AALTO UNIVERSITY BIOINNOVATION CENTER

ANNUAL REPORT 2024

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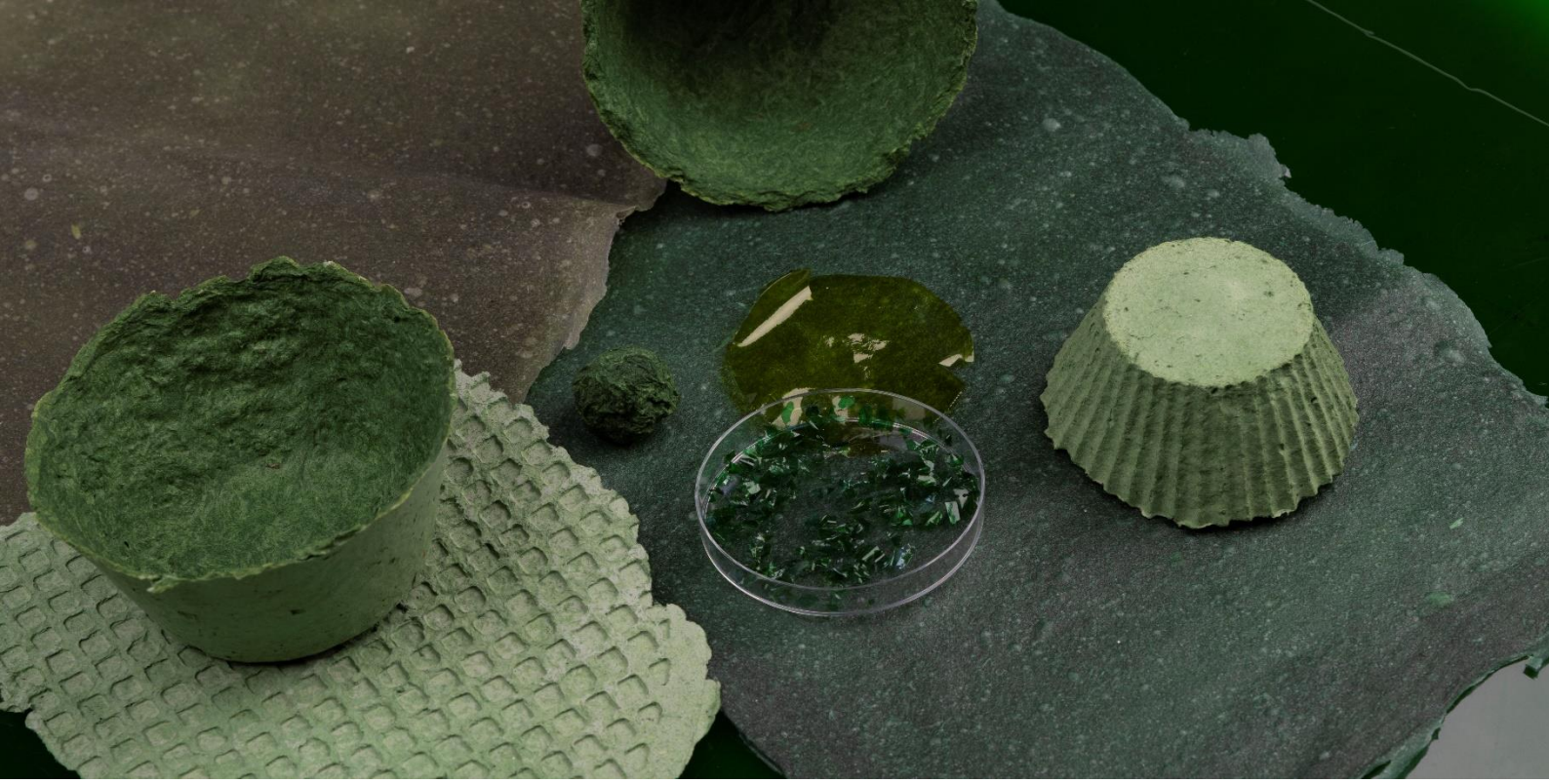
Aalto University
Bioinnovation
Center



