labor in the years to come?

Changes in Production and Portfolio

Chemical markets are experiencing a lot of activity, with expectations for high prices on the supplier side as producers are forced to pass on their rising energy and raw material costs. Whilst inflation slowed down in the first quarter of 2023, price stability is not expected to return for the foreseeable future. Moreover, recent years have shown that supply chains are prone to disruption for various reasons and companies should make provisions for failure. The production landscape is also changing as a result of cost considerations, with a trend away from Europe and towards the Middle East and the USA. Geopolitically, China, the current leading chemical production location, is being increasingly questioned, and efforts to find alternative locations are ongoing. Given this situation, it is advisable to conduct a risk assessment of current suppliers and clients, as well as to increase flexibility in order to reduce over-dependence. Regarding the customer side of chemical distribution, it is expected that passing on higher prices will become more challenging due to shrinking margins in many sectors, particularly in the manufacturing industry, and a gloomier macroeconomic outlook. This puts

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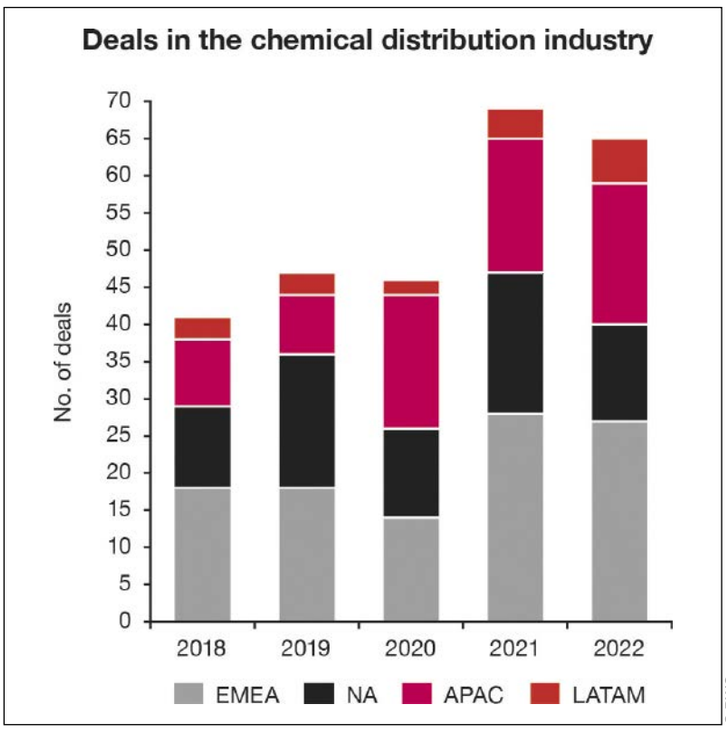
distributors in a "sandwich position," facing pressure from both suppliers and customers. In this context, it is advisable to assess the customer portfolio for default risks and adjust commercial terms accordingly. In the long term, it may be sensible to reallocate the portfolio and shift towards less volatile sales markets.

Transactions and Digitalization on the Rise

The number of transactions in chemical distribution reached record levels in 2021 and 2022 despite a myriad of crises, and M&A activities were regularly used as growth drivers or to streamline portfolios. Due to continually fragmented markets—particularly in Asia—we expect a further increase in deals in the medium to



Deal numbers in the chemical distribution industry were at an all-time high in the past two years.

long term, especially when more and more financial investors come out of the defensive. Here, it is important to start looking for targets early in order to benefit from correct valuation levels in the short term and not to miss the boat in the medium to long term.

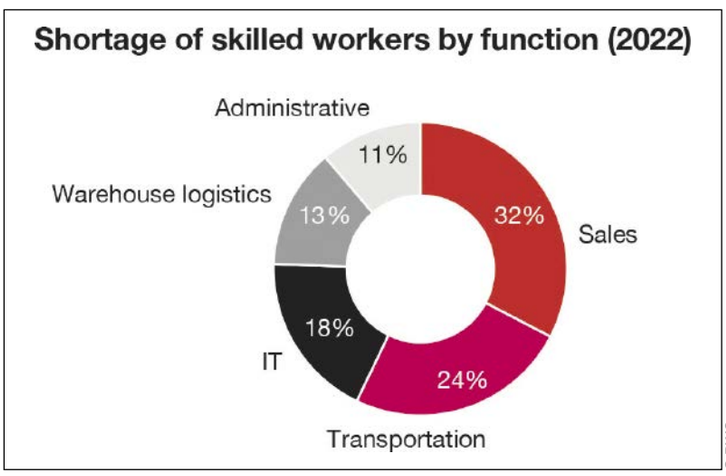
The latter also applies to digitalization, which chemical companies have been adapting to for many years. We are currently observing developments in the direction of digital trading platforms and ecosystems, which pioneers in the agrochemical and healthcare industries are driving forward with the aim of retaining customers through comprehensive technical solutions (end-to-end) and a customer experience geared to private consumer habits. The use of customer and product data also opens up new opportunities for value creation, whereby companies should bear in mind that part of the required digital competences must be built up in-house. Given the labor market situation, this is no easy undertaking.

ESG and Skills Shortage as Focus Topics

In the past, activities related to ESG and regulation were often viewed as mere "tick box" exercises. However, a new opportunity is emerging for chemical distributors, given their role as intermediaries between producers and end-users. The chemical industry provides a wealth of information about planned applications and associated products, which can be leveraged for ESG initiatives and the development of environmentally friendly products. In this way, distributors can offer advisory services for sustainable products alongside trading activities. Additionally, there is potential for consultation on compliance with regulatory requirements and reporting obligations, which can be facilitated by utilizing available product data, such as origin and carbon footprint information.

Last but not least, chemical distributors are also exposed to the shortage of skilled workers. It is important to secure the workforce today that will be needed for the work of tomorrow. Currently, the image of chemical distribution is often perceived as traditional, which may not appeal to younger, digital-savvy workers. Moreover, companies have been slow to consider New Work requirements such as demonstrating the company's purpose or providing mobile work devices to increase flexibility in working time and location. There is a definite need for action to attract the workers who will be necessary for the tasks that lie ahead in the upcoming years. In conclusion, chemical distribution is undergoing a series of developments that will bring about transformative change for companies. Amidst changing geopolitical conditions, distributors must question their own footprints and adjust their business models to address issues such as inflation, unstable supply chains, and differences in target industries, like the automotive industry.

Additionally, trends in strategic areas including M&A, digitalization, ESG, and recruitment cannot be disregarded or addressed in isolation. To achieve a successful transformation, we recommend a holistic approach that takes into account all relevant fields of action.



Chemical distributors state that skills shortages affect sales teams the most; IT experts are also hard to find but are the key to driving digital agendas (graph numbers include rounding differences).

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The Big Squeeze

Chemical Distribution in China

In the 2022 ICIS list of the Top 100 global chemical distributors, there are only four distributors listed with their headquarters in China — three in the mainland (Sinochem Plastics at position 8 by 2021 sales, Sunrise Group at position 10, and Guangzhou Lifly Chemicals at position 75) and one in Hong Kong (Echemi at position 56).

This limited presence almost certainly gives a misleading impression of the relative importance of chemical distribution in China. One reason is that of course, the leading Western distributors also have a presence in China — in fact, companies including Brenntag, Helm, DKSH and IMCD all are among the top 10 distributors in Asia, according to ICIS (the list does not provide separate figures for China). Another likely reason is that ICIS may have less information — and possibly even less interest — in somewhat smaller Chinese chemical distributors that by their sales would also merit inclusion into the list.

In fact, the Chinese chemical distribution market is very likely the largest in the world. Taking 2020 CEFIC data for chemical sales in China (€1,547 billion) and an estimated distribution share of 5–7% results in an estimated size of the distribution market of between €77 billion and €108 billion, a far larger figure than the about €55 billion for the US or the similar figure for the EU area, and indeed, a rather substantial share of the estimated global figure of about €230 billion in 2022.

In fact, the distribution share of 5–7% given by some experts may well be an underestimate as many multinational chemical companies achieve around 50% of their China sales via distributors, which would indicate that based on an estimated market share of foreign companies of 20%, the distribution share from their business alone could reach up to 10% of the total chemical market. The uncertainty about the actual share is in itself an indication of the immaturity and changing nature of the Chinese distribution market. In any case, this is certainly a market meriting closer analysis.

