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CLIB

networking biotechnology
creating sustainability

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Let us continue to be ready to change!

Dear CLIB members and friends,

The last twelve months have certainly been special in many ways. The COVID-19 pandemic has shaped the last year and affected us all. It has had, and continues to have, an impact on our daily lives, on how we live with family and friends, and also on how we work. We have worried about those close to us falling ill, seen us struggle under the weight of the pandemic and the tragic consequences, and are mourning the many thousands of lives lost to the virus. Many things we had previously taken for granted and commonplace now seem far away. Attending concerts, travelling, or participating in conferences almost seems like a memory of a bygone era. Instead, new realities have entered our everyday lives in ways we could hardly have imagined. Travel restrictions, distance bans and the wearing of face masks were not in our minds at the beginning of 2020 when the last brochure of our cluster went to press. And yet today we are all - to varying degrees depending on the region or country - invested in this new reality.

Apart from many restrictions and the compulsion to change or even give up our habits, this pandemic has also brought about positive changes. Never before have terms like biotechnology, mRNA, or genetic engineering been so present and positively connoted as through the development of the mRNA-based vaccines that are currently being administered worldwide. We should use this positive momentum for science and biotechnology by also pointing out other contributions and successes of this technology. Many people are still unaware of the many places where biotechnology is already being used today and what it is capable of achieving, be it in the health sector, plant breeding, or industrial production. Without biotechnology, many products could only be produced with far greater effort and a correspondingly large ecological footprint.

And the pandemic has also shown this: the issues of sustainability, climate and environmental protection remain on the agenda.

Even if the COVID-19 pandemic has pushed these issues into the background in some places, they have remained present and on the agenda of policy makers, associations, companies, and citizens. The achievement of the two-degree target remains acute, and fast action is needed more than ever. The changes and upheavals necessitated by the pandemic were profound on the one hand, but on the other hand they showed what is possible, provided there is a sense of urgency. We should also use this insight in our efforts to transform the economy and combat climate change. Even if the impacts of climate change seem less tangible, they are no less urgent. Therefore, it is our duty to meet this challenge with as much commitment as this pandemic. For it too will have a profound impact on all our lives and it too will require change.

150 years ago, Charles Darwin published his work "The Descent of Man, and Selection in Relation to Sex". In it, he describes the workings of natural selection and variation; and he comes to a remarkable conclusion that, even 150 years later, is hard to beat in terms of relevance:

"It is not the strongest species that survives. Nor is it the most intelligent. But rather the one that is most willing to change."

Let us therefore continue to be ready to change! We will do our part with our activities in the network, be it through our projects, our online events, or our physical ones that will hopefully take place again soon. Join us in this endeavour!



Karl-Heinz Maurer



Dennis Herzberg

CLIB: Networking Biotechnology – Creating Sustainability

CLIB is an international open-innovation cluster of large companies, small- to medium-size enterprises (SMEs), start-ups, academic institutes and universities, as well as other stakeholders active in biotechnology and the circular- and bioeconomy as a whole. In our non-profit association, the members shape our cluster's interests and activities, and we work to promote industrial biotechnology in sustainable processes. We are active since 2008 and have built a strong and trustworthy network since then. Together with our members we are putting our mission into practice – networking biotechnology, creating sustainability.

Our membership of about 100 organisations comprises an international share of about 25 % (see figure 1). We are based in Düsseldorf, in the state of North-Rhine Westphalia (NRW): the chemistry and industry heartland of Germany, well connected to the neighbouring chemical regions of the Netherlands and Belgium. We do not see ourselves as a regional, but an international cluster. We aim to network our members within and beyond the cluster in order to initiate new research and business projects. Our goal is to network stakeholders along and across value networks and to identify new opportunities. In this regard, we try to include diverse industries and markets such as biotechnology, chemistry, food and feed, home and personal care, specialty chemicals, textiles, and others into our network. At CLIB, we link feedstock owners with technology providers, processing industries, and consumer industries, and this also is reflected in our membership structure.

An innovative field like the bioeconomy also needs scientific excellence. This is why our network also integrates universities with strong track records in basic research while also branching out into applied research and start-ups. Some of them have set up platforms to create novel technologies and to generate new scientific insights crucial for biotechnological processes and products. Our “CLIB-Competence Centre Biotechnology” (CKB, see page 20) offers an integrated infrastructure for the bioeconomy in NRW: From gene and enzyme to process and product. The research and technology organisations (RTO) in our network have a dedicated applied focus, such as the German Fraunhofer Institutes and several of our international RTOs.

An invention only becomes an innovation if it can be implemented and commercialised, and especially start-ups and SMEs benefit from access to a thriving ecosystem comprising experts and facilities essential for bringing an innovation to market. To this end, CLIB seeks to include within its network competence in intellectual property (IP) and legal issues, techno-economic evaluation, process development, and scale-up. Our members also include investors, consultants, infrastructure providers, pilot plants, and other networks.

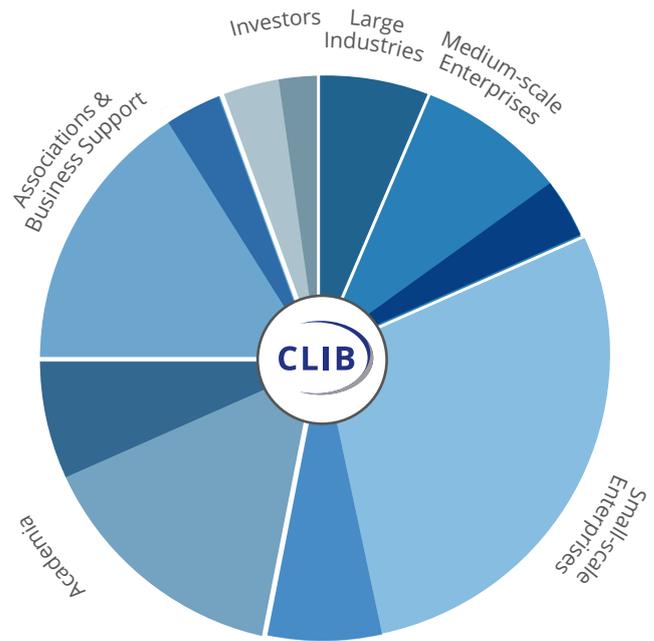
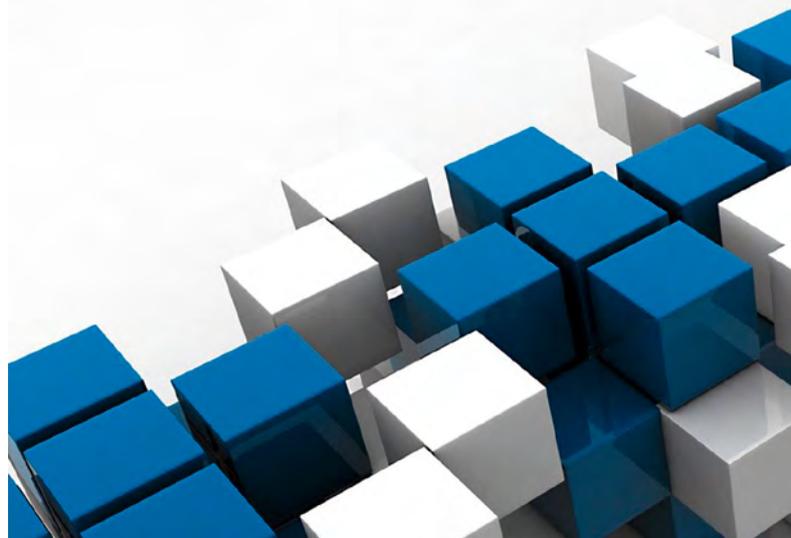


Fig. 1: CLIB members. Categories subdivided in national / international members

Both the circular- and the bioeconomy are a worldwide trend requiring a global approach. Our members and strong partners in Germany, Europe, Russia, the Americas, China, South-East-, and Australasia are the cluster's links to global markets. We have CLIB contact points at our partners' offices in Brazil, Canada, China, and Russia. It is in these regions, and Europe, that most of our activities are centred.

CLIB is also active in the European public-private partnership Biobased Industries and its successor, the CBE. (see page 17). Closer to home, CLIB has worked to form strong trilateral contacts between its German home state of NRW, The Netherlands, and Flanders. The well-established BIG-Cluster initiative has led to several R & D & I projects, some of them currently being funded by the German Federal Ministry of Education and Research (BMBF) as part of the “Internationalisation of Leading Edge Clusters” funding programme (see pages 21 – 22).



CLIB Strategy

CLIB has worked hard to build – and merit – a reputation of being creative, credible, independent, competent, and authentic. Our members appreciate our reliability, neutrality, and competence in the fields of industrial biotechnology, project management, funding opportunities, and networking. As a synthesis of this reputation and as an incentive to become even better in the future, we commit ourselves to our mission statement:

As a reliable and competent partner we will deliver value to all our stakeholders, by professional networking within industrial biotechnology, across disciplines, regions, and nations; bringing together the expertise and knowledge needed to create sustainable products and processes, and to support the circular bioeconomy.

Networking biotechnology – creating sustainability:

In four words, this claim summarises the mission of CLIB. In all our discussions with our members, networking is our most appreciated core business and strength. As for every cluster, this includes the identification and acquisition of new potential members. At a time when traditional boundaries between sectors are becoming increasingly blurred, it is more important than ever to identify innovative partners who can enrich the network and add to the membership. It is, however, equally important to maintain the existing network and to create additional value beyond the sum of its members.

While few words have been used as frequently in recent years, sustainability is still considered the most important driver for CLIB. This is what we measure novel trends, technologies, projects, and ideas by. Industrial biotechnology is one key to foster sustainability in its three dimensions: people, planet, and profit

In our work as CLIB team, both terms go hand in hand: a network must be created sustainably to meet future requirements. Without strong partners, sustainability cannot

CLIB e.V.

CLIB is a registered association under German law, based in Düsseldorf, NRW. The main bodies of our association are the Extended Board, the Advisory Board, and the annual General Assembly. Our Extended Board (see page 35 – 37) has 12 seats, with each group of members (industry, SME, academia, and others) represented by three seats. The Extended Board meets at regular intervals throughout the year to make strategic decisions, and it elects the Executive Board of four chairpersons. CLIB receives strategic input from an international Advisory Board made up of eight experts from academia and industry (see page 38 – 39). The General Assembly is called once a year to give members an overview of current activities and strategy and to allow them to comment and provide input. At the CLIB office in Düsseldorf, a staff of eight carries out the cluster work and organisation.

be achieved for a complete industry, let alone for a global community. To live up to our mission statement, our activities, actions, and projects are centred on five strategic elements: networking, regulatory framework, technology transfer, scale-up, and education (see figure 2).

Networking

As stated above, networking is our core business. We connect our members with one another, along and across value chains, sectors, and disciplines. We also open the cluster to input from external partners and stakeholders and work together with trusted associations to attract new ideas and impulses, thereby providing our members with new opportunities in business, networking, and partnering. At CLIB, we have designed and implemented a structured networking process (see pages 10 – 11) to connect matching stakeholders and to provide a fruitful, constructive setting in which to exchange ideas and form project consortia.

Framework

The implementation of the bioeconomy and the circular economy needs a supporting regulatory framework on regional, national, and EU levels. CLIB has for years been active at all these levels to promote the potential of bio-based and alternative feedstocks and bio(chemical) processes, as well as to help identify technologies and market requirements. Although no new sector should only depend on subsidies, a positive regulatory framework that includes the certification of bio-based products, the use of side- and waste-streams for the circular bioeconomy, combined chemical-biotechnological approaches, and a focus on cradle-to-cradle product evaluation can accelerate the implementation of a sustainable, bio-based economy. If implemented correctly, initiatives such as the EU's Green Deal and the related policy initiatives can be a decisive turning point.





Fig. 2: The five elements of the cluster's strategy.

So far, there has been no level playing field for the circular bioeconomy to compete with existing technologies. The latter have often been directly subsidised, benefitted from regulation and tax benefits, and their sustainability cost is often being borne by the taxpayer or society. To help develop to a circular bioeconomy, we need to harmonize new technologies and regulation. Policies should be developed based on facts and allow for timely adaptation to scientific progress (e. g. regarding novel gene editing technologies such as CRISPR). To adopt these new technologies, industry needs sufficient planning certainty and a clear regulatory framework in which investments can be made.

In light of the current pandemic crisis and the discussion about climate change, which has only briefly receded into the background, biotechnology has received a lot of attention in the political landscape and public perception. This is an important momentum which we want to seize to advance the sector: to create societal benefits on a foundation of sustainable, sound circular bioeconomy.

Technology transfer

For a successful bioeconomy, ideas developed in science labs need to be swiftly translated into application. Despite an excellent science scene, it is still rare for ideas to enter the market. To promote technology transfer, it has proven very important to anchor the idea of entrepreneurship and of creating a spin-off in minds of young scientists at an early stage of their career. We actively support technology transfer from academia to SMEs and industry, for example in the CLIB Competence Centre Biotechnology (CKB). Through our structured networking process, we are able to match technology developers with their downstream value chains and can initiate and evaluate consortia.

A very effective instrument for technology transfer can be start-up companies who can explore new grounds flexibly and innovatively. Accordingly, we offer coaching and support to start-ups and give them opportunities to pitch their ideas to relevant stakeholders. Our annual G-BiB competition for pre-post doc stage entrepreneurs has already coached over 30 start-up ideas and seen several young teams launch their research into a marketable idea. We have established ourselves as an important contact point for start-ups.

Scale-up

A major hurdle for successful technology transfer is scale-up and demonstration. Even after partners have been found and have all agreed on the further development of a research result, it can be a challenge to scale up a process from the lab to an industrially relevant environment, or even to produce enough sample material for testing a novel molecule or substance. Many ideas and young companies fail in the notorious "valley of death" between laboratory scale and market entry.

In our strategy, we focus on higher-value products, which are relatively easily accessible and can serve as enablers to establish biotechnology in the industry. This lowers the hurdle towards industrial scale and economic feasibility. Even for these relatively small-scale processes however, universities, RTOs, and SMEs don't always have the necessary equipment to achieve the required scale. This is a major hurdle and CLIB is supporting different efforts to overcome it. The CKB is a decentralised organisation to provide better access to research facilities for academics, speed up process development and interact with SMEs.

The Dutch-German Network Circular Bioeconomy also provides support to SMEs by co-financing testing and feasibility studies. Within the HiPerIn 2.0 project we are identifying innovation hurdles to the market entry of high-performance ingredients, we build relevant cross-sectorial networks, and set-up consortia to overcome these hurdles. In addition, we also support enhanced integration with chemical processes and in chemical parks. Starting in 2020, CLIB and several other partners collaborate in the MPowerBIO project (see page 26) to specifically support SMEs to find the right investors. Funded by the Ministry of Economic Affairs, Innovation, Digitalization and Energy of the state of NRW, CLIB is currently analysing parameters for a Bio Scale-up Center NRW, to allow companies to scale-up their biotechnology processes towards competitive TRL level.

Education

The most important “resource” for a sustainable circular bioeconomy and its underlying biotechnological landscape are well educated professionals, who are optimally prepared for the challenges ahead. A dedicated education approach is crucial for fields such as biotechnology as well as the circular- and bioeconomy, in which multiple scientific disciplines intersect. Only through specialised initiatives can new professionals be trained who are experts in their own disciplines but are also able to take a holistic approach to a process, product, or value chain. CLIB especially supports the collaboration of academia

and industry in applied research and is working on cross border concepts of education in key biobased technologies. For this purpose, new online education concepts are increasingly being used, which have a large international multiplier effect (see page 27).

CLIB provides added value to its members by integrating them into an international network of academia, investors, SMEs, and industry and by building knowledge in relevant topics, markets, and technologies as well as trends in biotechnology and clean technologies. The cluster provides access to specialists in the fields of biology, chemistry, and engineering, and helps to create novel business models through the formation of networks and the analysis of novel value networks in biotechnology and bioeconomy. The formation of tailored consortia, the provision of information on current calls and strategy processes in the field of the bioeconomy and circular economy, and the support of demo or pilot projects and processes help CLIB members to realise new research, demonstration, and innovation projects either in consortia or in bilateral contacts.

To fulfil our mission statement, we always seek to ensure that all our projects address two or more of our strategic elements. New projects are measured by how well they fit into the CLIB strategy to add value to our members (see figure 3).

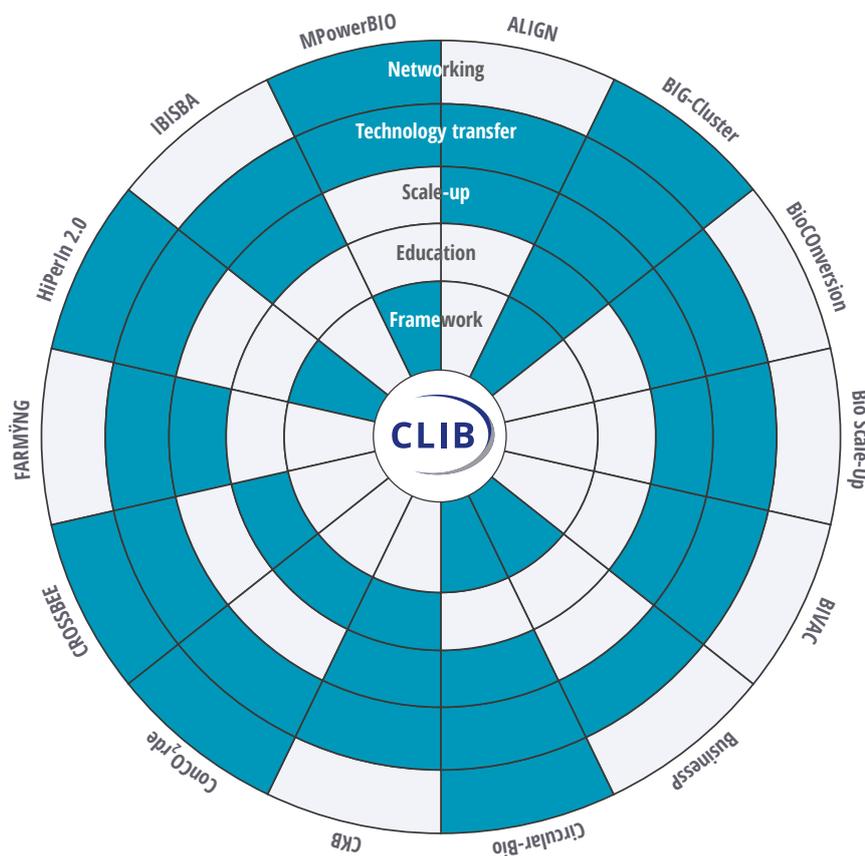


Fig. 3: Classification of projects according to the cluster's strategic elements. Shades of blue indicate the elements mainly pursued within each project.

Member Benefits

The CLIB teams works to bring benefits to the cluster's members. Like all networks, we depend on our members, and can only act as a multiplier of your own commitment. We invite you to become involved and contact us regarding your requests or wishes. We are always ready to arrange a telephone call, a short visit, or a presentation with you and your colleagues.

Like many other things, CLIB does not stay the same. Technological leaps, changing framework conditions and global trends constantly require foresighted adaptation. What has not changed over the past years and will not change in the future is our diligence, our trustworthiness, and our enthusiasm to shape the future of the circular bioeconomy together with our members!



CLIB is a networker

We connect our members to each other and create an innovative matrix through carefully chosen additions to our network. Our experience of more than 13 years gives us fast and reliable contacts to partners, experts, and investors. Especially in view of the current contact restrictions, personal contact must be maintained through high-quality virtual exchange. Regardless of the digital possibilities, however, we still consider "real" encounters to be indispensable and will organize such events as soon as possible again!



CLIB is a scout

We keep our eyes and ears open for our members. Through our well-developed international and interdisciplinary network, we - as trained scientists - can provide information on developments and innovations in the technologies and markets relevant to the circular bioeconomy. We are close to the current and future developments in several initiatives and keep the wishes and interests of our members in mind.



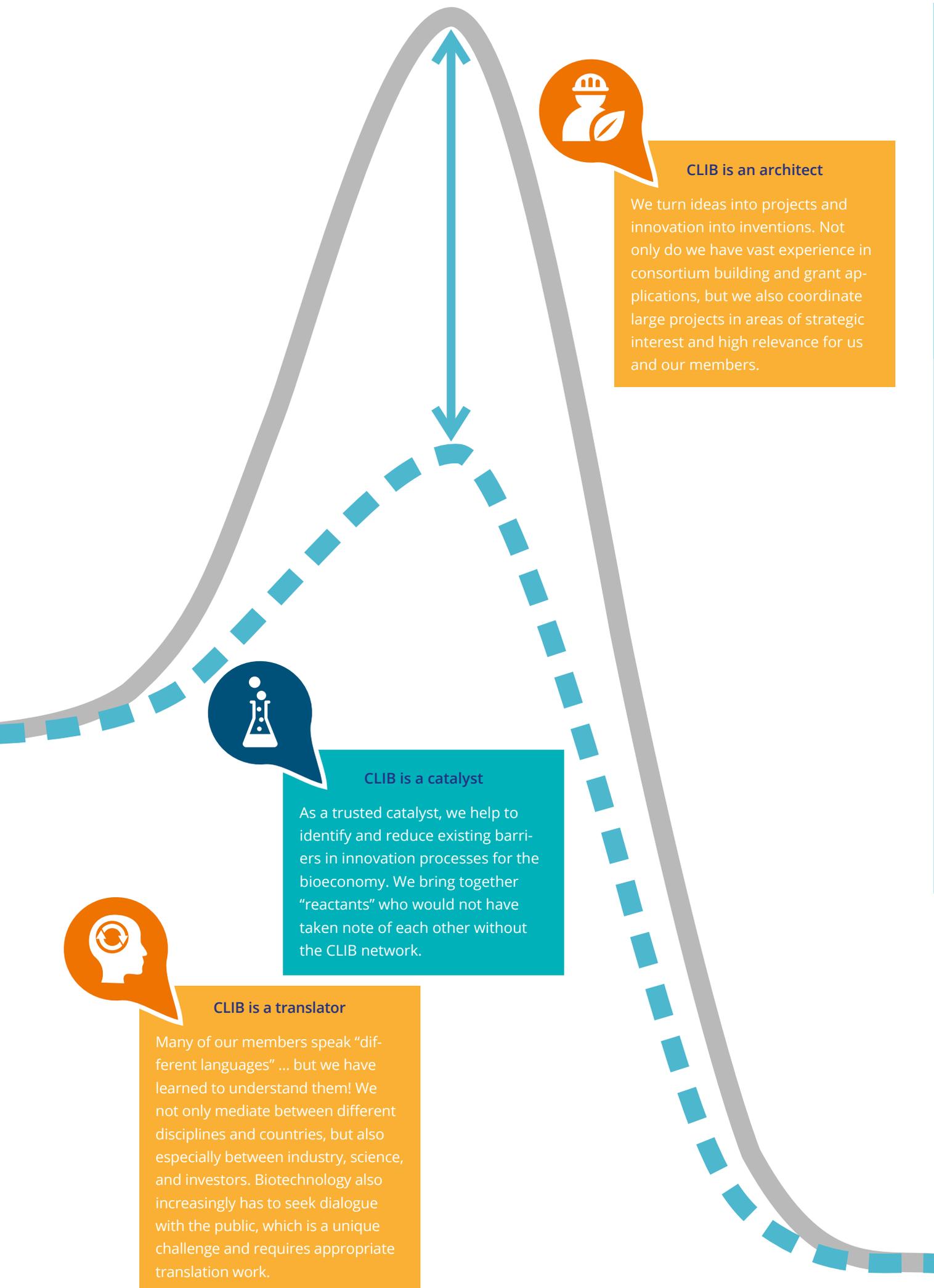
CLIB is a globetrotter

We believe that global challenges require international consortia. As one of the BIG-Cluster core partners, we can establish contacts to provide access to Dutch and Belgian fund-raising options. We partner with clusters across Europe in the 3Bi Intercluster and are active in pan-European initiatives. To support and further expand the already existing international network, we have organised delegation trips for our members to many different areas of the world, including China, Brazil, Canada and Russia.



CLIB is an advisor

As door opener, we support start-ups in identifying their intellectual property, developing their business model, and finding investors of different risk acceptance and investment volume: we help young enterprises to cross the infamous "valley of death". We also make efforts to promote and educate future biotechnologists through innovative programs, events, and coaching.



CLIB is a translator

Many of our members speak “different languages” ... but we have learned to understand them! We not only mediate between different disciplines and countries, but also especially between industry, science, and investors. Biotechnology also increasingly has to seek dialogue with the public, which is a unique challenge and requires appropriate translation work.



CLIB is a catalyst

As a trusted catalyst, we help to identify and reduce existing barriers in innovation processes for the bioeconomy. We bring together “reactants” who would not have taken note of each other without the CLIB network.



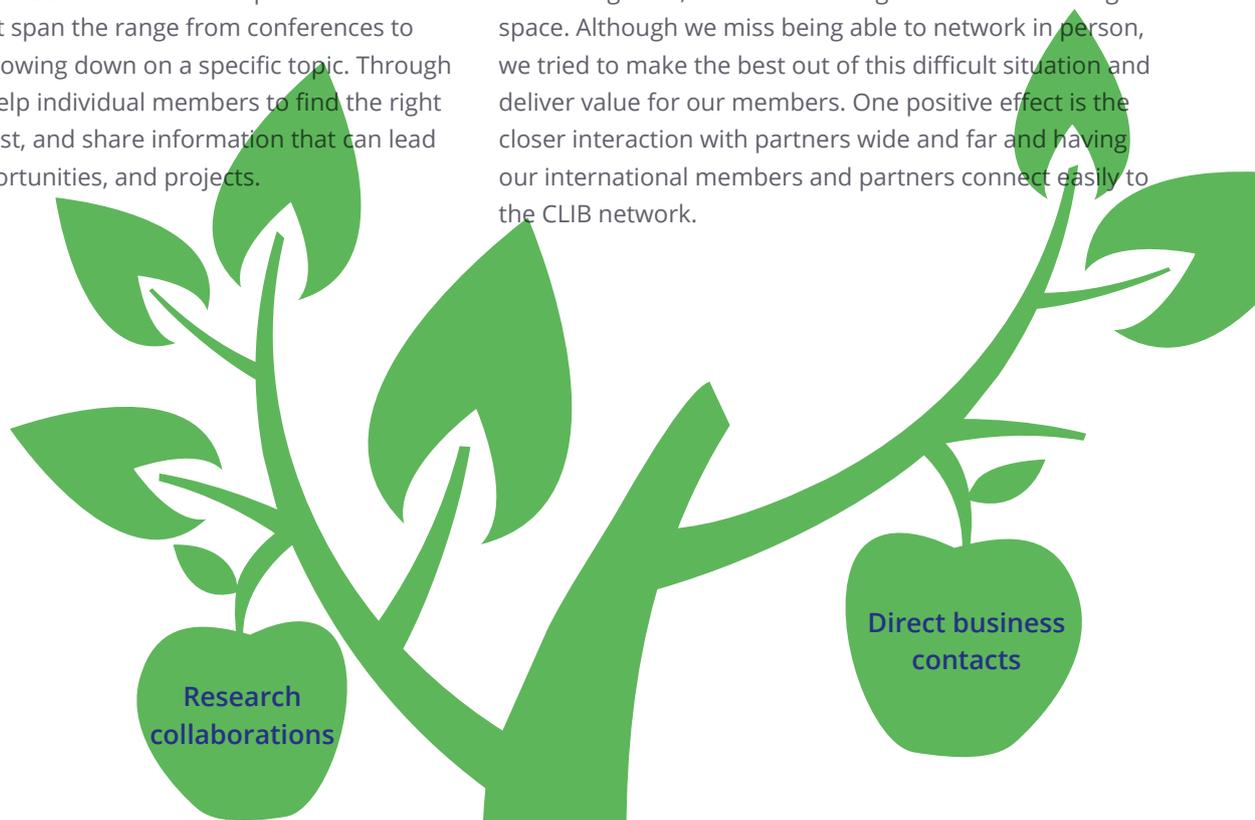
CLIB is an architect

We turn ideas into projects and innovation into inventions. Not only do we have vast experience in consortium building and grant applications, but we also coordinate large projects in areas of strategic interest and high relevance for us and our members.

