Research Educate Connect

BioSC
Bioeconomy Science Center

BioSC Newsletter October 2020

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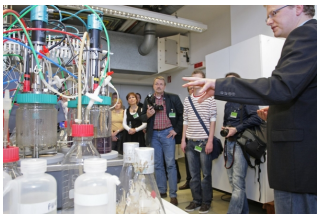
Ten years Bioeconomy Science Center

At the end of September 2010, the founding contract for the Bioeconomy Science Center was signed. RWTH Aachen University, the Universities of Bonn and Düsseldorf and Forschungszentrum Jülich established a cross-institutional and interdisciplinary cooperation in basic and applied research for the transformation to a sustainable bioeconomy, which is still unique today. Ten years later, the BioSC has developed into a renowned center of excellence for bioeconomy research in Germany and Europe, from which numerous contributions to solutions have been developed through integrative research projects and where cross-disciplinary educational approaches have been implemented.

Founding press conference on October 21, 2010



Guided tour for journalists in April 2011

Founding Symposium on September 12, 2011

The first BioSC Lecture with M.S. Swaminathan on June 28, 2013

The concept of a „Knowledge-based Bio-Economy“ (KBBE) as a driver for a competitive and sustainable economy was first formulated by the European Commission in 2005. In 2007, experts from academia and industry evaluated the prospects for a knowledge-based bioeconomy in the so-called „Cologne Paper“. They pointed out, among other things, the considerable need for interdisciplinary research and education and the important role of society. At the end of 2007, the state of NRW then established a KBBE office with Dr. Dr. h.c. Christian Patermann, the former head of the Research Directorate at the European Commission and „father“ of the KBBE, which was to advise the state government in this „emerging field of research and innovation“.

In North Rhine-Westphalia, the importance of the knowledge-based bioeconomy was recognized early on by research institutions and universities, so that initial discussions began as early as 2005 on how a comprehensive concept could be implemented here. The idea of founding a competence center for bioeconomy research developed on the basis of scientific excellence, high synergy potential and cooperation in bioeconomy-relevant research fields that already existed between Forschungszentrum Jülich, the universities of Bonn and Düsseldorf and RWTH Aachen University. In the spirit of the „Cologne Paper“, these four partners developed a concept for the cross-disciplinary bundling of their competences.

In 2010, the founding contract for the Bioeconomy Science Center was signed - in the same year in which the German government adopted the National Research Strategy Bioeconomy 2030. In 2013, the federal government and the state of NRW concluded an agreement to jointly support the development of the BioSC for a period of at least ten years. Since 2013, the research association has been funded within the framework of the NRW strategy project BioSC.

Workshop at the first internal BioSC Forum, November 3, 2014

Presentation of the first Supervision Award on November 3, 2014

"Grüne Woche" in Berlin in January 2016

First International BioSC Symposium in Cologne on October 18, 2016 with Prof. Regina Birner

Until 2016, the research program of the strategy project followed a „bottom up“ approach: BioSC members could apply for open-topic one- or two-year projects if those were interdisciplinary and supported by at least two of the four participating institutions. Through peer review procedures, a total of 41 projects were implemented in this first phase. Based on the results of the first phase, a thematic focus was then set from 2017. In six large multidisciplinary cooperation projects, the FocusLabs, up to ten working groups each worked on an integrative project over a period of three to four years. In addition, in the second phase, applications for projects lasting one to two years could still be submitted in order to address cross-FocusLab topics and new developments. Since 2013, the NRW strategy project BioSC has resulted in around 180 publications in scientific journals and numerous patents.

The research of the BioSC is characterized by a systemic approach that combines basic research and application. Only in this way can bio-based products and production processes be successfully established, which requires technological innovations and innovative infrastructures, but also transformations in consumer habits, business models and value chains. The BioSC thus creates economic, ecological and social solutions for the provision of food and feed as well as bio-based materials, chemicals and energy sources.

It is not possible to acknowledge the many approaches of the BioSC in a short text. Therefore, here are some example topics that have been worked on in the past 10 years - without prioritization and certainly not with the claim of completeness.