Traditionally, many commodity producers in China relied heavily on a large number of small, very local distributors with narrow portfolios — a consequence of the large distances to be covered in China, and the large number of often small end customers. In addition, Chinese chemical companies mainly saw their key role as producers rather than as marketers of their products and shied away from the complexity of dealing with small orders. This left a substantial role for distributors in breaking up bulk chemicals, organizing logistics, receiving payment, giving credit based on intimate knowledge of their customers, and providing some low-end technical service.

Despite these functions, the Chinese market for chemical distribution has always been a location with substantially lower margins than in most other distribution markets, a result of the intense competition, large number of distributors and the often relationship-based and somewhat unprofessional start of principal-distributor relationships. This strong emphasis on personal relationships still makes it hard to include China in global distribution deals between global chemical distributors and their global principals, as local managers in China tend to be wary of the increased transparency that comes with such deals.

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Tighter Regulation

In the past few years, the traditional role of chemical distributors in China has been threatened. The number of small and mid-size customers is decreasing as the Chinese government is enforcing the chemical industry more tightly. The same tightening of regulation has also made the transportation and storage of dangerous goods more complicated, which may increase distribution costs and act as an entry barrier for smaller distributors.

In addition, two main factors have made life tougher for chemical distributors in China. One is the increasing tendency of chemicals producers to directly supply a larger share of their customers. Instead of only directly supplying key accounts, now mid-size customers are also targeted directly, leaving less of the total market to distributors. Some chemical MNCs have informally stated the ambition to reduce their distribution share of sales from about 50% to about 20%, a reasonable goal given the huge importance of the Chinese market for global sales. Chemicals producers thus more and more only pass the least desirable customers on to distributors — the smallest ones, the ones in remote areas, the ones with highly complicated needs, and those in need of generous credit terms. Maintaining stable distribution sales thus means constantly searching for new areas and new opportunities.

Another, very important factor is digitalization, given that China is one of the most advanced countries with regard to e-commerce. Many produc-

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ers of chemicals now sell their products online on digital platforms such as Alibaba or the dedicated chemicals platform 1688.com, whose customers include Dow, BASF, Evonik, Clariant, Solvay and Arkema. These platforms offer an alternative to distributors that is even open to small customers. Digitalization reduces producers' cost to serve small customers and allows easier access. It also allows producers to better and faster capture changes in demand and adapt their prices accordingly.

For end customers, digitalization means more choices, greater transparency and a more convenient buying process. It leads them to expect lower prices than previously obtained from their distributors while at the same time reducing their loyalty to their suppliers.

Although distributors may also sell their portfolio online, they typically do not have a compelling competitive advantage via this channel compared to the producers of chemicals. Their share in traditional chemical markets is shrinking, while new markets such as for "green" chemicals are only gradually opening up. And while they also benefit from lower costs to serve customers, they suffer particularly from the reduced impact of their key differentiators, such as the fulfillment of small orders and close contact with their customers.

Adapting to the New Reality

In this situation, how can chemical distributors still earn money? One approach taken by some distributors is to speculate. Another is to be in possession of some distinct success factors—in China, an important one is access to storage capacity, as this is limited in China, and the creation of additional storage space is increasingly restricted by government regulation.

But even some of the traditional services of distributors such as providing local storage, breaking cargo and offering credit now are offered by producers—particularly with regard to offering storage space, as producers rent storage tanks in key markets. Still, according to an industry expert, the number of chemical distributors in China is not shrinking as other parties such as logistics providers also enter the market.

So far, the success of Western chemical distributors in the Chinese chemical market has been relatively modest. Several have failed to establish a profitable business in the country. One exception is Brenntag, a company that started with the early acquisition of coatings distributor Zhong Yun in 2011 followed by several acquisitions in the specialty chemicals area, including the 2017 acquisition of pigments and additives producer Wellstar Group and the most recent acquisition of food ingredients distributor Zhongbai Xingye in 2021. Industry experts credit these acquisitions—possible by a willingness to invest in China—with the success of Brenntag in the country.

Acquirer	Year	Target	Chemical Segment
Univar	2020	Zhuhai Techi Chem Silicone	Silicones
Azelis	2020	Bronson and Jacobs	Personal Care
Azelis	2020	CosBond	Personal Care
Brenntag	2021	Zhongbai Xingye	Food ingredients
IMCD	2021	Syntec	Personal Care
IMCD	2021	Aquatech	Coatings
IMCD	2021	Yuanhe	Coatings, Textile
Azelis	2021	WWRC China	Coatings
Azelis	2021	China Plus	Personal Care
IMCD	2022	Welex	Coatings, Plastics, Agrochemicals
IMCD	2022	Sanrise	Personal Care

Recent China acquisitions of Western chemical distributors

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Other foreign distributors such as IMCD seem to follow a similar strategy of focusing on specialty chemicals and relying on acquisitions such as the five the company has done in 2021 and 2022. In fact, most of the strong growth of foreign companies appears to come from such acquisitions rather than from organic growth, as entering a new area from scratch is difficult due to existing relationships between suppliers, distributors and customers.

In acquiring Chinese distributors of specialty chemicals, globally acting suppliers such as IMCD may add value by leveraging their global supplier network, improving the systems, promoting digitalization, and enhancing cross-selling—the latter being facilitated by a broad portfolio in a specific area of specialty chemicals as well as formulation capabilities. On the other hand, some of the functions of domestic chemical distributors which are sometimes euphemistically described as providing "flexibility" may have to end in order to comply with the internal guidelines of MNCs. Then again, the transparency offered by global distributors may in the future attract other principals from countries such as India and South Korea.

Increased Importance of Local Sourcing

Global chemical distributors still mostly rely on foreign rather than on Chinese principals. Existing personal relationships with local distributors are a barrier blocking multinational distributors from acquiring Chinese principals. In addition, multinational distributors typically seek exclusivity, something that Chinese producers aiming for sales volume rather than good margins are reluctant to grant.

Another approach is to add other elements to the core distribution function. In the case of Helm, this includes local sourcing, provision of logistics as well as global swaps. Such an extension of functions may help prevent the revenue erosion resulting from a decline in the traditional distribution market, as described above.

Particularly local sourcing may increase in importance for foreign distributors as China becomes increasingly self-reliant for an ever-growing number of chemicals. According to OEC, between December 2021 and December 2022 the imports of China's chemical products have decreased 9.6%, almost certainly affecting those foreign distributors mostly relying on imported products. Assuming that this trend will continue, foreign chemical distributors in China may face tougher times than their domestic counterparts. It remains to be seen whether their strong focus on specialties—with its potentially higher growth, larger product variety and greater need for technical support—can counteract this.

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Catalyst for a Sustainable Planet

Johnson Matthey Set to Catalyze the Net Zero Transition

Johnson Matthey (JM) looks back at a legacy of 200+ years. Established in 1817, the London, England-based chemical company reported annual revenues of about €18 billion in 2022. JM has built a global presence with operations in more than 30 countries. The company's strategy is based on the vision for a cleaner, healthier world and mirrors society's need to create a more sustainable future. JM has set out to catalyze the net zero transition by delivering sustainable solutions to customers enabled by innovative technology and leading positions in JM's key markets automotive, chemicals, and energy. To get a better understanding of the role JM's technological developments play for a sustainable future, Michael Reubold spoke with Maurits van Tol, the company's Chief Technology Officer.

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Maurits van Tol, CTO, Johnson Matthey

CHEManager: Johnson Matthey, like many other chemical companies, calls itself a global leader in sustainable technologies. What characterizes a leader in sustainable technologies, especially in the chemical industry?

Maurits van Tol: JM does not produce bulk chemicals or fuels; it develops catalysts and engineering solutions for its customers. 40% of all chemicals are produced through syngas, an optimized mixture of CO and hydrogen. JM is the number one licensor of syngas related technologies, enabling us to help our customers transition from fossil-based feedstocks to alternative feedstocks that have much lower greenhouse gas emissions.

JM is also the number one licensor of hydrogen production technologies. Traditionally for hydrogen from natural gas, but now extended to a combination with CO_2 capture for use or storage: our LCH technology. JM also has a long history in fuel cells—from providing the platinum to the inventor of the fuel cell in 1842 and manufacturing components for the Apollo missions to the moon, to fuel cell component development for static and mobile applications converting methanol or hydrogen into electricity. This know-how is applied to the development and production of the reverse process: electrolysis of water to produce hydrogen and oxygen. JM and its partners, like Plug Power, are again leading the industry. It is also worth remembering that JM has the broadest catalyst portfolio in the world, spanning heterogeneous and homogeneous catalysts, enzymes, and biocatalysts.

