AALTO UNIVERSITY BIOINNOVATION CENTER

ANNUAL REPORT 2023

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Aalto University
Bioinnovation
Center

INTRODUCTION

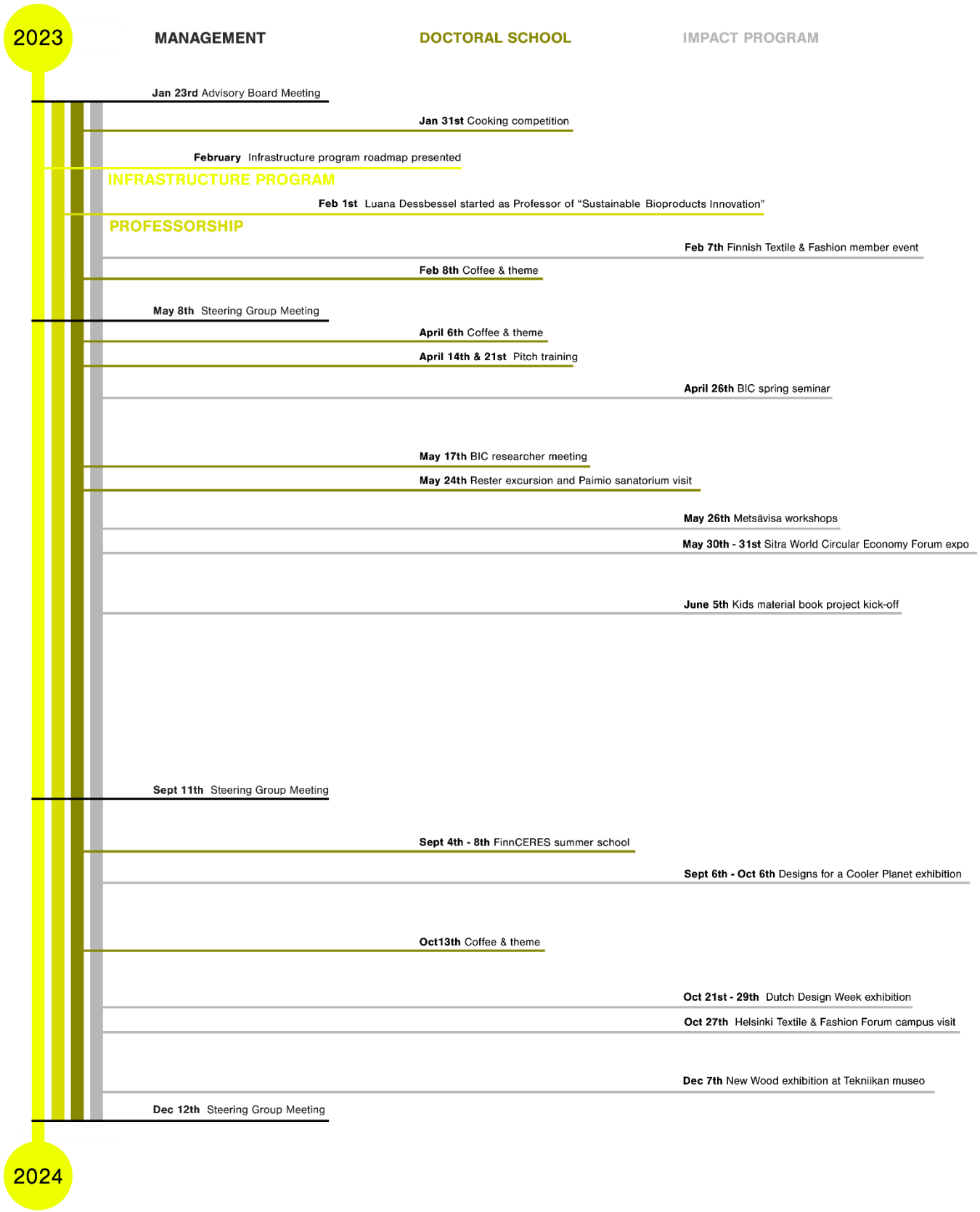
Aalto University Bioinnovation Center is an interdisciplinary research and learning center targeting to accelerate the transition to a circular economy and bioeconomy, and to create opportunities for sustainable economic growth in Finland. The Bioinnovation Center focuses on innovations in sustainable bio-based materials, with special focus on textiles and packaging.