INTRODUCTION

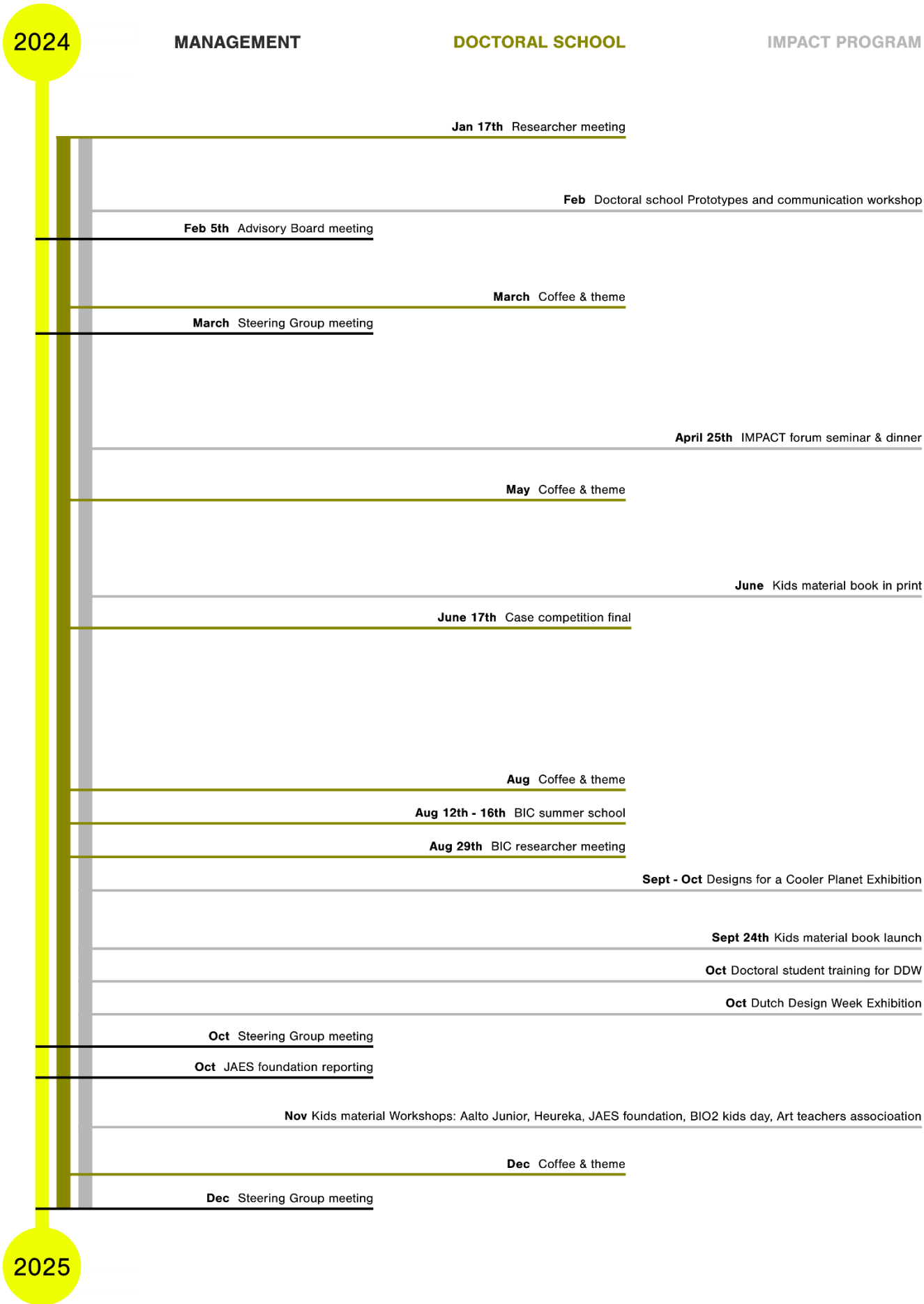
Aalto University Bioinnovation Center is an interdisciplinary research and learning center targeting to accelerate the transition to a circular economy and bioeconomy, and to create opportunities for sustainable economic growth in Finland. The Bioinnovation Center focuses on innovations in sustainable 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 2021-2024, and funds remaining as of 1.1.2025.

Table 1 Bioinnovation Center overall budget, funds spent in 2021-2024, and funds remaining as of January 1st, 2025.