Structured Networking Process

Our structured networking process is designed to connect our members with one another, along and across value chains, sectors, and disciplines in order to provide a fruitful, constructive setting in which to exchange ideas and to initiate new research and business projects. All this under our claim **networking biotechnology – creating sustainability**. The CLIB team has developed a series of event formats that span the range from conferences to bilateral talks narrowing down on a specific topic. Through this process, we help individual members to find the right partners, build trust, and share information that can lead to new ideas, opportunities, and projects.

In 2020, the CLIB team faced a challenge to its usual networking due to the global Corona pandemic response. We needed to develop networking formats which would work online: we quickly switched to an online videoconferencing tool to offer web-seminars, scouted for online collaborative tools to mimic working on flip-charts and whiteboards together, and started using a virtual networking space. Although we miss being able to network in person, we tried to make the best out of this difficult situation and deliver value for our members. One positive effect is the closer interaction with partners wide and far and having our international members and partners connect easily to the CLIB network.



CLIB International Conference (CIC)

At the beginning of each year, CLIB organises the large CLIB International Conference (CIC), which allows our cluster members, but also friends and partners of the network, to hear and discuss information about new topics and trends, and innovative technologies and methods. The conference also offers the possibility to meet face-to-face and exchange ideas with the international CLIB family. Before each CIC, the CLIB team identifies the interests of the members and focuses on innovative topics. Through the CIC, we create a platform for cross-sectoral communication and exchange between different industries and disciplines.

After the CIC, CLIB analyses the most important topics discussed during the conference and uses this information to subsequently organise so called forum events.

Forum Events

This type of event has a strong focus on particular topics and offers a discussion platform that enables all participants to exchange new ideas and innovations on specific subjects. Forum events bring together members, but also include external stakeholders, which provide an interesting addition and added value to the CLIB network. Topics cover broad fields such as food, feed, cosmetics, home care, or coatings and are discussed on the basis of new technologies, feedstocks, or processes. More structural topics, like the support of start-up companies or education, can also be the subject of a forum. Presentations come from large companies, SMEs, and academia, from the CLIB network and beyond. This ensures that at each forum the industry view, new technologies or business ideas, and also cutting-edge science are represented. Forums thus aim to cover the entire value chain, from feedstock suppliers via technology providers to chemical process industry and brand owners. Introducing cross-cutting topics makes these value-chains branch into value-networks.

Project development

Actors interested in a concrete project idea can be supported by the CLIB team in consortium formation, the more precise specification of a topic, or in the identification of suitable funding opportunities for new project ideas. Finally, we can support the newly formed consortium in writing the proposal to apply for a public funding.

R&D projects

Round Table Meetings

Round table meetings usually build on forum events and aim to develop concrete actions to initiate cooperation or collaborations, draft proposals, and projects. Available technologies, industry-relevant applications and cooperation partners are identified by the CLIB team. Subsequently, discussions are organised in smaller groups to support the early stage of a direct cooperation.

CLIB acts as a mediator of such meetings, highlighting topics and directing discussion partners in a target-oriented way. Due to the large basis of trust between our members and us, this often happens without an NDA.

Direct business collaborations

Project ideas

Within a R&D project, CLIB can ...

- Support you in drawing up the consortium agreement through our expertise in the CLIB team and in the network;
- Foster the internal communication between the project partners (academic partners, industry, SMEs) and the external communication to stakeholders from the bio-based sector, society, and policy makers by the use of multiple channels (e. g. website content, social media, meetings);
- Spread the innovative outcomes achieved within the project;
- Exploit the project results, e. g. by the assessment of technology transfer models, market chances, and reference customers, or by helping to transfer these results to marketable innovations;
- Help you make the most of your project!

In Dialogue with CLIB

CIC2020, February 2020

After a year off, the CIC was back on the international stage. With 165 participants, 30 lecturers and two days full of exciting topics, CLIB wanted to illuminate how sustainable foundations can be built for future generations. Already the initial lectures suggested that the topics of sustainability and biotechnology are no longer just theory and science, but have actually found their way into real products.

The first day was in the light of high-performance ingredients and the corresponding HiPerIn 2.0 project, funded by the MWIDE. In his greeting, Minister Pinkwart emphasised that the time has now come for biotechnology to finally create facts in form of start-ups and scale-ups and how HiPerIns can act as pioneers in this regard with their high added value. However, external framework conditions also influence the current state and the future development of the biotech-sector. Accordingly, the first day also touched these cross-cutting topics like digitalisation, circularity and regulatory frameworks. Furthermore, a whole session addressed the topic of alternative protein sources for food and feed. With a growing world population and a more demanding middle class, the already visible problems with our current systems and processes to produce proteins will become even more pressing. The first day ended with a lively panel discussion about public perception of bioeconomy and biobased products. It clearly highlighted the different perspectives that must be considered when trying to address the broader public about ideas and innovations.

The second day focussed on the tri-national open innovation initiative Bioinnovation Growth mega-Cluster (BIG-Cluster) and the three R & D & I projects ALIGN, BioCONversion, and CROSSBEE, all coordinated by CLIB. 14 speakers from four nations presented academic innovations, industrial successes, and promising start-up cases. The day was opened by Prof. Dörte Rother, Forschungszentrum Jülich, talking about enzyme cascades which her group develops to access large product platforms. The first session "CO₂ utilisation: The complex world of a simple molecule" dem-

onstrated a number of successful examples of technical innovations in this sector such as synthetic enzymes and cells to design a process, sustainably produced H₂ for artificial photosynthesis, bio-ethanol from acetogenic microbes and single cell protein for animal feed. The second topic presented was all about the required skills and competencies in the bioeconomy. The session "Crossing borders – Shaping future education" aimed at showing how diverse entrepreneurship in Germany is and which competencies are required to enable young professionals to transfer innovations from the lab to the market. The BIG-Cluster day was completed by the third session on biobased aromatics for the growing adhesives market. Plenty of adhesives and a multitude of other chemicals and building blocks are made of biobased aromatics, so the session "Aromatics: Rings that glue the world together" showed a broad range of technologies and products that can be based on aromatics and lignin. Like the first day, also the second day of the CIC was shaped by the attendants and their lively discussions at the end of each session and during all breaks. The BIG-Cluster projects clearly proved their importance in the European biotechnology and bioeconomy sector.

For the CLIB management, the CIC2020 was a great success. "We enjoyed seeing our members and broader network using every minute of the breaks for discussions and networking. Supporting biotechnological innovations by providing a platform which is so well received is a great compliment for our cluster and our CLIB team.", says cluster manager Dennis Herzberg, "We thank all speakers, moderators and visitors for their input and I would also like to thank the whole CLIB team again for organising this successful conference."

In retrospect, it was a great stroke of luck having been able to hold the conference without any restrictions. Due to the emerging pandemic, the CIC remains as one of the few real events in 2020. However, let's not take it as a sad reminder of better times, but rather make us look forward to future events after the crisis has been overcome.



13th International Conference on Bio-based Materials , May 2020 (co-organised)

The 13th International Conference on Bio-based Materials, organised by the nova-Institute, was one of the first conferences shifted into the online space. It presented key innovations in the fields of bio-based building blocks & polymers, fine chemicals, breakthroughs in lignin utilisation, industrial biotechnology and biodegradable solutions

CLIB was again a premium partner of the conference and hosted the session on fine chemicals for pharma, cosmetics, body care, and specialties, moderated by Dennis Herzberg. James Philp from the OECD talked about chances and pitfalls of synthetic biology. Gerard Santiago from Nostrum Biodiscovery presented how they are engineering enzymes using computer-aided methods. Jakob Köchermann from the German Biomass Research Centre DBFZ talked about their production of furfural and levulinic acid in a two-stage hydrothermal conversion process. Ulrich Schörken from the TH Köln presented insights on the biotechnological conversion of renewable resources for cosmetic applications with a focus on surfactants and bioactive ingredients. The last presentation of the session was given by Kathrin Brandt from Evonik and Roland Breves from Henkel on their joint project on bio-based glycolipids now used in a toothpaste distributed by Henkel.

As part of the advisory board, CLIB was involved in the nomination of the six finalists for the "Bio-based Material of the Year 2020" which was then chosen by the participants of the conference. The first place went to a wood fibre-based ready meal tray certified for home composting from Huhtamaki Lurgan (UK / Finland). With a sustainable self-adhesive tape made from bio-based PLA and a natural rubber adhesive and a functional barrier coating enables mono-material packaging, the second and third place were taken by material innovations from Germany.

RIN Workshop "Sustainable plastics economy", May 2020

In May 2020, an online event within the RIN Stoffströme project addressed the topic of plastics. Against the backdrop of current criticism regarding littering of the oceans and microplastics in the environment, the workshop addressed the question whether plastics are an obstacle to a sustainable economy or whether they can even be an important building block for establishing it.

Two presentations addressed different aspects of this topic were. Henning Wilts from the Wuppertal Institute analysed the status of the circular economy in Germany and the EU. While recycling rates remain quite high (almost 70 % in Germany), the cyclical material use rate (i. e., the share of material resources used which came from recycled products and recovered materials) remains low, with only 12 % in Germany. The same discrepancy is true for plastics recycling: only 12 % of the plastics processed in Germany are based on recycled material, whereas 88 % are virgin material. There are several barriers for the utilization of recycled materials, which usually are more expensive, as their collection and separation are quite labour intensive. Moreover, the regulatory framework sets a heavy burden on materials once labelled as wastes.

How to approach these issues from a technical but also a value chain perspective was presented by Hartmut Pflaum from Fraunhofer UMSICHT. The Fraunhofer cluster Circular Plastics Economy (CCPE®) combines a material, a business, and a systems division. In addition to searching for materials that are either recyclable, degradable, and / or biobased, the cluster also looks into a set of technologies, helping with recycling, circular logistics, data management and circular assessment. To complete these activities, the business division develops prototypes for circular product design, e. g., child safety seats.

The event highlighted that circularity within the plastics economy needs a true systems approach, from waste-management and recycling, to processing and product design, and customer behaviour.



3Bi web-seminar “How to Create a Circular, Bio-based Recovery in a Petro, Post-COVID World”, July 2020

3Bi, Brokering Bio-based Innovation, is Europe’s Bioeconomy Intercluster, a partnership between the French cluster IAR, the Dutch Circular Biobased Delta, the UK-based BioVale, and the German clusters CLIB and BioEconomy Cluster. In its first joint web-seminar, 3Bi discussed “Crisis and Opportunity: How to Create a Circular, Bio-based Recovery in a Petro, Post-COVID World?”.

Dutch refineries were hit hard by the COVID-19 lockdowns, as they could not reduce output quickly enough to match the decreased demand explained Erik Klooster from VNPI. Refineries which are well integrated with the chemical industry and able to transition to low carbon fuels will be better positioned to deal with the coming energy transition and electrification. Mercedes Alonso from NESTE emphasised the importance of reducing the amount of carbon released into the atmosphere through innovative circular solutions to reuse carbon again and again. NESTE works on solutions from renewable diesel and aviation fuels to work on renewable plastics and recycling. To accelerate circularity, plastics must be rethought with an end-of-life in mind to allow for e.g. liquefaction and upcycling, but virgin carbon via renewable polymers from bio-based feedstock is essential. A presentation from Frank Kuijpers (SABIC) focused on SABIC’s Trucircle™, which includes recyclability design, mechanically recycled polymers, circular polymers, and renewable polymers, in order to close the loop. Chemical recycling offers materials which are equal to the original polymers, making plastics completely recyclable without loss of quality. SABIC aims to build a demo plant as a first step towards fully commercial production level facilities.

It became clear that many technical boundaries are being broken, but that the economics of the new circular bioeconomy have to compete with depreciated conventional plants, legislation lagging behind current developments, and a public not yet convinced that bio-based feedstock is put to good use in the chemical industry. We have made a recording available [here](#).

Workshops at Global Bioeconomy Summit GBS2020, November 2020

The Global Bioeconomy Summit (GBS) is a high-level, biennial international conference. It aims to globally review and discuss emerging opportunities and challenges of the bioeconomy and develop visions for the future development of a sustainable bioeconomy among key actors from governments, science and innovation, business, and civil society. The summit links bioeconomy policy closely to global sustainable development and climate agendas.

CLIB was actively involved in two of the 12 pre-summit workshops. Together with our partners in 3Bi, we elaborated a workshop designed to showcase SMEs scaling-up their bio-based processes and products to the market and identifying hurdles and chances to achieve market entry: **“Scaling-up and industrial transition to bioeconomy”**. CLIB was also invited to co-moderate a breakout session on broadening the spectrum of utilised raw materials and feedstocks for biotechnological processes. This session was part of the workshop **“New Technologies as Accelerator of a Sustainable Bioeconomy”**

In the workshop on scale-up, established multinationals explained how they are developing non-fossil-based products in their portfolio, and young SMEs founded in the bio-based space presented their novel bio-based products and processes. Four key messages were developed:

- De-risking is essential to achieve scale
- Collaboration is essential, especially public-private partnerships
- Novel bio-products need to hit the sweet spot and be competitive on price, performance, and sustainability
- Start-ups are technology drivers and collaboration between large industry and them is a success model

The workshop drew a lot of interest in both the overarching topics as well as the individual companies’ approaches.

In the workshop “New Technologies as Accelerator of a Sustainable Bioeconomy”, CLIB was co-hosting a breakout



session on (raw)materials and feedstocks. Following three input presentations on regional bioeconomy strategies from China, Germany and Canada, key questions were discussed. Three main statements were elaborated:

- Bioeconomy has to build on regional biogenic resources
- The cascading use of feedstocks (primary biomass and processing residues) should be prioritised
- Political/financial support is required to foster the effectiveness and economic viability of the Bioeconomy

HiPerIn 2.0 Forum “Biotechnology and Textiles”, November 2020

As part of the HiPerIn2.0 project, this CLIB Forum took a closer look at the textile market under the motto „Biotechnology and Textiles: Can biotechnology help the fibres and textiles sector towards sustainability?“. This foray into a relatively new field for CLIB was met with significant interest, having over 80 live participants.

Dr. Tatjana Schwabe-Marković gave an overview on the challenges and opportunities of the textile industry, especially regarding the integration of biotechnology. Prof. Dr. Georg Gübitz (BOKU Vienna, Austria) explained where enzymes are already being used commercially in the textile space and where such processes are being developed. He pointed out that re-purposing enzymes which are already being used at large scale in second generation biomass processing for the use in textile processing is possible and can be economically feasible.

Dr. Stan Theophilou from BlueGene Technologies presented bio-based dyes produced by E. coli strains, an innovation designed to help dye the two billion pairs of jeans produced globally per year. As final speaker, Dr.-Ing. Sascha Schriever (ITA, RWTH Aachen University) presented where biotechnology and textiles meet in technical examples such as biopolymers or functional coatings. The institute is also co-coordinating an innovation space on biotextiles. It became clear that biotechnology can offer innovations for the textile industry, beyond the production of fibres,

including finishing chemicals, dyes, and also recycling. The challenge will be to bring the two sectors together and identify scaleable processes.

HiPerIn 2.0 Forum “Biotechnology appeals to all senses”, December 2020

Christmas cookies, scented candles and mulled wine not only appealed to our senses during the Christmas season, but also inspired the traditional December CLIB Forum. Within the framework of the CKB and the HiPerIn 2.0 project, the biotechnological production of flavours, fragrances and colourants was viewed from different angles.

Dr. Markus Müller briefly introduced the different fields of application and current market trends of flavours and fragrances. Fabienne Hilgers (IMET, HHU Düsseldorf) described her research on heterologous sesquiterpene production in *Rh. capsulatus*. To optimise metabolic fluxes, she designed a promising optogenetic toolbox including photocaged inducer compounds.

Dr. Nadja Henke from the start-up Bicomer presented her business model of the microbial production of the high-potential terpenoid astaxanthin. Having its main application fields in the cosmetic and feed industry, astaxanthin can be used as high performant colourant providing antioxidant, anti-aging and UV-protective functionalities. Demonstrating the proof-of-principle for its engineered production strain and process, Bicomer is aiming to scale-up the process for market entry.

Dr. Daniel Solis Escalante (Firmenich) described the entire targeted development route for the industrial production of terpenoid molecules. Microbial synthesis routes often compete with chemical synthesis and enzymatic conversion when establishing economically viable process routes. Firmenich resolves this by combining the various disciplines directly in the process development, identifying the most efficient synthesis route. This leads to innovative high-performance ingredients that are produced sustainably, based on renewable substrates.



Framework

Implementation of the bioeconomy and the circular economy needs a supporting regulatory framework on regional, national, and EU levels. CLIB has for years been active at all these levels to promote both the opportunities as well as the needs of the circular and bioeconomy. This is mainly done through our strong connections with the political stakeholders in NRW and the federal ministries in Germany. But also, our close ties with other German networks and associations like DECHEMA, BIO Deutschland, or BIO.NRW help us to give the bioeconomy a strong voice. Some of our projects with a regional focus like the now finished RIN Stoffströme or the Dutch-German Network Circular Bioeconomy also address the municipal political level. It is in the cities and districts where the foundation of the bioeconomy has to be built.

The upcoming structural change in the lignite mining area of NRW is both a demanding challenge as well as an enormous chance. It may result in the transition from the biggest fossil-based power producing region in Germany to a model region for sustainable production and living, based on regenerative energy and the concepts of a circular and bioeconomy. CLIB is engaged in shaping this process which started in 2019 and will continue until 2038. It will see massive funding with up to 15 bn euros over the course of the next 19 years.

On the European level, CLIB is also present to give its members a voice. We give input to consultations on topics which matter to our members, and advise on work programmes in the European framework programmes. We are a founding member of the Biobased Industries Consortium (BIC), which is the private partner of the Biobased Industries Joint Undertaking (BBI JU) PPP in Horizon2020, and aims to be part of the successor PPP Circular Biobased Europe (CBE) in Horizon Europe. We are also active in the Vanguard Initiative “New Growth Through Smart Specialisation”, where CLIB is involved in the pilot project on bioeconomy, specifically in the demo case dealing with biogas. Being part of several Horizon2020 projects (see page 27 – 32) also helps to widen our European network. Without a doubt, the BIG-Cluster Initiative is the most prominent example for our efforts to join forces across borders to push the bioeconomy and to facilitate joint projects and investments.



RIN Stoffströme

To improve the utilisation of side and waste streams in industry, agriculture, or forestry, the Regional Innovation Network (RIN) “Model Region for Innovative and Sustainable Material Flow”, in short RIN Stoffströme, was set up in 2014. The project’s main goal was to improve the exploitation of biomass, wastes, and side streams in the cross-border region of NRW and The Netherlands. The aim of the RIN was to develop feasible concepts for that task through an interdisciplinary approach which also integrates users and society. The experience showed that although including such stakeholders increases the complexity of the work, it can be very rewarding, leading to new approaches and synergies, and even raising new scientific questions.

The RIN lay the basis for several project dealing with concrete side streams (BIVAC, Business-P), or dealing with the issue of public acceptance and involvement (BioDisKo). Its approach and topics are now picked up and developed further within the Circular-Bio project. Looking back at the six very successful years in this project, the RIN broadened the CLIB network and competencies in areas like stakeholder management, circular-economy concepts, and sustainability. The close ties that have formed between the project partners CLIB, EnergieAgentur.NRW and DGAW will be sustained and cultivated further.



Circular-Bio INTERREG Network

A concept for a circular bioeconomy network linking the Netherlands and NRW, including two municipalities as part of the project consortium, started in early 2020. Different types of event formats support the stakeholders in the region in the development of new, innovative, and cross-border value chains and business models in the bioeconomy sector. In addition, the project offers an innovation coupon scheme for SMEs to further develop their business cases and foster their process development. It further aims to network stakeholders from agriculture, logistics, biotechnology, academia, and the processing industry, as well as municipalities to lay the foundation of a thriving circular and bioeconomy within the cross-border region.

BIG-Cluster BioInnovation Growth mega-Cluster

The BioInnovation Growth mega-Cluster (BIG-Cluster) is a cross-border Smart Specialisation Initiative aiming to make Europe's industrial mega-cluster in the Flanders region of Belgium, The Netherlands, and NRW a global model in comprehensive bio-based value chains. The region has been a powerhouse of industrial innovation for decades and seeks to keep this prominent position in the future bioeconomy. The BIG-Cluster was initiated by the three cluster organisations BE-Basic (The Netherlands), Catalisti (Flanders, Belgium), and CLIB (NRW, Germany) and is backed by additional cluster organisations and networks in the three regions. Today BIG-Cluster is coordinated by Circular Biobased Delta, Catalisti and CLIB.



BIG-Cluster's purpose is to speed up the transition to the bioeconomy and circular economy in the participating regions, to identify and take advantage of critical mass and synergies in public and private R & D as well as in training and education facilities, and to build capacity. One of the long-term goals is to enable pilot and demonstration activities for the production of chemical building blocks and fuels based on alternative feedstocks sourced in the region, such as 2nd generation biomass and



industrial waste gases. The BIG-Cluster focuses on the feedstock-to-product (F2P) value chains "Aromatics and Fine Chemicals from Woody Biomass" (Biobased Aromatics), "Chemicals from CO and CO₂" (C1 Bioconversion), and "Biomass strategies"; and the cross-sectional topics "Circular Economy Education" (Education) and "Closing the loop". In 2018, CLIB initiated three international consortia focused on these topics (see chapter technology transfer and education on the following pages). An updated innovation agenda to drive BIG-Cluster's activities in the upcoming years has been elaborated with stakeholders from industry, SMEs and academia coming from all three regions and was published in spring 2021.

BIC

CLIB is a founding member of the Biobased Industries Consortium (BIC), the private partner of the Biobased Industries Joint Undertaking (BBI JU) PPP in Horizon2020. As the BBI JU has now closed its last call for proposals in 2020, the focus of BIC is shifting to the potential successor PPP in the Horizon Europe framework. In Circular Biobased Europe (CBE), BIC will seek to expand the partnership to include primary producers and brand owners, and reach out to society in order to achieve the vision of a carbon-neutral bioeconomy, replacing fossil-based products to mitigate climate change in a circular bio-society.

In this partnership, we see a chance for industry to identify knowledge and technology gaps to be addressed in collaborative funded projects, to de-risk much needed investment in reaching higher technology readiness levels (TRLs) for biobased processes, and to create a critical mass in bringing the best ideas to bear on innovation in the biobased sector. This means structuring the sector and leading the way to creating a circular bioeconomy in Europe. As a cluster member, we represent several of our SMEs in BIC. We are a member of the programming core team, which we are chairing in 2020/2021, member of the education team, and give active advice on future strategic orientations and work programmes of the PPP.



Technology Transfer

Bridging the gaps – transferring technology from academia to industry or from SME to large enterprise – is one of the challenges taken on by CLIB each day. CLIB brings together stakeholders from academia and industry along the whole value chain in its structured networking process. CLIB moderates the related exchange between academic and industrial stakeholders in order to further the understanding of each other's needs and expectations. One example is to give academia an understanding of market needs, and the required specifications and performance of new products and processes. The goal is to initiate R & D & I projects with defined technology development goals. Moreover, CLIB supports market-oriented technology development by selecting target products in a dedicated process and choosing the appropriate technology approaches, based on market needs. This structured networking process is also showcased on pages 10 – 11.

The exploitation of research results by academic institutions is often limited due to an insufficient technology readiness level (TRL) and a lack of commercialisation strategies. Since the technical and financial risks are high, industry is often hesitant to pick up such ideas for further development. The transfer of research results into commercial applications requires tremendous financial and time efforts as well as diverse scientific and economic expertise. The extraordinary diversity of life science technologies, their areas of application, and the necessary knowledge needed to apply them further complicate technology transfer in this sector.