The Bioinnovation Center was established in 2021 with a 10.5 M€ grant from Jane and Aatos Erkko foundation. The Center operates in interdisciplinary research fields, facilitates educational efforts in bio- and circular economy at Aalto University, and strives towards ground-breaking new technologies and innovations. The Center's four pillars are the Doctoral School, a new Professorship, a targeted Infrastructure Program, and an overarching Impact Program. Table 1 shows the overall budget allocated to the four pillars, funds used in 2021-2023, and funds remaining as of 1.1.2024.

Table 1 Bioinnovation Center overall budget, funds spent in 2021-2023, and funds remaining as of January 1st, 2024.

Bioinnovation Center pillars	Overall budget M€	Funds spent 2021-2023, M€	Funding remaining M€
Professorship	2.5	0.1	2.4
Doctoral school	3.5	0.7	2.8
Infrastructure program	4.0	3.1	0.9
Impact program	0.5	0.1	0.4
Total	10.5	4.0	6.5

Timeline


2023
MANAGEMENT
DOCTORAL SCHOOL
IMPACT PROGRAM
Jan 23rd Advisory Board Meeting
Jan 31st Cooking competition
February Infrastructure program roadmap presented
INFRASTRUCTURE PROGRAM
Feb 1st Luana Dessbessel started as Professor of "Sustainable Bioproducts Innovation"
PROFESSORSHIP
Feb 7th Finnish Textile & Fashion member event
Feb 8th Coffee & theme
May 8th Steering Group Meeting
April 6th Coffee & theme
April 14th & 21st Pitch training
April 26th BIC spring seminar
May 17th BIC researcher meeting
May 24th Rester excursion and Paimio sanatorium visit
May 26th Metsävisa workshops
May 30th - 31st Sitra World Circular Economy Forum expo
June 5th Kids material book project kick-off
Sept 11th Steering Group Meeting
Sept 4th - 8th FinnCERES summer school
Sept 6th - Oct 6th Designs for a Cooler Planet exhibition
Oct13th Coffee & theme
Oct 21st - 29th Dutch Design Week exhibition
Oct 27th Helsinki Textile & Fashion Forum campus visit
Dec 7th New Wood exhibition at Tekniikan museo
Dec 12th Steering Group Meeting
2024

Bioinnovation Center Steering Group

Kristiina Kruus
Dean, School of Chemical Engineering

Janne Laine
Vice President, Innovation

Michael Hummel
Director of Bioinnovation Center, Associate Professor of Biopolymer Chemistry and Engineering (CHEM)

Pirjo Kääriäinen
Associate Professor of Design and Materialities (ARTS)

Tapani Vuorinen
Professor of Wood Chemistry (CHEM)

Minna Halme
Professor of Sustainability in Business (BIZ)

Jouni Partanen
Professor of Materials to Products (ENG)

Kirsi Niinimäki
Associate Professor of Fashion/Textiles Futures (ARTS)

Markus Linder
Professor of Biomolecular Materials (CHEM)

Juho Rousu
Professor of Computer Science (SCI)

Jorma Kyyrä Professor of Power Electronics (ELEC)

Susanna Ahola
Coordinator of Bioinnovation Center, Secretary of Steering Group

Luana Dessbessel
Assistant Professor of Sustainable Bioproducts Innovation (CHEM)

The Bioinnovation Center steering group has professors from all the six Schools of Aalto University. (CHEM, ARTS, BIZ, ENG, SCI & ELEC)

In 2023, Assistant Professor of Sustainable Bioproducts Innovation Luana Dessbesell was added to the steering group.