Bioinnovation Center pillars	Overall budget M€	Funds spent 2021-2024, M€	Funds remaining M€
Professorship	2.5	0.3	2.2
Doctoral school	3.5	1.1	2.4
Infrastructure program	4.0	1.0	3.0
Impact program	0.5	0.3	0.2
Total	10.5	2.7	7.8

Timeline


2024
MANAGEMENT
DOCTORAL SCHOOL
IMPACT PROGRAM
Jan 17th Researcher meeting
Feb Doctoral school Prototypes and communication workshop
Feb 5th Advisory Board meeting
March Coffee & theme
March Steering Group meeting
April 25th IMPACT forum seminar & dinner
May Coffee & theme
June Kids material book in print
June 17th Case competition final
Aug Coffee & theme
Aug 12th - 16th BIC summer school
Aug 29th BIC researcher meeting
Sept - Oct Designs for a Cooler Planet Exhibition
Sept 24th Kids material book launch
Oct Doctoral student training for DDW
Oct Dutch Design Week Exhibition
Oct Steering Group meeting
Oct JAES foundation reporting
Nov Kids material Workshops: Aalto Junior, Heureka, JAES foundation, BIO2 kids day, Art teachers associoation
Dec Coffee & theme
Dec Steering Group meeting
2025

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)

Luana Dessbesell
Assistant Professor of Sustainable Bioproducts Innovation (CHEM)

Susanna Ahola
Coordinator of Bioinnovation Center, Secretary of Steering Group

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

Bioinnovation Center Executive Team

Michael Hummel
Director of Bioinnovation Center

Luana Dessbesell
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, Chairwoman, Sulapac

Co-founder and chairwoman 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, Chief Sustainability Officer, Halton Group

Chief Sustainability Officer at Halton Group. Prior to shifting to Halton Group, Riikka has worked e.g. as Sustainability Partner at EY-Parthenon and the Director for Circular Economy at Stora Enso. Riikka has a MSc degree from Sustainable enterprising from the University of Stockholm.

DOCTORAL SCHOOL

The Bioinnovation Center Doctoral School (DS) offers *interdisciplinary research and doctoral education* to create new innovations that foster the transition towards bio and circular economy, and to educate future experts with knowledge and skills 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.

SEREPLAS project aims to improve recycling efficiency of liquid packaging boards in industrial collaboration with Stora Enso and Valmet. Photo by Esa Kapila.

Actions 2024

In 2024, the first 10 interdisciplinary research projects were ongoing. In addition, four new projects were initiated.

The project *Textiles for planetary emergency* started in September 2024 in collaboration with the Swedish School of Textiles, University of Borås.

A Business Finland project SciSustain kicked off in June 2024. Bioinnovation Center co-funds three doctoral research projects within this consortium: Recycling of Multimaterial Cardboard, Carbamated Cellulosic Films, and Regenerated Cellulosic Films. These projects started in the fall 2024. At the end of 2024, there were in total 14 doctoral students in the Bioinnovation Center doctoral school.

Table 2 Doctoral School projects ongoing in 2024.

PROJECT NAME	PIs	DOCTORAL STUDENT	COLLABORATION 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
CELLFIL	Prof. Luana Dessbesell Prof. Kirsi Niinimäki	Maria Livia de Almeida	-	CHEM, ARTS	09/2023

CELLFIL	Prof. Luana Dessbesell Prof. Eeva Vilkkumaa	Tooba Qureshi	-	CHEM, SCI	11/2023
TEXTILES FOR PLANETARY EMERGENCY	Prof. Kirsi Niinimäki Prof. Pirjo Kääriäinen	Elise Piquemal	University of Borås, Swedish School of Textiles	ARTS	09/2024
SCI SUSTAIN: RECYCLING OF MULTI-MATERIAL CARDBOARD	Prof. Luana Dessbesell Prof. Jouni Paltakari Jenny Müller-Wahlman (Stora Enso)	Vida Hardjono	Business Finland project SciSustain	CHEM	08/2024
SCI SUSTAIN: CARBAMATED CELLULOSIC FILMS	Prof. Luana Dessbesell Janak Sapkota (UPM)	Waleed Mehmood	Business Finland project SciSustain	CHEM	09/2024
SCI SUSTAIN: REGENERATED CELLULOSIC FILMS	Prof. Luana Dessbesell Prof. Michael Hummel Jatin Sethi (Metsä)	Karam Moussa	Business Finland project SciSustain	CHEM	09/2024

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 August 2024, the Summer School *Measuring the Sustainability Potential of Your Research* (5 ECTS) was organized in the Haikko Manor & Spa in Porvoo, Finland. The 1-week intensive course gathered 23 students of 16 nationalities. The responsible teacher of the summer school was Prof. Luana Dessbesell and Susanna Ahola was the event coordinator. Prof. Ronalds Gonzales from North Carolina State University joined the course as the invited international keynote speaker. In addition, several experts from academia and industry joined the course as speakers. The students experienced a week of talks, discussions, group work, presentations, and indoor and outdoor bonding activities.