To establish biomass as a raw material substitute for crude oil, numerous biotechnological, chemical and process engineering methods have been developed. Processes have been established for biomass pulping that enable additional added value through the gentle separation of high-quality plant ingredients. On laboratory and pilot scale, plant cellulose, hemicellulose and pectin have been established as starting materials for the biotechnological production of bulk chemicals such as itaconic acid or pyruvate as well as biosurfactants. New microbial synthesis pathways for the production of high-value compounds, such as bioactive substances, were successfully designed and optimized. In various projects, contributions to biorefinery concepts have been developed that integrate the pulping of biomass of different quality and origin, its conversion into products and their separation and purification.

First NRW PhD Day, October 2016

First BioSC Spotlight, February 2017

RWTH Science Night, November 2017

"Tag der Neugier" at Forschungszentrum Jülich, July 2019

For the sustainable supply of biomass, for example, innovative and environmentally friendly concepts have been developed for the cultivation of perennial plants on nutrient-poor soils. For crop protection, new biological active ingredients were identified and a system for the sparing and targeted application of agrochemicals was developed. Projects for the recovery of nutrients such as phosphate and nitrate aimed at closing resource cycles.

By integrating socio-economic research approaches, the connection of technological innovations to markets, politics and society was established. In various ways, it has been investigated how the economic and social changes in the transition from a fossil-based to a bio-based economy can be managed and shaped in such a way that they are ecologically compatible, technically feasible and socially accepted.

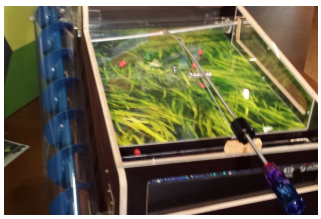
In the context of numerous scientific events there was an intensive exchange with academia and industry. Young scientists were inspired to new approaches through excursions, workshops and PhD retreats which highlighted the diversity of bioeconomy. Since its foundation, the BioSC has also offered and implemented numerous information and dialogue formats for the public, for example in the context of science nights or citizens' forums.

Ten years after its foundation, the BioSC is on the point of entering the third funding phase of the NRW strategy project. Topics with high relevance for an integrated and sustainable bioeconomy will be continued and further developed in order to implement the BioSC's systemic perspective for bioeconomy research at regional, national and international level. In the meantime, the BioökonomieREVIER initiative has also developed from the scientific strength of the BioSC. It aims to develop the Rhenish mining district into a bioeconomy-based model region within the framework of structural change - building on the scientific results and with continued scientific input from the BioSC, in practical action of economy, ecology and social responsibility.

Photos: Forschungszentrum Jülich

Minister Karliczek visited BioSC exhibit "AlgaeFlipper" at the MS Wissenschaft

On July 30, the MS Wissenschaft, the Science Year exhibition ship, started in Münster. On board is a joint exhibit of the Bioeconomy Science Center and IBG-2 Plant Sciences, Forschungszentrum Jülich. The AlgaeFlipper shows how algae can be used to clean wastewater and recover valuable nutrients. Federal Minister of Research Anja Karliczek informed herself about the exhibit and the underlying research during her visit on August 21.

Photos: BMBF/Hans-Joachim Rickel (1, 4); Forschungszentrum Jülich (2,3)

Since 2002, the exhibition ship MS Wissenschaft has been travelling on German and Austrian inland waterways during the summer months. Interactive exhibits on the topic of the respective science year are on display. In the Science Year 2021|21 Bioeconomy, a pinball machine is on board, which playfully illustrates wastewater treatment with microalgae. During her visit on August 21, Federal Research Minister Anja Karliczek tried out the AlgaeFlipper and had herself informed by Dr. Holger Klose, IBG-2, about the underlying research.

Microalgae, whose original habitat are the oceans with their low nutrient density, can absorb and store large quantities of nutrients. Since they are unicellular organisms, they also reproduce very quickly. Scientists are trying to make use of these properties: Algae are intended to absorb nutrients such as phosphate and nitrate from wastewater, and the algae biomass is to be spread on fields instead of mineral fertilizers. In this way, the nutrients are to be fed back into a cycle instead of ending up in sewage sludge or in waters where they are no longer available or even harmful to the environment.