Catalysts lower the amount of energy that is required to produce products and if tailored well they do so also with a high selectivity, saving raw materials, solvents, and energy at the separation and purifica-

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tion steps in chemicals, life sciences and pharmaceutical products. In my opinion a leader also thinks about how to reduce the physical footprint of plants, as smaller plants need less concrete and steel. This is what we applied extensively in our LCH plant design, nearly halving the footprint and a 40% lower capex.

The chemical industry, by its own right, is a major originator of greenhouse gas emissions and has embarked on a path toward carbon neutrality. What will be instrumental measures for chemical companies to reduce their own emissions?

M. van Tol: At JM, it starts with designing energy efficient plants for our customers. Our customers can then select low carbon emitting energy sources to provide the remaining energy demand. Customers also approach us to help them retrofit their CO_2-emitting hydrogen plants with carbon capture.

Visionary chemical companies help technology providers scale-up their sustainable technologies, through pilots and large global contracts that help the value chain to "design once, build many", bringing efficiency through scale. Based on a long history of platinum group metals—PGMs—recycling, we help our catalyst customers by ensuring circularity is taken into account at the beginning of our innovation process. JM is the largest secondary refiner of PGMs in the world.

As the key enabler of technological progress in other industrial sectors, the chemical industry is critical for reaching the overall goal of carbon neutrality. In your key markets automotive, chemicals, and energy, what have been recent milestone developments to support this goal?

M. van Tol: In the chemicals space, our role in helping the global syngas chains reach net-zero is very strong. Next to that we have technology that helps to ship hydrogen around the world, for example in the form of methanol—JM being the number one licensor of methanol technology—or ammonia. Sustainable methanol and ammonia, made through fossil-free syngas, can be used as hydrogen carriers. On sites that produce hydrogen this can be converted into methanol or ammonia, then shipped where they can be converted, releasing hydrogen. We provide catalysts in this area, for example. Both methanol and ammonia can be used directly as chemical and as fuel. In the latter case our catalytic converters are applied to reduce emissions, building on our great heritage in the automotive industry.

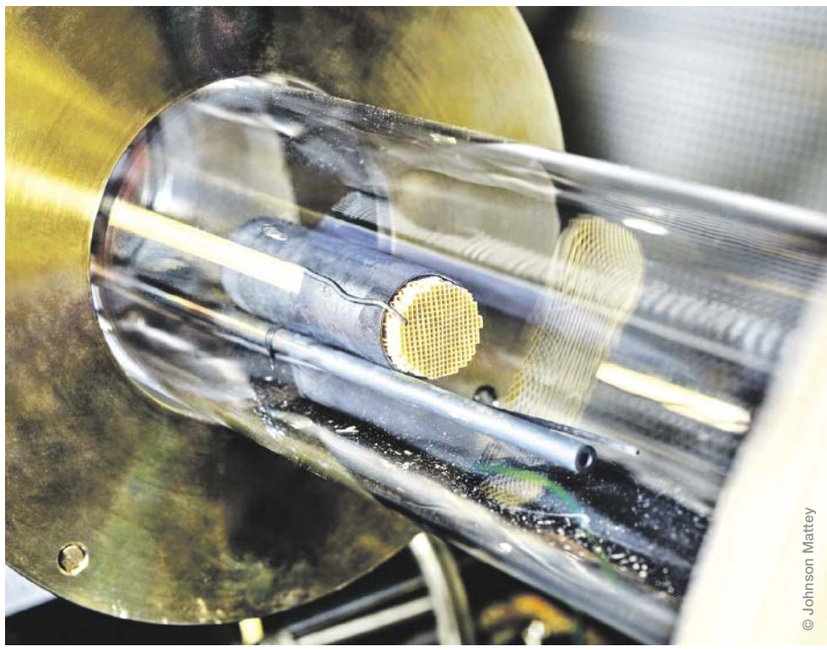
In the automotive space, our fuel cells contribute to decarbonization, and we have invested heavily in a new gigafactory at our site in Royston, UK, to scale up the production of hydrogen fuel cell components. In January, we announced a long-term strategic partnership with Plug Power, a leading provider of turnkey hydrogen solutions for the global green hydrogen economy, to co-invest in what is expected to be the largest—5 Gigawatt scaling to 10 Gigawatt over time—CCM manufacturing facility in the world which will be built in the US.

In the energy space our award-winning Fischer-Tropsch CANS technology, developed with BP, allows our customers, like Fulcrum, to use municipal solid waste and landfill as a feedstock to produce synthetic crude oil for clean transportation fuels. Repsol and Aramco are going to convert carbon dioxide and electrolytic hydrogen into aviation fuel, and together with Virent we have a technology that converts biomass into aviation fuel or aromatics that can be used in the chemical industry.

For the chemical and energy industries, the two pillars of decarbonization are carbon replacement and carbon reduction. For chemicals and materials manufacturers, it will be critical to transform the feedstock base of their value chains. Which technologies does JM offer to support other chemical companies?

M. van Tol: Our reverse water-gas shift technology enables our customers to convert carbon dioxide into synthesis gas. The technology that JM developed with Virent for the production of sustainable aviation fuel can also be used to produce aromatics for the chemicals, materials and pharma industries. We have our broad portfolio of hydrogen production technologies, including through an investment in Enapter, leaders in AEM electrolysis technology.

JM offers other technologies to support sustainability in many value chains based on syngas. Which technologies can be used in downstream processing of syngas to produce fuels or other value-added chemicals?



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Johnson Matthey's technological developments play an important role in creating a sustainable future.

M. van Tol: An important technology that allows syngas conversion into a variety of fuels is our Fischer-Tropsch CANS technology that we developed with BP. And when using syngas produced from renewable sources—electrolytic hydrogen and renewable or waste sources of carbon—our customers produce 'renewable' or e-methanol or ammonia. The opportunities through syngas are basically endless.

The circular economy is indispensable to reach carbon neutrality. As a leading producer of catalysts and other chemical compounds, how do you manage closed loops for the materials needed?

M. van Tol: JM has a long history in PGM recycling. We know how to source materials ethically and sustainably through the value chains. We have an established closed loop in a broad range of sectors, such as pharmaceuticals and nitric acid, and we do the same for our fuel cell and electrolyzer customers.

As the world's largest secondary refiner of PGMs, we have the network, knowledge, and scale. In the innovation process we take design for end-of-life solutions very seriously, from the beginning. Reduce, re-use, recycle are key words in our innovation process. We are actively researching a more sustainable route to recycle fuel cells and electrolyzers.

What is your strategic approach to innovation and how is technology R&D organized and managed at JM? How much investment is dedicated to innovation?

M. van Tol: At JM, we translate our company strategy into an innovation and R&D strategy, using technology road mapping approaches. This includes workshops and cross functional discussions to develop business and topic roadmaps across our organization. The roadmaps help link technology resources to business objectives by pulling together information on markets and customer drivers, product development plans and technology investment areas to help prioritize R&D objectives.

Our innovation portfolio covers all our innovation efforts, and the global leadership team ensures that our capital allocation, our resources, are aligned with this portfolio and that the portfolio allows us to play a leading role on the global stage in areas core to the company.

The CTO is accountable for the overall innovation delivery, but I do that with a fantastic team of R&D units across the business and innovation directors that work seamlessly together to ensure we are successful. This joint team represents about 1,600 colleagues in R&D, innovation, technology development and scale-up, in which we invest about €230 million.

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High-Performance Solutions for a Better World

Challenges in the Surfactants Industry and the Path Forward for New Solutions in a Variety of Applications

Surfactants are used in a wide spectrum of applications from detergents to cosmetics to crop protection to oil & gas — and many more in between. This broad range will be the focus of the 12th World Surfactants Congress to be held in Rome in early June 2023. The congress will broach the challenges in the surfactants industry that needs to transform its operating model to become more sustainable and contribute to the EU Green Deal objectives. Tony Gough, President of CESIO, the European Committee of Organic Surfactants and their Intermediates, and Director of Innovation for Sustainability at Innospec, provides a status report on the surfactants business, market, and technology.