Summer school participants enjoyed networking, fruitful discussions, and beautiful nature around Haikko Manor & Spa. Photos by Shubhajit Dutta (left) and Susanna Ahola (right).

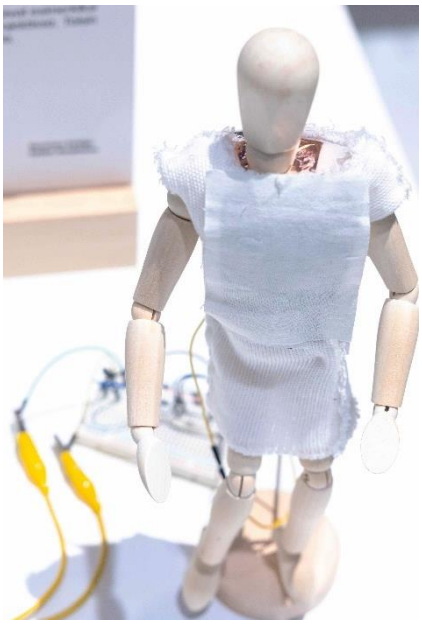
Prototyping, research visits, and innovation activities

The doctoral school students gathered in *coffee&theme* - meetings in March, May, August, and November. In these meetings the doctoral students gave presentations/workshops to each other. In 2024 the themes included intelligent packaging, EU regulations, innovation services, and outreach activities.

A communication and prototyping workshop was organized for doctoral students in February. The students presented their project prototypes in research stands during the spring seminar *IMPACT Forum* in April. The doctoral students also prepared project prototypes for the Center's *Fostering Bioinnovation exhibition* which was presented at the Designs for a Cooler Planet festival at Aalto University as a part of Helsinki Design Week, and at Dutch Design week in Eindhoven.

In 2024, a mobility program for BIC doctoral students was launched. BIC offers the possibility to apply for mobility funding targeted to international research visits. Two BIC students did a research visit in 2024.

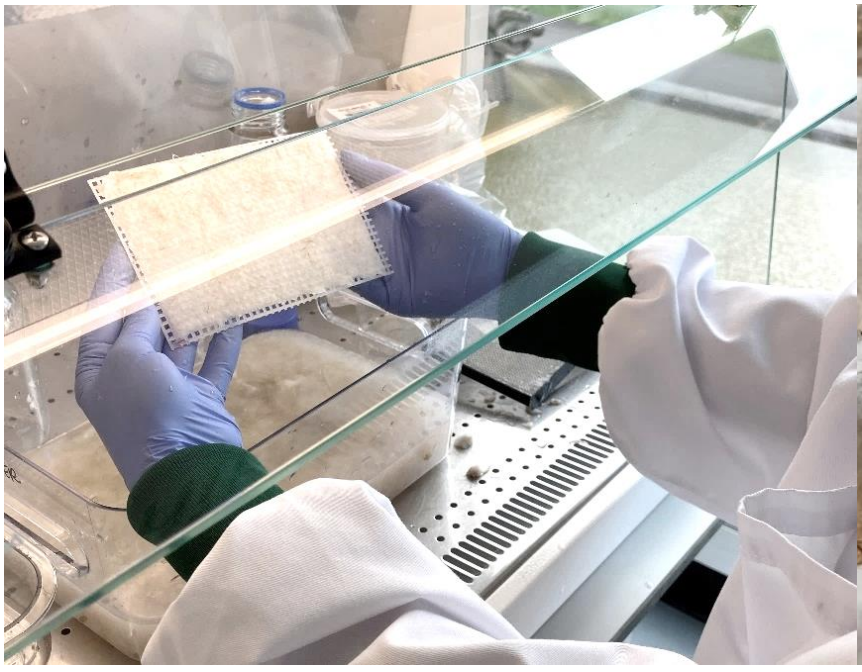
A mentorship program was also launched in 2024. Target of the Bioinnovation Center doctoral school mentorship is to provide an outsider's perspective from industry towards doctoral studies and career planning.



AIYarn project by Matteo Iannacchero, Aalto University. Photo by Mikko Raskinen.