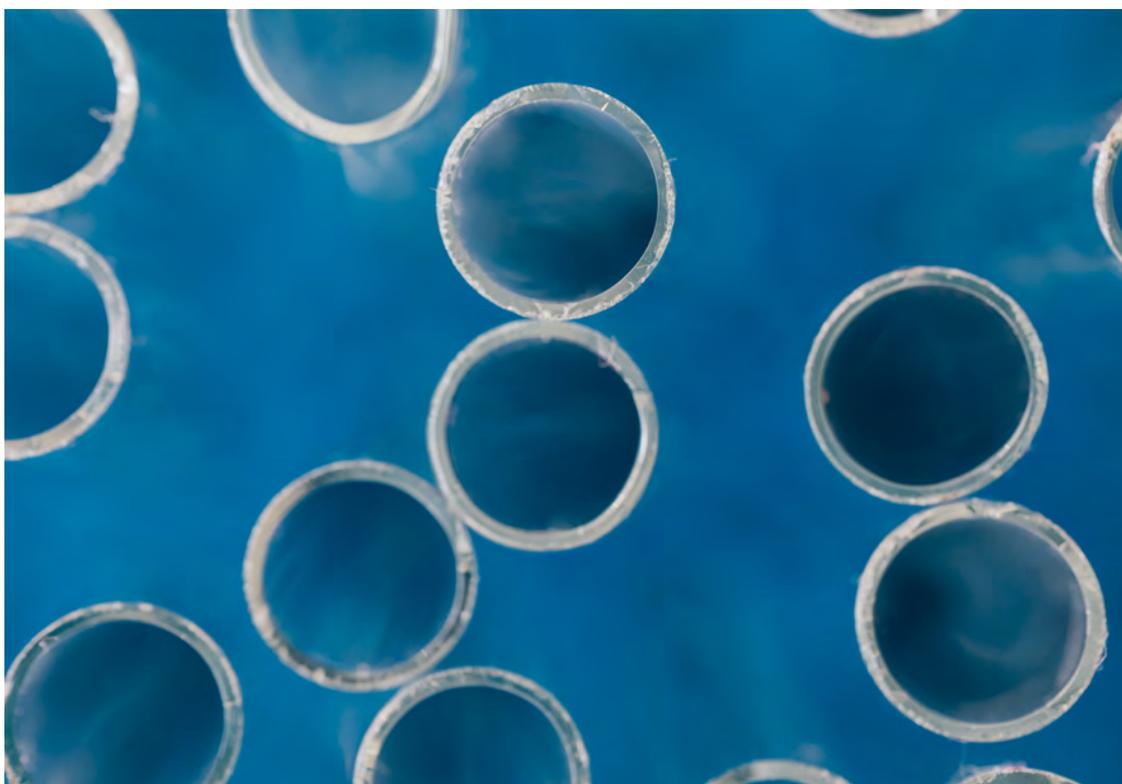
To bridge this gap and to trigger industrial interest for further development, CLIB supports technology transfer through a multifaceted approach that also involves its strong network of strategic partners. Furthermore, the cluster creates visibility for novel technologies and young companies through presentations at its events and in its publications.

In projects involving technology transfer, CLIB can perform several kinds of analyses, depending on the cluster's involvement in the individual project and the funding available. It starts with the development of a dedicated workflow fitted to the demands of the given topic. CLIB

performs value-chain analyses in order to identify available technology approaches, relevant stakeholders, and potential markets. Based on this evaluation, a SWOT analysis elucidates the near-, medium-, and long-term business opportunities of the value chain in focus. As was done in BIG-Cluster, CLIB can help to select one or two technology approaches or concepts of novel value chains with extraordinary potential for commercialisation. For these, tech-transfer strategies are then developed by evaluating the technology readiness as well as potentials and risks. In addition, CLIB can prepare business models, including calculations of production costs, investments, and revenues as well as estimations of volume availabilities and market shares. Moreover, IP concepts and strategies for further technology developments and strategic partnerships can be designed. CLIB collaborates with experts from its network on several of these areas.

Novel Value Chains

Catalysing the establishment of novel value chains within the bioeconomy is one of the major tasks of CLIB. Such value chains can form within a given industry or sector, but they are more likely to develop at the boundary of different industrial sectors. When as-yet individual branches, such as the chemical sector and the pulp and paper sector, start to converge, new value chains will form. This might happen because an enterprise seeks to forward integrate its product portfolio to gain access to later stages of the value chain or to diversify its product portfolio. Examples include agriculture or forestry enterprises starting to develop chemicals in addition to their original products for food and feed or for construction. This is one of the major opportunities of the bioeconomy: creating new business models for agriculture and forestry.



New value chains might also form where previously separate markets start to converge. One example is the fields of nutraceuticals, at the convergence of the pharmaceutical with the food industry). The nutraceuticals market includes functionalised food and beverages, as well as dietary supplements and is projected to grow at a CAGR of 8.3 % over the period 2020-2025. Well-known and developed biotechnology-based examples would be sweeteners as replacements for sugars or valuable fatty acids, e.g. produced by algae.

These often fragmented and still smaller markets are easier to penetrate by new biotechnological processes not yet developed at large scale. Smaller-scale but high-value products offer the chance to find a niche to be profitable with a new bio-based or biotechnological process, even offering business cases for pilot or demo projects. In this regard, such specialties can be enabling products for long-term markets of bulk chemicals and fuels.

The aforementioned developments typically emerge from market pull. Technology push can also create novel value chains. Especially in rather young ecosystems such as the bioeconomy, technological breakthroughs can be the force behind the formation of completely new services and products. For instance, the ability to utilize gaseous carbon substrates on a commercial scale to produce platform chemicals such as ethanol (e.g. then converted into (poly-)ethylene), opened up new value chains integrating biotechnology, chemicals, and the steel industry.

Another kind of market pull also plays an important role: the regulatory framework. While this is not new, it has taken on a new dimension as countries across the globe have committed in the Paris Agreement that anthropogenic global warming should be kept to less than 1.5 °C. Although the process is slow, an increasing part of society and more and more well-known individual citizens are demanding action on climate change. Already companies are considering the importance of their sustainability reports to attract potential investors, and publicly pledging their commitment to climate-neutrality in order to increase consumer acceptance. These movements are here to stay and will in the long run lead to regulatory frameworks raising the price of carbon emissions, and limiting the use of fossil-based resources. In December 2019, the EU heads of state met in Brussels and agreed to make the union “climate neutral” by 2050. The European Green Deal aims to achieve this, by setting out a Climate Target Plan to reduce greenhouse gas emissions by 55 % by 2030, investing in research and innovation, and protecting the environment. At CLIB, we believe that biotechnology in a circular bioeconomy is an essential part towards achieving these goals.

Regulation can also play a strong role in forcing new value chains to emerge through direct interventions. The ban on BPA in certain products has led to a shift in the use of additives for the plastics and coatings industry and we can expect this drive towards substances with less impact on human health and the environment to continue. These regulations often come with long lead times, enabling a slow shift towards new products, but increasingly they are introduced more swiftly as with the ban on single-use plastic. CLIB aims to anticipate these regulatory effects, enable members to act on them and with its partners to advise both industry and policy on their effects.

It is in the fields just described that CLIB aims to offer a radar for new developments and opportunities. In close interaction with our members from industry and academia, we analyse markets which show interesting developments, inform about political regulations, or identify technologies with a high innovation potential. Currently, CLIB focuses on the following near-term markets because they show dynamic growth rates and offer opportunities where biotechnological processes can provide advantages over chemical routes:

<p>Personal & home care</p> <ul style="list-style-type: none"> • Biodegradability • Cosmetics • Flavours and fragrances • Surfactants 	
<p>Food, feed & nutrition</p> <ul style="list-style-type: none"> • Alternative protein sources • Crop protection • Flavours and fragrances • Nutraceuticals • Supplements 	
<p>High performance materials</p> <ul style="list-style-type: none"> • Adhesives • Coatings • Functionalised surfaces • Packaging • Textiles (fibres) 	

In addition, process technology and education are two focus topics at CLIB because they have the potential to create further technology push for the bioeconomy. We consider bulk chemicals as well as fuels and energy to be long-term markets for biotechnology that we keep an eye on but which are not a priority in our cluster.

HiPerIn 2.0

One of the strengths of biotechnology is the conversion of functional starting materials into high-quality products. This area of high-performance ingredients ("HiPerIns") ranges from specialty chemicals through the cosmetics and food industry to the pharmaceutical sector. During the original HiPerIn project coordinated by CLIB between 2016 and 2019, essential networks and projects could be initiated in this area. However, global challenges, disruptive innovations, and changing framework conditions have made it necessary to design a revised, science-based concept to shape the next generation of bio-based high-performance ingredients: HiPerIn 2.0.



HiPerIn 2.0 expands its thematic focus to reflect the rapid change in biotechnology and includes cross-cutting issues which had been identified by CLIB and validated in an exploratory phase in late 2019. It became clear that the increasing digitalisation of biotechnology, the renewed concept of a circular economy, the end-of-life debate, the public perception of biotechnology, and increased regulatory requirements are cross-cutting topics which are of interest to many stakeholders. After the kick-off in February 2020, where CLIB was lucky enough to hold the first and last real-life bioeconomy conference of the year, the project had to contend with the challenge of expanding a network when networking was shifted entirely into the online space. CLIB still used the time to pursue the topics of biosurfactants (in a white paper due early 2021), textiles (in a forum event), flavours and fragrances (also a forum event), and food/alternative proteins (part of the CIC Event Series). Another focus in the HiPerIn project is the support for project consortia and the identification of potential funding lines.

CLIB-Kompetenzzentrum Biotechnologie

Within the first HiPerIn project, CLIB developed a plan for a Competence Centre to combine the necessary experience and speed up technology transfer. The project CLIB-Competence Centre Biotechnologie (CLIB-Kompetenzzentrum Biotechnologie – CKB) is supported through the research infrastructure initiative by the German state of NRW and started in May 2018. This virtual centre has been established by four academic members of CLIB: Bielefeld University, TU Dortmund University, Heinrich Heine University Düsseldorf, and the Forschungszentrum Jülich. The CKB builds on the previously funded separate

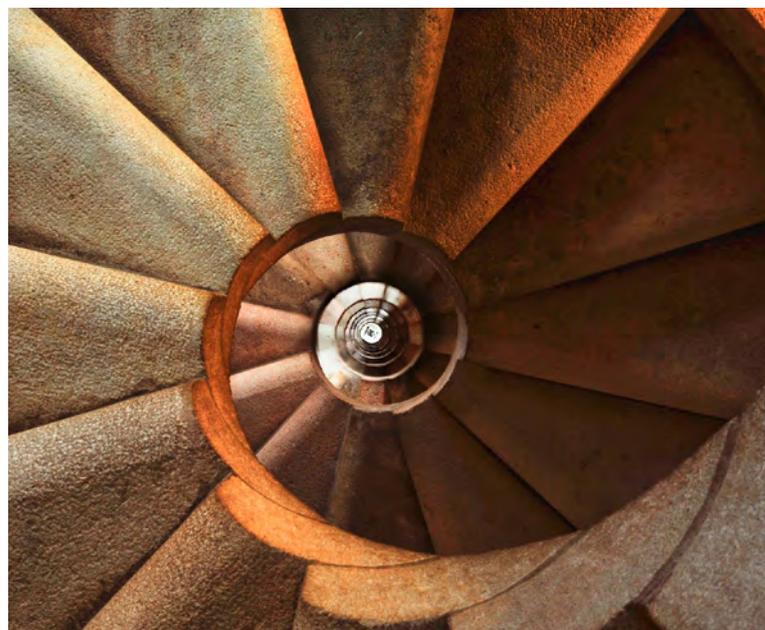


CKB CLIB-Kompetenzzentrum Biotechnologie

technology platforms at the institutions, which are now integrated within a joint centre to develop biotechnological processes in a holistic approach. CLIB anchors this centre within its network and the region. The project is aiming at speeding up technology developments by integrating all process steps allowing for parallel optimisation of the process. It focuses on the three megatrends resource efficiency, raw materials, and health in three work packages, which are all implemented across the CKB's locations and disciplines.

Circular-Bio INTERREG Network

Several stakeholders of the RIN Stoffströme have developed a concept for a border-crossing network, integrating companies, academic institutions as well as municipalities in Limburg (NL) and NRW. Led by CLIB, this project involves nine organisations (two municipalities, four companies, one academic institute and one network) working together to create novel value chains in the circular and bioeconomy in the region. It features feedstock suppliers from agriculture, forestry, waste management and the process industry to integrate materials and side streams in new regional process developments. The project supports the creation of innovative, biobased, and sustainable product designs for the chemical industry, the energy sectors, feed and food markets, mobility/fuels, and the pharmaceutical industry. These developments require involvement of practitioners in the various industrial sectors but also supportive framework conditions. The elaboration of the business cases and the process development will be supported using innovation coupons, which are offered within the project to support SMEs in their efforts.



BIG-Cluster Project BioCOnversion

We urgently need to change our thinking in relation to the increasing greenhouse gas emissions and the associated consequences for the climate and the environment. While the fossil energy sector might be the most obvious producer of GHG emissions, the processing industry also generates a stream of gaseous by-products at a constant quantity – and this will not decrease much with the coming shift to renewable energy sources. CO-containing process gases from steel mills are among the most relevant of these industrial side streams. In a paradigm shift, these process gases should not be considered waste, but as valuable feedstock streams. They could feed the biotechnological production of chemical building blocks currently produced from petrochemical processes, such as mid-chain carbon compounds with multifunctional groups. Making these important components and products from waste and side streams instead of fossil resources would be a major step to establish a sustainable bioeconomy.

BioCOnversion

One of the projects coordinated by CLIB is focused on the development of a new value chain to achieve this objective. CLIB supports this through various activities, initiatives, and projects. One example is the development of a biotechnological process and the establishment of a new value chain in the BioCOnversion project. The process under investigation starts with a gas fermentation converting CO-containing process gases from the steel mills of ThyssenKrupp Steel Europe into an intermediate, followed by an enzymatic upgrading to a plastic precursor.

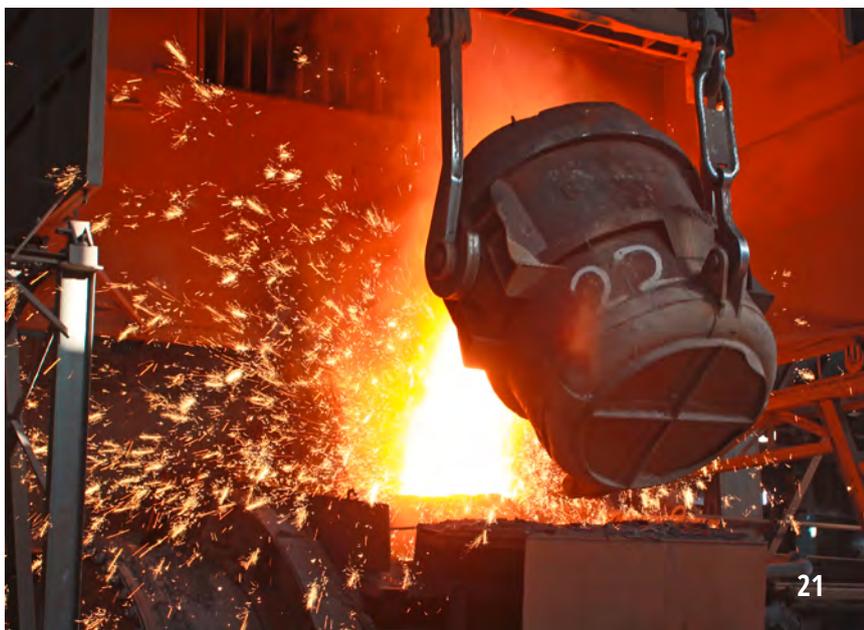
In a first project phase, the individual process steps were experimentally tested independently of each other. Now, in the second project phase, the most promising approaches are combined, and the conceptual design is developing step by step. The process performances of the different steps are evaluated by techno-economic assessments and life cycle analysis. Based on these results, the overall process will be experimentally validated and further optimised. BioCOnversion unites several innovative providers of conversion and recovery technologies into a powerful consortium covering the entire value chain – producing a high-value building block in a CO-based, climate friendly process.



BIG-Cluster Project ALIGN Aromatics from LIGNin

The production of aromatics is crucial for the chemical industry: they present a significant share of today's chemical building blocks, are used for a wide variety of applications across the chemical industry, and their growth rate is expected to be proportional to GDP growth. Currently, virtually all aromatic building blocks are produced from fossil oil. However, the availability of aromatic hydrocarbons from fossil sources will decrease, as less crude oil will be refined for energy use. Instead, the production of chemical building blocks from (shale) gas increases, but this process has a much smaller BTX (benzene, toluene, xylene) stream. The resulting gap between supply and demand can be met by using bio-based, renewable feedstocks for the production of aromatics.

This is addressed in the BIG-Cluster project ALIGN. It targets highly functionalised bio-based aromatics, which can be used in many different fields of applications, such as coatings, adhesives, or cosmetics. To produce them it is essential to establish lignin extraction processes which maintain the structure and functionality of lignin and combine them with innovative chemical and biotechnological conversion routes. Conventional lignin extraction processes are often optimised towards the fractionation and purification of cellulose for pulp production. In this case, lignin is usually a by-product of poor quality, meaning an undefined structure and a low degree of functionalisation. In order to make biorefineries profitable and optimally use the biomass feedstock, it is essential to convert also the lignin into high-value products. The use of lignin extraction processes which maintain the structure



and functionality of lignin, in combination with innovative chemical and biotechnological conversion routes enable the production of functionalised bioaromatics.

The ALIGN project not only addresses the issue of using bio-based feedstock instead of fossil-based resources to create products with high market potential, but also demonstrates the successful collaboration of different regions and disciplines to establish an innovative value chain. Partners with great expertise in chemical but also in biological conversion technologies focus on the conversion of woody biomass to lignin and subsequently to bio-based functional aromatics. By bringing together stakeholders from academia (technology providers) and industry (brand owners) and by fostering an active communication between these different parties, obstacles in the establishment of the value chain can be quickly identified when they arise. All stakeholders together can then define measures to overcome these hurdles. Such cooperation is crucial when adapting a technology to the industry's needs and when a fast market entry is desired.

Structural Change in Germany

The structural change in the German lignite mining areas represents an immense challenge for the actors in the affected regions in the states of Brandenburg, North Rhine-Westphalia, Saxony, and Saxony-Anhalt. According to the German Lignite Association, some 70,000 jobs in Germany are linked to the extraction and conversion of lignite into electricity.¹ If we consider the necessary restructuring of the energy infrastructure which goes hand in hand with the coal phase-out, the extent of this change, which reaches far beyond the regions mentioned, becomes apparent.

The German federal government is providing up to 40 billion euros in funding until 2038 to actively shape the structural change, which offers an enormous opportunity to strengthen local economies. In this sense, the coal phase-out can provide the necessary impetus to break up established structures and create space for new, innovative, and future-oriented concepts. The reference to the German Sustainability Strategy in the "Strukturstärkungsgesetz Kohleregionen" (Structural Strengthening of Coal Regions Act) can be understood as an indication that the German government also sees the opportunity to implement more sustainable and resource-efficient economic methods.²

The overarching concepts of the bioeconomy and circular economy with their different facets are also addressed in the Economic and Structural Programme ("Wirtschafts- und Strukturprogramm", WSP) 1.0 in the Rhenish lignite mining area, which sets the thematic framework for the structural change in this region. The mission statement reads: "As a European model region for energy and resource security, the Rhenish Future District is committed to the sustainable development of industrial value chains in the Rhenish lignite mining area. [...] The region is developing into a model region for closed material cycles and the circular economy, establishing new value creation in the bioeconomy."⁴ To achieve these goals, the existing linear value chains must be completely converted to circular value chains. This requires a rethinking of established procedures and the cooperation of actors throughout the entire production process.

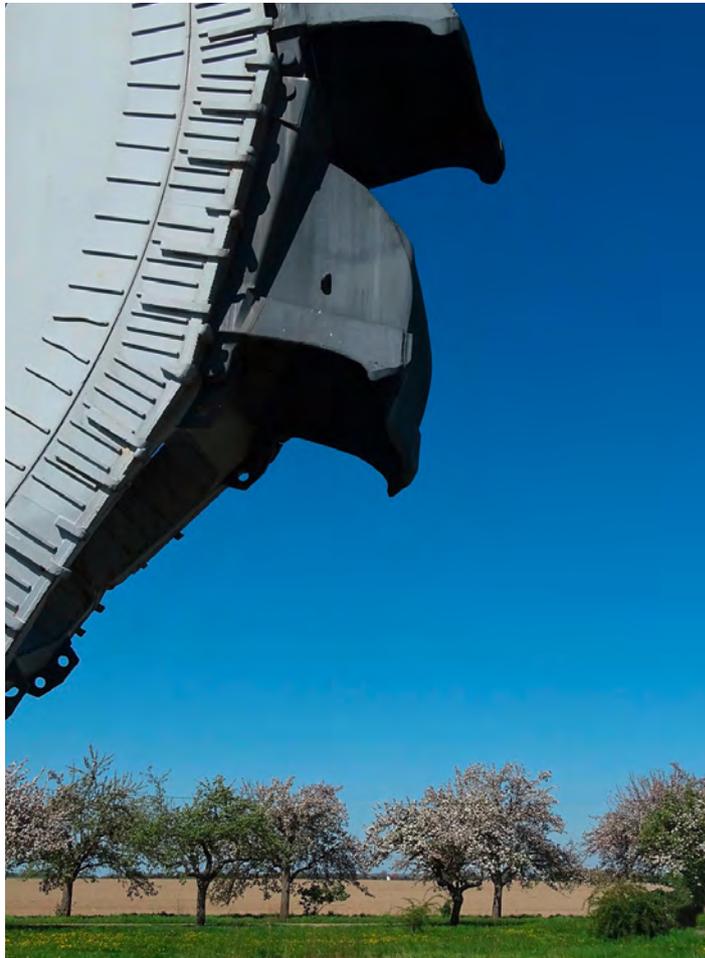
- 1 <https://braunkohle.de/wp-content/uploads/2019/04/Braunkohle-in-Deutschland-Daten-und-Fakten-Statistikfaltblatt-deutsch.pdf>, accessed 24.08.2020
- 2 Investitionsgesetz Kohleregionen InvKG vom 08.08.2020
- 3 Wirtschafts- und Strukturprogramm für das Rheinische Zukunftsrevier 1.0, p. 21



The biologically-oriented conception of technical developments with the aim of innovative and sustainable value creation is summarised under the term “biological transformation”⁴, a change from an oil-based to a largely bio-based industry. The adoption of biological designs, principles and processes leads to highly functional manufacturing techniques and products with novel properties can be produced in a resource-saving manner and used in a circular economy. It necessitates the development of the associated processes, procedures, plants, and machinery to change linear to circular value chains in a biological transformation requires the integrative interaction of biotechnology and chemistry, together with computer science, mechanical and plant engineering.

This is the next and necessary step in the evolution of biotechnology: Process development needs to extend beyond going from gene and enzyme to intermediate and ingredient towards integrating the finished product and its life cycle. Such a holistic approach raises several questions: How can a bio-based monomer, for example, be processed? Which additives are used and are they also bio-based and/or biodegradable? Is the entire product recyclable at the end of its life cycle - and if so, under what conditions? Finding answers to these questions requires detailed knowledge across the entire process and involving various disciplines and actors along the whole value chain.

CLIB is involved in Bio4MatPro, one of the planned projects within the structural change process in the Rhenish lignite mining area. It is coordinated by Prof. Dr. Ulrich Schwaneberg (RWTH Aachen University & DWI Leibniz Institute) and combines the expertise of a powerful mix of leading large companies and SMEs, a successful incubator with a planned Bio4MatPro translational research laboratory and excellent scientists in a growing innovation network, which is linked to investor funds via a venture capital accelerator.



The overriding aim is to use the opportunities offered by biotechnology and production technology as the next scientific and industrial development stage to rethink established product concepts. The competence centre will help to exploit these opportunities based on regional renewable raw materials for industrial value creation. In line with the cross-sectional character of biotechnology, the

Bio4MatPro competence centre is striving for broad diversification with a large number of customer industries (e.g. automotive, plastics processing, textiles, medical technology, or consumer goods). In addition to biotechnology and chemistry, the production, processing, and mechanical engineering industries are also centrally integrated into the competence centre. As a unique selling point of Bio4MatPro, products with customised biofunctional building blocks and the equipment, machines and technologies required for processing and production are thus developed in parallel. This creates an innovation network that is unique in this form and is intended to create an important growth core

with high local added value in the structural change region of the Rhenish lignite mining district.

Our vision for the region after a successful structural change sees a sustainable economic zone comprising a variety of smart agricultural production on recultivated land, production facilities based on renewable energies, biorefineries connected to existing processes, recycling plants, small-scale production facilities for high-quality ingredients, start-up incubators, and academic institutions. In such a diverse landscape, we see CLIB as the ideal accompanying designer, moderator, and catalyst, always in close exchange with the actors in the region and beyond.

4 Neugebauer R. (2019): Biologische Transformation. Springer Verlag, ISBN 978-3-662-58243-5

Scale-up and Demonstration

In biotechnology, the path from initial experiment to industrial process bridges many orders of magnitude. While the first trials and screenings often take place in bench-top devices at microliter scale, industrial bioprocess run in fermenters of several cubic meters of solution. An increase in volume of over eight orders of magnitude is not uncommon. For clarity: this is equivalent to scaling the weight of a toy car to that of a bucket-wheel excavator. Scale-up is a major hurdle, especially for the realisation of new bioprocesses.

Apart from these scientific and technical challenges which need to be overcome, financing is also a hurdle. At the latest on the demonstration scale, large financial investments are necessary, which often exceed the possibilities of small businesses. This is one reason why larger biotechnological processes are still rare in Europe. Another reason is the lack of experience regarding important process steps for large biotechnological processes (whereas the knowledge about chemical processes is much greater).

To establish biotechnology in the industry, CLIB focuses on higher-value, smaller-scale products, which are relatively easily accessible and can serve as enablers. But even for these relatively small-scale processes, universities and RTOs do not usually have the necessary equipment of the required scale. CLIB's strategy therefore calls for a timely involvement of the industry in research projects in order to integrate the industrial perspective at an early stage and to identify and develop scalable processes. The regular exchange of experience is vital to ensure projects don't "reinvent the wheel" and waste valuable time and resources. Additionally, the cluster supports the integration of biotechnological and chemical processes, as well as the realisation of processes in chemical parks. CLIB has considerable expertise in projects helping SMEs and academia to access equipment for testing, for example in the CKB or in the EU-funded project MPowerBIO, which aims at supporting SMEs in increasing their investment readiness level to attract financing. CLIB aims to continue supporting SMEs and start-ups, to cross the valley of death between a validated process in pilot scale and the commercial process. The Bio Scale-up Center NRW will enable biotechnological processes to be scaled up and validated in large volumes. The plant will address a TRL range of 7-9 and thus work complementary to existing pilot plants in Northwest Europe. The state of NRW will co-finance the facility and is already funding a conceptual design project lead by CLIB, which will shape the basic features of the Bio-Scale-up Center.