CHEManager: CESIO organizes the World Surfactant Congress only once every four years. That means, a lot has happened in and around the industry since the previous Congress in 2019. How did the industry do during the Covid pandemic with its supply chain disruptions and lockdowns? The global Covid outbreak being hardly over, Russia started a war in Europe with dramatic consequences for the market and business conditions. How is this ongoing conflict in the Ukraine affecting the surfactants industry?

Tony Gough: Since early 2020, just nine months after our previous CESIO Congress, Covid-19 came upon us and triggered lockdowns all over the world with huge impacts on supply chains and industrial manufacturing; not to mention the mental and physical stress exerted on individuals across the globe. Then in early 2022, when the world had made good progress in being able to get the virus under control, Russia started the war in the Ukraine which caused a great hike in inflation due to reduction in Russian gas and oil supply. This resulted in a dramatic increase in prices of surfactant and chemical feedstocks, which now seem to be stabilizing in most areas, with prices of some feedstocks even starting to come down, although still beeing generally higher than in pre-Covid times.

A side effect of the pandemic on the surfactants industry was a massive demand for sanitizers, cleansing, and household cleaning products. However, other sectors and industries weren't so fortunate. The lockdowns had a huge adverse impact on institutional cleaning in the hotel, restaurant, and tourism sectors. Also, consumer buying habits have been affected by increasing numbers of purchases being made online, causing retail sales to decline.

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Tony Gough, President, CESIO

On top of all of that, there have been major issues with shipping, availability of bulk-containers, availabilities of feedstocks in the far east, shortages of trucks and truck drivers in Europe particularly, and severe hikes in costs for transporting goods in all regions of the world, which also caused problems with surfactant and feedstock supply chains, but the situation now seems to be gradually improving.

Recovery from all of these set backs is showing that our industry has a great degree of resilience and is able to absorb external shocks like Covid-19. Surfactants are manufactured from a plethora of feedstocks and are enablers for many downstream applications. It is this versatility and diversity that keeps the surfactant industry alive. We hope that the world has some good learnings from Covid-19 and now knows what steps to take and which not to take in the unlikely event that another global pandemic occurs within our lifetimes.

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The climate crisis has even bigger potential to transform the industry than the war and the pandemic.

That is saying something …! Does the agenda of CESIO 2023 reflect the importance of the global fight against climate change?

T. Gough: Whilst it is debatable in some quarters that the world has reached the stage of being in a climate crisis, there is a need to reduce man-made emissions of carbon dioxide—CO_2—to limit global warming to just a 1.5 °C rise and REACh net zero in global CO_2 emissions by 2050 according to the Paris Agreement. Confounding this is the fact that it is estimated that the demand for carbon-based chemicals globally will more than double by 2050. If the demand is not to be satisfied by fossil-based feedstocks, renewable carbon production will need to increase by 15x to phase out the use of fossil carbon in consumer products. Big challenges are therefore set for the chemical and surfactants industry to take action and reduce their reliance on fossil fuels-based energy and feedstocks.

The program for the upcoming Congress lists one keynote from a high-level speaker from the EU Commission, ten plenary speakers, almost 60 session speakers, numerous posters and a panel discussion as the last session of the event. Many of the speakers will focus on 'sustainable surfactants' such as bio-based surfactants, the future of palm oil in Europe, biomass as a basis for surfactant design, clean future for consumer goods, sustainable cleaning and the transformation of the home and personal care industry, and so on. Many will also demonstrate how the green deal and the EU chemical strategy for sustainability will affect our industry, for example, the expected notification and registration of polymers under REACh, the so-called Safe-and-Sustainable-by-Design strategy or the mixture assessment factor within the REACh-review. Participants will have a colorful picture of challenges provoked by the fight against climate change and opportunities for our industry.

The green transformation has been on the CESIO agenda for more than 20 years already but obviously picked up pace in recent years. What are the major strategies of surfactant manufacturers to reduce their carbon footprints and become carbon neutral?

T. Gough: As has been mentioned above, the chemical and surfactants industry needs to take action to reduce its reliance on fossil fuels for both energy and raw materials.

Many surfactant manufacturers have programs in place to address this by analyzing their types of carbon emissions associated with their products through Life Cycle Assessments —LCAs—, Product Carbon Footprints —PCFs and Product Environmental Footprints—PEFs. These will help them to identify ways to improve their processes to use less energy (for example better catalysts), and use more sustainable feedstocks which are bio-based, from circular sources or from carbon capture and utilization. Surfactants manufacturers are also increasingly looking at using their products to develop novel example guide formulations for their customers which are more sustainable than conventional product types. Examples of these are solid or concentrated cleansing formats for personal care, home care and I&I. Manufacturers of surfactants used in laundry detergents are also looking at ways to make example guide formulations which are effective for low temperature washing, as most of the CO_2 emissions associated with current laundry detergents arise from heating the water used in the washing process.

> *"A side effect of the pandemic on the surfactants industry was a massive demand for sanitizers, cleansing, and household cleaning products."*

Until the end of the last century, surfactants were mainly fossil-based and biobased surfactants were exotic foreigners. How has the feedstock base of surfactants changed in the past decades?

T. Gough: While there are surfactants on the market that are 100% naturally derived, and some that are 100% fossil-based, many surfactants are hybrids.

At present, some 50% of surfactants in Europe already have at least one constituent from a renewable feedstock. The choice of the feedstock will depend upon the type of application, properties required, availability, its sustainability, and also its cost. With regards to the use of palm kernel oil, this feedstock has become very attractive over the last 25 years

Continued Page 18 ▶

due to the aftermath of the mad cow disease at the end of the 1990's which led to a decreased use of tallow as feedstock. There is also the recent emergence of biosurfactants such as the glycolipids, sophorolipids, and rhamnolipids which are now available on industrial scale. Manufacturers of these biosurfactants have established their factories in areas where they can locally source these feedstocks. Another example of a new feedstock for surfactants is bionaphtha obtained by various means from plant derived materials. This can be 'cracked' as per conventional naphtha to give feedstocks like ethylene. However, these types of feedstocks are often available solely as a 'mass balance' approach since global supply is too low to allow 100% fossil free material to be made and it would currently be prohibitively expensive.

However, we know that just because a material is either naturally derived from fermentation or renewables does not always mean that it is 'more sustainable' or has a better safety profile. It is the chemistry behind them, the energy used, the ecofootprint and the way the feedstocks have been manufactured and transported which determines the sustainability and safety profile. Ultimately, our interest is in open and competitive access to any feedstocks which meet customer needs, and in their contributions to more sustainable products and processes.

The EU Chemical Strategy for Sustainability is part of the EU's zero pollution ambition—a key commitment of the European Green Deal. Its implementation will have far-REAChing consequences for the chemical industry and the users of chemical products. How does CESIO evaluate the measures and rules proposed by the CSS?

T. Gough: CESIO has been monitoring and contributing to policy development initiatives to realize the objectives of the EU Chemical Strategy for Sustainability—CSS—and wants to play a constructive role in its implementation. We believe a holistic approach is needed that incentivizes innovation and improved sustainability in Europe, whilst also recognizing the relevance of existing legislation for REAChing sustainability targets. It is especially important for us to help to ensure that companies operating within Europe are never put at a competitive disadvantage as they strive to meet important sustainability targets compared to companies operating outside Europe.

CESIO has researched and expanded knowledge on polymeric surfactants, including biodegradability and future registration requirements. They've worked with AISE in the ERASM initiative for over 30 years to assess surfactant risks. A lot of tests and data, such as developed by the HERA Project or for REACh, are widely available or can be accessed on the OECD Existing Chemicals Database.

Sustainability is not an inherent property of a substance. Surfactants often show their positive effects mainly in the end use. Is it the right way to go for a primarily hazard-based approach that provides for a general ban of certain substances?

T. Gough: Whether or not a weapon is good or bad depends on how it is used. We can use this analogy for chemicals: whether or not a chemical is harmful to living things or the environment can only be determined by the hazard, the exposure from use and the risk resulting from the combination of the two. A chemical may be toxic to fish or daphnia—that is, it is hazardous—but this is irrelevant if this chemical will never be released into aquatic environments. Furthermore, if a chemical is banned or restricted solely on the basis of its hazard, this will lead to overregulation. In addition, substances could be withdrawn from the markets which even have a positive impact on sustainability!