The annual theme for Bioinnovation Center in 2024 was *Fostering Innovation*. Bioinnovation Center doctoral school students were provided information about innovation related topics and several experts were invited to give talks in BIC events throughout the year. In June, Bioinnovation Center organized a case competition *Walk the Plank* in collaboration with Aalto University Innovation Services, in which also BIC doctoral students participated.

As an outreach activity, doctoral candidate Helena Westerback organized *Clothes and climate* -themed lectures and workshops for school groups as a part of Aalto University Junior's Scientists in Schools -program. She reached 1280 students and teachers in 2024.



Doctoral candidate Laureen Mahler did a research exchange at TU Eindhoven in 2024. She investigated the viability of growing tessellations with mycelium and cellulose-based substrates. Photos by Laureen Mahler.

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 via circular economy and sustainability to have a social, environmental, and economic impact in wider perspective.

2.4M Euros

13 people
2 postdocs
8 PhDs
3 masters

SciSustain

Accelerating bioinnovation realization via sustainability assessments

CIMANET

LCA-driven future kraft pulping: a design for added-value Trackability of MMCF supply chain

Emissions Free Pulping

Reduce biomass burning and increase the product yield from wood form 50% to 70%

CleanCELL

Cellulose-based membrane for water-borne impurities removal

CELFILL

A Horizon Europe project developing sustainable, bio-based Lyocell filaments

Professor Luana Dessbesell's research group size, research funding, and main projects in 2024.

Dr. Luana Dessbesell

Prof. Luana Dessbesell is reaching the end of her second year in the professorship with excellence in research and teaching. Her initial efforts in networking have resulted in the successful grant approvals adding up to 2.4M Euros. The largest project being SciSustain (Science Translation Framework for Sustainable Bioproducts Innovation) with 1.2M Euros coming from Business Finland and companies (Valmet, Paptic, LignEasy, Stora Enso, Boreal Bioproducts, UPM and Metsä). All the successful funding applications resulted in more than doubling her research group size. Now her main priority is to support her group.

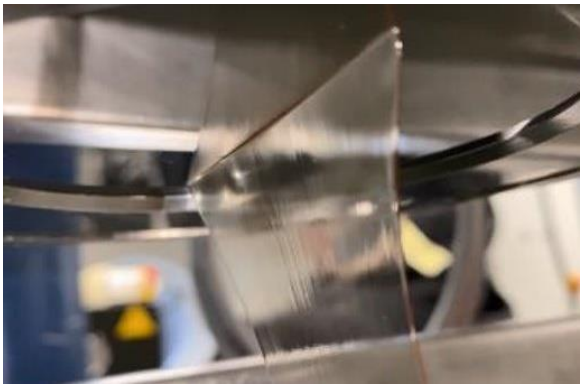
In teaching, in addition to the summer school, Luana has developed two entirely new courses on sustainability. The first course was delivered to 58 students in the fall 2024 with a lot of fun, interaction, and mutual learning.

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 very 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 build and commission a prototype pilot plant. In spring 2022, Ioncell Oy was founded. The technology development is now led by the new CEO Antti Rönkkö. In 2024, the ownership of the pilot plant was transferred to Aalto University to make it available for Ioncell Oy.