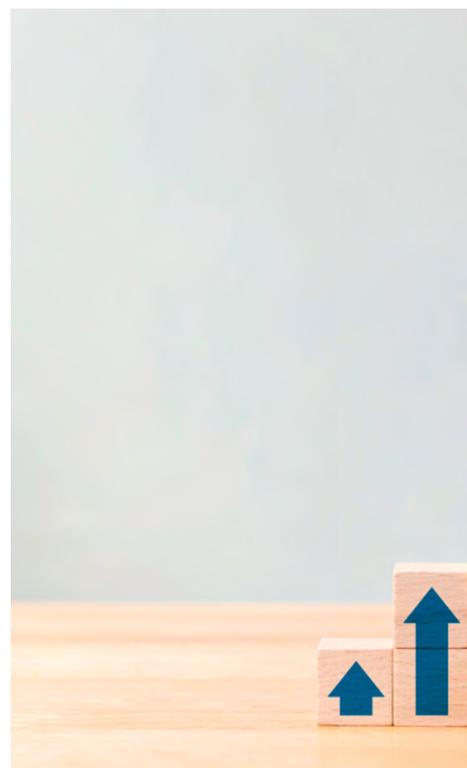
BIG-Cluster

An essential element of the circular bioeconomy is the efficient conversion of renewable non-food resources into chemicals in biorefineries, in order to reduce our dependency on fossil resources and to reduce the carbon footprint of many production processes. The BIG-Cluster region of Flanders, The Netherlands and NRW is Europe's leading industry region with a notably strong chemical industry. The BIG-Cluster initiative aims to establish novel value chains within the topics "Aromatics and Fine Chemicals from Woody Biomass" and "Chemicals from CO and CO₂". Within the project BIG-Cluster funded by the German Federal Ministry of Education and Research (BMBF), the implementation phase started in 2018 with the realisation of the projects "ALIGN: Bio-based Aromatics from LIGNin" and "Bioconversion of CO/syngas into a plastic precursor". Both projects aim to establish economically viable biotech processes, ready to be scaled up to commercial scale in the future.

CLIB-Competence Centre Biotechnology

The CLIB-Competence Centre Biotechnology (CLIB-Kompetenzzentrum Biotechnologie – CKB) aims at offering an integrated infrastructure for the bioeconomy in NRW: From gene and enzyme to process and product. The integration of all process steps: upstream - fermentation - downstream, will shorten the time from idea to market entry and thus enable a faster and more efficient upscaling of biotechnological processes. More than 20 working groups from the Heinrich Heine University Düsseldorf, the TU Dortmund University, the Forschungszentrum Jülich, and Bielefeld University are working on three megatrends: resource efficiency, raw materials, and health. They aim to develop new technologies and protocols to overexpress, secrete, and immobilise proteins and enzymes to make biotechnological processes even more selective and efficient.

The bioeconomy needs to be able to use a variety of feedstocks as raw materials and researchers in the CKB are working to improve the efficiency of conversion and





downstream processing. Researchers in the megatrend of health are harnessing and combining the advantages of both biological and chemical conversions by combining muta- and semisynthesis to diversify potentially active products for healthcare and the food market.

In the diverse research projects carried out within the CKB, the scientists aim to integrate individual units of operation. They want to establish a close interaction in order to

generate a continuous feedback and whole-process evaluation between feedstock preparation, catalyst and process development, as well as downstream processing. This will enable the CKB to shorten the time to develop a biotech process and drive towards successful scale-up.

The integration of an industrial advisory board and an IP board ensures that the academic research carried out within the CKB answers market demands and can be commercialised in a comparably short time.

BIG-Cluster Project ALIGN

Aromatics represent a significant share of today's chemical building blocks used for a wide variety of applications in fields such as polymers, adhesives, coatings, resins, surfactants, anti-oxidants, and cosmetics. Currently, aromatic building blocks are mainly produced from fossil resources, but this BTX feedstock stream will decrease in future. Also, the development of less toxic, natural molecules to replace toxic, synthetic ones, is strongly supported by consumer demand and regulations. The only large source for biobased aromatics is the abundant natural polymer lignin, but this is currently only used in limited amounts. Conventional lignin extraction processes are often optimised towards the fractionation and purification of cellulose for pulp production, leading to a low-quality lignin. It has an undefined structure and a low degree of functionalisation and is mainly burnt for heat production. However, in an integrated, efficient biorefinery the lignin should be converted into high-value products to optimise biomass use and revenue. To date, the production of high-quality aromatics from lignin fractions with a high degree

of functionalisation and defined structure possible only at small scale.

The ALIGN project focuses on the scale-up of three different, innovative extraction processes that each lead to a high-value lignin fraction and a pure cellulose / sugar fraction. These lignin fractions differ in their composition with regard to the degree of depolymerisation and functionalisation. From these different lignin derivatives, a wide variety of bio-based aromatics with unique properties can be produced through enzymatic depolymerisation and specific downstream processing strategies, which harbour great potential for a wide variety of applications in the aromatics sector ranging from fine chemicals to bulk products. One of the high-value products is natural vanillin for food and beverages. Project partners will aim to scale-up not only the lignin extraction, but also the production of natural vanillin. They benefit from a close interaction within the project, and the expertise each partner brings. Several project partners already have experience and equipment to scale-up to industrial scale, while others bring in their background in downstream processing. Direct interactions with companies intending to use the resulting molecules in applications means the consortium is able to plan all steps of the processes holistically and to incorporate economic parameters.



FARMYNG

The Biobased Industries Joint Undertaking (BBI JU) is the only support instrument funding the up-scaling of biotechnological processes to a first commercial scale. Its flagship projects provide funding of between 12 – 20 million euros to consortia which build first-of-a-kind plants at commercial level. So far, BBI has funded 12 flagships over the last six years. CLIB is a member of BIC, the private partner in the PPP BBI, with the public partner being the European Commission. We expect the successor partnership Circular Biobased Europe to continue these efforts under the Horizon Europe framework programme.

FARMYNG, a consortium led by the French start-up YNSECT, aims to establish the largest global fully-automated flagship industrial plant to produce premium proteins from insects (*Tenebrio molitor*) for animal and fish nutrition. CLIB is happy to be one of the 20 partners, which come from eight countries and ensure that the entire value chain needed for such a scale-up is represented. These include feedstock and larvae producers, companies

specialising in automation, and labs specialised in the analytics necessary to ensure the identity and good health of the beetles, but also to verify the final product specifications. The consortium also includes end-users who will utilize the final products. YnSECT is the SME behind the YnFarm™, and has grown from a start-up in 2012 to over 100 employees and 372 million USD in investment in 2020. It now coordinates the project, which has 19.6 million euros of funding.

At YnFarm™, wide range of sustainable products from beetles will be produced: protein meal, oil, and organic fertilizer. It will demonstrate the technoeconomic viability of the first full-scale industrial plant for the production of sustainable and alternatively-sourced proteins. It will also establish new bio-based value chains from agricultural by-products to the production of fish feed and pet food products. Another targeted value chain from insect excrement (frass) to fertiliser has moved closer within reach through the approval of frass for inclusion in (organic) fertiliser. It will now be tested by a vineyard owner and on other agricultural products as well as for horticulture. CLIB will, together with the clusters IAR and WPCC, ensure the dissemination of the project's results. CLIB will also analyse how feedstock from beetles can in the long term be used in the chemical industry.



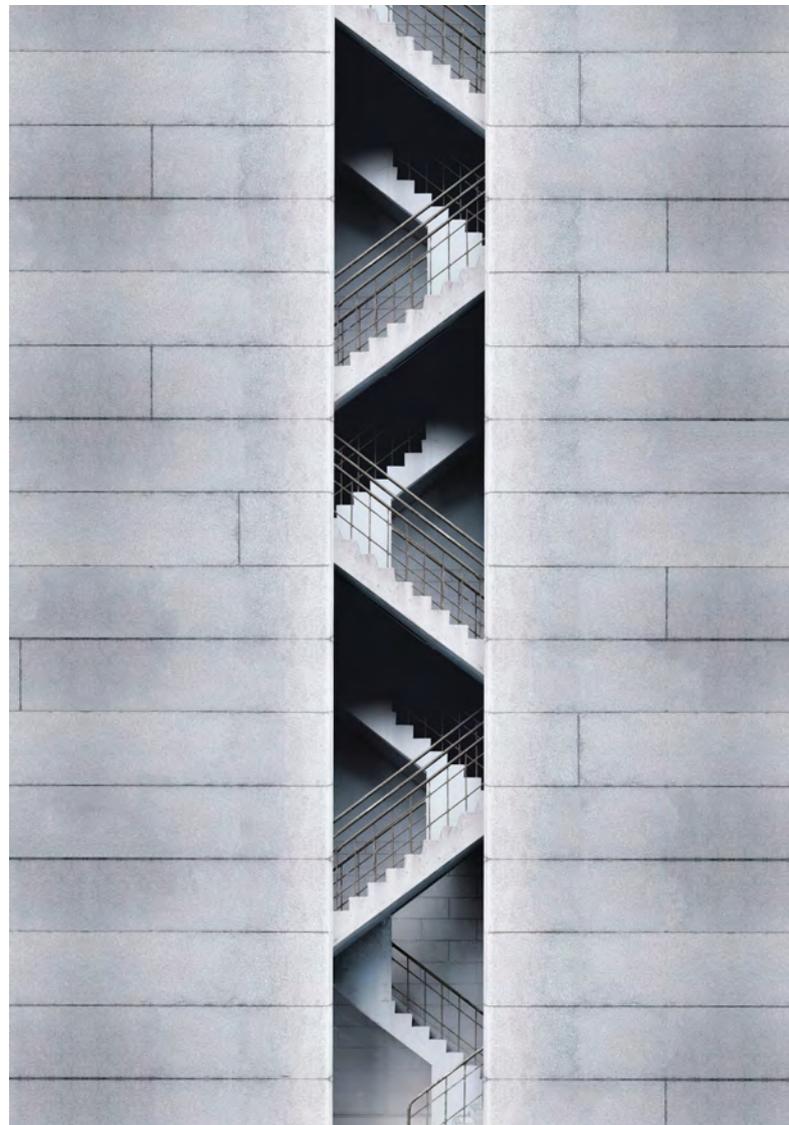
MPOWERBIO

SMEs are often technology drivers but can find it difficult to attract investors, especially for risky undertakings such as scaling up novel processes. The MPOWERBIO project aims to provide bioeconomy clusters with the capacity to support their SME members in assessing and increasing their investment readiness level, and finding funding. MPOWERBIO will also engage SMEs directly in a business support programme to provide training and mentoring. Through regional bootcamps and competitions, SMEs can get the chance to pitch in front of investors at the European Bioeconomy Venture Forum. In the project, CLIB will coordinate this cluster training, support its own SME members, and organise regional events.

Bio-Scale-Up Center NRW

The Ministry of Economic Affairs, Innovation, Digitalization and Energy (MWIDE) of the state of NRW has committed itself to co-fund the construction of a Bio Scale-Up Center in NRW. This will enable biotechnological processes to be scaled up and validated in large volumes. The facility is to address a TRL range of 7 - 9 and thus work complementary to existing pilot plants in Northwest Europe. Since only limited flexibility in terms of the processes that can be mapped is possible to achieve such a high TRL, processes and usable input flows must initially be restricted. However, the plant is to have a modular design so that later extensions are possible.

In order to design these basic features of the facility, a conceptual design project, also funded by MWIDE, is currently underway. Within the scope of this project, the needs, and requirements for such a facility are to be queried and analysed. The goals of this project are to outline the basic technical design of the facility based on this survey, to identify possible locations in NRW, and to develop the basic features of the business model.



Fostering Biotechnology by Promoting Interdisciplinarity and Entrepreneurship

Interdisciplinarity

Biotechnology and bioeconomy are wide-spanning fields, intersecting multiple scientific disciplines and engineering. Future bioeconomy experts will need a broad knowledge of multiple disciplines and have to be able to take a holistic view of a process or technology. These competencies can only be acquired via a tailor-made education approach. CLIB is fostering such training and education by collaborating with different partners from its network.

Within the BIG-Cluster project CROSSBEE (Cross-border Bio-Economy Education), a consortium of nine partners has developed and produced a Massive Open Online Course (MOOC) about Biobased Products for a Sustainable (Bio) Economy, available at edX. CLIB also serves on the education team of BIC. This works towards different education programmes for the bio-based industry in Europe, aiming to meet the demand for students and professionals with the right skills and competences.

The CLIB-Competence Centre Biotechnology (CKB) is coordinated by Bielefeld University. The consortium members Bielefeld University, Heinrich Heine University Düsseldorf, TU Dortmund University, and the Forschungszentrum Jülich were all part of the very successful CLIB-Graduate Cluster Industrial Biotechnology, which ran from 2009 to 2015 and awarded over 120 doctoral degrees. Within the CKB, several doctoral students are active and CLIB is responsible for the scientific exchange not only between the group leaders, but also these students. In the EU-funded MSC-ITN ConCo2rde, a European innovative training network will train 11 Early Stage Researchers to develop smart autotrophic biorefineries for the conversion of CO₂. CLIB will support several training activities with a focus on soft skills in this project.

CLIB cooperates with the Bioeconomy Science Center (BioSC) in co-organising the Annual PhD Student Day Bioeconomy, which brings together students from all over NRW and is supported by several other graduate programmes.

Entrepreneurship

CLIB also wants to foster entrepreneurship in Germany and Europe. Innovation and new technologies need young scientists enthusiastic about developing their research into a marketable idea. CLIB is active in promoting such an entrepreneurial spirit and in helping students to learn how to evaluate business ideas from an economic perspective.

CROSSBEE does so via the G-BiB, the Global Biobased Businessplan Competition. This student competition challenges teams of pre-postdoc students to develop an innovative business plan based on a design for a sustainable production process for bio-renewable products. During the competition, the teams learn to write a business plan, pitch their idea, and are individually mentored by experts. The first G-BiB took place in 2017, with students from Germany, the Netherlands, and Brazil. Winners were the Brazilian team SANergya, which received the Corbion-sponsored award of 10,000 euros at the finals during the 3rd Brazilian BioEnergy Science and Technology (BBEST) Congress. In 2019, the G-BiB took place for a second time with several teams from Germany and Belgium. The German team EBS – Engineering Biosurfactants won the G-BiB 2019: a sparring day at the High-Tech Gründerfonds as well as 7,500 euros prize money sponsored by Henkel.

In autumn 2020, the third round of the G-BiB started with teams from the United Kingdom, Finland and Germany. The international final was held online in February 2021 and the UK team “InsBio” won the final award together with a sparring day sponsored by the HTGF.

The next round of the G-BiB will start in autumn of 2021 and CLIB will again support young students in learning how to become entrepreneurs. We are proud that several teams who participated in the competition have since founded their start-ups and gone on to win further awards and investments.

In October 2020, we (Alexander Setchfield and Dr. Daniel Leadbeater), two researchers from the Centre for Novel Agricultural Products (CNAP, University of York, UK) entered the G-BiB competition. It became apparent from the onset that Alex's PhD research, supervised by Prof. Neil Bruce (CNAP), had significant commercial potential - transforming inedible crop residues into feed for Black Soldier Fly Larvae (BSFL). The G-BiB came at a perfect time, and under the name 'InsBio', we attended two masterclasses hosted by BioVale and Skillfluence. These, along with invaluable mentorship from Prof. Neil Bruce and Dr. Tom North, were crucial in developing our business plan and strategy. On 13 January 2021, we pitched at the UK semi-final and were declared the winning team. Taking onboard the judges' feedback and pivoting

our business model, we then pitched InsBio's business plan at the international final on 17 February 2021, facing stiff competition from Germany's and Finland's finalists. After an intense pitch and questioning from a panel of expert judges, we were declared the international winner of G-BiB 2020! We now look forward to a business mentoring programme by High-Tech Gründerfonds, a German venture capital investor for innovative technologies. Through this, we will prepare for a pitch later in the year with the hope of securing significant investment. InsBio soon hopes to form as a university spin-out company, whose technology will enable BSFL producers to increase production scale and gain greater security of raw material supply using sustainable novel feeds.

Overview of Current CLIB Projects

ALIGN – Biobased Aromatics from Lignin

Funded by:	German Federal Ministry of Education and Research (BMBF)
Duration & volume:	2018 – 2021, 1.8 M EUR
Partners:	Axxence Aromatic, CLIB, Fraunhofer CBP, Henkel, LXP Group, Phytowelt GreenTechnologies, TU Braunschweig, UPM Biochemicals (all DE); KU Leuven, VITO (both BE)
Responsible at CLIB:	Sarah Refai, Tobias Klement, Annika Thamm
Website:	www.bigc-initiative.eu/align.php



The ALIGN Project started in April 2018 and brings together experts in the field of bio-based aromatics from academia and industry. It deals with the conversion of lignin to bio-based aromatics with a high market value. This will help address the need for aromatic compounds in the chemical industry, which currently relies exclusively on building blocks from fossil oil – more specifically from a BTX stream which is already decreasing.

The consortium consists of three partners with extensive expertise in lignin extraction and depolymerisation (Fraunhofer CBP, KU Leuven, LXP), one partner especially analysing the possibility of enzymatic depolymerisation, one partner conducting downstream processing procedures (VITO) and four partners focusing on potential applications (Axxence Aromatic, Henkel, Phytowelt Green Technologies, UPM Biochemicals) to produce high-pressure-laminates, adhesives and coatings as well as natural vanillin for food and beverages. The German project partners will receive 1.3 m EUR from the Federal Ministry of Education and Research (BMBF).

BIG-Cluster – BioInnovation Growth mega-Cluster

Funded by:	BMBF
Duration & volume:	Scoping phase (2016 - 2017), 722,000 EUR Implementation phase (2018 - 2020), 3 M EUR 3 dedicated R & D projects with multiple partners
Partners:	CLIB (DE), Biobased Delta (NL), Catalisti (BE) (scoping phase) and seven additional clusters
Responsible at CLIB:	Katrin Kriebs
Website:	www.bigc-initiative.eu



The BioInnovation Growth Mega-Cluster (BIG-Cluster) is a cross-border “Smart Specialization Initiative” aiming to transform Europe’s industrial mega-cluster in the Flanders region of Belgium, The Netherlands, and the German state of North Rhine-Westphalia into the global leader of the bio-based economy.

Within the BMBF project, the first two years constituted a scoping phase, within which the value chains “C1 gases to chemicals” and “Aromatics from lignocellulosic biomass”, and activities for bio-based education were investigated. In 2018, three projects coordinated by CLIB and funded by the BMBF started: ALIGN, BioConversion and CROSSBEE.

The BIG-Cluster initiative continues its work and published a new innovation agenda with updated flagship topics in spring 2021.

*coordinator

BioCOnversion – Bioconversion of CO into a plastic precursor



Funded by:	BMBF
Duration & volume:	2018 – 2021, 1.5 M EUR
Partners:	CLIB, Covestro, Fraunhofer IME, Fraunhofer UMSICHT, nova-Institut, Ruhr University Bochum, RWTH Aachen University, thyssenkrupp Steel Europe AG, VDEh Betriebsforschungsinstitut (all DE); TU Eindhoven, Wageningen University (both NL); TU Graz (AU); BBEPP, VITO (both BE)
Responsible at CLIB:	Sarah Refai, Markus Müller, Annika Thamm
Website:	www.bigc-initiative.eu/bioconversion.php

The project BioCOnversion started in April 2018 and aims at developing and implementing a sustainable process from carbon monoxide (CO) to a defined polymer precursor by evaluating different technologies. In an international consortium, industrial and academic partners join their high-level, multidisciplinary expertise to develop a microbial bioconversion process comprising the primary conversion of CO/syngas into an intermediate alcohol through gas fermentation and the enzymatic upgrading conversion into the polymer precursor.

The project focusses on developing technologies for the individual process steps and on the conceptional design of the overall process. In a first phase, the individual process steps were independently developed. Next, their performance is evaluated by techno-economic assessments and life cycle analysis. Based on these results, the overall process is experimentally validated and further optimised. A final process evaluation along the whole development chain will be done from a techno-economic viewpoint. BioCOnversion is coordinated by CLIB and unites several innovative providers of conversion and recovery technologies – making a high-value building block available from a CO-based, climate friendly process.

Bio Scale-Up Center NRW conceptual design project

Funded by:	Ministry of Economic Affairs, Innovation, Digitalization and Energy of NRW (MWIDE)
Duration & volume:	2021, 86,000 EUR
Partners:	CLIB, Covestro
Responsible at CLIB:	Dennis Herzberg, Tobias Klement, Markus Müller, Sarah Refai, Tatjana Schwabe-Marković

A Scale-Up Centre is to be established for the scaling and validation of biotechnological processes in NRW. In order to design the basic features of this facility, a conceptual design project financed by the MWIDE and implemented by CLIB together with Covestro was set up.

Within the framework of this project, the needs and requirements for such a facility are to be surveyed and analysed. The goals of this project are to outline the basic technical design of the facility on the basis of this survey, to identify possible locations in NRW, and to work out the basic features of the business model.

BIVAC – Bio-value chains for novel high-value products and compounds

Funded by:	INTERREG Deutschland - Nederland
Duration & volume:	2017 - 2021, 2.4 M EUR
Partners:	Phytowelt GreenTechnologies*, CLIB, Rhine-Waal University of Applied Sciences (all DE); Biorefinery Solutions, Grassa, NewFoss (all NL)
Responsible at CLIB:	Dennis Herzberg
Website:	www.bivac.eu



Aiming at resource-efficient, environmentally sound, and sustainable production, this industry-driven project addresses the development of novel, economically viable products and processes based on waste streams originating from agriculture (e. g. grass, vegetables), horticulture, forestry, and food industry. Envisioned products include health-promoting food additives, fermentable sugars for the production of high-value compounds like astaxanthin, enzymatically optimized feed-additives, as well as fruit flavours to reduce large-scale on-field production and CO₂ emissions. In the consortium, partners from industry and academia located at different positions in the value chains of the agricultural and food/feed industry are brought together.

BusinessP – Business Case Evaluation: P-Retrieval from renewable sources

Funded by:	Ministry of Economic Affairs, Innovation, Digitalization and Energy of NRW (MWIDE)
Duration & volume:	2018 – 2021, 629,000 EUR
Partners:	RWTH Aachen University*, University of Bonn, CLIB (all DE)
Responsible at CLIB:	Dennis Herzberg, Markus Müller, Tobias Klement
Website:	www.biotec.rwth-aachen.de/go/id/omvt



Phosphorous is a finite resource of outstanding economic and social importance, which is currently exclusively obtained by rock mining. Phosphorous is mainly used in fertilizers (80 %) but its higher value-added products or uses are manifold and comprise, e. g., melting salts, food additives, metal processing, street construction, or fire protection agents. The reduction of rock phosphorous use and replacement by phosphates from renewable resources would enable the closing of the phosphorous cycle and an efficient P-management. An emerging field is the enzymatic production of green phosphate by processing of feed plant material and food manufacturing side products (oilpress cakes and plant meals).

The aim of the Business-P project is to answer the questions whether, at what cost, and in which valorisation products, processes using organically bound phosphorus, and related recycling strategies of this valuable resource, are economical. Within the Business-P project, the work group of Dr. A. J. Ruff from Institute of Biotechnology headed by Prof. Dr. U. Schwaneberg at RWTH Aachen University investigates the extraction of phosphorous from rape seed press cake and meal. Their expertise in protein engineering is applied to generate tailor-made enzymes for the P-recovery strategy. RWTH Aachen provides key data for economic assessments. Prof. Dr. S. Bröring, chair of Technology and Innovations Management in Agri-business at University of Bonn, analyses the new emerging value chains, valorisation potential, market entry, and the patent landscape. CLIB arranges the dissemination by organising workshops that identify valorisation potentials and facilitates a transfer of the generated data into industrial follow-up projects.

*coordinator

Circular-Bio INTERREG Network



Funded by:	INTERREG Deutschland - Nederland
Duration & volume:	2019 – 2022, 992,000 EUR
Partners:	CLIB*, EE Energy Engineers GmbH, Hochschule Niederrhein - University of Applied Science, Stadt Krefeld, WFG Wirtschaftsförderungsgesellschaft Krefeld, USV Agrar - Unternehmensberatung & Sachverständigenbüro Dr. A. Becker (all DE); Arvalis, Brightlands Campus Greenport Venlo, Gemeente Venray (all NL)
Responsible at CLIB:	Dennis Herzberg, Sarah Refai, Sabine Kortmann
Website:	www.circular-bio.com

This project will establish an active network for the circular and bioeconomy linking the Netherlands and NRW. Circular-Bio is funded by the INTERREG-programme Germany-Netherlands and supports the creation of new, innovative, and cross-border value chains and business models in the bioeconomy sector. Raw material suppliers from agriculture, forestry, waste management and the processing industry are interested in new regional options for their materials and side streams. Processors from the chemical industry, the energy sector, food and feed markets, mobility / fuels, and the pharmaceutical industry are interested in new technological processes to create innovative, biobased, and sustainable product designs. Bringing both groups together is at the centre of Circular-Bio. But also new logistics concepts, changes in framework conditions, and regulations are important factors, which are also taken up in the project.

Circular-Bio will offer an innovation coupon scheme to SMEs to further develop their business cases and foster their process development. It aims to network stakeholders from agriculture, logistics, biotechnology, academia, and the processing industry, as well as municipalities through numerous events, inspired by CLIB's structured networking process.

CLIB-Competence Centre Biotechnology



Funded by:	European Regional Development Fund (ERDF) and MWIDE
Duration & volume:	2018 – 2021, 8 M EUR
Partners:	CLIB, Forschungszentrum Jülich, University of Düsseldorf, TU Dortmund University, Bielefeld University* (all DE)
Responsible at CLIB:	Katrin Kriebs, Markus Müller, Annika Thamm
Website:	ckb.cebitec.uni-bielefeld.de/index.php

The CLIB-Competence Centre Biotechnology is a multi-site joint project fostering a sustainable, resource-efficient economy in North Rhine-Westphalia. The project partners Bielefeld University, TU Dortmund University, the Heinrich Heine University Düsseldorf, and the Forschungszentrum Jülich aim to provide an integrated infrastructure for the bioeconomy in NRW.

The CKB builds on previous experience to establish a multi-site, integrated centre: from gene and enzyme to process and product. Through this, it will establish innovative technologies in NRW and bring them to a first scale of application. More than 20 working groups are working on the three megatrends resource efficiency, raw materials, and health. As a subcontractor, CLIB is responsible for the coordination of public relations and the integration into the local, national, and international economy via SMEs and industry.

*coordinator

ConCO₂rde

Funded by:	Horizon2020, Marie Skłodowska-Curie
Duration & volume:	2021 – 2024, 2.9 M EUR
Partners:	acib GmbH*, CLIB, 15 additional partners from 5 European countries
Responsible at CLIB:	Katrin Kriebs, Sarah Refai



ConCO₂rde is a European innovative training network that brings together a diverse team of chemists, synthetic biologists, enzyme technologists and process engineers. The main objective of this team is to train 11 Early Stage Researchers (ESR) in different research disciplines that together allow the conversion of CO₂ by smart autotrophic biorefineries.

The concept is based on autotrophic microorganisms that utilize renewable energy for the accumulation of biomass and, therefore, provide potential sources for future materials of our society. The network of ConCO₂rde combines chassis strain development of these autotrophic microorganisms with process engineering in order to bring biotechnological processes to the next level.

CLIB will be involved in training the 11 ESRs and integrating the project consortium into its broad C1 network.