At IBG-2, intensive research work on nutrient recycling using algae has been underway for some time, also within the framework of BioSC projects. In recent years, for example, it has been investigated how much phosphate algae can absorb under different environmental conditions and whether algal biomass is a suitable substitute for mineral fertilizers when growing wheat. In 2018, a pilot plant for so-called AlgalTurfScrubbing was installed for the first time in Germany at the Jülich Research Center's wastewater treatment plant. Here, wastewater is passed over a lawn of algae that absorbs the nutrients from the water and thus cleans it. The nutrient-laden algae are harvested approximately every 10 days. The technique is simple, inexpensive and applicable in many places.

The AlgaeFlipper on the MS Wissenschaft illustrates this AlgalTurfScrubbing. Blue and green balls representing water and nutrients are directed onto a surface representing an algae turf. The nutrient balls

are magnetically attached to the surface, the water balls continue to flow and can be returned to the beginning with an Archimedean screw. The nutrient balls can be „harvested“ with a scrubber. They can then be returned to the cycle.

This year's MS Wissenschaft Tour ended on 17 October. In 2021, there will be a second tour on the topic of bioeconomy. More information and the tour schedule can be found at https://ms-wissenschaft.de/.

BioSC International Online Summer School „From plants to pilot plant“

The BioSC International Summer School took place from 24-28 August 2020 as a virtual format with participants from all over Europe. Scientists from RWTH Aachen University, Forschungszentrum Jülich and Campus Kleinaltendorf (University of Bonn) as well as lecturers from business and industry gave lectures on the utilization of lignocellulosic biomass - from sustainable plant biomass production and processing in biorefineries to the evaluation of economic efficiency and sustainability. Workshops with case studies rounded off the program. The program opened with an introduction to the bioeconomy by Dr. Christian Patermann.

„Bioeconomy and Circular Economy are partners for sustainability“, said Dr. Dr. h.c. Christian Patermann, former director of the EU Commission, who has played a key role in establishing the bioeconomy in Europe. In his opening lecture, he outlined the development of the past 15 years with the implementation of meanwhile more than 60 national bioeconomy strategies worldwide, the increased focus on sustainability and circular economy in recent years and the current trend of the development of regional bioeconomies.

This provided a comprehensive framework for the topic of the Summer School, the utilization of lignocellulosic biomass. Holger Klose (Forschungszentrum Jülich) started the event with a lecture on new technologies for plant phenotyping and their application for a sustainable production of biomass plants. Onno Muller (Forschungszentrum Jülich) went into detail about the interaction of plant characteristics, environmental factors, experiments and sensors in phenotyping. Silvia Schrey (Forschungszentrum Jülich) closed the day with an introduction to the cultivation of *Sida hermaphrodita* on marginal soils.

On the second day of the Summer School the first step of processing plant biomass was focused on: fractionation into its main components lignin, cellulose and hemicellulose. Holger Klose explained why this step is a challenge: plant cell walls have developed in evolution in such a way that they are maximally resistant to degradation, e.g. by pests or weather. Philipp Grande (Forschungszentrum Jülich) presented various strategies for fractionation. Martin Leipnitz (RWTH Aachen) explained process development for a biorefinery. This was also the topic of the following workshop "Downstream processing", in which the participants had the opportunity to design process sequences in small groups.

On the third day, the focus was on the fermentative production of high-quality chemicals from plant sugars and their subsequent purification. Michael Zavrel (Clariant company) presented possibilities for the utilization of agricultural waste streams. Michael Kopf (BASF) spoke about the challenges involved in the purification of biobased products. Afterwards, Jörn Viell (RWTH Aachen University) gave a virtual tour through the pilot biorefinery of the Aachen Process Engineering Department. At the "Upstream Processing" workshop in the afternoon, the participants had again the opportunity to put what they had heard into practice in small groups.