Bioinnovation Center Executive Team

Michael Hummel
Director of Bioinnovation Center

Luana Dessbessel
Doctoral School

Tapani Vuorinen
Impact program

Pirjo Kääriäinen
Impact program

Susanna Ahola
Coordinator of Bioinnovation Center

Elli Käpylä
Corporate Relations Manager

Greta Salonen
Project Coordinator

Sonja Dallyn
Graphic Designer

Bioinnovation Center Advisory Board

The Advisory Board's main role is to support and guide the functions and development of the Bioinnovation Center. The Advisory Board has five external members from academia and industry, and internal members from the Bioinnovation Center steering group. The Advisory Board does not have formal authority to govern the organization, but it will make recommendations and provide key information and materials to support the success of the Center.

Prof. Elvin Karana, TU Delft, Netherlands

Elvin Karana is Professor of Materials Innovation and Design at the Faculty of Industrial Design Engineering at Delft University of Technology. Her main research interests are materials innovation and design, materials experience, bio-based materials and bio-technology for product design. She has founded the research group Materials Experience Lab, which introduces new ways of understanding and designing (with) materials by combining methods and tools from design, social sciences, materials science, and engineering.

Niklas von Weymarn, CEO, Metsä Spring Ltd

Niklas has a Doctor of Science degree in biotechnology from Aalto University. He has also studied economics and innovation strategies. He has wide experience from R&D and startup companies. At Metsä Group, he first served as Vice-President of Research at Metsä Fibre Ltd, after which he moved to Metsä Group's innovation company Metsä Spring Ltd.

Suvi Haimi, CEO, Sulapac

Co-founder and CEO of Sulapac, a material innovation company with the mission to save the world from plastic waste. Suvi has a PhD in Medical Biomaterials from the University of Tampere. Before founding Sulapac, she worked in leadership positions for 10 years at universities in Finland and The Netherlands.

Tuomas Mustonen, Managing Director, Paptic Ltd

Managing Director of Paptic with a history of working in the paper & forest products industry and research institutes. Tuomas has an MBA degree in International Finance and Global Marketing from Aalto University, and a MSc degree in Industrial Physics from the University of Jyväskylä.

Riikka Paarma, Sustainability Partner, EY-Parthenon

Sustainability Partner at EY-Parthenon. Prior to shifting to EY-Parthenon, Riikka was the Director for Circular Economy at Stora Enso. Prior to Stora Enso, Riikka was the Director for Sustainability Services at Deloitte Finland, and the global co-lead for Circular Economy at Deloitte. She has also led sustainability at Alma Media Corporation. Riikka has a MSc degree from Sustainable enterprising from the University of Stockholm.

DOCTORAL SCHOOL

The Bioinnovation Center Doctoral School (DS) specializes in *interdisciplinary research and doctoral education* to create new innovations that help the transition towards bio and circular economy, and to educate future experts with abilities to thrive and innovate in diverse multidisciplinary teams. The Doctoral School's research projects aim at innovations in line with the main themes of the Center: *sustainable textiles and packaging*. The doctoral school combines fields from all the six Schools of Aalto University, such as chemistry, biomaterial sciences, design, digital production, artificial intelligence, entrepreneurship, and business. The doctoral school is a thematic school for doctoral students coordinated by the Bioinnovation Center.