CROSSBEE – Cross-border Bio-Economy Education

Funded by:	BMBF
Duration & volume:	2018-2022, 186,000 EUR
Partners:	b.experts GmbH, CLIB*, Ostwestfalen-Lippe University of Applied Sciences and Arts, RWTH Aachen University, SeSaM Biotech GmbH (all DE); Ghent University (BE); Delft University of Technology, Wageningen University (both NL)
Responsible at CLIB:	Katrin Kriebs, Annika Thamm
Website:	www.bigc-initiative.eu/crossbee.php



CROSSBEE is tackling the challenge of combining diverse disciplines and expertise in different fields relevant for bioeconomy under the coordination of CLIB within a four-year project funded until 2022. CROSSBEE implements two activities in the BIG-Cluster region:

- Within the Massive Open Online Course (MOOC) “Biobased Products for a Sustainable (Bio)economy”, students from all over the world learn bioeconomy basics and discover state-of-the-art biobased product examples. The MOOC was first published in January 2019.
- Within the annual student competition Global Biobased Business Plan Competition (G-BiB), the student teams are individually trained in competencies and skills relevant for entrepreneurship and thus learn to think outside the scientific box.

*coordinator

FARMYNG – FLAGSHIP demonstration of industrial scale production of nutrient Resources from Mealworms to develop a bioeconomy New Generation



Funded by: Horizon2020, BBI JU, BIC
Duration & volume: 2019 – 2023, 19.6 M EUR
Partners: YNSECT* (FR), 19 project partners from across Europe, including CLIB
Responsible at CLIB: Tatjana Schwabe-Marković
Website: www.farmyng.eu

Increasing protein production for feed and food is a major challenge in order to keep up with the increasing global demand for meat and fish. Beetles are protein-rich and can be sustainably farmed, with a relatively light environmental footprint in terms of production and processing. The use of insect protein is already allowed in pet food and feed for aquaculture, and is being approved for human consumption in the EU. The EU-funded FARMYNG project will develop on an industrial and automated scale the breeding and transformation of *Tenebrio molitor* (mealworm) for the production of animal nutrition and fish nutrition. It will demonstrate a bio-based value chain for sustainable, safe, and premium feed products. The project aims to produce 1,500 tonnes of protein and 400 tonnes of oil per month – rates never demonstrated in the insect protein production market. CLIB is a project partner, tasked to disseminate the projects results and to support business model development.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837750.

HiPerIn 2.0 – Shaping the next generation of bio-based High-Performance Ingredients



Funded by: MWIDE
Duration & volume: 2020 – 22, 600,000 EUR (realisation phase)
Partners: CLIB*, CURE (RUB, formerly KWI Essen) as subcontractor (both DE)
Responsible at CLIB: Tatjana Schwabe-Marković, Katrin Kriebs, Markus Müller, Annika Thamm, Tobias Klement
Website: www.clib-cluster.de/en/projects

A key strength of biotechnology is the conversion of functional, bio-based raw materials to high-quality products in diverse areas including specialty chemicals, cosmetics, or the food industry. These “high performance ingredients” (HiPerIns) can thus pave the way for new technologies, new processes and ultimately a bioeconomy. In addition to new intrinsic innovations, the biotechnological sector is increasingly influenced by external factors: disruptive technologies such as digitalisation and the drive towards a circular economy are radically changing existing markets, regulatory framework conditions and consumer wishes concerning sustainability are crucial for the success of a product today.

In 2020, the realisation phase of HiPerIn 2.0 has been granted funding by the Ministry of Economic Affairs, Innovation, Digitalization and Energy of the State of North Rhine-Westphalia. With a funding volume of 600.000 € und a funding period of three years, it will allow CLIB to tackle the most urgent hurdles, to find the most promising product groups and to create a lasting impact for the biotechnology scene in NRW. The cross-sectional topics digitalisation, circular (bio-) economy, regulatory frameworks, end-of-life-product design, and public perception will be analysed in relation to the product and market areas of food and feed, home and personal care, coatings, adhesives, and textiles.

*coordinator

EU-IBISBA - Industrial Biotechnology Innovation and Synthetic Biology Accelerator

Funded by:	Horizon2020
Duration & volume:	2019 – 2022, 4 M EUR (Preparation Phase)
Partners:	Institut National des Sciences Appliquées – INSA* (FR), 17 other project partners from across Europe, CLIB as subcontractor to RWTH Aachen University
Responsible at CLIB:	Tobias Klement, Dennis Herzberg
Website:	www.ibisba.eu



The Industrial Biotechnology Innovation and Synthetic Biology Accelerator (EU-IBISBA) is a distributed Research Infrastructure aiming at supporting research in industrial biotechnology. IBISBA simplifies access to advanced multidisciplinary services that accelerate end-to-end bioprocess development and contributes to the delivery of low environmental footprint technologies for a wide variety of market sectors. To achieve this, IBISBA will provide access to first class facilities for all industrial biotechnology professionals, including academic researchers, SMEs and large companies. In the Preparation Phase (PREP-IBISBA), CLIB supports RWTH Aachen University as a subcontractor by gathering wishes and concerns of the German biotechnology scene to shape the further development of the project.

IBISBA is currently being developed in two projects: IBISBA 1.0 and PREP-IBISBA. Both receive funding from the EU's H2020 research and innovation programme and are defined by independent contractual agreements (n° 730976 and 871118) with the European Commission.

MPowerBIO

Funded by:	Horizon2020, BBI JU, BIC .
Duration & volume:	2020 – 22, 1.5 M EUR
Partners:	Food & Bio Cluster Denmark* (DK), TechTour Global (BG), Corporacion Tecnologia de Andalucía (ES), Consorzio Italbiotec (IT), FoodScale Hub (RS), EIT Food (BE), Irish Bioeconomy Foundation (IE), Q-PLAN International (GR), Sustainable Innovations Europe (ES), CLIB (DE)
Responsible at CLIB:	Tatjana Schwabe-Marković, Katrin Kriebs
Website:	www.mpowerbio.eu



Many SMEs need financing or investment to bring their business to market. To increase their chances in this challenging step is the aim of the EU-funded MPowerBIO project. MPowerBIO will empower clusters within the bio-based industry across Europe to offer better support for their SMEs to overcome the challenge of finding sufficient investment to get from idea to business. A Capacity Building Programme will help clusters deepen their expertise. SMEs will receive direct support through a Business Support Programme with concrete tools with which to improve their investment readiness level and pitching skills. Finally, MPowerBIO will connect SMEs and investors by arranging regional and international events where SMEs have the opportunity to pitch their business plan.

MPowerBIO is coordinated by Food & Bio Cluster Denmark, and has ten partners from nine European countries.

This project has received funding from the Bio-Based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No. 887501.

*coordinator

Members of the CLIB Extended Board

Dr. Karl-Heinz Maurer – *Chairman*

Karl-Heinz Maurer is Chairman of the CLIB Board. In 2019, he co-founded the start-up Aachen Proteineers. From 2011 to 2019, Dr. Maurer was part of the Senior Leadership at AB Enzymes GmbH, where he held positions including Director of Business Development and Regulatory Affairs, Head of Global Business Organisation (Marketing and Sales), Director of Global Marketing, and Head of Regulatory Affairs and Special Projects. From 1986 to 2010, he worked in different positions in the Henkel organisation (including Cognis Biotechnology), starting in R & D Biotechnology, which he directed from 2000 to 2010 as Director Biotechnology (Corporate, later Laundry and Home Care division).

Karl-Heinz Maurer is a biochemist and microbiologist by training and received his doctorate from the University of Tübingen in 1994. He was co-founder and Chairman of the Board of the Industrieverbund Mikrobielle Genomforschung (now Industrieverbund Weiße Biotechnologie) until 2018. In 2009, he received an honorary professorship from the University of Greifswald.



Dr. Roland Breves – *Vice Chairman*



Roland Breves currently is Head of Corporate Microbiology of Henkel AG & Co KGaA in Düsseldorf, which as a corporate function acts for all business units, including Cosmetics, Laundry and Home care and Adhesives. After studying chemistry and obtaining a PhD in microbiology (on chitinases from *Streptomyces*) in Hannover, he worked as a post-doc at the IPK Gatersleben on plant cell wall degrading enzymes.

After joining Henkel in 1997 (initially in COGNIS Biotechnologie GmbH), he was responsible as head of laboratory for the development and expression in *Bacillus* of detergent enzymes. In 2000, he joined the microbiology department as project leader „Smart Hygiene“. Topics were non-biocidal mechanisms against microbes and their negative impacts, e. g. malodour and biofilm formation, as well as prebiotic cosmetics. In addition to these explorative and classical microbiological topics, the department develops innovative concepts for biomaterials like adhesive bioconjugates. Roland Breves is active in several national and international expert groups (DIN, CEN, DECHEMA, AISE).

Prof. Dr. Karl-Erich Jaeger – *Vice Chairman*

Karl-Erich Jaeger received a Staatsexamen in biology and chemistry and a PhD in microbiology from Ruhr-Universität Bochum in Germany. In 1995, he obtained the *venia legendi* for microbiology with a habilitation thesis on bacterial lipases. Karl-Erich Jaeger is co-founder and served as Chairman of the Management Board and Member of the Scientific Advisory board of the biotech company evocatal GmbH (now evoxx technologies GmbH). In 2002, Karl-Erich Jaeger was appointed as Professor for Molecular Microbiology at the Department of Biology of Heinrich Heine University Düsseldorf and director of the Institute of Molecular Enzyme Technology.

In 2013, he was additionally appointed as director at the Institute of Bio- and Geosciences IBG-1: Biotechnology of the Helmholtz-Forschungszentrum Jülich. His research interests focus on bacterial enzymes and fluorescent proteins, their biochemical and structural characterization as well as their biotechnological applications. He has published about 200 peer-reviewed papers, several textbook chapters, and a textbook; he is co-inventor on about 20 patents and member of various scientific organisations, editorial and advisory boards.



After his studies of law at the Universities of Bonn and Freiburg, Hans-Jürgen Mittelstaedt worked as an attorney in Düsseldorf from 1988 to 1992. In 1992, he joined the Association of the Chemical Industry (VCI) at the department of environmental legislation.

He held several positions in Frankfurt and Brussels before he became CEO of VCI NRW, the Association of the Chemical Industry in North Rhine-Westphalia. In this position, he is also CEO of BPI NRW, the Association of the Pharmaceutical Industry in North Rhine-Westphalia. Hans-Jürgen Mittelstaedt is one of the founding members of CLIB and has been holding a position in the extended board since the foundation of the cluster.

Hans-Jürgen Mittelstaedt – *Treasurer*



Prof. Dr. Ludo Diels

Prof. Ludo Diels, Dr. in chemistry & biotechnology, works at the University of Antwerp, and is ex senior advisor Sustainable Chemistry for the Flemish Institute for Technological Research (VITO) in Mol, Belgium. He is the chair of the Industrial Research and Innovation Agenda Group of the PPP SPIRE / Processes4Planet (Sustainable Process Industry by Resource and Energy Efficiency/Circular and Climate Neutral Industry) bringing together 10 large industrial sectors (chemistry, steel, cement, minerals, non-ferro, engineering, ceramics, water, pulp & paper and refining) and he is member of the SPIRE-BBI JU working group.

He is strongly involved in the set-up of a biobased economy in Flanders and Europe, and the collaboration between Europe and India on bioeconomy and water business. He is also chair of the advisory board of the Shared Research Centre on Bio-aromatics (BIORIZON). He is founding father of the BIG-Cluster and the Vanguard Initiative. He is also working on the combination of bio- and circular economy with a strong emphasis on the use of wood and wood residues (strong focus on lignin) for integrated applications in many sectors with a first focus on construction materials.

Dr. Thorsten Eggert

Thorsten Eggert is Managing Director of ERBER Enzymes GmbH in Dortmund, Germany, a company of the ERBER Group, headquartered in Getzersdorf, Austria. Since October 2020, the whole group is part of DSM. He studied biology at the Ruhr University Bochum and received his PhD at the Institute for Biology of Microorganisms in 2001. Subsequently, he established the Directed Evolution Research Group at the Institute for Molecular Enzyme Technology at the Forschungszentrum Jülich, which he headed until accomplishing his habilitation in molecular microbiology at the Heinrich Heine University of Düsseldorf in 2007.

In 2006, Thorsten Eggert co-founded the company evocatal GmbH. As Managing Director (CEO), he developed evocatal, which was renamed into evoxx technologies in 2016, into a leading provider of enzymes for the chemical and pharmaceutical industries as well as the food and animal feed sector. In 2017, he achieved the company sale to the global enzyme manufacturer Advanced Enzymes Technologies Inc., India. Since 2019, he works for the ERBER-Group as part of DSM.



Dr. Henrike Gebhardt

Henrike Gebhardt advocates the research and innovation interests of Evonik Industries AG in the European policy environment since 2015. She maintains the relationships of Evonik with European institutions and international associations such as CEFIC, SusChem, A.SPIRE and the Bio-based Industries Consortium (BIC).

Henrike Gebhardt holds a PhD in biochemistry from the University of Cologne, an engineering degree in biotechnology from the Technical University of Berlin and studied at AgroParisTech (then Institut national agronomique Paris-Grignon), France and Technion, Israel. She began her professional career within the strategic research unit Creavis of Evonik Industries AG (then Degussa AG) in 2006. As project manager, she was in charge of the development of biotechnological processes for the production of surfactants and nutraceuticals. In 2012, she moved to the Corporate Innovation Unit of Evonik to bundle strategic and communicative aspects of the Bioeconomy and to advocate for the interests of Evonik in EuropaBio, CEFIC, EU-RRM, DIN, and CEN.



Dr. Claas Heise

Since 2008, Claas Heise is responsible for Venture Capital Investments and Early-Stage Financing at NRW.BANK in Düsseldorf, Germany. He heads the venture capital activities of NRW.BANK, including the management of several venture funds focused on NRW, which together have more than 50 investments. He is also responsible for over 10 investments in European venture capital funds and manages fund-of-fund activities sponsoring now 13 regionally-focused seed capital funds.

From 2006 to 2008, Claas Heise was a partner at Innovature Capital Partners, an advisory and venture capital/secondary services firm based in the Silicon Valley, California. From 2002 to 2006, he was the Managing Director for T-Venture of America, a subsidiary of the Corporate Venture Capital unit of Deutsche Telekom/T-Mobile, based in Foster City, CA, USA. He joined Deutsche Telekom in 1995 and held a variety of management positions. He helped to found the enterprise software start-up TRAIAN and joined TRAIAN in October 2000, where he led the partnership business development efforts.



Dr. Gernot Jäger

Gernot Jäger is heading the Competence Center for biotechnology within Covestro. He joined Covestro (formerly Bayer MaterialScience) in 2012 and held different responsibilities in Innovation Management, Process Research, Project Portfolio Management, and the Competence Center for Catalysis. Up to now, he has contributed in various public committees including GDCh (sustainable chemistry, board) and VCI (renewable resources).

Gernot Jäger studied biotechnology at RWTH Aachen University and received his PhD (summa cum laude) in biochemical engineering from the "Aachener Verfahrenstechnik" in 2012. His research areas include industrial biotechnology, pharmaceutical biotechnology, process development/conceptual design, and bioanalytics.



Peter Kallien

Peter Kallien holds a degree in business administration and is an expert in business model development and financing of innovative companies. In 1992, he became co-founder and managing director of a consulting company, which supports physicians and pharmacists in setting up their own businesses. In 1996, he moved to the Private University of Witten/Herdecke. During his ten years as Managing Director, he was involved in the successful establishment of approximately 15 start-ups originating from the university. Together with Thomas Schwarz and Gerhard Schembecker he founded b.experts GmbH in 2013 and b.value AG in 2016, and is a member of both Management Boards.

He has been operationally involved in the implementation of numerous successful start-ups. Peter Kallien was a long-time member of the supervisory boards of cardiac research GmbH in Dortmund and of bitop AG in Witten. He is currently the Chairman of the Supervisory Board of ISR Software Solutions AG.



Dr. Peter Welters

After studying biochemistry in Germany and doing his doctorate at the Max-Planck-Institute for Plant Breeding Research in Cologne, Peter Welters spent three years at the University of California, San Diego, and two years in Rouen, France, as a postdoc. In 1998, he founded Phytowelt GmbH in Nettetal and in 2002 was appointed CEO of GreenTec GmbH, a spin-off company of the Max Planck Institute in Cologne.

In 2006, both companies merged to form Phytowelt GreenTechnologies GmbH with Peter Welters as CEO. The company offers contract research in the fields of agro- and industrial biotechnology. In addition, the company developed and commercialises an enantiopure and natural raspberry flavour, R- α -Ionon. In 2018, Phytowelt was awarded the "Most Innovative European Biotech SME Award" by EuropaBio in the category agricultural biotechnology and Phytowelt's BBI-JU funded project BioForever was among the Top 20 European Biorefinery Projects of the internet platform BiofuelsDigest. Peter is also a founding and board member of CLIB and a board member of DIB.



Prof. Dr. Volker F. Wendisch

Volker F. Wendisch holds the Chair of Genetics of Prokaryotes at the Faculty of Biology at Bielefeld University. He is Deputy Scientific Director of the university's Center for Biotechnology (CeBiTec) and speaker of its research area "Metabolic Engineering of Unicellular Systems and Bioproduction". He served as Senator of Bielefeld University, Vice-Dean of Biology from 2014-2016, and Dean of Biology 2016-2018. Volker F. Wendisch received his diploma in biology from Cologne University. After having completed his PhD at the Institute of Biotechnology 1 of the Forschungszentrum Jülich in 1997, he worked as postdoctoral researcher at University of California, Berkeley, CA, USA. In 2004, he received the *venia legendi* in microbiology from HHU Düsseldorf. From 2006 – 2009, he was Professor for Metabolic Engineering at the University of Münster. His research interests concern genome-based metabolic engineering of industrially relevant microorganisms, systems and synthetic microbiology. Currently, he coordinates the multi-university ERDF.NRW- funded research infrastructure "CKB – CLIB Kompetenzzentrum Biotechnologie".



Members of the CLIB Advisory Board

Dr. Kai Baldenius

Kai Baldenius is a chemist by formation. After having received a PhD from Hamburg University, he spent a post-doc research year at The Scripps Research Institute, and then joined BASF in 1993. At BASF, Kai served in various positions in Research, Process Development, Production, Marketing & Sales. From 2009 to 2018 he led BASF's Biocatalysis research group. In September 2019, Kai has left BASF to become an independent consultant for applied biotechnology. Baldenius Biotech Consulting offers advice to venture capital and young start-ups for best technology positioning.



Dr. Manfred Kircher

Based on more than 30 years' experience in chemical industry and bioeconomy, Manfred Kircher works on regional as well as international bioeconomy strategies. His career milestones are biotechnological research and development (Degussa AG, Germany), production (Fermas s.r.o.; Slovakia), venture capital (Burrill & Company, USA), biotechnology partnering, and branding (Evonik Industries AG, Germany) and building the bioeconomy cluster CLIB. He chairs the Advisory Board of CLIB (since 2014) and is Member of the Board of the bioeconomy association BioBall (bioeconomy in a metropolitan region; since 2019). In 2020, he has been appointed to the Advisory Board for Sustainable Bioeconomy of the State Government of Baden-Württemberg and as Chairman of the Organics Valorisation Section of the European Federation of Biotechnology (EFB). Manfred is owner of KADIB, a company consulting on important aspects of industrial bioeconomy.



Dr. Dr. h.c. Christian Patermann

Christian Patermann studied Law, Economics, and Languages in Germany, Switzerland, and Spain and completed his doctoral thesis in law at the University of Bonn in 1969. He entered the German public service in 1971 by joining the Federal Ministry of Science and Education. From 1974 to 1978, he was Science Counsellor at the German Embassy in Washington D.C., USA. He then returned to the Ministry of Research and Technology, where he held many positions in Germany and in international organisations, like ESA, ESO, and EMBL. In 1996, he joined the European Commission, DG Research and Technology and was appointed Director for Environment and Sustainability.

In January 2004, he was named Programme Director for Biotechnology, Agriculture & Food Research, where he was responsible for launching the Knowledge based Bioeconomy in the European Commission. He also served for four years as co-chair in the EC-US Task Force Life Sciences and Biotechnology Research. He retired in 2007 but remains active in advising public and private institutions and companies on European affairs and the Bioeconomy. He was a member of the 1st German Bioeconomy Council from 2009 – 2012 and has been strongly involved in the preparation and implementation of the Global Bioeconomy Summits in Berlin in 2015, 2018 and 2020



Prof. Dr. Ulrich Schwaneberg



Ulrich Schwaneberg graduated in chemistry (in 1996) and received his PhD (in 1999; supervisor Prof. R. D. Schmid) from the University in Stuttgart. After a post-doc at Caltech in the lab of the Nobel laureate Prof. Frances H. Arnold he was appointed as Professor at the Jacobs University Bremen in 2002. In January 2009, he moved to the RWTH Aachen University as Head of the Institute of Biotechnology and is since 2010 co-appointed in the Scientific Board of Directors at the DWI Leibniz Institute for Interactive Materials.

Furthermore, he has been appointed to the Board of Directors of the Bioeconomy Science Center, serves as Speaker of the RWTH profile area Molecular Science & Engineering and coordinates RWTHs' bioeconomy activities in the "Strukturwandel". He is a cofounder of the companies SeSaM Biotech & Aachen Proteineers and has a special interest in protein engineering to provide tailored protein building blocks for the biological transformation of material science and production. In 2016, Ulrich received the BMBF-Forschungspreis for the next generation of bioprocesses and has published over 270 original manuscripts and is co-inventor on more than 20 patents (mostly with industry).

Dr. Willem Sederel



Willem Sederel is a chemical engineer and polymer scientist from the University of Technology Twente in Enschede (NL). He completed his education cum laude and did a post doc on biomedical materials at Case Western Reserve University in Cleveland, Ohio. In 1977, he started his industrial career with Shell in Amsterdam, and then moved to General Electric where he fulfilled global leadership roles in process, product and application development and marketing. His last role before retiring from his 36-year long career in industry was global innovation leader with SABIC. Willem joined Biobased Delta in 2013 as director and chairman. From April 2016 -2020, he was responsible for the international activities within the Board. Since April 1, 2020 he is again chairman of what is now called Circular Biobased Delta.

Willem is also the founding father of the Green Chemistry Campus in Bergen op Zoom which opened in 2011. Willem contributed to the transition agenda biomass and food in the Netherlands. Since many years, he has been a member of the Policy Group Innovation of the Dutch Chemical Branch Organization VNCI and a member of the Advisory Board of Biorizon, the shared research center for the development of bio-aromatics.

Prof. Dr. Kurt Wagemann



Kurt Wagemann studied chemistry in Munich and received his PhD in 1989 at the Max-Planck-Institute of Quantum Optics. Since 1989, he headed some of the large departments at the DECHEMA, e.g. for congresses as well as for research management and administration. In 2010, he took over the position of DECHEMA's Executive Director.

He regularly operates as an expert for the evaluation of research institutions and is currently chairman of the life science jury for the EXIST programme of the BMWi (Federal Ministry of Economics and Energy). He serves as a member of advisory boards of research institutes and networks, e.g. as Head of the Scientific Advisory Board Energy at the Karlsruhe Institute of Technology. In February 2011, he was appointed honorary professor at the University of Stuttgart, where he fulfils a teaching assignment on "Technical Chemistry and Technical Biochemistry – Biorefineries" since 2006. Furthermore, since 2010, he gives lectures at the University of Magdeburg in the field of "Chemical Processes – Renewable Raw Materials".

Dr. Thomas Schwarz

It is with deep regret that we must report that our former Chairman and Member of the Advisory Board Thomas Schwarz passed away much too early in July 2020. We will miss him as a person, a source of ideas and a tireless advocate for biotechnology..

The Team of the CLIB Office



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Large Industry

Covestro Deutschland AG
Evonik Industries AG
Henkel AG & Co. KGaA
LANXESS Deutschland AG
Uniper Kraftwerke GmbH

Medium-scale Enterprises

Axxence Aromatic GmbH
Bio Base Europe Pilot Plant BV
c-LEcta GmbH
Concord Blue Engineering GmbH
Corbion NV
DASGIP Information and Process Technology GmbH
Heinrich Frings GmbH & Co. KG
Jäckering Mühlen- und Nahrungsmittelwerke GmbH
LanzaTech Inc.
Mitsui & Co. Deutschland GmbH
Neste Germany GmbH
Pfeifer & Langen GmbH & Co. KG

Small-scale Enterprises

Aachen Proteineers GmbH
Altar S.A.S.
aquila biolabs GmbH
Autodisplay Biotech GmbH
b.fab GmbH
b.value AG
Biomillenia SAS
biotechrabbit GmbH
bitop AG
Blucon Biotech GmbH
Carbon Minds GmbH
CO2 BioClean
Corvay GmbH
Deep Branch Biotechnology
Dutch DNA Biotech BV
Enzymaster Deutschland
ERBER Enzymes GmbH
evoxx technologies GmbH
Holiferm
INOFEA
INOSIM Consulting GmbH
Kuhner Shaker GmbH
LignoPure GmbH
LXP Group GmbH
Nouvellune GmbH
Phytowelt GreenTechnologies GmbH
Senbis Polymer Innovations BV
SenseUp GmbH
Senzyme GmbH
SeSaM-Biotech GmbH
Syngip BV
Ulrich Windmüller Innovation GmbH & Co. KG

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Prof. Dr. Detlev Riesner
Sofinnova Partners SAS

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nova-Institut GmbH
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Schnee Research
SolarBioproducts Ruhr
Verband der Chemischen Industrie (VCI) NRW
YNCORIS GmbH & Co. KG

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FRC of the Russian Academy of Sciences»
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Forschungszentrum Jülich GmbH
Fraunhofer IGB
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Fraunhofer UMSICHT
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Heinrich-Heine Universität Düsseldorf
Hochschule Hamm-Lippstadt
Hochschule Niederrhein
Novo Nordisk Foundation Center for Biosustainability
Qingdao Institute of Bioenergy and Bioprocess Technology
RWTH Aachen
SCION - New Zealand Forest Research Institute Limited
TH Köln - University of Applied Sciences
TU Dortmund University
TU Eindhoven
Universität Bielefeld - CeBiTec
Wageningen University and Research



Aachen Proteineers GmbH

Aachen Proteineers is a Start-Up focussing on coating solutions. We have developed a platform technology to adhere various biomolecules to a wide range of surfaces using special peptides. This technology intensifies processes, cuts cost, and achieves very high coating densities in water at room temperature. We tailor these peptides regarding application conditions, surface specificity, and binding strength through protein engineering strategies, such as directed evolution.

We are currently evaluating products for research, diagnostics and process technology markets, and are open to discussing new applications and to exploring them in partnerships.