This is why we have a huge concern with regards to the so-called generic risk approach favored by the EU regulators, which would restrict larger groups of chemicals due to specific properties, such as their persistency. This approach is nothing more than restriction based on the hazard profile, and, in many cases based on just a single hazard property. 'Generic' in this context means: should not be present in a consumer product or end up in the environment as a 'forever chemical', even though there is no evidence or proof of a specific risk. This approach is ill-considered and would not be good for the invaluable contribution the chemical industry makes to the world economy or humankind in general.

Do you think that more or tighter chemicals legislation and regulation will propel the development of more sustainable products? What is CESIO's approach to sustainable development?

T. Gough: Many legislative changes are currently taking place in Europe, which should help to REACh CSS targets. This includes the revisions of the European chemical and labelling regulations—REACh and CLP—, the EU Ecodesign legislation, initiatives to support Safe & Sustainable by Design products, among many other initiatives linked to water and GHG emissions. In addition, other updates to existing vertical legislation, such as to the Detergents Regulation and to existing EU ecolabel criteria are planned.

As noted earlier, it is important to ensure that any new legislation constructively contributes holistically to improving sustainability whilst supporting innovation. To achieve this, any new rules should be fit for purpose and not duplicate or overlap with existing frameworks. CESIO will continue to play its part both in on-going research projects and contributing to the development and implementation of any new legislation.

Apart from sustainability, what drives the development of new surfactants? What are the hot trends in finished product R&D these days?

T. Gough: The obvious answer to this is that a new surfactant must address an identified unmet market need. It must also possess all the usual expected properties such as biodegradability, low toxicity and be cost effective. However, it is a rare occurrence for a new surfactant to be launched onto the market. Biosurfactants such as sophorolipids and rhamnolipids are relative newcomers being geared up for large industrial scale production and are being positioned mainly for their sustainability. We expect that mainstream surfactants will continue to be mainstays of the surfactants industry and be in major demand globally for many years to come. They will also undoubtedly be subjected to sustainability scrutiny in attempt to improve their LCAs.

Product developers, manufacturers and consumers are all seeking more and more sustainability aspects associated with personal care and home care products. This goes for both the contents and the packaging that are used for the products. This has led to the recent emergence of more solid-format and concentrated-format products on the market which use no water, or reduced water content in their manufacturing less packaging than conventional products. We therefore require surfactants which are capable of being used in these formats. Examples are solid shampoos which can be in powder form or bar form, concentrated shampoos which contain less water than conventional shampoos, and various novel solid or concentrated formats for laundry detergents.

Another trend is for formulators to seek surfactants which have some kind of eco-organisation certification. Examples of this are Ecocert Cosmos and Ecocert Detergent, Natrue, etc. There are currently relatively few surfactant types which meet the criteria of these agencies, but the list is expected to grow as more surfactants emerge that are either synthetic but are 100% naturally derived or are biosurfactants.

Yet another trend with continuing growth is sulfate free cleansers in the personal care sector. Surfactants with continuing growth in this category include isethionates, taurates, alpha-olefin sulfonates, glutamates and betaines, to name a few.

Pre-Covid, the overall market situation for surfactants in Europe was pretty stable. Given the current uncertain market and business conditions, can you provide an outlook on the market development for surfactants and the growth expectations in the years to come?

T. Gough: The outlook for surfactants is extremely healthy. Demand for most, if not all current surfactant types, is expected to grow, not just in Europe but globally. Also, surfactants with increasing levels of sustainability, including those which are fossil free, are expected to increase in demand. Fossil free surfactants will have two categories; those synthesized from fossil free feedstocks and those made through biotechnology routes. The future—therefore—looks bright for the surfactants industry!

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CHEManager INTERNATIONAL

INNOVATION PITCH

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Connected Workforce
A New Shopfloor Digitalization Platform for Real-time Decisions

Renewable Energy
Direct Air Capture Technology Extracts CO_2 from Ambient Air

Green Hydrocarbons
Direct Air Capture Technology Extracts CO_2 from Ambient Air

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Building a Connected Shopfloor Workforce

Unlock Sustainable Manufacturing by Empowering Operators to Make Real-time Decisions

For too long, analytics and reporting have been the domain of high-level management. But this top-down approach creates a bottleneck, blocking people from using valuable insights throughout an organization, resulting in delays that can cost businesses millions in missed cost savings. To solve this, Cyzag created Whiteboard, a digital platform to democratize manufacturing data and create a stronger, more holistic culture of data literacy in the chemical manufacturing industry. John Papastylianou, founder and CEO of Cyzag, who has led the team to develop and deliver a best-in-class shopfloor digitization platform that enables and sustains continuous improvement, tells the story.

© Cyzag

John Papastylianou, Cyzag

CHEManager: What inspired you to start Cyzag?

John Papastylianou: I've always been focused on chemical manufacturing efficiencies, leading and delivering large-scale manufacturing execution systems projects. Working mainly with big-tech vendors, I saw that two-year-plus projects for manufacturing systems weren't working and that users were left behind, meaning that the critical link to the shopfloor was broken and many projects ultimately failed to deliver.

Thinking about restoring the shopfloor link and delivering digital tools faster and more effectively, I initially launched Cyzag in 2012 because I wanted to show that focusing on shopfloor users was fundamental to chemical manufacturing's success. When data is passing safely from the hands of a few analysts into the hands of the masses within a company, you increase the population of decision-makers. This leads not only to greater efficiency and time, energy and cost savings but also improves staff retention and employee attraction. Since then, Cyzag has evolved manufacturing software based on customer needs and market changes. In 2018, we released our flagship product, Whiteboard.

What are the key ideas that drive Cyzag?

J. Papastylianou: Cyzag exists to innovate how manufacturers enable their teams. We serve our customers to be driven by data and powered by people. We understand that operations want to own performance, but they need the tools to do the job. They need to access data and, as operation specialists, they need autonomy to make decisions in a timely manner, increasing speed and productivity and removing waste, but keeping the standard work processes and traceability.

> *"Cyzag exists to innovate how manufacturers enable their teams."*

Whiteboard places real-time manufacturing data and decision-making into the hands of the right people, in the right place, at the right time. To do this, we developed a secure, cloud-based platform that can be easily tailored to each user in a matter of minutes. And users can develop their own flows and processes in a no-code and intuitive platform, gaining autonomy and speed.

To deliver sustainable continuous improvement, people are empowered to experience the tool's value, in addition to business requirements. This makes adopting the tool easier and the sustainability of the results much easier to reach. Cyzag focuses solely on processes in the chemicals manufacturing industry, so our customers know our product is created specifically for their needs.

What key challenges is the industry experiencing?

J. Papastylianou: We talk to executives and managers across production operations, business performance and operational excellence in major chemicals manufacturers. There is a big desire to connect the shopfloor, increase performance in sustainability and input cost drivers, but many find it difficult to know where to start. Some have identified huge amounts of data but not enough information and insights to affect performance, particularly on the shopfloor. Many big digitisation initiatives have failed to bridge the gap between management performance objectives and the shopfloor.

Where is Cyzag on its journey?

J. Papastylianou: We have our foundation customers, which are international chemical companies using our software in more than 80 chemical plants in 11 countries, reaching thousands of users. The product market fit is proven, and we see a big demand for products like Cyzag Whiteboard in chemical manufacturing. We are at a high pace of development with a two-week release cycle. Right now, we are at the beginning of our scale-up, increasing our industry partners and investment.

Personal Profile

John Papastylianou, founder and CEO of Cyzag, is an innovator and creative and collaborative entrepreneur. He studied Mechanical Engineering at the University of KwaZulu-Natal, Durban, South Africa,and has an MBA from the Imperial College London. He began his professional career in 2001 and has more than 20 years' experience in the process industry, working for, among other companies, Hyperion Systems Engineering and GE Intelligent Platforms. John led and managed large-scale manufacturing execution system (MES) projects and worked as an MES consultant and software engineer. He continues to innovate, working with chemicals manufacturers to improve manufacturing performance at scale across their businesses.

Business Idea

Democratizing Manufacturing Data

Driven by numerous challenges, chemical manufacturing organizations have learned how to work leaner, cut costs and use data analytics and digital technologies to stay competitive. But the data revolution is not just about collecting or keeping the information in a few hands—digital technologies cannot be restricted to specific initiatives or parts of the organization.

Cyzag believes technology and data are best used when they enable individuals to perform better in their daily work, pursuing a culture of improvement and feeling valued. Cyzag Whiteboard creates a solid foundation from which chemical manufacturers can embed best practice and scale. Whiteboard connects shopfloor workers with the data they need to improve manufacturing performance, shift by shift, day by day.