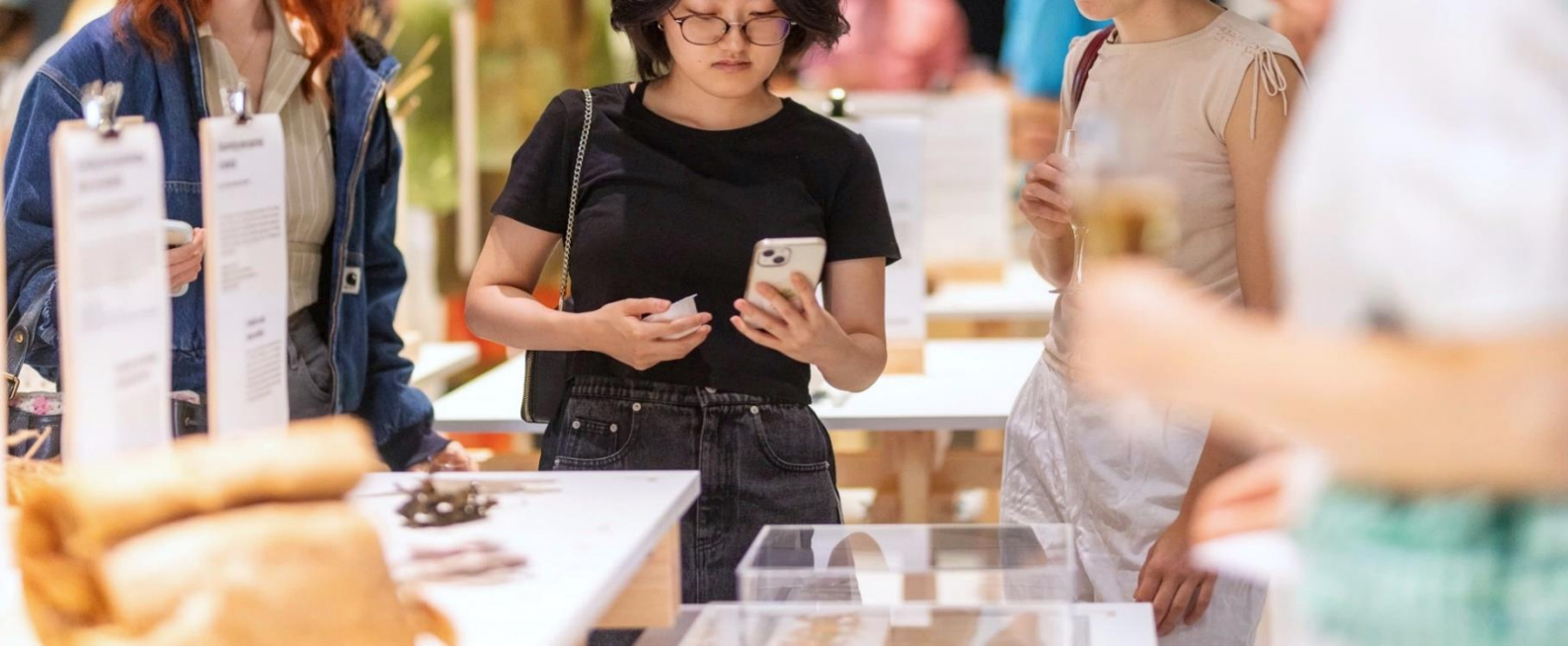
In 2023 and 2024, the Bioinnovation Center infrastructure program provided funds for equipment investments in CHEMARTS to support interdisciplinary collaboration. First expansion of the academic Ioncell research facilities were undertaken to develop the continuous production of cellulose films based on the Ioncell technology. The liquid-state nuclear magnetic resonance (NMR) facilities at CHEM were renewed to support ongoing research activities in the area of biobased products and beyond. A new size-exclusion chromatographic (SEC) setup was installed to provide state-of-the-art analytical competencies to research groups at CHEM, other schools and to industrial collaborators.



Future infrastructure investments include Ioncell laboratory scale equipment updates. Photo by Kalle Kataila.

Biodegradation laboratory

During 2024, the vision for a flagship biodegradation laboratory to support bioproducts development and the transition towards bioeconomy was formed. The laboratory will be installed in two phases. The planning of phase I was completed in 2024 and first procurement actions will take place early 2025. Phase I should be finished by the end of 2025.



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 2024, the impact program's theme was *fostering innovation.* This theme was highlighted in events, exhibitions, and doctoral school activities throughout the year.

Actions 2024

Bioinnovation Center's spring seminar *IMPACT Forum - Sustainability through innovative bio-based materials* was organized in collaboration with the FinnCERES Flagship and took place on April 25, 2024 in the center of Helsinki at Paasitorni. The event brought together 170 onsite participants (330 online) from different fields of academia, industry, and politics. Top experts were invited to present the latest developments in the area of bioproducts economy and to discuss the societal impact of innovative bio-based materials. Research stands that were spread throughout the venue allowed our doctoral students to showcase their research through prototypes which they have prepared. This interactive way of presentation provided the students the opportunity to network with industry representatives and decision makers.

Prof. Luana Dessbesell facilitated a panel discussion in the IMPACT FORUM event. Photo by Chien-Chi Kuo.

Doctoral candidate Sahar Babaeipour showcased her research through prototypes in the IMPACT Forum event. Photo by Chien-Chi Kuo.

Kids material book Mainiot Materiaalit

After more than a year of preparation, the Bioinnovation Center launched a material experiment book for children and youth *Mainiot Materiaalit* (in Finnish) on September 24, 2024. The book contains 17 bio-based material recipes utilizing bio-based, recycled, and natural ingredients. The target of the book is to inspire children and youth to experiment with the development and design of bio-based materials in a playful and engaging way.