Arnold-Sommerfeld-Ring 2, 52499 Baesweiler

Phone: +49 157 84470080

Internet: www.aachen-proteineers.de

Founding year: 2019

Number of employees: 3



ALTAR S.A.S.

The competitiveness of Industrial Biotechnology processes is often hindered by the low performance of the microorganisms. To unlock the potential of this promising field, we must shift the paradigm and no longer adapt processes to the metabolic limitation of Industrial Microbial Hosts, but instead adapt microorganisms to industrial requirements.

Altar develops enabling technologies for the adaptation of microbial strains to industrial requirements. Our automated fluidic platform harnesses natural selection for the adaptive evolution of microorganisms. It has successfully proven to leverage metabolic engineering and non-GMO development for a wide range of organisms (bacteria, yeasts, microalgae) in several industrial fields (food, feed, chemicals, biofuels, materials, health, cosmetics...).

5 rue Henri Desbruères, 91000 Evry
France

Phone: +33 688 284235

Internet: www.altar.bio

Founding year: 2017

Number of employees: 6



aquila biolabs GmbH

aquila biolabs is a German biotechnology start-up company focusing on the development of innovative laboratory devices for the control and analysis of bioprocesses in bioreactors and incubation shakers.

Our founding idea was a product for hassle-free biomass sensing, the Cell Growth Quantifier (CGQ). The CGQ is a sensor-based technology that offers highly parallelized, non-invasive online monitoring of biomass in shake flasks and bioreactors.

Our second product line, the Liquid Injection System (LIS), allows for automated feeding of liquids in shake flasks. This automated miniature pump is the first commercially available technology of its kind and can be used for a broad range of applications.

aquila biolabs was founded in 2014 and was ranked among the TOP 10 start-ups in Germany in 2015.

Arnold-Sommerfeld-Ring 2, 52499 Baesweiler

Phone: +49 163 2922615

Internet: www.aquila-biolabs.de

Founding year: 2017

Number of employees: 11



Arnold & Porter Kaye Scholer LLP

Arnold & Porter Kaye Scholer is an international law firm with over 1,000 lawyers in 13 offices around the world. The Frankfurt Biotech/Pharma team has substantial experience relating to partnership alliances, licensing, technology transactions, distribution agreements, strategic partnerships and investments, protection of intellectual property, financing matters, corporate and tax optimized structuring. In our London office, a team of highly reputed attorneys is dedicated to regulatory issues in the chemicals, healthcare and other industries. The firm's clients range from individuals and small/medium sized companies to large international corporations.

Bockenheimer Landstraße 25,
60325 Frankfurt am Main

Phone: +49 69 2549 40

Internet: www.APKS.com

Founding year: 1917

About 25 highly experienced attorneys in Frankfurt advise on law areas including Corporate, M&A, Finance, Antitrust, Pharma & Biotech, IP/Patent Litigation, Labor/Restructuring & Business Reorganization, Compliance, Tax, Litigation/Dispute Resolution, Restructuring & Insolvency.

Autodisplay Biotech GmbH

Autodisplay brings proteins and peptides to the surface of gram negative bacteria. The transport of molecules to the bacterial surface avoids protein expression issues such as inclusion bodies and incorrect folding.

With our proprietary cell surface display technology, we create custom-tailored solutions for our clients. Services include:

High-throughput screening of binding interactions and enhanced enzyme activity via FACS.

Development of whole cell biocatalysts that combine the benefits of soluble enzymes and classic whole cell biocatalysts - no limitations regarding permeability of substrate or product, yet easy recovery of the biocatalyst for re-use.

Functionalisation of solid surfaces with the highest levels of control regarding target molecule orientation. Autodisplay helps prevent the activity loss by-effect which occurs during immobilisation.



c/o Lifescience Center, Merowinger Platz 1a,
40225 Düsseldorf

Phone: +49 211 9945 9650

Internet: www.autodisplay-biotech.com

Founding year: 2008

Number of employees: 10

Axxence Aromatic GmbH

Axxence Aromatic was founded in 1986 and is a privately held company with head office in Emmerich, Germany. Over the years our focus has been of the dedication to be one of the most reliable and innovative sources within our prime field of expertise: NATURAL AROMA INGREDIENTS for the flavour & fragrance industry worldwide.

By strategic investments in R & D of both novel natural ingredients and new manufacturing processes, we constantly strive to expand the use of our products in existing and new applications as well as markets. Axxence has around 100 employees. Sales offices and warehousing are present in Germany, France, USA and Japan. Manufacturing and R & D facilities are located in the Slovak Republic.



Tackenweide 28, 46446 Emmerich

Phone: +49 2822 685610

Internet: www.axxence.com

Founding year: 1976

Number of employees: 100

b.fab GmbH

Smart Bioprocess consults companies in bioprocess development and innovation management in industrial and pharmaceutical biotechnology.

With more than 15 years practice in bioprocess development we consult you in all stages of the development process: screening, media optimization, fermentation optimization, technology selection and scale up. Our special focus is the implementation and application of microbioreactors and automation to accelerate the development process.

Through our experience in establishing new technology in international markets we guide start-ups and SMEs through the innovation process from idea to product. In the innovation process we apply Design Thinking and Agile Project Management for the efficient progress of your product and ideas.

Our German and international business network will help to enter new markets and establish your business.

With Smart Tools to Smart Bioprocess.



Vondelstr. 33, 50677 Köln

Phone: +49 176 13221322

Internet: www.smartbioprocess.com

Founding year: 2015

Number of employees: 3

b.value AG

As one of the first German venture capital providers for industrial biotechnology, life sciences and chemistry, the b.value AG seeks to fully deploy the economic potential of bio-based technologies in common interest of founders and investors. The b.value AG invests in start-ups mainly in the seed stage in the D-A-CH region. Thereby, b.value acquires majority and minority interests in almost all cases together with other co-investors.

The b.value team is characterised by an exceptional scientific and technological specialization. The management team have >40 years of experience in the establishment, management, and development of technology companies and biotechnology innovations. Besides this, the portfolio companies benefit from the unique "Company-Building" approach and a broad network.



Otto-Hahn-Straße 15, 44227 Dortmund

Phone: +49 (231) 70097907

Internet: www.b-value.de

Founding year: 2016

Number of employees: 4



Universitätsstr. 27, 33615 Bielefeld
Phone: +49 521 106 8760
Internet: www.cebitec.uni-bielefeld.de
Founding year: 1998
Number of employees: 150

Bielefeld University - Center for Biotechnology (CeBiTec)

CeBiTec is one of the largest faculty-spanning central academic institutions at Bielefeld University. Its purpose is to bundle the biotechnological activities and research projects at the university, to foster cross-linking of research approaches and technologies from different research fields, and to develop innovative projects within its two main research areas 'Large Scale Genomics and Big Data Bioinformatics' and 'Metabolic Engineering of Unicellular Systems and Bioproduction'.

The availability of comprehensive technological infrastructure as being provided by CeBiTec's Technology Platforms is crucial for a successful scientific work. The Graduate Center creates an inspiring interdisciplinary environment for high-level academic training of graduates. Furthermore, the CeBiTec considers itself as a central communication platform and a 'think tank' of the university with respect to initiatives and activities with a dedicated biotechnological perspective.



Varrentrappstr. 40-42, 60486 Frankfurt am Main
Phone: +49 69 15 32 25 678
Internet: www.bcnpc.com
Founding year: 2002

BCNP Consultants GmbH

BCNP Consultants GmbH is specialized in the industries biotech, chemistry, nanotech and pharma (BCNP). The three divisions of BCNP Consultants are:

BCNP strategy

On basis of our business analyses (market and competitor analysis, technology comparisons) you are able to design and sharpen your business model, to write the business case and to identify new M&A targets.

BCNP connect

On the basis of our vivid business networks in the life sciences industry we bring you together with relevant people in order to support you in filling your customer pipeline.

European Chemistry Partnering

Since 2017 innovators – from chemistry to bio-economy, from engineering to digitization - have been meeting twice a year: In February at the European Chemistry Partnering and in September at the ECP Summer Summit.

ECP THE FIRST INDUSTRY BUSINESS SPEED DATING

www.european-chemistry-partnering.com



An event by:



ONLINE OR ONSITE EVENT

Bio Base Europe Pilot Plant

Bio Base Europe Pilot Plant is an open innovation pilot and demonstration facility for process development, scale-up and custom manufacturing of biobased products and processes from lab to multi ton scale. We combine technologies (biomass pretreatment, biocatalysis, green chemistry, (gas)fermentation, biorefining and downstream purification) for advanced manufacturing of biobased products utilising a wide and flexible spectrum of modular unit operations. As such, our team of highly trained and experienced engineers and bioprocess technicians facilitates the translation of your biobased laboratory processes into viable industrial processes.

From 2013 to 2019, Bio Base Europe Pilot Plant successfully conducted 322 bilateral (private) projects with 124 different small, medium and large sized companies. On top of these private/bilateral projects, Bio Base Europe Pilot Plant has been involved in more than 50 public project consortia.



Bio Base Europe Pilot Plant

Rodenhuizekaai 1, 9042 Gent
Belgium
Phone: +32 9 335 70 01
Internet: www.bbeu.org/pilotplant
Founding year: 2008
Number of employees: 109

Bioindustrial Innovation Canada

As a not-for-profit organization, Bioindustrial Innovation Canada (BIC) supports Ontario and Canada become globally recognized leaders in the field of sustainable technologies. With a vision to create jobs and economic value sustainably for Canada, BIC provides critical strategic investment, advice and services to business developers of clean, green and sustainable technologies. In Sarnia and Lambton County, a true hybrid cluster has developed around sustainable chemistry, based on fostering partnerships and bringing the right individuals together from industry, colleges, universities and governments to support the development of the cluster.

In 2016, BIC established the Centre for Commercialization of Sustainable Chemistry Innovation (COMM SCI) initiative program, which acts as a hub for the commercialization of sustainable chemistry and bio-based innovation. BIC's proven expertise in commercialization is the differentiator that will enable us to build a stronger and more sustainable Canada.



1086 Modeland Road, Sarnia,
Ontario, Canada N7S 6L2
Phone: + 1.226.778.0020 Ext 237
Founding year: 2008
Number of Employees: 8

BioIndustry e. V.

BioIndustry e.V. is a registered association whose main purpose is to activate, concentrate and develop biotechnological competences in the Ruhr region. The key aspects of BioIndustry's activity are industrial biotechnology and bioprocessing technologies, microstructure technology, X-omics and bioinformatics. As a networking service cluster of 50 companies, research and training institutes, technology centres, biotechnological service providers and public business development organizations, the associations objective is to generate product- and process-innovations. This objective will be met by supporting the active transfer from ideas to market.



BMZ Dortmund, Otto-Hahn-Str. 15
44227 Dortmund
Branch office: Universitätsstr.
136, 44799 Bochum
Phone: +49 234 9783660
Internet: www.bioindustry.de
Founding year: 2000
Number of employees: 1

Biomillenia SAS

BIOMILLENIA, a France-based privately held company, is a leading technology solution provider for the development of novel green chemistry products. BIOMILLENIA's disruptive BIOMILLENIA DIMENSION 300X platform, based on licensed technology that was developed by Harvard University, the BROAD Institute and ESPCI Paris, uniquely combines advanced genomics and bioinformatics technologies with microfluidics-based ultrahigh-throughput screening. This unique technology platform delivers novel microbes, production strains and enzymes for manufacture of chemicals and natural products at throughputs and speeds several orders of magnitudes higher than with traditional methods. BIOMILLENIA "Unlocks Nature's Potential" for cost-competitive and sustainably manufactured novel biology-based products for a better life.



10 Rue Vauquelin, 75005 Paris
France
Phone: +49 175 1925335
Internet: www.biomillenia.com
Founding year: 2014
Number of employees: 1-10



Life Science im Rheinland e.V.

Merowingerplatz 1a, 40225 Düsseldorf

Phone: +49 211 3160610

Internet: www.bioriver.de

Founding year: 2004

Number of employees: <10

BioRiver - Life Science im Rheinland e.V.

BioRiver - Joining forces for Life Sciences & Biotechnology

Founded in 2004, BioRiver – Life Science im Rheinland e.V. is fully committed to representing the Life Sciences sector in the bioregion Rhineland as an independent industry organization. The essential aims of BioRiver are to build a strong network within the biotech sector, to improve the political and economic conditions as well as to market the bioregion Rhineland and its members. Thanks to the strong profiles of the partners in the network, it has been possible to initiate various collaboration projects and gain direct access to experts in both business and academia.



Volmerstr. 9, 12489 Berlin

Phone: +49 30 55578210

Internet: www.biotechrabbit.com

Founding year: 2011

Number of employees: 25

biotechrabbit GmbH

biotechrabbit GmbH was founded in 2011 in Henningsdorf; already 4 years later, in 2015, a second research and production site was opened in Berlin/Adlershof. Biotechrabbit is a team of top class scientists, experienced managers and business developers who are determined to offer highest quality products and services for diagnostic companies and life science research. We value the relationships with our partners and customers and are driven to exceed current limitations with flexibility, innovation and highly customized solutions to match specific requirements.

Biotechrabbit's offering includes enzymes for molecular diagnostics, antibody generation and production, high-capacity protein fermentation, lyophilization for diagnostic test kits and pharma, highly parallel, cell-free protein synthesis, mRNA for therapeutics, site-directed amino acid incorporation for labeling or cancer biotherapeutics and a full molecular biology products catalog.

Our way of doing business combines the passion and pure curiosity of excellent researchers with the agile spirit of true entrepreneurs.



Extremolytes for Life

Stockumer Str. 28, 58453 Witten

Phone: + 49 2302 914400

Internet: www.bitop.de
www.ectoin.net

Founding year: 1993

Number of employees: 37

bitop AG

bitop AG is a biotechnology company focused on products based on extremolytes, a group of natural protective molecules responsible for the stress resistance of extremophilic microorganisms. bitop develops and employs fermentative and biocatalytic bioprocesses for extremolyte production.

The company offers innovative medical devices based on the extremolyte Ectoin® in the areas of allergy, dermatology, respiratory diseases and dry epithelia with scientifically confirmed efficacy and tolerability. Furthermore, bitop offers extremolyte products like Ectoin®, Glycoin®, and 28Extremoin® as cosmetic active ingredients as well as hydroxyectoin as biostabilizer for diagnostics and life sciences.



In den Baumäckern 5a, 76865 Insheim

Phone: +49 6341 93 55 442

Fax: +49 6341 987 568

Internet: www.black-ip.de

Founding year: 2016

Number of employees: 5

BlackIP GmbH

The main focus of the consulting company BlackIP GmbH is on intellectual property. BlackIP is building bridges between stakeholders 'speaking different languages', developers, scientists, and engineers, and includes expertise on intellectual property rights. The company offers support in the organisation/re-organisation of internal patent systems and training for employees, monitors technology fields with respect to patent-relevant activities of competitors, conducts research and analyses, and offers the service of an external patent department.

BlackIP supports clients throughout the whole process, starting with the early development phase, then monitoring intellectual property processes together with the client's attorneys and experienced attorneys from BlackIPs network, and ending with the exploitation of these rights.

Blucon Biotech GmbH

Plastics from Nature for Nature®

BluCon Biotech is developing a unique technology by which L-lactic acid can be produced from non-food feedstocks like straw or wood by direct fermentation with BluCon's proprietary extremophilic production bacteria. The business purpose is to allow the bioplastic polylactic acid (PLA) to be produced on a sustainable basis and commercially competitive to fossil fuel based plastics.

BluCon Biotech collaborates with a network of expert groups and companies, at academia and in the industry, for efficient and rapid launch of its technology. BluCon is welcoming further collaborations regarding conversion of all kinds of feedstock to value added fermentation products, as well as collaborations with the purpose of PLA production.



Nattermannallee 1, 50829 Köln
Phone: +49 221 93338860
Internet: www.blucon-biotech.com
Founding year: 2017
Number of employees: 21

Bundesanstalt für Materialforschung und -prüfung (BAM)

The Federal Institute for Materials Research and Testing (BAM) is a research facility under the authority of the Ministry of Economics and Technology. Its competences are to improve safety and reliability in chemical and materials technologies through research, testing, analysis, and information.

The division Biodeterioration and Reference Organisms performs research and development in the field of i) materials protection against biological deterioration and ii) biotechnology with bacteria. We are especially interested in biotechnology and molecular biology of bacteria from extreme environments. Our expertise in molecular biology with extremophiles comprises a wide range of technologies to manipulate metabolic pathways with the goal to improve productivity of strains currently used in industry.



Unter den Eichen 87, 12205 Berlin
Phone: +49 3081041410
Fax: +49 3081041417
Internet: www.bam.de
Number of employees: 1660

Capricorn Partners NV

Capricorn Partners is a European manager of venture capital and equity funds, investing in innovative companies with technology as competitive advantage. With its team of seasoned investment managers with deep and broad technology expertise, Capricorn Partners invests out of the venture capital funds Capricorn Digital Growth Fund, Capricorn Sustainable Chemistry Fund, Capricorn ICT Arkiv and Capricorn Health-tech Fund. Jointly with Capricorn Scorpio Investment Management in China, Capricorn Partners acts as the exclusive investment advisor of the China-Belgium (Europe) Technology Innovative Industry Fund. It is the management company of Quest for Growth, quoted on NYSE Euronext Brussels, and the investment manager of Quest Cleantech Fund and Quest+, sub-funds of Quest Management SICAV.



Lei 19/2, 3000 Leuven
Belgium
Phone: +32 16284100
Internet: www.capricorn.be
Founding year: 1993
Number of employees: 21

Carbon Minds GmbH

Carbon Minds is a data analytics startup. We use our proprietary digital model of the global chemicals and plastics industry to offer our clients unprecedented levels of transparency about environmental impacts in global supply chains.

We bring down the cost of reaching climate targets by providing market intelligence that enables our clients to reduce their environmental impacts in the most cost-efficient way possible through the choice of suppliers. Our data covers thousands of suppliers, accounting for more than 80 % of the global greenhouse gas emissions due to chemicals and plastics production.

In addition to providing data, Carbon Minds builds digital twins of complex integrated production sites and uses novel optimization approaches to identify cost-efficient transition pathways.



Eupener Str. 165, 50933 Köln
Phone: +49 1573 7975079
Internet: www.carbon-minds.com
Founding year: 2019
Number of employees: 13



Perlickstr. 5, 04103 Leipzig
 Phone: +49 341 355 214 0
 Internet: www.c-lecta.com/
 Mail: contact@c-lecta.com
 Founding year: 2004
 Number of employees: 100

c-LEcta GmbH

c-LEcta is a leading industrial biotechnology company, using best-in-class biotechnologies to efficiently provide customized enzymes and microbial strains to industrial applications. Scientific excellence is combined with in-depth commercial and regulatory know-how to bring innovative and competitive bioprocessed products into scale. Besides our in-house project and product pipeline we have a strong focus on strategic cooperation with industrial partners.

Moreover, c-LEcta is an established enzyme supplier, manufacturing unique, quality-controlled enzyme products on large technical scale.



Friedrichstr. 15A, 61476 Kronberg
 Phone: +49 174 4657708
 Internet: www.co2bioclean.com
 Founding year: 2019
 Number of employees: 2

CO2BioClean GmbH

CO2BioClean prevents the release of industrial CO2 emissions by capturing them before their release into the atmosphere. The CO2 is transformed into 100% biodegradable biopolymer (PHA) via an efficient fermentation process. Making use of this polymer, a versatile set of items ranging from textile fibres, packaging items and interior design can be produced. The fermentation process used to produce the biodegradable polymers allows to tune the properties of the PHA such as aesthetics and mechanical properties, ranging from rigid to flexible, soft-touch and adhesive. This way, we can address requirements of complex end use applications.



Königsallee 6-8, 40212 Düsseldorf
 Phone: +49 211 320364
 Internet: www.concordblue.de
 Founding year: 1997
 Number of employees: 160

Concord Blue Engineering GmbH

Concord Blue is a waste management company that transforms nearly any form of local waste into a variety of clean, renewable fuels. Concord Blue has developed a revolutionary closed-loop system that efficiently and cost-effectively produces the highest quality sustainable energy with virtually no pollutants. Unlike other available waste-to-energy processes, Concord Blue's unique technology benefits the environment, fulfilling all international, EPA and European regulations for renewable energy and air emissions.



Arkelsedijk 46, 4206 AC Gorinchem
 The Netherlands
 Phone: +31 183 695695
 Internet: www.corbion.com
 Founding year: 2013
 Number of employees: 2,000

Corbion NV

Corbion is the global market leader in lactic acid, lactic acid derivatives, and a leading company in emulsifiers, functional enzyme blends, minerals, vitamins and algae ingredients.

We develop sustainable ingredient solutions to improve the quality of life for people today and for future generations. For over 100 years, we have been uncompromising in our commitment to safety, quality and performance. Drawing on our deep application and product knowledge, we work side-by-side with customers to make our cutting edge technologies work for them.

At Corbion, we live our brand promise "Keep creating", through our science, clear understanding of the markets we serve, and of course through our creative people.

Corbion's strategy and every aspect of our operations are built around advancing sustainability and applying high ethical standards, whether this relates to the management of our global supply chain, responsible procurement of our raw materials, or the safety and wellbeing of our people.

Corvay GmbH

Corvay provides consulting and project management services to multinational, medium and small enterprises. Corvay builds and helps building businesses. Some examples: biotech cluster BioRegioN in Lower Saxony, Vakzine Projekt Management, advising Direvo and later building and managing BluCon Biotech Cologne. Recently we established Corvay Bioproducts, Leuna, developing bioproduction processes. Our trade company Corvay Specialty Chemicals is selling long chain aliphatic diacids and specialty enzymes to the chemical industry, and vitamin D3 to the food and feed industries; we are interested in expanding our specialty portfolio. Corvay's value for you: i. high performance proven over 20 years, ii. operational expertise and international management experience iii. efficient business network.



Sophienstr. 6, 30159 Hannover
Phone: +49 511 449895-0
Internet: www.corvay.de
Founding year: 2002
Number of employees: <10

Covestro Deutschland AG

Covestro is a world-leading supplier of high-tech polymer materials: innovative, sustainable, and diverse.

We are serving key industries (such as automotive, construction, and electro/electronics) around the globe with technologically leading processes. Our products and application solutions are used in many areas of modern life.

In line with our vision "We will be fully circular" we are on the way to a circular economy. Alternative raw materials (such as biomass, CO2, plastic waste) and alternative production technologies (e.g. via biotechnology) are the basis for various new innovative products and production processes.

With approximately 17,200 employees Covestro posted sales of 12.4 billion euros in 2019.

It has some 30 major production sites worldwide that operate in a safe, efficient and ecofriendly way. The product range includes the high-performance polymer polycarbonate and precursors for polyurethanes that are used to produce foam.



Kaiser-Wilhelm-Allee 60, 51373 Leverkusen
Phone: +49 214 6009 2000
Internet: www.covestro.com
Founding year: 2015
Number of employees: 17,200

DASGIP Information and Process Technology GmbH

DASGIP has been an industry-leading supplier of benchtop bioreactor solutions for the biotech, pharmaceutical and chemical industries as well as academia and research institutions since 1991. Our parallel bioreactor systems for the cultivation of microbial, plant, animal and human cells utilize industry-standard benchtop glass and single-use bioreactors.

DASGIP's best-in-class configurable control systems and state-of-the-art bioprocess analyzers deliver unparalleled functionality coupled with user-friendly design for optimal bioprocessing. Our proven solutions for interconnectivity to 3rd party bioprocess analyzers, supervisory control systems and DoE tools, combined with our best-in-class control systems, enable migration strategies for optimization of legacy benchtop bioreactor equipment.

The outstanding DASGIP bioprocess solutions support QbD-driven process development. As of January 2012, DASGIP is an Eppendorf company. DASGIP is headquartered in Juelich (Germany) and has operations throughout Europe, North America and Asia.



Rudolf-Schulten-Str. 5, 52428 Jülich
Phone: +49 2461 980 0
Internet: www.dasgip.com
Founding year: 1991
Number of employees: about 70

Deep Branch Biotechnology Ltd.

Deep Branch Biotechnology are a UK-based start-up that produce single cell protein for animal feed. The company utilises carbon dioxide as a feedstock for their proprietary gas fermentation process, producing high-quality protein for aquafeed and monogastric animals.



D6 Thane Road, NG90 6BH, Nottingham
United Kingdom
Internet: www.deepbranchbio.com
Founding year: 2018
Number of employees: 10



Padualaan 8, 3584 CH Utrecht
The Netherlands
Phone: +31 (0)88 066 6194
Internet: www.ddna-biotech.com
Founding year: 2015
Number of employees: 21

Dutch DNA Biotech BV

Dutch DNA Biotech (DDNA) started in 2015 as a management buyout from The Netherlands Organization for Applied Scientific Research (TNO) with the mission to contribute to the society by developing sustainable fungi-based production processes for innovative products.

DDNA is focused on the development of fungal strains and fermentation processes for the production of proteins and organic acids.

DDNA has a mixed business model; in addition to contract research DDNA develops proprietary technology which is out-licensed.

The R & D team consists of molecular biologists and fermentation experts; eight of them have a PhD. The CSO, Professor Peter Punt, holds a chair at Leiden University. DDNA has a seasoned management. The company is based at the Science Park of Utrecht University, The Netherlands.

EDER | SCHIESCHKE | PARTNER

Patentanwälte • European Patent, Trademark and Design Attorneys

Elisabethstr. 34, 80796 München
Phone: +49 89 278 148-0
Fax: +49 89 278 148-50
Internet: www.eder-ip.de

Eder Schieschke & Partner mbB

The chemical department of the intellectual property law firm Eder Schieschke & Partner mbB has specialized in representing clients in the field of organic chemistry, biochemistry and biotechnology before the European Patent Office, the German Patent and Trademark Office, the German Patent Court and the European Intellectual Property Organization in all areas of intellectual property law.

Amongst obtaining patent rights, utility model rights and trademark rights Eder Schieschke & Partner mbB's expertise is also directed to license agreements, preparation of invalidity, infringement and freedom-to-operate studies, as well as German employee law.

As a member of CLIB, Eder Schieschke & Partner mbB is supporting the Cluster with the realization of IP coaching seminars for start-ups and SMEs.



Groene Loper 5, 5612AE Eindhoven,
The Netherlands
Phone: +31 402479111
Internet: www.tue.nl
Founding year: 1956
Number of employees: 3239

Eindhoven University of Technology

Eindhoven University of Technology (TU/e) is a research university, founded in 1956, specializing in engineering science & technology. The Department of Chemical Engineering and Chemistry aspires to be an academic institution for education and research in chemical science and engineering of the highest international standard. The aim is to generate and to develop technology and scientific knowledge relevant for the long-term needs of society.