Lignin yarn prototype from Cellumimicry project. Photo by Anne KInnunen

Actions 2023

In 2023, the first six interdisciplinary research projects, fully funded by the Bioinnovation Center, were ongoing. In addition, two new co-funded projects were initiated in collaboration with corporate partners/research organizations. *SEREPLAS-project* focuses on the development of a selective recycling technology for plastic-coated cartons and fiber substrates. The project is co-funded with Stora Enso and Valmet. *Bio Dyes-project* is co-funded with Natural Resources Institute Finland (Luke). The project aims to develop feasible bio-based colorants for the textile industry. The project is conducted partly in collaboration with the European Chemicals Agency (ECHA). In addition to these two new projects, Bioinnovation Center has agreed to co-fund a project *Textiles for planetary emergency* in collaboration with the Swedish School of Textiles, University of Borås. This project will start in 2024.

Table 2 Doctoral School projects ongoing in 2023.

PROJECT NAME	PIs	DOCTORAL STUDENT	CORPORATE PARTNER	SCHOOLS OF AALTO PRESENTED	PROJECT STARTED
CELLUGAMI	Prof. Masood Masoodian Prof. Jarkko Niiranen Univ. Lecturer Kirsi Peltonen	Laureen Mahler	-	ARTS, ENG, SCI	03/2022
AIYARN	Prof. Jaana Vapaavuori Prof. Patrick Rinke	Matteo Iannacchero	-	CHEM, SCI	03/2022
SUSTAINABLE LIGNIN COATINGS	Prof. Monika Österberg Prof. Pekka Oinas	Sahar Babaeipour	-	CHEM	06/2022
COMPUTATIONAL FABRIC	Prof. Kirsi Niinimäki Prof. Simo Särkkä Prof. Yu Xiao, Prof. Jaana Vapaavuori	Sofia Guridi	-	ARTS, ELEC, CHEM	06/2022
INTELLIGENT PACKAGING	Prof. Jouni Paltakari Prof. Riku Jäntti	Madhawa Basnayaka	-	CHEM, ELEC	04/2022
CELLUMIMICRY	Prof. Michael Hummel Prof. Samuli Patala Prof. Minna Halme	Helena Sederholm	-	CHEM, BIZ	09/2022
SEREPLAS	Prof. Jouni Paltakari Prof. Petri Kuosmanen	Emilia Kauppi	Stora Enso Valmet	CHEM, ENG	06/2023
BIO DYES	Prof. Ali Tehrani Prof. Michael Hummel Prof. Pirjo Kääriäinen Prof. Kirsi Niinimäki	Senni Heimala	Luke	CHEM, ARTS	09/2023

The doctoral school curriculum is based on the Aalto University doctoral program curriculum. In addition, the Bioinnovation Center organizes or co-organizes an annual Summer School for the students. In 2023 the Summer School was organized in collaboration with the FINNCERES flagship. The 1-week intensive course *INTERACT: Harnessing the power of Interactions for Lignocellulosics Design (3/5 ECTS)* gathered 50 students from 21 nationalities in Hotel Korpilampi, Espoo in September.

Workshopping, pitch training & excursions

The doctoral school students gathered in *coffee&theme* -meetings in February, April, and October. In these meetings the doctoral students gave presentations/workshops to each other. In 2023 the themes included prototyping, philosophical discussions, and origami-folding. In addition, the DS students and PIs gathered in a joint researcher meeting in May.

Pitch training sessions were organized to all the doctoral students. The students gave pitch presentations at the Bioinnovation Center spring seminar in April. In addition, the students presented their project prototypes in research stands during the seminar. The doctoral students also prepared project prototypes for the Center's *Behind Bioinnovations exhibition* which was presented at the Designs for a Cooler Planet festival at Aalto University, and Dutch Design week in Eindhoven.

In May the doctoral school visited the textile recycling company Rester, and Paimio Sanatorium in Paimio. A joint cooking competition activity was organized to the doctoral school students and Bioinnovation Center steering group in January.

Doctoral school visited the textile recycling company Rester in Paimio.

Doctoral students and steering group members preparing the dishes together at the cooking competition.