Day four shifted the focus from the development of technologies to the evaluation of their sustainability and profitability. In the morning, Christina Wulf and Andreas Schonhoff (Forschungszentrum Jülich) presented methods for assessing sustainability. In the afternoon session, Sandra Venghaus (Forschungszentrum Jülich) presented concepts for the transformation of the Rheinische Revier into an exemplary bioeconomy. Michaels Carus (nova-Institut) and Meike Henseleit (Forschungszentrum Jülich) gave presentations on the perspectives of the bioeconomy in Germany. In the Business Model Workshop that followed, it was again possible to illustrate what had been learned in small groups using concrete cases. On the evening of the fourth day, a joint virtual dinner was held, at which all participants prepared typical city or country dishes or drinks and presented them to the others. In this way more personal contacts could be established and deepened.

On the last day of the Summer School three major projects of the BioSC were presented: FocusLabs AP^3, Bio^2 and Transform2Bio. These served as case studies to illustrate how important an interdisciplinary approach is already at the research level. At the final wrap-up, all participants expressed that the holistic perspective provided in this Summer School had given them new insights and a better understanding of the bio-economy.

5th NRW PhD Day „Future bioeconomy“

On October 6, 2020, the 5th NRW-wide PhD student day „Future Bioeconomy“ took place. At the virtual event, nearly 50 students discussed with representatives of small and medium-sized industry, with managers of research infrastructures and with founders of start-ups, both in plenary sessions and in intensive form in small groups in the afternoon.

Agenda 5. NRW-Doktorandentag

As in previous years, the NRW PhD Day was organized by various graduate schools and bio-economic networks, which were presented at the beginning of the event (CLIB, CEPLAS, BioökonomieREVIER, Theodor Brinkmann Graduate School Uni Bonn, MPIPZ Graduate School, BioSC). Prof. Dr. Ulrich Schurr (Executive Board BioSC) combined introductory words with a short overview of the bioeconomy in the region. Afterwards the students were welcomed by RBr Dr. Steffen Krätzig, also on behalf of the Ministry of Culture and Science. Dr. Krätzig particularly emphasized the positive development of the BioSC as a co-designer of the bioeconomy in recent years and the exemplary character of this joint event under the coordination of the BioSC.

The scientific lecture part „Plant Biomass: Selection, Breeding, Cultivation“ was opened by Dr. Jens Freitag (IPK Gatersleben). He spoke mainly about the necessity that research institutes of basic research should always have contacts towards application in order to keep in focus what is really needed with regard to bioeconomy development. The subsequent presentation by Dr. Viktor Korzun (KWS SAAT SE & Co. KGaA) supplemented this with an overview of KWS' tasks for the preservation and improvement of seeds and showed that different strategies are sometimes pursued on different continents. The CRISPR/CAS gene scissor is a tool with which plants can be optimized in a targeted manner, but whose products are not approved as food on the European market. This topic was taken up and intensively discussed in the following discussion round. After a short break, the second series of lectures followed with the title „Biomass: Sustainable use, Processing and Products“. The first lecture was given by Dr. Arne Kätelhön (carbonminds), who shared his experience with the students about the foundation of a start-up company with a focus on Life Cycle Assessment. He emphasized the importance of aligning the product of a start-up company with the needs of the market and accordingly to seek contact with potential buyers and users at an early stage. In her presentation, Dr. Henrike Gebhardt (Evonik Industries) used various examples to

show how important it is also in the development of biopolymers to consider the entire production process chain, i.e. from biomass cultivation to the entire upstream and downstream processing to the degradability or recyclability of the product. In the last presentation of the day, Dr. Timm Wagner (Adidas AG) gave an overview of the sporting goods manufacturer Adidas from the perspective of an innovation manager and its contribution to the conversion of the apparel industry to new products made of renewable raw materials and recycled plastics.