Scientific curiosity and the use of newly generated knowledge are the main driving forces behind the continuing enhancement of our expertise in (electro-)chemical reactor engineering, multiscale & multiphase modelling, process intensification, membrane processes and heterogeneous catalysis



Neusser Str. 39, 40219 Düsseldorf
Phone: +49 211 15821610
Internet: www.enzymaster.de
Founding year: 2018
Number of employees: 6

Enzymaster Deutschland GmbH

Enzymaster provides a one-stop solution for the development and commercialization of innovative and sustainable enzyme catalysis technologies. With our proprietary BioEngine® platform and long-term experience, we offer R&D services combined with establishment of complete technology transfer packages, and manufacturing collaborations to fine chemical, pharmaceutical, and other industries. Our portfolio includes enzyme panel screening, smart enzyme engineering, process development, enzyme preparation by fermentation, and biocatalytic manufacturing. Enzymaster Deutschland GmbH, a subsidiary of Enzymaster (Ningbo) Bio-Engineering Co. Ltd., represents your partner in the international market for enzyme applications and products manufactured by biocatalytic processes. Green Magic Happens Here!

ERBER Enzymes GmbH

ERBER Enzymes is a spin-off company of EFB, ERBER Future Business GmbH, ERBER Group's in-house incubator.

ERBER Enzymes GmbH is headquartered in Dortmund, Germany, and with our focus on microbiological and enzymatic solutions we address selected food and feed markets.

According to our customers' needs, we develop suitable specialty enzymes or microbial strains in close cooperation with our sister companies at ERBER Group or in direct cooperation with leading market participants. In line with the core competencies within the group, we focus on food and feed safety; however, we also walk new paths in markets ERBER Group has not yet addressed.



Otto-Hahn-Str. 15, 44227 Dortmund

Phone: +49 231 9865 2845

Internet: www.erber-group.net

Founding year: 2018

Number of employees: 8

The European Circular Bioeconomy Fund GmbH (ECBF)

ECBF is the first venture fund exclusively dedicated to the bioeconomy and the circular bioeconomy in Europe. It aims to fill a funding gap in the Bioeconomy landscape by identifying the most promising investment targets, syndicating with private and public investors, and bringing Europe's circular technologies and bio-products to market. Being a growth-stage venture capital fund, ECBF is able to provide mezzanine financings as well as typical venture capital investments to the EU-27 and 16-HORIZON 2020 associated countries.

Established in Luxembourg, ECBF is managed by Hauck & Aufhäuser Funds Services S.A. (AIFM) and advised by the experienced investment team of ECBF Management GmbH. It relies on powerful networks to catalyse sustainable innovations and fuel business growth.



Godesberger Hof 2, 53173 Bonn

Phone: +49 170 220 9067

Internet: www.ecbf.vc

Founding year: 2019

Number of employees: 10

Evonik Industries AG

Evonik is one of the world's leading specialty chemicals companies.

We may not manufacture tires, mattresses, medications, or animal feeds, but Evonik is part of all of those products –and many more. While we often contribute only small amounts of material, those contributions are precisely what make the difference. That's because Evonik products make tires fuel-efficient, mattresses more elastic, medications more effective, and animal feeds healthier. That's what specialty chemicals are all about. And when it comes to specialty chemicals, we're among the best in the world.

Evonik is one of the world leaders in specialty chemicals. The company is active in more than 100 countries around the world and generated sales of €13.1 billion and an operating profit (adjusted EBITDA) of €2.15 billion in 2019. Evonik goes far beyond chemistry to create innovative, profitable and sustainable solutions for customers. More than 32,000 employees work together for a common purpose: We want to improve life, today and tomorrow.



Rellinghauser Str. 1-11, 45128 Essen

Phone: +49 201 177 01

Internet: www.evonik.com

Founding year: 2007

Number of employees: 32,000

evoxx technologies GmbH

evoxx technologies GmbH, a German industrial biotechnology company, is focusing on the development and production of industrial enzymes. As European subsidiary of the global enzyme manufacturer Advanced Enzymes Technologies Ltd. a comprehensive product portfolio of enzymatic solutions for human nutrition, animal nutrition, bio-processing, and pharma industries is offered.

Product development is based on the proprietary technology platform covering the whole value chain from early enzyme and process development to industrial scale production and product deregulation. evoxx industrial partners and customers benefit from the unique metagenomics libraries, the enzyme development skills and tech transfer, and production capabilities. evoxx is located on the Creative Campus in Monheim am Rhein and on the Biotech Campus Hermannswerder in Potsdam.



Alfred-Nobel-Str. 10, 40789 Monheim am Rhein

Phone: +49 2173 4099-40

Internet: www.evoxx.com

Founding year: 2006

Number of employees: 40



FEDERAL RESEARCH CENTRE
«FUNDAMENTALS OF
BIOTECHNOLOGY»
OF THE RUSSIAN ACADEMY
OF SCIENCES

Leninsky prospect, 33, Bld. 2, Moscow,
119071, Russian Federation

Phone: +7 495 9545283

Internet: <http://www.fbras.ru/en/>

Founding year: 2014

Number of employees: 500

Federal State Institution «Federal Research Centre «Fundamentals of Biotechnology» of the Russian Academy of Sciences»

Russian Academy of Sciences was organized through merging the A.N. Bach Institute of Biochemistry RAS (INBI RAS), the S.N. Winogradsky Institute of Microbiology RAS and the Centre «Bioengineering» RAS.

The Research Centre of Biotechnology RAS carries out basic and applied research in the fields of biochemistry and biotechnology, microbiology, genomics, bioengineering and genetic engineering, biocatalysis, system and structural biology, biogeotechnologies, bioremediation, agrobiotechnologies, food quality and safety.

The Centre is the key member of the Russian Technology Platform «Bioindustry and Bioresources–BioTech2030». The Russian National Contact Point on Biotechnology, three core facilities, an accredited testing laboratory, and an experimental greenhouse are functioning at the Centre.



Boeretang 200, 2400 Mol
Belgium

Internet: www.vito.be

Founding year: 1990

Number of employees: 750

Flemish Institute for Technological Research, VITO

Within "Sustainable Chemistry", VITO focuses on process intensification and replacing fossil with sustainable resources. Key is the integration of conversion with separation processes to improve overall efficiency and sustainability: *in situ* product recovery within biocatalytic processes, biocatalyst immobilization, and novel separation approaches (membranes are often integrated in these processes) are some of our developments in this field.

Using alternative resources (like CO₂, biomass) requests different approaches to deliver high added value products: mild disclosure, (scCO₂) extraction, fractionation and biocatalytic processes, (bio)electrochemical reactions with CO₂. VITO is one of the partners involved in the inventories and strategic research agenda for "Sustainable Chemistry" especially in the Flemish (CATALISTI) and European context (BIG-Cluster, SPIRE, BBI, SusChem), but also on a global level (India). VITO is also founding partner of Biorizon, a shared research center for bio-aromatics.



Wilhelm-Johnen-Straße, 52425 Jülich

Phone: +49 2461 61 3294 (Prof. Bott)

3118 (Prof. Wiechert)

Internet: <http://www.fz-juelich.de/ibg/ibg-1>

Founding year: 1977

Number of employees: 120

Forschungszentrum Jülich GmbH - IBG-1: Biotechnology

IBG-1: Biotechnology is a leading institute in the field of microbial biotechnology and biocatalysis. Multipurpose microbial production platforms (e. g. *C. glutamicum*, *P. putida*) are used for the production of industrially, nutritionally or pharmaceutically relevant products (bulk / fine chemicals, natural products, enzymes/proteins) from renewable carbon sources. Methods of synthetic biology are used for establishing novel concepts in strain development and engineering of metabolic pathways. Moreover, multi-step enzyme cascades for cell-free biosynthesis are developed.

Process development is based on lab automation systems combined with extensive digitalization. IBG-1 runs an extensive "omics" platform (sequencing, proteomics, metabolomics and fluxomics) for strain characterization and a single-cell analysis lab. Microbial cultivation facilities range from microfluidic devices over parallelized mini bioreactor systems up to pilot plant scale. Lab investigations are tightly integrated with mathematical modelling, data analysis, experimental design and process optimization.



Heinrich Frings GmbH & Co. KG

Boschstr. 32, 53359 Rheinbach

Phone: +49 2226 8929-400

Internet: www.frings.com

Founding year: 1878

Number of employees: 70

FRINGS

The company Heinrich Frings GmbH & Co. KG is a worldwide supplier of machines, equipment and components for process technology in the industry sectors food, biotechnology, and the chemical industry as well as environmental technology with special focus on fermenters and bioreactors.

FRINGS not only supplies customized systems for each application, but also offers assistance and consulting services. FRINGS has extensive know how and experience concerning process optimization and product development. For downstream processing FRINGS delivers membrane filtration systems (crossflow filtration) for many different industrial sectors.

Fraunhofer IGB

The Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB develops and optimizes processes and products in the fields of health, chemistry and process industry, as well as environment and energy. In the area of industrial biotechnology we focus on establishing, optimizing and scaling up processes that take place with the help of enzymes or microorganisms. For example, hydrolases and oxidoreductases as well as a wide variety of bacteria, fungi and yeasts are used for this purpose.

In some cases, the desired conversion also becomes possible through combination with chemical transformation processes. In the development of the conversion processes under laboratory conditions and the optimization of the biocatalysts themselves, the focus is already on scaling up the processes and processing the products. At the Fraunhofer Center for Chemical-Biotechnological Processes CBP, the Leuna branch of the institute, infrastructure and pilot plants are available to scale up processes to production-relevant dimensions.



Nobelstr. 12, 70569 Stuttgart

Phone: +49 711 970 4167

Internet: www.igb.fraunhofer.de

Founding year: 1953

Number of employees: 339

Fraunhofer IME

The Fraunhofer Institute for Molecular Biology and Applied Ecology IME conducts research in the field of applied life sciences from a molecular level to entire ecosystems. By strategic orientation along the value chain, the Fraunhofer IME follows the mission to take innovative products closer towards the market, to develop enabling technologies, and provide scientific services to partners from academic institutions and industry.

In the area of industrial biotechnology, the Fraunhofer IME offers research in the field of directed evolution, classical strain improvement, metabolic pathway engineering, and fermentation. Besides scientific expertise, we possess state-of-the-art facilities for high-throughput screening, enzyme production & purification, fermentation process development, and protein crystallization and modelling.



Forckenbeckstr. 6, 52074 Aachen

Phone: +49 241 6085 0

Internet: www.ime.fraunhofer.de

Founding year: 1959

Number of employees: approx. 600,
incl. at international locations

Fraunhofer UMSICHT

The transformation to a sustainable and climate-neutral economic system requires responsibility, great commitment and the cooperation of all social groups. Together with partners, the Fraunhofer UMSICHT researches and develops climate-neutral energy systems, resource-efficient processes and circular products. We offer process engineering research and development services incl. industrial property rights in chemistry, petro-chemistry, refinery and iron and steel production. Our know-how encompasses the areas of fine and specialty chemicals, polymers as well as chemical mass products and biofuels. Biomass, synthesis gas and selected residues constitute the portfolio of possible raw materials. Know-how regarding the upstream and downstream processing round out our expertise.



Osterfelder Str. 3, 46047 Oberhausen

Phone: +49 208 8598 0

Internet: www.umsicht.fraunhofer.de

Founding year: 1990

Number of employees: 560 (456 in Oberhausen
and Willich, 104 in Sulzbach-Rosenberg)

Fraunhofer WKI

The Fraunhofer Institut für Holzforschung, Wilhelm-Klauditz-Institut (WKI) works as closely and as application-oriented with the companies of the wood and furniture industries and the supplier industry as it does with the construction industry, the chemical industry and the automotive industry. Virtually all procedures and materials, which result from the research activities of the Institute, are used industrially.

WKI has extensive competence in the areas of intermediates preparation from biosourced raw materials and polymer synthesis. The focus was laid on the modification of vegetable oils, saccharides, utilising building blocks generated by industrial biotechnology, and the utilisation of lignin for various applications for generating coatings, adhesives, sealants and elastomers.

WKI stands for R&D along the value chain, starting with monomers to end-use applications.



Bienroder Weg 54 E, 38108 Braunschweig

Phone: +49 531 2155 329

Internet: www.wki.fraunhofer.de

Founding year: 1946

Number of employees: 175



Heinrich Heine
Universität
Düsseldorf

Forschungszentrum Jülich GmbH,
Wilhelm-Johnen-Straße, 52428 Jülich
Phone: +49 2461 61 3716
Internet: www.iet.uni-duesseldorf.de
Founding year: 1986
Number of employees: 40

Heinrich Heine University Düsseldorf - Institute of Molecular Enzyme Technology (IMET)

The Institute of Molecular Enzyme Technology (IMET) of Heinrich Heine University Düsseldorf is located on campus of the Forschungszentrum Jülich as part of the Institute of Bio- and Geosciences IBG-1: Biotechnology which holds a leading position nationally and internationally in the field of basic research and biotechnological applications of microorganisms.

The IMET is directed by Prof. Dr. Karl-Erich Jaeger and currently employs about 40 people. Five groups cover the scientific topics "Bacterial Cell Factories" (Dr. Andreas Knapp), "Bacterial Enzymology" (Dr. Filip Kovacic), "Bacterial Photobiotechnology" (Dr. Thomas Drepper), "Molecular Biophotonics" (Dr. Ulrich Krauss), and "Natural Product Biosynthesis" (Dr. Anita Loeschcke/Dr. Stephan Thies).



Henkelstr. 67, 40589 Düsseldorf
Phone: +49 211 797 0
Internet: www.henkel.com
Founding year: 1876
Number of employees: 52,000

Henkel AG & Co. KGaA

Henkel operates globally with a well-balanced and diversified portfolio. The company holds leading positions with its three business units - Laundry & Home Care, Beauty Care and Adhesives - in both industrial and consumer businesses thanks to strong brands, innovations and technologies. Founded in 1876, Henkel looks back on more than 140 years of success. Henkel's preferred shares are listed in the German stock index DAX. The DAX-30 company has its headquarters in Düsseldorf, Germany. Henkel employs more than 52,000 people worldwide, over 80 percent of whom work outside of Germany. As a recognized leader in sustainability, Henkel holds top positions in many international ratings and rankings. In the fiscal year 2019, the company reported sales of approx. 20.1 billion euros and an operating profit of around 2.9 billion euros (adjusted for one-time gains/charges and restructuring charges).



HOCHSCHULE
HAMM-LIPPSTADT

Marker Allee 76-78, 59063 Hamm
Phone: +49 2381-8789-115
Internet: www.hshl.de
Founding year: 2009
Number of employees: 388

Hochschule Hamm-Lippstadt

Founded in 2009 Hamm-Lippstadt University of Applied Sciences has developed rapidly, currently counting 6.200 students in 14 Bachelor and 10 Master degree programs. The focus is on the students, professional and individual development is supported by practice-oriented teaching which is oriented towards the needs of the changing society and the dynamic working environment.

Mentoring between scientific and practical experts, research marketing and reporting, founding, inventions and industrial property rights, promotion of cooperations between science, companies, and institutions are the main tasks. With cooperative doctoral studies, the HSHL offers the opportunity for a further scientific qualification in research projects for qualified graduates of Master degree programs.



Greenheys Building, 61 Pencroft Way
M15 6JJ Manchester
UK

Phone: +44 (0)7981 056 471
Internet: www.holiform.com
Founding Year: 2018
Number of employees: 5

Holiform

Holiform develops holistically improved fermentation technology giving massive fermentation and downstream cost reductions for biosurfactant production.

We are a technology development company that holds proprietary technology developed by our founders at The University of Manchester, UK. Our technology uses gravity separation to recover insoluble lipids as they are produced by fermentation and has been demonstrated to pilot scale with sophorolipid biosurfactants, doubling titre and productivity and reducing costs by >50%. Holiform's technology has been demonstrated to double the state of the art for two of the most economically important KPIs of the sophorolipid production process, reaching titres >800 g/l and productivities >5 g/l/h, leading to large reductions in the cost of production.

Industrial Biotechnology Innovation Centre

The Industrial Biotechnology Innovation Centre's (IBioIC) role, as a specialist in the Industrial Biotechnology (IB) sector, is to stimulate the growth of the IB sector in Scotland to £900 million by 2025. IBioIC connects industry, academia and government, and facilitates collaborations, provides scale-up capabilities, creates networks, and develops skills.

IBioIC supports transition into IB by helping companies to understand the benefits and opportunities, overcome any barriers and to make sure our members are in touch with the right people to guide them through the technology and its consequent translation and implementation in their business.



121 George Street, Glasgow G1 1RD
UK
Phone: +44 (0)141 548 3192
Internet: www.IBioIC.com

INOFEA AG

INOFEA was created to meet a critical need of the industry: to make enzymes more stable, re-usable and suitable for continuous processes. We immobilize enzymes and protect them with a tailor-made shield, making them easy to use in biocatalysis, bioanalysis (diagnostics), and as active ingredients. INOFEA's technology allows enzymes to be recycled by about 20 times and makes them significantly more stable (10-fold improvement). Our technology allows a reduction of raw materials needed for synthesis, a reduction of energy consumption during the production process and a reduction of waste and solvents in biocatalytic processes. We supply to customers who are among the top players in their industry, namely Pharma, Food, Crop Protection, Specialty & Fine Chemicals and Consumer Care.



Hofackerstr. 40b, 4132 Muttenz
Switzerland
Phone: +41 76 4050743
Internet: www.inofea.com
Founding year: 2014
Number of employees: 6

INOSIM Consulting GmbH

INOSIM Consulting GmbH is a German company providing sophisticated technological advice and simulation services for process industries and biotechnology.

Our engineering and simulative methods for the design and optimization of biotechnological processes allow setting up the mass and energy balances of a process, applying as little experimental and process data as possible. Thereby, alternative process ideas can be evaluated in both process design and scale-up as well as in the optimization of existing processes and plants. Looking at the complete process and plant with all interdependencies in-between helps to develop resource-saving processes and production plants. Besides the resource efficiency, production costs and capacity can, of course, be included in the rating as well.



Joseph-von-Fraunhofer-Str. 20, 44227 Dortmund
Phone: +49 231 970 025 0
Internet: www.inosim-consulting.com
Founding year: 2010
Number of employees: 5

IP Services

The international protection of Intellectual Property (IP) is of great importance for successful collaboration and commercialization. The successful protection of biotechnological inventions e.g. representing one part of a complete value chain requests a sound experimental set-up from the initial idea to patent filing. IP Services assists throughout the process of translating ideas into valuable Intellectual Property Rights.

Based on a 17 year experience in a biotech company working as project manager and IP manager in the field of recombinant expression in yeast, I started my own business in 2005.

The objective is to represent the interface between a company and a law firm and providing any IP service needed by small or mid-sized biotech companies on a cost efficient basis and independent of the company's location.

The service comprises assessing the value of a company's technologies, collaboration with R & D, IP searches, definition of patent filing strategy, analysis and maintenance of IP portfolio, patent application processing, cooperation with law firms, preparation for due diligence (M&A processes), IP administration, cost control, and IP training.



Unter Linden 35, 50859 Köln
Phone: +49 221 790 077 30
Internet: www.weydemann.net
Founding year: 2005
Number of employees: 1



Jäckering Mühlen- und Nahrungsmittelwerke GmbH

The Jäckering group of companies has developed over 100 years (foundation 1910) into a group of various activities reaching from wheat starch production to machinery business and by-product recycling in the PVC industry with its main production site in the harbour of Hamm in Germany.

Just recently an 85 Mio. € investment was executed by Jäckering in its mill and wheat-based biorefinery with an increase of its raw material input from 300,000 tons to 600,000 tons of wheat. The signs point to growth and expansion, with an important pillar in the biotechnological production of e.g. biobased plastics, organic acids as well as microbial astaxanthin and protein using the existing side-streams as substrates.

Research is already carried out together with leading universities and institutes. The research & development centre onsite is readily available and offers facilities for bioprocess development and up-scaling of up-stream-, down-stream- and fermentation processes from shaking flask over 10L and 300L up to 1500L.

Approval for usage of GMO (S1) for research is possible.

Vorsterhauser Weg 46, 59067 Hamm

Phone: +49 2381 4220

Internet: www.jaeckering.de

Founding year: 1910

Number of employees: 100



KADIB - Kircher Advice in Bioeconomy

KADIB offers comprehensive expertise in Industrial Bioeconomy. We provide consultancy in positioning profitable chemical and energy value chains in your Political, Economical, Societal, Technological, Legislative and Ecological (PESTLE) environment. KADIB provides advice and moderates decision-making:

- Analysing the Bioeconomy Potential
- Designing strategic Bioeconomy Concepts
- Implementing Bioeconomy Strategies
- Focusing on Markets, Technologies and Business Opportunities
- For Industries, Research Institutes, Governmental Agencies

KADIB works through its unique network of senior experts. KADIB is a member of CLIB-Cluster (Cluster Industrial Bioeconomy) and BioBall (Bioeconomy in Metropolitan Regions).

Kurhessenstr. 63, 60431 Frankfurt am Main

Phone: +49 69 95104772

Internet: www.kadib.de

Founding year: 2014

Number of employees: 1



Kuhner Shaker GmbH

The Kuhner Shaker GmbH distributes shaking machines and application technologies for shaken bioreactor systems. Moreover, we produce and develop innovative feeding technologies for microtiter plates, shake flasks and spin tube bioreactors. The product portfolio covers bench top shakers, industrial shaking machines for GMP environments as well as the feeding technologies FeedPlate, FeedBead and FeedTube.

Kuhner Shaker is driven by a personal and trustful contact to our customers. Based on a long-term experience and our expert knowledge regarding shaken bioreactors we are capable to offer individual and custom-made solutions. As partner of the science, we actively contribute to academic research projects.

Kaiserstr. 100 , 52134 Herzogenrath

Phone: +49 2407 554 88 22

Internet: www.kuhner.com,
www.feedingtechnology.com

Founding year: 2015

Number of employees: 6



LANXESS Deutschland GmbH

LANXESS - at the heart of the chemical industry

LANXESS is a leading speciality chemicals company based in Cologne. With around 14,400 employees in 33 countries, we are an established company on the global market. Our primary expertise lies in producing, developing and marketing chemical intermediates, additives, specialty chemicals and plastics, with annual sales of EUR 6.8 billion (2019).

Sustainability and responsibility are key factors behind our successful business operations. They help us become an even more efficient and competitive company while also supporting social goals such as protecting the environment. Our products also play a role in this, providing sustainable solutions in key areas such as electric mobility.

Our aim is for the company to be carbon neutral by 2040. Setting this ambitious target builds on our previous, successful commitment to environmental protection.

LANXESS is listed in the leading sustainability indices Dow Jones Sustainability Index (DJSI World and Europe) and FTSE4Good.

Kennedyplatz 1, 50569 Köln

Phone: +49 221 8885 0

Internet: www.lanxess.com

Founding year: 2004

Number of employees: 14,400

LanzaTech Inc.

Founded in 2005, LanzaTech has developed a fully integrated gas to liquid technology platform that produces fuels and chemicals from gas resources. The potential feedstock ranges from industrial waste gases (steel mills, refineries and phosphorous plants) to biomass syngas (MSW, organic industrial waste, and agricultural waste); as well as biogas.

LanzaTech employs a strong technical team based in the USA, China and Europe and has a rapidly growing patent portfolio. With agreements now in place across a variety of sectors internationally, including steel, aviation, refining and chemicals, LanzaTech's technology is being scaled to commercial production.



8045 Lamon Avenue, Skokie, 60077 IL USA

Phone: +1 847 324 2400

Internet: www.lanzatech.com

Founding year: 2005

Number of employees: 120

LignoPure GmbH

LignoPure is a pioneer in helping materials science and life science companies revolutionize their portfolio with tailor-made, sustainable product solutions. For this purpose, LignoPure uses the raw material lignin, which is as good as unknown, but actually the second most abundant biopolymer in the world!

We offer lignin-based solutions for your product ideas. LignoPure is a spinoff of the Hamburg University of Technology – A multidisciplinary team with expertise in process engineering, product development & business administration.

From its versatile biorefinery network, LignoPure can source suitable lignins and process them specifically for the customer's application. In addition, LignoPure offers tailor-made development services to the processing customer.



Harburger Schloßstraße 6-12, 21079 Hamburg

Phone: +49 40 428784295

Internet: www.lignopure.de

Founding year: 2019

Number of employees: 4

LXP Group GmbH

LXP is a tech company, active in the field of industrial biotechnology. The objective of the company is the development, marketing and licensing of technical solutions for the economic and ecological processing of plant residues on the basis of closed carbon and mineral cycles. Our mission is to maximize the ecological and economic efficiency of biotechnological processes.

The core technology is based on a patent protected pre-treatment process called LX-Process. This process provides alternative/2G-carbohydrates/-sugars and is easy to integrate into biotechnological processes. It allows the conversion of virtually all carbohydrates of lignocellulosic non-food materials to chemicals or biofuels. Additionally, sulphur free lignin is obtained.



Alte Dorfstr. 14a, 16348 Marienwerder

Phone: +49(0)3337 / 3774140

Internet: www.lxp-group.com

Founding year: 2009

Number of employees: <10

Mitsui & Co. Deutschland GmbH

Mitsui & Co. Deutschland GmbH is a subsidiary of Mitsui & Co., Ltd., one of the most diversified and comprehensive trading, investment and service enterprises which covers a wide range of industries: Metals, Machinery & Infrastructure, Chemicals, Nutrition & Agriculture, Energy, Lifestyle, and Innovation & Corporate Development. We currently comprise 133 sites in 65 countries/regions and a network of more than 500 affiliates, employing approximately 45,000 talented people worldwide. In every arena, Mitsui & Co. provides high added value services and solutions that truly reflect our customers' needs. Our job is to imagine new businesses and bring them to life. Creating new value for this era and innovating for the next.



MITSUI & CO.

Herzogstr. 15, 40217 Düsseldorf

Phone: +49 211 9386418

Internet: www.mitsui.com/de

Founding year: 1954

Number of employees: 179



Uusikatu 24 G 70, 90100 Oulu, Finland
Phone: +358 40 552 8880
Internet: <http://www.ncpartnering.com>

NC Partnering Ltd.

We favour renewable over finite-supply, but prefer those technologies that require little or no subsidies to thrive; commercially viable concepts will ultimately stand the test of time. We believe the best long-term effects are achieved when each component in biomass is utilised to its full potential.

With respect to wood, this means preferring advanced value chains over simple usages. Our vision calls for a Biofuture that goes beyond traditional solutions. We see danger in over-simplified calls for anything renewable, and prefer an integrated approach to biomass and biotechnology. There are immense opportunities open to those who want to take today's bioeconomy to the next stage - the Biofuture, but only if innovation and commercial sense advance hand in hand! Our newest tool for driving bio-innovation is the BioFutureFactory™, of which more on our website.