PROFESSORSHIP

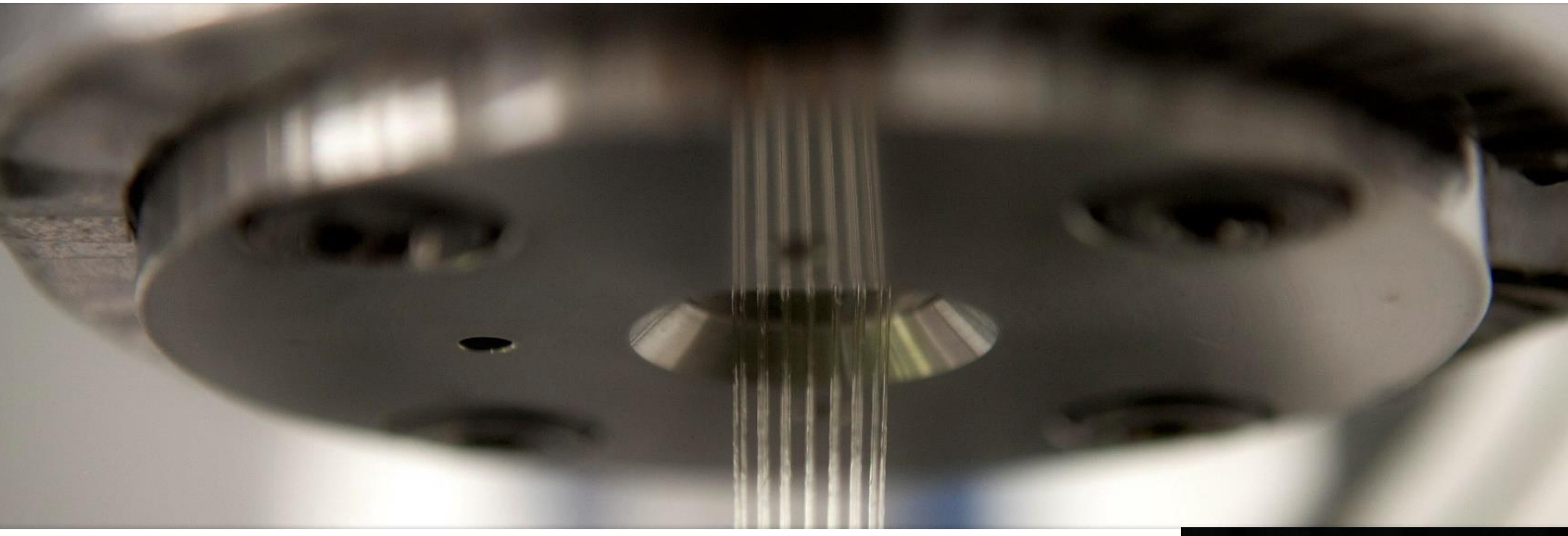
The vision of the Bioinnovation Center also encompassed a new professorship to provide strong expertise in materials research and circular economy, and to proactively network with stakeholders such as experts in the field of bio- and circular economy and creative industries, large companies, and start-ups. This new professor shall release the interdisciplinary potential in bioinnovation development from research ideation to commercialization in the context of circular economy and sustainability to have a social, environmental, and economic impact in wider perspective.

Dr. Luana Dessbesell started as the Professor for Sustainable Bioproducts Innovation. Photo by Kristina Tsvetkova

Dr. Luana Dessbesell

Prof. Luana Dessbesell started in this position on February 1st, 2023. Her role is to enhance the research and teaching that fosters the concept of true interdisciplinarity envisioned by the Bioinnovation Center, to take an active role in the Bioinnovation Center doctoral school, to strengthen the collaboration between Aalto University's fields (technology, design, and business) related to biobased materials, and to promote and develop collaboration between Aalto University and external stakeholders.