By giving operations powerful tools that make their job easier and harness their talents, Cyzag is able to embed a digital infrastructure through which they can implement consistent processes and build collaboration and improvement culture from the shopfloor up. The tool is built based on a three-step process to continuous improvement (CI) and sustainable business growth. These steps are:

Align: Cyzag makes sense of customer data, generating a single source of truth and streamlining standardized work processes, such as daily meetings boards, task management, shift logbook and handover.

Optimize: Cyzag moves decision-making to frontline workers, saving time and money. Whiteboard offers a unique way to track and optimize real-time data, making use of already familiar tools and overlaying contextual information.

Scale: Cyzag provides the foundations that businesses need to drive sustainable CI, guaranteeing transparency and boosting collaboration. That makes benchmarking between sites and plants instant and easy.

Whiteboard enables people to work smarter and impact the decisions they make for the business, building an agile organization that identifies and solves issues timely.

- Cyzag Ltd., London, UK
  www.cyzag.com · info@cyzag.com

Elevator Pitch

Driven by Data

London-based UK start-up Cyzag developed Whiteboard as a simple, modern and user-friendly digital platform that reduces cost and waste by providing shopfloor workers and operations managers in the chemical manufacturing industry with live information at their fingertips. The team around founder and CEO John Papastylianou understands the value of data and how frustrating and expensive it can be when it's not accessed and analyzed fast enough to solve problems.

Whiteboard integrates real-time data from multiple sources into a single source of truth, enabling workers to quickly identify which parts of the process and equipment will likely contribute to production losses or overconsumption. The secure, cloud-based software platform empowers them to make informed decisions based on accurate data, and follow standard working processes, saving time, generating cost-efficiencies, reducing waste and driving sustainable business growth.

Identifying manufacturing quick wins can save up to €1 million a year. Legacy software can be eliminated or consolidated into the platform, saving up to €460,000 annually on license fees. The platform empowers employees at every level to derive real growth and value from their analytics.

Milestones

2012:
- Cyzag incorporated

2012-2015:
- Manufacturing execution system (MES) consulting for General Electric, Land Rover, Qatar Steel and AkzoNobel

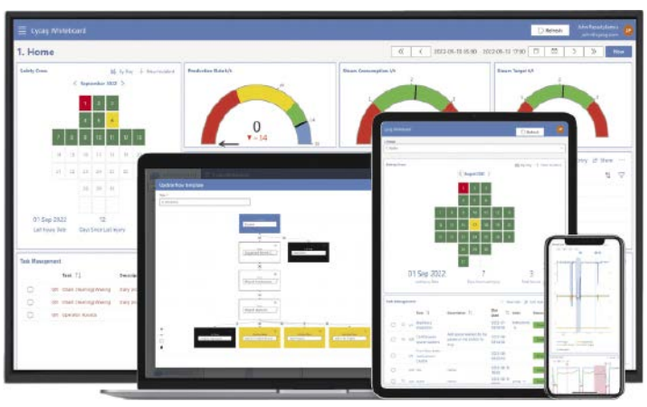
2015-2018:
- Manufacturing excellence (MX) consulting for Nouryon

2018:
- Cyzag Whiteboard developed

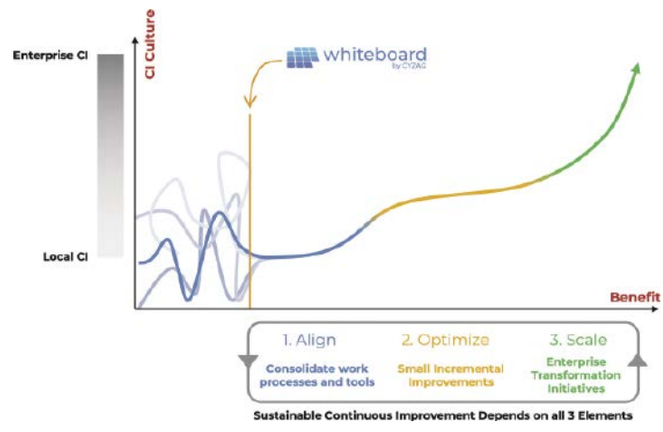
2018-2022:
- Cyzag Whiteboard implemented in Nouryon, Nobian, Nefco and Perstorp

Whiteboard key numbers

- Value delivery < 8 weeks
- Implemented at > 80 plants in 11 countries
- Demonstrated savings of €400 k/plant/year
- 2 hours saved/shift/plant
- 4–5 x increase in user engagement



Three steps — align, optimize and scale — support sustainable continuous improvement.



Cyzag Whiteboard empowers workers in chemical manufacturing plants to make real-time decisions.

Climate-Positive Power

Highly Efficient Power Plants for Carbon-Negative Renewable Electricity and Gas Generation

Reverion is a highly tech-driven climate company and a spin-off from the Technical University of Munich, Germany. Over the years, they have successfully developed and patented their micro power plants, that enable a highly flexible and efficient decentralized energy supply. Founded in 2022, Reverion has expanded its team to more than 40 employees by now and they are poised to revolutionize the renewable energy sector. Felix Fischer, co-founder, managing director and COO of Reverion, provides details of the journey so far

© Reverion

Felix Fischer, Reverion

Personal Profile

Felix Fischer, co-founder, managing director and COO of Reverion, is a driven climate tech enthusiast, who is co-founder. During his PhD studies at the Chair of Energy Systems at the Technical University of Munich, he developed one of the key components of Reverion's technology. Currently, he is dedicated to scaling the company and managing daily operations. On top of that, he is responsible for research projects and for the sales department.

CHEManager: What was your entrepreneurial journey?

Felix Fischer: Our journey began in 2015 with a groundbreaking vision: to pave the way to 100% renewable energy by unlocking the full potential of biogas.

Stephan Herrmann, who until recently was a group leader at the Chair of Energy Systems at the Technical University of Munich (TUM) in Garching, developed the idea for the new system design as part of his PhD. Over the years, together with the now co-founders, we developed and patented our novel high-temperature fuel cell system. After our prototype proved successful, Reverion was founded in 2022 to commercialize this technology.

Can you describe your technology and innovation? How does biogas contribute to achieving a 100% renewable energy system?

F. Fischer: The transition to a future without fossil fuels is among the greatest challenges humanity has ever faced—and the problem is more urgent today than ever before. 85% of global CO_2 emissions still originate from the combustion of fossil fuels. Fossil-based power generation covers the electricity demand when there's not enough renewable energy in the grid. Furthermore, the current energy crisis has highlighted the problems of the European Union's high dependence on natural gas imports.

Biogas can substitute imported gas and is the only major renewable energy source that is weather independent and can produce power 24/7. However, today's biogas plants use only 40% of the energy potential, are not flexible and emit tons of CO_2.

This is where our technology comes in. Our solution is a highly efficient, reversible, CO_2-negative power plant for biogas. Reverion plants can double the electricity production from the same amount of biogas through higher electrical efficiencies (up to 80%). In the process, pure, storable CO_2 is captured, enabling negative CO_2 emissions. In addition, the same plant can reverse the process and produce green hydrogen or methane from surplus electricity. Reverion plants can therefore be used when they are most needed— both to generate electricity at times when there is not enough renewable energy in the grid, and to produce gas when there is an excess of renewable energy. In this way, we also contribute to stabilizing the electricity grid and offer solutions for long-term energy storage.

What impact does your product/solution have on the energy transition?

F. Fischer: In Germany alone, the potential for electricity generation from existing biogas plants can be increased from around 5.5 GW today to up to 11 GW with Reverion plants. If we use the full flexibility of the technology, even 20 GW of electricity can be generated at peak times, up to 30% of total electricity consumption in Germany (more than coal-fired power generation today). If the technology were rolled out across Europe, it would also be possible to capture more than 100 million tons of CO_2 annually as true negative emissions and save 10% of Europe's total CO_2 emissions by additionally displacing fossil fuels.

Furthermore, synthetic, renewable natural gas from Reverion plants can be used for electricity, heat or mobility via the existing natural gas grid. In doing so, a long-term storage effect is achieved by using the existing gas infrastructure. At the same time, we reduce our dependence on gas-selling countries through decreased energy imports by both leveraging the potential of biogas and generating renewable gases.