The afternoon was made very interactive with world cafés in smaller groups of 7-10 participants. The students were assigned to the speakers of the morning according to their wishes. In these rounds, the development of the bioeconomy and its relevance and acceptance in society were controversially discussed, including related areas such as biotechnology, genome editing, and land use issues. However, as always at the NRW PhD Days, not only science was in the foreground, but also the personal background or personal experiences of the speakers were discussed. This year's NRW PhD Day was concluded by Prof. Ingar Janzik, who thanked all participants for the extensive discussions and interactions and announced that there will be another NRW PhD Day „Future Bioeconomy“ in 2021.

BioSC Supervision Award: The call is open

Winners 2019: Dr. Thomas Drepper, Dr. Stephan Noack

Winner 2018: Dr. Anita Loeschcke

Winners 2017: Dr. Markus Schwarzländer, Dr.Ulrich Krauß

Winners 2015: Dr. Nick Wieckx, Dr. Ljubica Vojcic

With the Supervision Award, the Bioeconomy Science Center (BioSC) honors junior scientists within BioSC for outstanding achievements in the quality of their supervision of doctoral candidates. The award of the prizes is decided by a panel of experts consisting of renowned scientists on the basis of the nomination proposals submitted. All Core Group and FocusLab heads as well as Core Group and FocusLab PhD students are eligible to submit proposals. The winner(s) will receive an award of up to EUR 25,000 as well as a certificate. The competition is part of the NRW strategy project BioSC. Documents and the call text including the prerequisites for the submission of nomination proposals can be found in the BioSC Intranet.

Submission deadline: 13th November 2020

The expert committee decides primarily on the basis of the excellent supervision and the ability of the scientists to motivate students and doctoral candidates to think interdisciplinary and thus also beyond their own "specialist area". The high quality of the teaching activities performed is also included in the evaluation. The aim of the award is to improve the starting conditions for excellent career development for young scientists.

Perspective projects from the FocusLabs

In the BioSC FocusLabs, relevant results have been achieved since 2017 and cross-disciplinary competencies in the BioSC have been developed. Individual aspects from the first FocusLabs will be further developed in the transition from phase 2 to phase 3 of the NRW strategy project BioSC in 12-month perspective projects on the scale of SEED FUND 2.0 projects. The projects have started on July 1 and August 1, 2020 respectively.

Photo: A. Biselli, AVT.FVT. RWTH Aachen University

DesignR: Tailoring Biosurfactants – Production of Designer Rhamnolipids

Project coordination: Dr.-Ing. Nina Ihling, AVT - Biochemical Engineering, RWTH Aachen University

Partners:

Dr.-Ing. Nina Ihling, Prof. Dr.-Ing. Jochen Büchs, AVT - Biochemical Engineering, RWTH Aachen University

Sonja Kubicki, Dr. Stephan Thies, Prof. Dr. Karl-Erich Jaeger, IMET - Molecular Enzyme Technology, HHU Düsseldorf

Andreas Biselli, Prof. Dr.-Ing. Andreas Jupke, AVT -

Fluid Process Engineering, RWTH Aachen University

Within the FocusLab Bio², a biorefinery process for the production of biosurfactants was developed. One of the target products were rhamnolipids (RL). They consist of two β-hydroxyalkanoic acids (HAAs) with different chain lengths as well as one or two rhamnose units (mono-RL or di-RL). Different congeners of RLs are expected to have different features; however, the relationship between the structural diversity of RLs and their physicochemical properties remains unclear. DesignR aims at filling this knowledge gap. Utilizing RLs as industrially established exemplary glycolipid, fundamental knowledge regarding structure-function relationships will be gathered. Findings will serve to lay the foundation for an even broader knowledge platform for production and purification of designer glycolipids with yet to be explored applications and market potentials. For this, structure-function relationships of different types of purified RLs and RL mixtures will be investigated in-depth. This will be addressed by (i) microbial production of mono- and di-RL, (ii) selective separation of mono-RL, di-RL, and HAAs, and (iii) bio- and physicochemical characterization of produced mixtures.