During 2023 Luana has visited more than 15 companies and stakeholders in the Finnish bioproducts innovation ecosystem. While also securing funding from FinnCERES for sustainability assessments of lignin applications and from Business Finland as one of the Aalto researchers on the Emissions Free Pulping project. Her vibrant research group currently comprises of 4 PhDs and 2 masters researchers. She was also the responsible teacher for Sustainability in the Bioproducts Industry and Planning and Execution of a Biorefinery Investment Project.



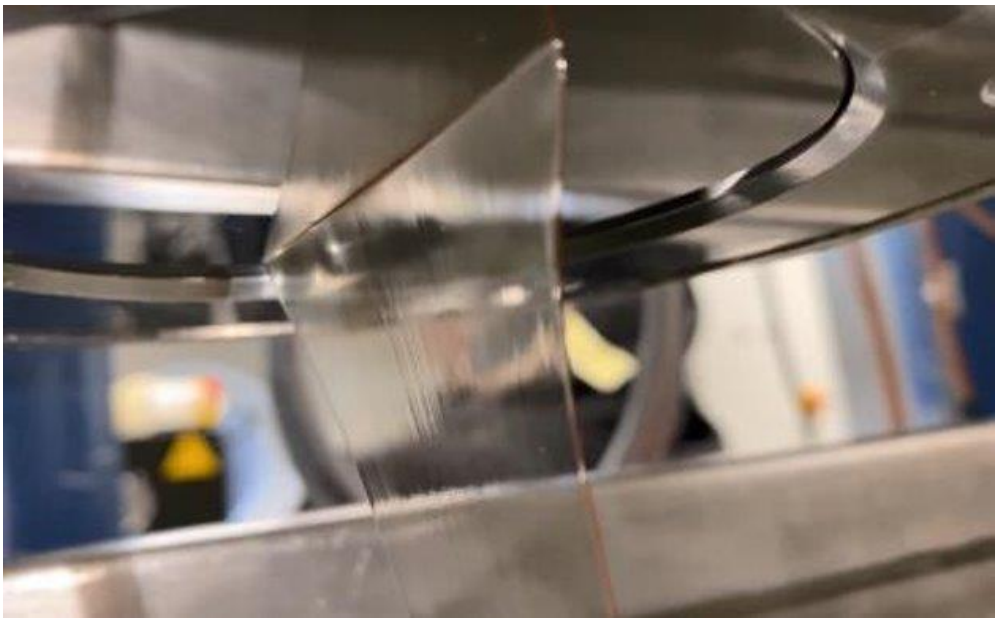
INFRASTRUCTURE PROGRAM

The Bioinnovation Center's Infrastructure Program provides funds for strategic investment in research infrastructure to support and promote developments at Aalto University in the field of bioeconomy towards commercialization.

The first investment of 2.3 M€ was dedicated to the upscaling of the Ioncell® technology which was developed jointly at the University of Helsinki and Aalto University. Through the investment funding of the Bioinnovation Center it was possible to upscale the spinning technology. In spring 2022, Ioncell Oy was founded. The technology development is now led by the new CEO Antti Rönkkö. In 2023, Ioncell Oy has been focusing on acquiring funding for further upscaling.

In 2023, the Bioinnovation Center mapped investments needs that are critical for ongoing developments in the field of sustainable textiles and packaging. An infrastructure investment roadmap was drafted. The critical areas where future investments will be directed include textile research and education, bioinnovation material research (including chemical characterization, product performance and end of life assessment), and interdisciplinary collaboration (CHEMARTS). Infrastructure investment planning continues in 2024.

A prototype made of Ioncell fibres produced in the pilot plant. Photo by Diana Luganski.



Future infrastructure investments include Ioncell laboratory scale equipment updates.

IMPACT PROGRAM

The Impact Program's target is to *maximize the scientific and societal impact* of the Bioinnovation Center. The Impact Program activities involve communication actions, events, exhibitions, and network collaboration. The main target groups of the Impact Program's actions are 1) academic and professional community, 2) decision makers, and 3) children and youth. In 2023, the impact program's theme was *interdisciplinary collaboration.* This theme was highlighted in events, exhibitions, and social media contents throughout the year.