© Reverion

Reverion's micro power plants enable a highly flexible and efficient decentralized energy supply.

What is the economic impact of your innovation on key stakeholders?

F. Fischer: For biogas plant operators, Reverion can double the revenues from electricity production and add additional revenue streams from selling gases (H_2, CH_4, CO_2) or for trading in balancing markets. With these additional revenues, our customers can more than fivefold their overall income. Grid operators profit from a controllable renewable energy source to stabilize the grid. And of course, society as a whole benefits by reducing its need to import gas, doubling the electricity output from the same amount of biogas and by reducing energy costs.

Going from five to 40 employees in less than one year is a rapid growth. Where are you now and what are your next steps?

F. Fischer: Yes, we are indeed growing fast. Since May 2022, we have moved our offices and production facilities to Eresing in Bavaria. This year we will produce our first commercial units and next year we will start series production. As we continue to expand, we are always on the lookout for talented individuals who share our vision and want to be part of our exciting journey! We have advertised several positions, and more will be added in the coming months.

Business Idea

Enabling a 100% Renewable Energy System

Volatile renewable sources require technologies that can balance the power grid and provide energy storage. Biogas is already a fundamental component of the energy transition and the only renewable energy source that can provide both secure base load and controllable power for the fluctuating feed-in from wind and photovoltaics. However, today's biogas plants are operated with gas engines that have very low efficiencies (max. 40%), are not flexible, do not offer storage capability, and emit millions of tons of CO_2 yearly.

Reverion power plants are the first all-in-one solution that

- electrochemically convert biogas or hydrogen into electricity with highest electrical efficiencies of 80% (which doubles the efficiency of state-of-the-art solutions);
- have a reversible operation mode and can also produce green hydrogen or methane from electricity (power-to-gas)
- capture pure, storable CO_2, enabling cost-effective, negative CO_2 emissions for the first time.

This ensures the future economic viability of existing biogas plants and contributes to stabilizing the energy system, bringing flexibility to the market and solving the problem of long-term energy storage.

When cattle manure or similar waste streams are used as feedstock, Reverion additionally solves major environmental problems (methane emissions, nitrate, etc.) and offers farmers or regional utilities financial revenues instead of incurring costs for disposal treatment.

Our technology consists of modular scalable standardized container units. These are designed for series production and plug & play installation to easily replace existing gas engines and enable rapid market penetration. The first 100 kW plant will be delivered in the first half of 2023, with series production up and running from 2024. More powerful and even more economical 500 kW units will be offered from 2025.

- Reverion, Eresing, Germany
  https://reverion.com

Reverion

Elevator Pitch

Milestones & Roadmap

Reverion manufactures highly efficient, reversible, carbon-negative power plants. The technology doubles the electricity production from biogas compared to state-of-the-art solutions. In the process, pure CO_2, ready for storage, is separated, allowing negative CO_2-emissions. Additionally, the plants can switch to gas generation (green H_2 or CH_4) and enable long-term energy storage.

Their mission is to make carbon negative power generation possible at scale, by making the most out of biogas and becoming the first cost competitive BECCS technology in the market.

Now, one year after founding their company, Reverion's team is manufacturing the first commercial units and has an order book filled to cover its production capacity until 2025.

Reverion has been recognized with several prestigious awards, both nationally and internationally. These include the XPRIZE Carbon Removal Competition funded by the Musk Foundation, the Science4Life Energy cup, the Innovation prize from the German Gas Industry, the Bavarian Energy Price, the Energy Start-up Bavaria, the PlanB biobasiert competition, and being finalists in the world's top-rated competitions TechCrunch, Hello Tomorrow and SXSW.

Milestones

2015 – 2021
- Development, planning and engineering of prototype
- Building and commissioning of prototype
- Patents

2021
- Winner XPRIZE Student Award
- Field test completed and prototype validated

2022
- Incorporation and seed financing round
- New production and office site
- R&D of first commercial units
- First pre-order contracts signed
- Grew team to 30 employees

Roadmap

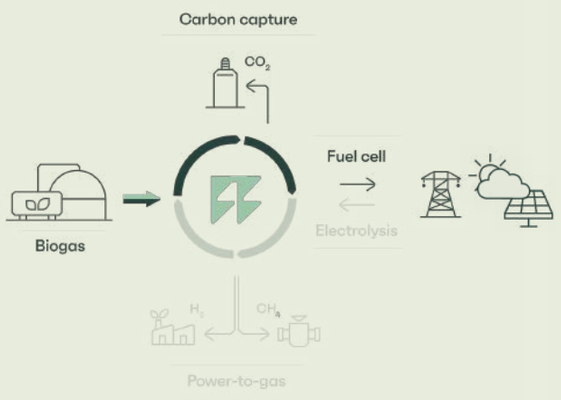
2023
- First commercial units delivered
- Expand team to 70 employees

2024
- Start series production
- Development of the 500 kW plant

REVERSIBLE OPERATION

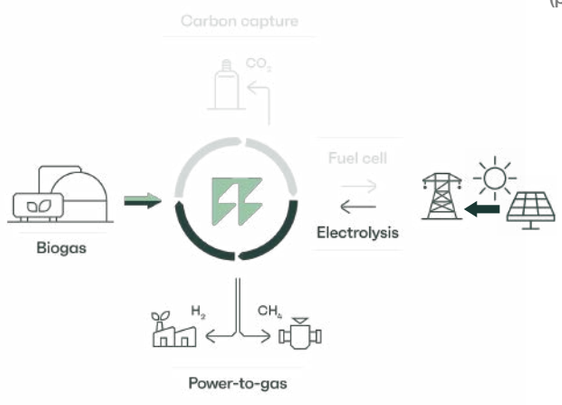
WHEN THERE IS NOT ENOUGH RENEWABLE ENERGY IN THE GRID

POWER GENERATION



WHEN THERE IS AN EXCESS OF RENEWABLE ENERGY IN THE GRID

GAS GENERATION



Reverion's plants have a reversible operation mode: They can electrochemically convert biogas or hydrogen into electricity and can also produce green hydrogen or methane from electricity (power-to-gas), both with highest electrical efficiencies of 80%.

Fueling the Circular Carbon Economy

A Breakthrough DAC Technology that Turns Air intro Green Hydrocarbons

In this interview, we speak with Florian Hildebrand, the CEO and co-founder of Greenlyte Carbon Technologies. Greenlyte has developed a breakthrough direct air capture (DAC) technology, which can extract CO_2 from ambient air and turn it into green hydrocarbons. Hildebrand discusses the company's mission to free the world from fossil fuels, relevance to the fight against climate change, current status, future plans, and how the team came together.

© Greenlyte Carbon Technologies

Florian Hildebrand, Greenlyte

Personal Profile

Florian Hildebrand is an accomplished entrepreneur with a background in mechanical engineering. He has spent over five years working in the consulting, steel, and automotive industries. In 2018, Florian co-founded Qualifyze, a digital audit company that helps businesses ensure compliance with quality management standards. During his time Qualifyze grew to over 100 employees and gained a reputation as a leading provider of digital auditing solutions. In 2023, he co-founded Greenlyte Carbon Technologies, which he leads as CEO today.

CHEManager: What does Greenlyte Carbon Technologies do?

Florian Hildebrand: Greenlyte Carbon Technologies aims to free the world from fossil fuels by fueling the circular carbon economy. Our breakthrough direct air capture—DAC—technology extracts CO_2 from ambient air and converts it into green hydrocarbons. We believe that our technology is a crucial step towards de-carbonizing industries such as the chemical industry, energy storage, and transportation. Renewable hydrocarbons are required to power these sectors sustainably, and our DAC technology provides a renewable and sustainable source of energy. We sell our technology to customers in the form of modular containers, which makes it highly adaptable and versatile.

Why is it relevant what Greenlyte does?

F. Hildebrand: Climate change is one of the most significant challenges facing humanity, and de-carbonizing as much as we can is crucial in the fight against it. However, some sectors, such as the chemical industry, face challenges in transitioning away from fossil fuels, and renewable hydrocarbons are required to power them sustainably. Energy storage and transportation are also significant contributors to CO_2 emissions, and we need renewable hydrocarbons to power them sustainably. Our DAC technology allows us to capture CO_2 from the air at low-energy rates and produce green hydrocarbons, providing a renewable and sustainable source of energy. This makes it a critical part of the circular carbon economy.

Where do you currently stand?