Growing up in an increasingly digitalized world, the physical contact with (biobased) materials and the experience to create products with the own hands can help children to (re-)connect with natural materials. In addition, the hands-on experimenting can ease climate anxiety by creating a mindset that we can take challenges in our own hands and create better alternatives.

Kids material experiment book Mainiot materiaalit was launched in September 2024. Photo by Esa Kapila.

The book is being sold at the Aalto University Shop and other vendors, such as Heureka Shop, Suomalainen Kirjakauppa, Akateeminen Kirjakauppa, and Adlibris. During the fall 2024, 300 copies of the book were sold.

To increase the visibility and impact of the material book, a mini-impact program was built around it. For communication purposes, webpages and social media accounts were created (Instagram and Facebook). Media collaboration included Helsingin Sanomat Lasten Uutiset (children's news). Video tutorials of four recipes were broadcasted in the national children's news broadcast as well as in the printed children's newspaper once a month during the fall 2024 (https://www.youtube.com/watch?v=lsMkjk4BARc). In addition, a Finnish national broadcast company YLE made an insert about the book in their popular documentary show Puoli Seitsemän (https://yle.fi/a/74-20107565). The book was also featured in Aalto University Magazine and in Stylus, a professional magazine for visual arts educators. The book received international exposure in the online magazine Frameweb.

Workshops were organized for children and teachers with collaborators such as Aalto University Junior and Heureka Science Center. Aalto University Junior organized an online artificial leather workshop for 5th-6th graders in November. Bioinnovation Center participated Heureka's Tietokirjafanit family event highlighting new Finnish non-fiction books. The workshop "Spruce cone figures" reached ~200 children and their families. In addition, Bioinnovation Center organized several other workshops for school groups, families, and teachers. In particular the latter group is of great importance. By educating the educators we can maximize the impact of the book and the mission of the Bioinnovation Center in general. Altogether, in 2024 Mainiot materiaalit workshops and events reached more than 700 children, teachers, and other professionals. The workshop collaboration will continue in 2025.

The target of the material book is to inspire children and youth to experiment with bio-based materials in a playful and engaging way. Photo on the left by Esa Kapila, middle and right by Sonja Dallyn.

Exhibitions

As the main exposition activity of the year, Bioinnovation Center created an exhibition *Fostering Bioinnovation*, 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 2024 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.

In addition, a separate kids book Mainiot materiaalit exhibition was presented at *Designs for a Cooler Planet*. Materials and objects made with the material book recipes were presented. Designs for a Cooler Planet exhibition was actively visited by Aalto University and Bioinnovation Center stakeholders during campus visits, organized tours, and events such as the *Marsio Opening Night*.

Materials and objects made with the material book recipes were presented in the Designs for a Cooler Planer exhibition. Photo by Kalle Kataila.

At Dutch Design Week (DDW), the exhibition gained interest and visibility among companies, decision makers, students, and the general public. *Fostering Bioinnovations* exhibition was visited by several curated 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. Bioinnovation Center doctoral candidate Laureen Mahler organized a "Design with Nettle" workshop for students at TU Eindhoven during Dutch Design Week 2024.

Designs for a Cooler Planet exhibition was actively visited by Aalto University and Bioinnovation Center stakeholders. Photos by Kalle Kataila.

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OUTLOOK

Each year, the Bioinnovation Center chooses a specific theme to set focus and to maximize the impact. The theme for 2025 is *From research to business*. Research commercialization related activities are being planned for 2025. Infrastructure investments will continue with the expansion of ongoing initiatives (biodegradation laboratory) and initiation of new ones to promote developments and innovations in bio-based material research.

The impact program activities will include two main exhibitions: *Designs for a Cooler Planet* and *Dutch Design Week*. The Bioinnovation Center has become a staple at these events, which proved to be great platforms to interact with existing and identify new stakeholders. Further, a fall seminar will be organized in late August.

The kids material book *Mainiot materiaalit* will be translated into English and possibly into Swedish in 2025. A mini-impact program will be continued around the book to maximize the impact, including exhibitions, kids summer camp in collaboration with Aalto University Junior, and teacher training sessions.

The Bioinnovation Center will start to develop its strategy for the future to continue its mission on promoting products and bioeconomy and to have a lasting impact in these areas.