Actions 2023

In February, a textile event was organized to the members of Finnish Textile and Fashion. The event included a tour in the DIALOGUES exhibition in Dipoli, highlighting Aalto University's textile research and education. Bioinnovation Center's activities were also presented.

Bioinnovation Center's spring seminar *TOGETHER! The power of many in interdisciplinary collaboration* gathered participants from different fields of academy and industry in April. Professor Luana Dessbesell gave a keynote talk about expanding our perspective of bioproducts innovation. A session of expert short talks focused on collaboration aspects. Bioinnovation Center doctoral students gave pitch presentation about their research projects and presented prototypes at research stands.

Expert panel in the spring seminar: Riikka Mäki-Koskela, Yu Xiao, Pirjo Kääriäinen, Manuel Arias Barrantes, and Tapani Vuorinen. Photo by Iines Jakovlev

Maarit Salolainen presenting textile prototypes to the members of Finnish textile and fashion.

Metsävisa

Metsävisa is a national competition about forest knowledge for youth aged 13-15, and it reaches approximately 20 000 students annually in Finland. For the Metsävisa competition's final event, Bioinnovation Center organized student and teacher workshops about bio-based products research, innovations, and education to the 50 Metsävisa finalists and 50 teachers from all around of Finland.

Metsävisa finalists in a biomaterial workshop. Photo by Vilma Issakainen

WCEF by Sitra 2023

World Circular Economy Forum was organized in Helsinki in 2023 by Sitra. Bioinnovation Center's activities and research were presented in an expo stand. The event gathered approximately 1900 people from 155 countries to discuss circular economy solutions from the perspectives of decision makers, industry, and academy.