F. Hildebrand: We have made significant progress since our inception. We have assembled a team of 15 highly skilled scientists and experienced engineers who are working tirelessly to develop our technology. We have built a prototype that captures a few grams of CO_2 per hour to validate our process end-to-end, which was a significant milestone for us. Our technology has also been patented, and we have raised €3.5 million pre-seed financing to fund our growth. We are currently developing an industrial demonstrator, Greenberry 2, which will have a capacity of 100 t CO_2 per year. We aim to complete this machine by September 2023, and it will allow us to demonstrate the effectiveness and scalability of our technology.

What's next for you?

F. Hildebrand: Our goal is to make our DAC technology widely available and to have a significant impact on reducing CO_2 emissions globally. We are starting sales activities and will be open to receiving the first limited orders for Greenberry 2. Our technology is highly adaptable and versatile, which makes it suitable for various industries, especially chemicals. We also plan to continue our research and development efforts to improve our technology, for example, through enhancements of our absorber chemistry and make it more efficient and cost-effective.

What inspired you to launch the company?

F. Hildebrand: After selling the majority of my shares in my previous venture, Qualifyze, I wanted to tackle the challenge of climate change. I scouted German universities for people and climate-related technologies that could change the world. After countless meetings, I finally met Peter, the inventor of our DAC technology. Peter's work on atmospheric chemistry and carbon capturing built the foundation for our company. We soon realized that we needed a third person that could build the bridge between business and science, and that's where Niklas came in. His entrepreneurial and engineering background and his passion for climate tech made him the ideal addition to our team. Together, we are committed to making a difference in the world and contributing to a sustainable future.

> *"We believe that our technology is a crucial step towards de-carbonizing industries."*

There are a lot of DAC companies out there, what makes you believe that you can offer something new to the market?

F. Hildebrand: While there are many DAC companies out there, none have reached significant scale yet. Our approach is different because it needs very low energy and produces hydrogen as a byproduct. Additionally, we not only have overall low OPEX but also focus on keeping CAPEX low by utilizing as many low-cost components as possible and using off-the-shelf parts to increase scaling speed. We believe that CAPEX is underestimated by many companies, and our approach addresses this issue.

How can the CHEManager community help you?

F. Hildebrand: We are looking for pilot customers for power-to-chemical applications. Additionally, one of our big focuses for the future is the continued development of our chemistry, so partnerships with AI-driven chemical development companies would be very helpful. We believe that the CHEManager community has the potential to help us connect with the right people to make these goals a reality.

Business Idea

Low-Energy, Modular DAC Approach

Greenlyte Carbon Technologies has developed a breakthrough direct air capture (DAC) technology that extracts CO_2 from ambient air and converts it into green hydrocarbons. The technology has several core advantages over other carbon capture methods.

First, it is highly efficient, utilizing low-cost components and operating at low temperatures close to the thermodynamic optimum. This means that it is cost-effective and sustainable, as it requires low energy rates to capture CO_2.

Second, the technology has dynamic scalability, which means that it can adjust to fluctuating renewable energy sources. This is because the process is decoupled, which enables it to utilize available low-caloric waste heat. This feature allows Greenlyte's technology to be an ideal solution for various sectors such as the chemical industry, energy storage, and transportation.

Finally, Greenlyte's DAC technology has the added benefit of producing hydrogen in parallel with CO_2 capture. The production of hydrogen can occur as part of the desorption process, allowing for direct mechanization. This is a significant advantage over other technologies as it provides a renewable and sustainable source of energy, which is essential for the circular carbon economy.

Modular System Ready for Fast Scale-up

Greenlyte is planning to start accepting pre-orders for its technology soon in the form of modular containers that capture and supply up to 10 kg of CO_2 per hour.

The technology is based on 15 years of research at the University of Essen and has been well understood through over 25 research papers. Greenlyte's strategy for scaling up involves using readily available and affordable components to construct their process quickly and efficiently. We focus on both low OPEX and CAPEX to achieve a CO_2 price point of less than $100 per ton in the future. These values are reflected in the company's daily decision-making processes.

■ Greenlyte Carbon Technologies GmbH, Essen, Germany
www.greenlyte.tech

Elevator Pitch

Low-Cost, Robust DAC Solution

Greenlyte Carbon Technologies has developed a revolutionary direct air capture (DAC) technology that extracts CO_2 from ambient air and converts it into green hydrocarbons—price competitive with fossil fuels. The technology is highly efficient, cost-effective, and sustainable, utilizing low-cost components and operating at low temperatures close to the thermodynamic optimum. It has dynamic scalability, allowing it to run on renewable electric energy only.

Milestones

2022

- GCT was founded with a pre-seed round of €3.5 million, allowing the company to begin developing its innovative direct air capture (DAC) technology at full speed.
- The company acquired the intellectual property for its technology and began building a continuous lap prototype to validate the technology end-to-end.
- At the end of 2022, Greenlyte's DAC technology reached a technology readiness level (TRL) of 4.

Roadmap

2024

- By 2024, Greenlyte plans to build its first DAC unit in a commercial setting
- The company plans to receive approval for its first non-dilutive grant consortium and plans to raise a seed round
- With the funds, the company plans to reach technology readiness level (TRL) 6

2026

- By 2026, Greenlyte will focus on scaling its production, sales, and research and development efforts
- The company will be building an integrated kilo-ton carbon capture and utilization (CCU) unit in an industrial setting
- The company plans to reach technology readiness level (TRL) 7

© Greenlyte Carbon Technologies

The founders of Greenlyte Carbon Technologies (f.l.t.r): Florian Hildebrand, Peter Behr and Niklas Friederichsen.

© Greenlyte Carbon Technologies

A modular container that houses Greenlyte's DAC technology, which can extract CO_2 from ambient air and turn it into green hydrocarbons.

CESIO World Surfactant Congress 2023

The 12th CESIO World Surfactant Congress, to be held in Rome, Italy, on June 5–7, 2023, provides an opportunity for experts across the surfactants value chain to meet. The theme for this edition will be: "Surfactants — High Performance Solutions for a Better World". This event represents the perfect opportunity to learn about the latest developments in key areas such as business & market trends, safety & regulatory affairs and technical & applications.

■ https://cesio-congress.eu/

Specialty & Agro Chemicals America 2023

The Specialty & Agro Chemicals America show — scheduled to take place on June 20–22, 2023, in Savannah, GA/USA — is a forum that promotes chemical manufacturing, chemical technologies, and related chemical industry services that have specific applications for the agrochemical and specialty chemical markets. The event will focus on the chemical products and technologies that have specific applications for the agrochemical and specialty chemical manufacturing markets.

■ www.chemicalsamerica.com

ChemOutsourcing 2023

ChemOutsourcing, to take place on September 6–8, 2023, in Parsippany, New Jersey/USA, is the largest USA-based API show and attracts annually 700–800 experts from the pharmaceutical, biotech, chemical, and chemistry services industries. It focuses on API development spanning early drug discovery through chemical development and commercial supply. Attendees are executive scientist "buyers" from pharmaceutical companies responsible for sourcing starting materials, intermediates, active ingredients, and commercial supply.

■ www.chemoutsourcing.com

FECC Annual Congress 2023

The FECC Annual Congress will return to Sitges near Barcelona, Spain, on September 11–13, 2023. FECC, the European Association of Chemical Distributors, will once again organize a program with inspiring speakers from different sectors and backgrounds, combining all relevant facts and figures companies need to be aware of with insights from experts as well as industry leaders. Additionally, networking opportunities along the entire chemical supply chain will extend the attendees' outreach towards existing and new peers.

■ www.fecc-congress.com

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The most modern fleet, shaping a sustainable future

Undoubtedly an architectural highlight: the Erasmus Bridge in Rotterdam – and in full swing and fully loaded M/T "Botticelli", the newest chemical tanker of GEFO, equipped with eight stainless-steel tanks, built in 2021. Four additional stainless-steel tankers will join in 2022, all named after painters who were ahead of their time: Canaletto, Tintoretto, Allegretto and Benedetto. All four new chemical tankers with Stage V engines according to new EU-standards and SCR-Catalysts. Most modern technology sets new benchmarks in their class by reducing hydrocarbons by 81 %, nitrogen oxides by 97 % and particulate matters by 95 %.

One tanker of the fleet of 150 tankers belonging to GEFO. 26 new build to reduce pollutant emissions. Which tanker will sail for you?

GEFO

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