Photo: IMET, HHU Düsseldorf

TaiLead: Lead verification of of tailored prodiginine derivatives

Project coordination: Dr. Anita Loeschcke, IMET- Molecular Enzyme Technology, HHU Düsseldorf

Partners:

Dr. Anita Loeschcke, Dr. Thomas Drepper, Prof. Dr. Karl-Erich Jaeger, IMET- Molecular Enzyme Technology, HHU Düsseldorf

Dr. Thomas Classen, Prof. Dr. Jörg Pietruszka, IBOC - Bioorganic Chemistry Chemie, HHU Düsseldorf

Dr. Sylvia Schleker, Prof. Dr. Florian Grundler, INRES - Molecular Phytomedicine, University of Bonn

Within the FocusLab *CombiCom* a whole range of natural compounds and derivatives were produced to screen them for relevant bioactivities especially for pest control. Here, prodiginine tripyrroles were found to suppress phytopathogenic nematode infection and one compound promoted plant growth. Moreover, BioSC activities uncovered nematode inhibiting activities of rhamnolipids, which also show enhanced antibacterial effects when combined with a tripyrrole. In the *TaiLead* project these leads will be combined. To this end, i) a microbe-based combinatorial platform will be established for effective production of previously inaccessible new potent tripyrrolic structural variants that are inspired by the plant growth-promoting hit. Further, ii) the new compounds will be examined regarding theirapplicability and activity spectrum aspotential agrochemicals.Here, activities on nematodes will be assessed and combined activities of prodiginines and rhamnolipids will be investigated. These analyses will indicate the application range for protection of e.g. sugar beet and soybean against specific parasitic nematodes. Building on key competences of and results obtained by the *CombiCom* FocusLab, this project thus aims to contribute to the development of sustainable production processes and eco-friendly crop protection solutions.

Photo: Forschungszentrum Jülich

LIFT: Lignin fractionation and separation to produce different technical lignins

Project coordination: Dr. Holger Klose, IBG-2: Plant Sciences, Forschungszentrum Jülich

Partners:

Dr. Holger Klose, Dr. Philipp M. Grande, Dennis Weidener, Prof. Dr. Ulrich Schurr, IBG-2: Plant Sciences, Forschungszentrum Jülich

Arne Holtz, Prof. Dr.-Ing. Andreas Jupke, AVT - Fluid
Process Engineering, RWTH Aachen University

Lignin valorisation can be a crucial step for lignocellulosic biorefinery concepts to reach economic figures. This necessitates the development of technologies and processes to efficiently purify and process lignin for further utilization. LIFT builds on the developed process from the FocusLab AP³ - lignin separation by precipitation - and will further develop this technology. Different lignin materials will be processed and characterised. Linking their compositional data to the fractionation process data will identify suitable strategies to produce different types of lignin.

Events and calls

SAVE NEW DATE:

The **5th International BioSC Symposium** which was originally planned for 16 and 17 November 2020 will now be held on **5 March 2021** as a hybrid event with a livestream fom Berlin and Düsseldorf. More information will follow.

Events (selected)

Informieren, Diskutieren, Teilhaben - aber wie?!, virtual
October 29, 2020
More Information

Digital Technologies for Crop Production (DIGICROP), virtual
November 10, 2020
More Information

Global Bioeconomy Summit, virtual
November 16-20, 2020
More Information

Interdisciplinary Circular Economy Conference 2020, virtual
November 30 - December 3, 2020
Registration deadline: October 15, 2020
More Information

Bio-raffiniert XI, Oberhausen
February 24-25, 2021
More Information

Calls (selected)

Ressourceneffiziente Kreislaufwirtschaft - Kunststoffrecyclingtechnologien (BMBF)
October 30, 2020
More Information

Hochschulwettbewerb 2021 im Wissenschaftsjahr Bioökonomie
October 31, 2020
More Information

"Zu gut für die Tonne!" Federal Prize 2020 (BMEL)
November 13, 2020
More Information

"Travelling Conferences" (BMBF)
November 20, 2020
More Information

Neue Wege der Strom-basierten Konversion von biogenen Rohstoffen und der elektrochemischen Herstellung von biobasierten Produkten (FNR)
January 18, 2021
More Information

European Green Deal
January 26, 2021
More Information

Bioeconomy International 2021 (BMBF)
March 19, 2021
More Information