Expo stand discussions at the World Circular Economy Forum. Photo by Sitra

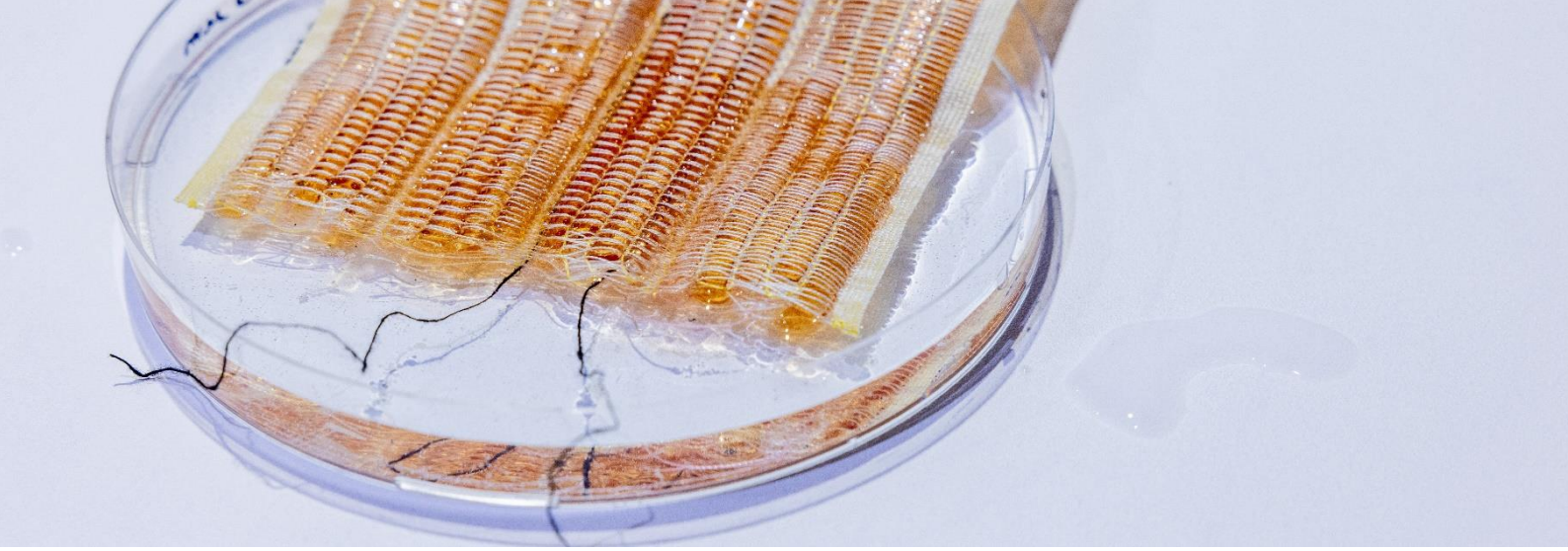
Exhibitions

As the main exhibition activity of the year, Bioinnovation Center created an exhibition *Behind Bioinnovations*, curated by Pirjo Kääriäinen and Anna van der Lei. The exhibition was presented at the Aalto University's *Designs for a Cooler Planet* festival in September/October 2023 as a part of Helsinki Design Week, and at Dutch Design Week in Eindhoven in October. The exhibition presented prototypes of Bioinnovation Center research projects and CHEMARTS student projects and visualized the collaborative processes behind biomaterial innovation. Designs for a Cooler Planet exhibition was actively visited by Aalto University and Bioinnovation Center stakeholders during campus visits and organized tours.

Bioinnovation Center doctoral student Laureen Mahler hosting a researcher tour at Dutch Design Week 2023.

At Dutch Design Week (DDW), the exhibition gained interest and visibility among companies, decision makers, students, and general public. *Behind Bioinnovations* exhibition was visited by 14 curated Design Tours, including participants from international companies and decision makers. In addition, an informal researcher gathering and curated DDW tour was organized in collaboration with TU Eindhoven, Professor Oscar Tomico. The event resulted in new contacts and collaborations for Bioinnovation Center researchers and executive team.

In October, Bioinnovation Center collaborated with Textile & Fashion Forum Helsinki 2023. As a part of the event, Bioinnovation Center hosted a campus visit for representatives of Finnish Textile & Fashion and EURATEX. In December, Bioinnovation Center collaborated with New Wood's exhibition at the Museum of Technology, Helsinki. As an example of Ioncell textile innovation, a dress made in Aalto University and worn by Finland's first lady Jenni Haukio at the Independence Day gala, was exhibited in the exhibition. The exhibition continues until March 2024.



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OUTLOOK

The Bioinnovation Center has chosen annual themes for coming years to get a better focus and to maximize the impact. The theme for 2024 is *Fostering Innovations*. Innovation-related activities will be organized in collaboration with Aalto University innovation services. New research projects in collaboration with industrial partners are envisioned, and a new cohort of doctoral students will start its journey in the doctoral school. New infrastructure investments will be planned and initiated to promote developments and innovations in bio-based material research.

The spring seminar *"IMPACT Forum - Sustainability through innovative bio-based materials"* will be organized in collaboration with the FinnCERES flagship in April. The event will focus on bio-based material innovations, ways to sustainably increase the added value of the forest sector, and the impact of national and EU policy on the future of the forest sector.

In August 2024, the Bioinnovation Center will be organizing a summer school "Measuring the Sustainability Potential of Your Research" that focuses on gathering a holistic understanding of the sustainability concept, connecting sustainability to individual research topics, and assessing sustainability. In addition, a mobility program will be launched for doctoral students to enable an international research exchange.

Impact program activities will include two main exhibitions: *Designs for a Cooler Planet* and *Dutch Design Week*, focusing on presenting the research project prototypes and innovations. A material book targeted for kids and youth, inspired by the highly popular CHEMARTS cookbook, will be published in 2024. A mini-impact program will be built around the book to maximize the impact, including workshops for school groups and teacher training sessions.