Fürstenwall 172, 40217 Düsseldorf
Internet: www.neste.com
Founding year: 1948
Number of employees: 4,400

Neste Germany GmbH

Neste (NESTE, Nasdaq Helsinki) creates solutions for combating climate change and accelerating a shift to a circular economy. We refine waste, residues and innovative raw materials into renewable fuels and sustainable feedstock for plastics and other materials. We are the world's leading producer of renewable diesel and sustainable aviation fuel, developing chemical recycling to combat the plastic waste challenge. We aim at helping customers to reduce greenhouse gas emissions with our renewable and circular solutions by at least 20 million tons annually by 2030, and are committed to reaching carbon-neutral production by 2035. We have consistently been included in the Dow Jones Sustainability Indices and the Global 100 list of the world's most sustainable companies. In 2019, Neste's revenue stood at EUR 15.8 billion, 82% of the our comparable operating profit coming from renewables.



**Hochschule
Niederrhein**
University of
Applied Sciences

Reinarzstr. 49, 47805, Krefeld
Phone: +49 2151 822 5038 (-4728)
Internet: www.imh.hsnr.de
Founding year: 2005
Number of employees: 5

Niederrhein University of Applied Sciences Institute for Modeling and High Performance Computing (IMH)

More and more companies and research projects analyze and optimize technical systems via computational fluid dynamics (CFD). The IMH applies CFD to very complicated geometries with focus on two-phase flows and program. Furthermore, the IMH programs and parallelizes additional software for commercial software programs.



nouvellune®

Kurfürstenstr. 27, 50678 Köln
Phone: +49 221 222 05 192
Internet: www.nouvellune.com
Founding year: 2015
Number of employees: 5

Nouvellune GmbH

Nouvellune GmbH is active in the development and sales of special bio-based ingredients and bio-active compounds in Germany, Switzerland and Austria. This includes the development, production and sales of Pro- & Prebiotics (Food & Feed), Extracts, Special Branded Ingredients, APIs, Vitamins & Minerals, but also vegan meat substitutes produced through High Moisture Extrusion through its brand "Stemmler". In addition, the company is researching in the area of alternative proteins because of its passion for sustainability. Last but not least, Nouvellune belongs to a larger conglomerate of companies named Phytonet AG, which is active in the above areas in 8 countries in Middle East & South East Asia, whereas Sourcing, Trading, Regulatory and Local Market Access play an additional role.

Novo Nordisk Foundation Center for Biosustainability

Why not use the smallest factories to make the biggest possible amounts of high-value chemicals and pharmaceuticals – biosustainably? The Novo Nordisk Foundation Center for Biosustainability is doing exactly this by developing new technologies for engineering microbes, turning them into cell factories, which are designed for efficient production of a specific compound in a commercially competitive way. The Center is part of a cluster of research centers that aim at attracting the world's best researchers, and thereby creating the basis for an internationally oriented and innovative research environment of the highest quality to benefit society.



Kemitorvet 220, 2800 Lyngby
Denmark
Phone: +45 45 25 80 00
Internet: www.biosustain.dtu.dk/english
Founding year: 2011
Number of employees: 253

nova-Institut GmbH

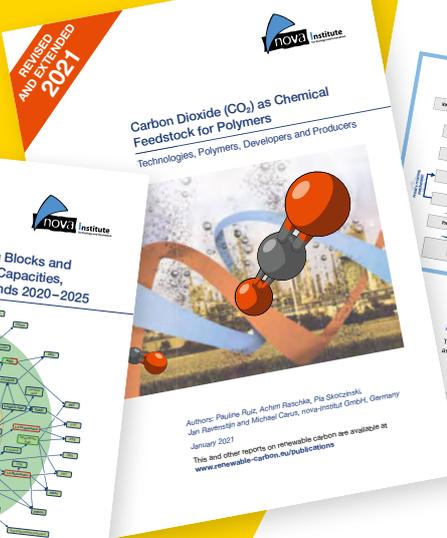
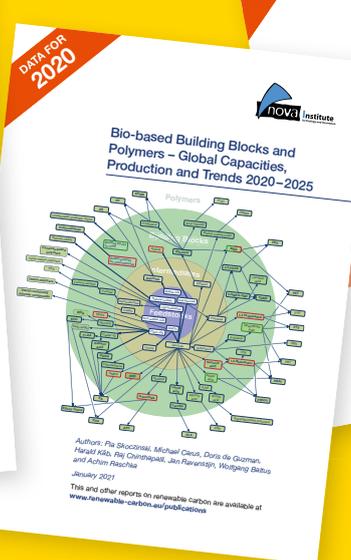
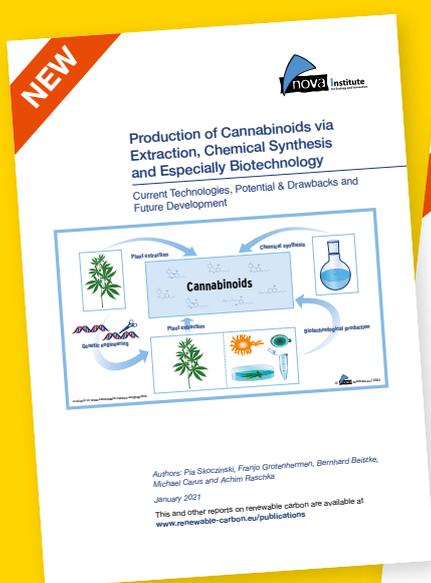
nova-Institute is a private and independent research institute, founded in 1994; nova offers research and consultancy with a focus on the transition of the chemical and material industry to renewable carbon.

What are future challenges, environmental benefits and successful strategies to substitute fossil carbon with biomass, direct CO₂ utilisation and recycling? What are the most promising concepts and applications? We offer our unique understanding to support the transition of your business into a climate neutral future.

Our subjects include feedstock, technologies and markets, economy and policy, sustainability, communication and strategy development. The nova team consists of more than 40 employees.



Industriestr. 300, 50354 Hürth
Phone: +49 2233 4814 40
Internet: www.nova-institute.eu
Founding year: 1994
Number of employees: 46



The best market reports available: pharma, renewable building blocks and polymers as well as chemical recycling



renewable-carbon.eu/publications



Kavalleriestr. 22, 40213 Düsseldorf
 Friedrichstr. 1, 48145 Münster
 Phone: +49 211 91741-0
 Internet: www.nrwbank.de
 Founding year: 2002
 Number of employees: 1,428

NRW.BANK

NRW.BANK is the promotional bank of North Rhine-Westphalia. It essentially orients its equity products on the business life cycle. The program "NRW.SeedCap" doubles initial investments of business angels in innovative start-ups under the same conditions. The "NRW.BANK.Seed Fonds Initiative" and the "NRW.BANK.Venture Fonds" invigorate early-phase funding in NRW. Within the "win NRW.BANK Business Angels Initiative" private investors (business angels) support young entrepreneurs with capital and know-how. The "NRW.BANK.Venture Center" is a specialist advisory unit for business founders from universities and research institutions as well as innovative start-ups.



Pfeifer & Langen

Aachenerstr. 1042a, 50858 Köln
 Research Facility: Dürener Str. 40, 50189 Elsdorf
 Phone: +49 221 4980 0
 Internet: www.pfeifer-langen.com
 Founding year: 1870
 Number of employees: 2,300

Pfeifer & Langen GmbH & Co. KG

Pfeifer & Langen operates five sugar factories in Germany. Sugar beets grown by farmers are processed to white sugar and the by-products sugar beet pulp and molasses. These products and intermediate products such as thick juice can be used as carbohydrate sources for biotechnological processes.

Pfeifer & Langen supplies sugar and sugar specialities for the food industry and the consumers. The production process of Pfeifer & Langen starts when the sugar beet seed is sold to the farmers and ends when the sugar is placed on the shelves of groceries. We are looking for opportunities to use our expertise in the process chain beginning with agriculture and ending in the food retail trade for new processes and products connected with biotechnology. Even though we offer deep knowledge in the development of enzymatic processes and enzyme production.

Pfeifer & Langen is with its affiliated company Savanna Ingredients GmbH active enters the on the field of production and sales natural functional carbohydrates.



phytowelt

Kölsumer Weg 33, 41334 Nettetal
 Phone: +49 2162 77859
 Internet: www.phytowelt.com
 Founding year: 1998
 Number of employees: 27

Phytowelt GreenTechnologies GmbH

Phytowelt GreenTechnologies GmbH is an experienced, innovative SME offering contract research and production in plant and industrial biotechnology worldwide. Our know-how in plant tissue culture, genetic and bio engineering assists our clients for the optimization of plants as well as the utilisation of secondary metabolites and enzymes for industrial use. Thus we enable the production of valuable molecules within plants via key technologies such as protoplast fusion or genome editing, or outside of plants in microbes, via bio-fermentation or bio-catalysis. Our approach to link plant and industrial biotechnology is maximizing synergies and so boosting sustainable development for example in aroma, pharmaceutical or agricultural industry.



Schlossstr. 11-15, 45468 Mülheim an der Ruhr
 Phone: +49 208 94105 0
 Internet: www.provendis.info
 Founding year: 2001
 Number of employees: 41

PROVendis GmbH

PROVendis acts as a professional service provider in the entire field of IP management for more than 30 universities and extra-university research institutions as well as for companies and start-ups.

We provide an exclusive access to licensable inventions of approx. 20,000 scientists from the areas of medicine, natural sciences and engineering.

Our Life Sciences Team consists of experienced innovation managers with professional expertise in the fields of biology, chemistry, medicine and pharma. They identify suitable partners, negotiate license agreements and promote long-term research collaborations.

Beantragen Sie schnell
und einfach Ihre
NRW.BANK.Förderung.
Alle Infos und FAQ:
www.nrwbank.de/corona

 @nrwbank
#TeamNRW

„Unsere Idee rollt weiter – vom
Start-up in Richtung Mittelstand.“

Fördern, was NRW bewegt.

Tanja Zirnstein und Katharina Obladen, Gründerinnen von **UVIS**, entwickeln innovative Technologien und Services für mehr Hygiene. Den Start finanzierte ein Business Angel zusammen mit dem NRW.SeedCap der NRW.BANK. Jetzt wächst UVIS in den Mittelstand.

Die ganze Geschichte unter: nrwbank.de/uvis



NRW.BANK
Wir fördern Ideen



Qingdao Institute of Bioenergy and Bioprocess Technology Chinese Academy of Sciences

The Qingdao Institute of Bioenergy and Bioprocess Technology (QIBEBT), Chinese Academy of Sciences is one of China's primary national research institutions for renewable energy and green materials, focusing mainly on research and development of the resources, technologies, products and processes for bio-based energy and materials. QIBEBT currently has a staff of 800, 470 of whom are full-time employees and 330 are graduate students. The institute offers PhD, Master and Postdoctoral programs in biology, chemical engineering and technology, and material science and engineering. The institute attaches high importance to promoting international cooperation and has more than 170 global partners including Boeing, Shell, P & G and Total.

No.189 Songling Road, Laoshan District,
Qingdao, 266101, P.R.China
Phone: +86-532-80662640
Internet: <http://english.qibebt.cas.cn>
Founding year: 2009
Number of employees: 470



RWTH Aachen - Lehrstuhl für Biotechnologie

We are experts in biocatalyst engineering with a focus on directed protein evolution. We are developing novel random mutagenesis methods (SeSaM: Sequence Saturation Method), high throughput screening systems and computational programs to manage the complexity of protein sequence space.

Based on our core competencies in directed protein evolution we founded a company (SeSaM-Biotech) and collaborate with leading companies in the field of industrial biotechnology. With our expertise we aim to understand structure-function relationships of biocatalysts and functional biomaterials in order to solve significant problems in industrial biocatalysis.

Worringer Weg 1, 52056 Aachen
Phone: +49 241 8024176
Internet: www.biotec.rwth-aachen.de
Founding year: 2008
Number of employees: 38



Saint-Hyacinthe Technopole

Saint-Hyacinthe Technopole manages economic development on the city of Saint-Hyacinthe's territory. Its mission is to attract new industrial and commercial businesses, as well as promote and develop tourism. One of the Technopole's main tasks is to attract potential investors to the Maskoutan region. It works closely with investors to help get their projects set up in our area and ensure their success. It also manages and develops the technology park, the City of Agri-Food, Veterinary and Agri-Environmental Biotechnology. The Technopole is in charge of managing and selling lots in the industrial parks. The Technopole also helps established businesses in the city centre with their development projects, namely by securing financing packages and guiding them.

1000 Dessaulles, J2S 8W1 Saint-Hyacinthe, Quebec, Canada
Phone: +450-774-9000
Internet: www.st-hyacinthetechnopole.com
Founding year: 2003
Number of employees: 14



INTELLECTUAL PROPERTY

Scheele Wetzel Patentanwälte Partnerschaftsgesellschaft mbB

We Protect Your Intellectual Property

Scheele Wetzel is a boutique IP law firm offering services in in all areas of German and European patent, trademark and design law. Our clients range from large enterprises, small and medium sized businesses, universities, institutions to private inventors.

The firm is a cooperation partner of US based law firm Ratnerprestia PC with offices in Philadelphia, Washington and Wilmington. The attorneys at Scheele Wetzel have been shareholders of RatnerPrestia and thus have a strong personal and professional relationship to the firm, which allows them to solve client's needs in European law as well as US law on short notice. By combining our patent attorney services and technical expertise in engineering and natural sciences, we effectively support our clients in obtaining, defending and enforcing their intellectual property rights.

The firm is located in Munich directly beneath the European Patent Office in the heart of Munich.

Bayerstr. 83, 80335 München
Phone: +49 89 125012162
Internet: www.swp.legal
Founding year: 2021
Number of employees: 3

Schnee Research

Schnee Research sees itself as a mediator between financial markets (e.g. investors) and small to mid-sized companies in different areas (e.g. biotech, chemical industry). Having worked for some years as analyst in the financial industry (independent research house, and rating agency), I now keep strong ties to the chemical industry from my background as a trained chemist (Dipl.-Chem.) and to biotech from my thesis work. My business activities in the area of white biotechnology are focused on evaluation and scouting. I focus on the analysis and evaluation of privately owned as well as listed biotech companies or their development projects.

I was contracted as independent specialist by an investment bank to consult and assist a white biotechnology company in obtaining funding. Schnee Research offers two different services directly or via its cooperation partners faireseach (pure-play financial research) and Breslin. As a consequence, Schnee Research can span an investment bank's value chain with its entire network. The services of Schnee Research are closer to the money market than to production.



P. O. Box 1104, 63461 Maintal
Phone: +49 6181 9455 262
Founding year: 2002
Number of employees: 1

SCION - New Zealand Forest Research Institute Limited

Scion is a New Zealand Crown Research Institute that specialises in research, science and technology development for the forestry and wood-derived materials: tree improvement, wood-related bioenergy, industrial biotechnology and high-value manufacturing. Scion is developing biorefinery processes to create new green chemicals and biopolymers from renewable resources, with a focus on lignocellulosic biomass: soft wood.

We develop microbial and enzyme-based processes that can be used by industrial partners for the production of valued compounds, enzymes and other biological products.

Scion is New Zealand's centre of expertise in bioplastic research and development: production and manufacturing of biopolymers as plastics, adhesives, coatings, foams, pulp/packaging, and fibre-composites.



49 Sala Street, 3010 Rotorua,
New Zealand
Phone: +64 7 343 5899
Internet: www.scionresearch.com
Founding year: 1947
Number of employees: 300

Senbis Polymer Innovations B.V.

Senbis Polymer Innovations is a privately-owned company that supports its customers with applied (bio)polymer research. The young organization is building upon 25 years of experience in polymer research, as it used to be the former R&D department of AKZO and Diolen.

Besides contract research, analysis and production for SMEs to multinationals, Senbis develops and produces its own products typically made from biopolymers. Examples are compostable yarns (PLA) for the horticulture industry, biodegradable fishing nets or trimmerlines. The company also has a strong focus on (mono)filaments for 3D printing. Please contact us if we can support you in developing your biodegradable application.



Eerste Bokslootweg 17, 7821AT Emmen,
The Netherlands
Phone: +31 591 69 2117
Fax: +31 591 69 3456
Internet: www.senbis.com
Founding year: 2016
Number of employees: 11

SenseUp GmbH

SenseUp develops and optimizes microbial strains for industrial amino acid production. Using its revolutionary metabolite-sensor based screening technology, SenseUp offers strains with superior productivity, massive IP-generation and short development times. The SenseUp-Technology is currently adapted to non-GM compatible natural evolution, enabling unique optimization of probiotic microorganisms in near future.

As a spin-off from Forschungszentrum Jülich, SenseUp combines decades of experience in microbial strain-development with novel disruptive technologies.



c/o Campus Forschungszentrum,
Wilhelm-Johnen-Straße, 52428 Jülich
Phone: +49 2461 61 5529
Internet: www.senseup.de
Founding year: 2015
Number of employees: 10



Gierlichsstr. 6, 53840 Troisdorf

Phone: +49 2241 2715 2000

Internet: www.senzyme.de

Founding year: 2000

Number of employees: 30

Senzyme GmbH

Senzyme GmbH is innovatively operating in biotechnology and develops and produces technical enzymes and other additives for applications in bioenergy, biorefinement, as well as in the food and feed industries.

The company has long and substantial experience in the cultivation of fungi using solid-state fermentation as the preferred method. Senzyme GmbH maintains a quality management system and guarantees the effectiveness and quality of all its processes and products. The company always welcomes cooperations with scientific institutions and other companies.



Quality Enzyme Solutions

Forckenbeckstr. 50, 52074 Aachen

Phone: +49 241 938 569 79

Internet: www.sesam-biotech.com

Founding year: 2008

SeSaM-Biotech GmbH

As an 'all-in-one' protein engineering service provider, SeSaM-Biotech improves industrial enzymes for various industry sectors like the chemical, dish&fabric, feed and food sector.

Our expertise covers a range of enzymes including amylases, lipases, esterases, cellulases, glucose oxidases, laccases, monooxygenases, phytases, proteases, pectinases, polymerases and isomerases which we already have improved towards e.g. higher activity, thermal resistance or many other characteristics. With our cutting-edge technologies for mutagenesis (e.g. SeSaM-Technology, OmniChange), computational modelling of enzymes, and individually adapted screening assays we follow our vision:

To provide our clients with 'Quality Enzyme Solutions' to make their products eco-friendlier, more cost effective and more valuable.



7-11 Boulevard Haussman 75009, Paris
France

Phone: +33 1 76 23 41 00

Internet: www.sofinnovapartners.com

Founding year: 1972

Number of employees: 45

Sofinnova Partners

Sofinnova Partners is a leading European venture capital firm specialized in Life Sciences, with a focus on healthcare and industrial biotechnology. Based in Paris, London and Milan, the firm brings together a team of over 40 professionals from all over the world. The firm focuses on paradigm-shifting technologies alongside visionary entrepreneurs. Sofinnova Partners invests across the Life Sciences value chain as a lead or cornerstone investor, from very early-stage opportunities to late-stage/public companies. It has backed 500 companies over 50 years, creating market leaders around the globe. Today, Sofinnova Partners has over €2 billion under management. For more information, visit: www.sofinnovapartners.com



Westring 303, 44629 Herne

Phone: +49 2323 956 5863

Internet: www.solarbioproducts.com

Founding year: 1965

Number of employees: 20

SolarBioproducts Ruhr c/o Wirtschaftsförderungsgesellschaft Herne mbH

SolarBioproducts Ruhr was founded by the business development agency Herne in cooperation with the Photobiotechnology group (Ruhr-University Bochum). SolarBioproducts Ruhr aims to intensify research projects, develop innovative ideas and bring together different fields of study.

We offer outstanding experience in the field of green biotechnology, including in-depth knowledge of biocatalysts from photosynthetic microorganisms. Our team is interested in collaborations across a broad range of fields. Our experience in gene expression and genetic manipulation is applicable in the field of renewable energy, but also for bioeconomical alternatives for industrial applications like the use of microorganisms as chassis for the production of chemical compounds or high-value products.

Syngip BV

Syngip is a next generation carbon capture biotechnology company. Syngip engineers carboxydophilic bacteria to produce biochemicals and biofuels from syngas and carbon waste gases (gases containing CO and/or CO₂, H₂). Currently, the main focus lies on the development of microbial biocatalysts for the production of light olefins.

Especially the major target isobutene is an important building block for plastics, rubbers and fuels. Global consumption of isobutene is over 15 million tons per year. Production of isobutene from syngas or industrial waste gases is a very innovative approach to reduce climate destroying greenhouse gases, enable a circular economy and offer an alternative to petrochemical production routes. Syngip has been acquired in 2017 by Global Bioenergies, who already developed an isobutene production process from sugar in E coli.



Burgemeester Lemmensstraat 360,
6163 JT Geleen, The Netherlands
Phone: +31 653230676
Internet: www.syngip.com

TH Köln - University of Applied Sciences

The TH Köln - University of Technology, Arts, Sciences offers students and scientists from Germany and abroad an inspirational study and research environment in the social, cultural, engineering, and natural sciences. Currently there are more than 24,000 students from about 120 countries enrolled in over 90 bachelor's and master's programs of 11 interdisciplinary faculties.

Climate change and scarce resources are some of the major challenges mankind will be facing in the coming decades. The faculty of Applied Natural Sciences at Campus Leverkusen engages itself in chemical and biotechnological research projects to address these 'great challenges' and actively contributes to the advancement of science and economy.

Technology Arts Sciences TH Köln

Gustav-Heinemann-Ufer 54, 50968 Köln
Phone: +49 221 8275-3051
Internet: www.th-koeln.de
Founding year: 1973
Number of employees: 1700

TU Dortmund University - Department of Biochemical and Chemical Engineering (BCI)

The Department of Biochemical and Chemical Engineering (BCI) at TU Dortmund University is the largest and one of the most successful engineering departments in Germany. It is active in all areas of biochemical and chemical engineering. The strength of the department is its multidisciplinary, linking various research areas, such as thermodynamics, fluidics, biomaterials, chemical biotechnology and process engineering, thus covering all stages of (bio)process and (bio)catalyst development. The BCI is the initiator of the SusChemEng research network, bringing together academia and large and medium sized companies for the design and optimization of safe, environmentally friendly and sustainable processes and products for the chemical, pharmaceutical, and related industries.



Emil Figge Str. 66, 44227 Dortmund
Phone: +49 231 755 2338
Internet: www.bci.tu-dortmund.de
Founding year: 1969
Number of employees: 200

Ulrich Windmüller Innovation GmbH & Co. KG

UWI is a young, high-innovative company for research and development of new technologies and processes in the field of chemical and biocatalytic modification of vegetable oils. These oils which are used as bio-based raw materials in the production of polyurethanes (PU) can replace a large amount of the crude oil-based polyols. The start-up, founded by Ulrich Windmüller in 2018, is working on this project in the new, well-equipped laboratory with motivated employees at Detmold with the aim of supplying Windmüller GmbH - a cooperation partner - with tailor-made polyols based on local vegetable oils. These polyols are used as building blocks to produce floor coverings and underlays made of PU.



Ottenheide 60, 33758 Schloss-Holte Stukenbrock
Phone: +49 5237 609100
Internet: www.uw-innovation.de
Founding year: 2018
Number of employees: 4



Holzstr. 6, 40221 Düsseldorf
Internet: www.uniper.energy

Uniper Kraftwerke GmbH

Uniper SE is an international leading energy utility with activities in more than 40 countries and about 12000 employees. Uniper Kraftwerke GmbH ("UKW") as well Uniper Technologies GmbH ("UTG") are subsidiaries of Uniper SE, which is headquartered in Düsseldorf, Germany. Core business of Uniper SE is reliable and secure provision of energy and corresponding support activities. Focus is the energy production in Europe and Russia and global energy trading. The innovation team within Uniper SE is looking for future business models in different areas. One of these areas is called "Carbon Recycling" as Uniper has identified its CO₂ emission not as a waste steam, but as a good accessible point source for the development of future value generation from CO₂.



Völklinger Str. 4, 40219 Düsseldorf

Phone: +49 211 67931 43
Internet: <http://nrw.vci.de>
Founding year: 1945
Number of employees: 6

Verband der Chemischen Industrie e. V. - NRW

The "Verband der Chemischen Industrie e.V. NRW" (the Chemical Industry Association in North Rhine-Westphalia) represents the politico-economic interests of more than 500 NRW chemical companies and NRW subsidiaries of foreign enterprises in contacts with politicians, public authorities, other industries, the world of science, and the media.

VCI NRW represents about 30% of the entire German chemical industry, an industry that realised sales of € 50 billion in 2018 and employed some 110,000 staff. A main focus of the last years was the interlinking of industry and science especially in the area of biotechnology. The association's policies are shaped by a presidential council which works in an honorary capacity and the VCI NRW executive management.



Droevendaalsesteeg 4, 6708 PB Wageningen
The Netherlands

Phone: +31 317 480100
Internet: www.wageningenur.nl
Number of employees: 8,254

Wageningen University and Research

To explore the potential of nature to improve the quality of life.

Wageningen University and Research is a joint venture between the Wageningen University, which focuses on education and fundamental research, and Wageningen Research which conducts applied research directly for industry. In CLIB, the WUR is represented by five academic chair group - Bioprocess Engineering, Microbiology, Systems and Synthetic Biology, Environmental Technology and Biobased Commodity Chemistry - and by the applied research centre Food & Biobased Research (WFBR)

The groups study microbial processes intra-cellular, cellular, inter-cellular, reactor, and environmental scale with a strong link to the chemical industry. The generated knowledge at the University is translated into application, by WFBR, for production and biorefinery of pharmaceuticals, healthy food ingredients, bulk chemicals, and biofuels.



Industriestr. 300, 50354 Huerth (Cologne)

Phone: +49 2233 48 6343
Internet: www.yncoris.com
Founding year: 1997
Number of employees: 1,160

YNCORIS GmbH & Co. KG

YNCORIS places particular emphasis on the engineering of individual plants - from process development and conceptual design to basic and detailed engineering, regardless of whether we just carry out sub-services or take over the general planning for every stage. YNCORIS does not supply one-size-fits-all solutions. Instead, we adopt a flexible approach and gear ourselves towards the specific requirements of the current project stage - step-by-step. Thanks to a broad range of diverse engineering fields and an extensive selection of methods, we can guarantee the highest degree of flexibility with regard to content.

The Chemiepark Knapsack near Cologne in Germany also offers companies a scale-up platform and access to know-how for bio-based production and integration into existing value chains. The innovative capacity of the Chemiepark Knapsack, solid infrastructure, plug&play services, as well as less bureaucracy and red tape all offer huge benefits for your company to commercialize your product.

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