BIO4ENERGY

Annual report 2025

www.bio4energy.se

Bio4Energy – a strategic research environment

Bio4Energy is a Strategic Research Environment funded through the Swedish Government's investment in high-quality research in 24 strategic research areas. Our research focuses on biorefineries for sustainable production of renewable energy carriers, chemicals and materials.

Partners are Umeå University (UMU), Luleå University of Technology (LTU), the Swedish University of Agricultural Sciences (SLU), RISE Research Institutes of Sweden and Processum.

Bio4Energy's research is at the international forefront and covers the entire value chain: From residual biomass feedstocks to end-products in the form of advanced biofuels, bio-based materials, and "green" chemicals. Our vision is to create environmentally friendly and sustainable technologies; alternatives to today's petrol-based systems.

Bio4Energy researchers collaborate with academia, research institutes and industry worldwide. The researchers are active in education and competence supply at undergraduate, advanced and doctoral levels. The research environment has been in operation since 2010 and involves over 200 researchers. Close to 150 PhD students have graduated from Bio4Energy, and over 180 postdocs have refined their researcher skills within our environment. Our research has resulted in around 2000 peer-reviewed scientific publications and more than 60 patent applications.

Management and coordination

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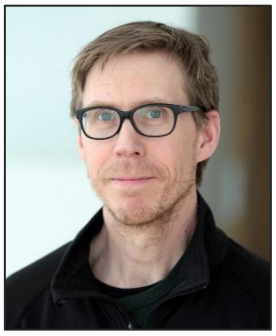

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Bio4Energy Board

Thomas Wågberg
UMU, Chair (from June 2025)

Katrine Riklund
UMU, Chair (until June 2025)

Pär Weihed
LTU

Karin Ljung
SLU

BIO4ENERGY

Introduction – overview of 2025

The year of 2025 continued along the tracks of the previous years, with the world marked by war, geopolitical uncertainty and growing concern of the pace of global climate action. At the same time, the need for resilient energy systems, sustainable materials and secure domestic value chains has become increasingly evident. In Sweden, the industrial green transition continues to develop, although with both progress and setbacks, and with a growing focus on competitiveness, energy preparedness and security of supply. Bio4Energy's research is largely motivated by the challenge of finding sustainable solutions for the climate, environment and society and we continue to see an increasing significance of much of our research, currently in particular related to energy security and the development of domestically sourced materials and products, such as fertilisers, polymeric materials and bio-based carbon materials.

We are thus happy to continue contributing to education, research and innovation within this critical area.

We would also like to take this opportunity to thank our long-time Chair of the Board, Katrine Riklund, and welcome Thomas Wågberg as new chair!

The year in numbers

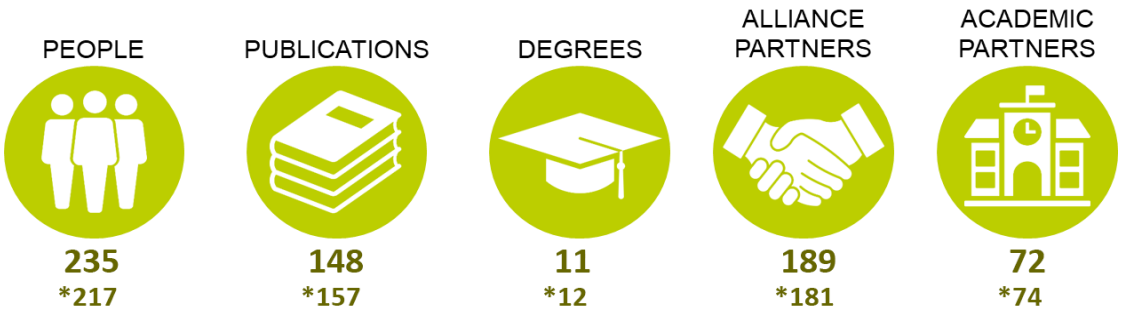
The figure below summarises a few of Bio4Energy's achievements of 2025 in numbers.

People are our most valuable assets! During the last decade, the number of researchers involved in Bio4Energy has been relatively stable at a bit over 200 persons, with 2025 showing a continued increase and reaching 235 researchers, above the long-term average.

PhD degrees are one of the ways in which we contribute directly to society and industry by providing competence for the future. In 2025, 11 PhD degrees were achieved. After an exceptionally high number in 2024, we are now in a build-up phase, with many new PhD students recruited during the year.

Publications is how most of our research is disseminated. In 2025, Bio4Energy contributed to 148 peer-reviewed journal papers. Of these, at least 18 are a direct result of cross-platform collaboration, meaning that researchers from two or more of the seven Bio4Energy research platforms have been involved.

Alliance partners and *academic partners* represent national and international collaborations, a central part of Bio4Energy's operations. Following strong growth in recent years, the number of both alliance and academic partners remained at very high levels in 2025.



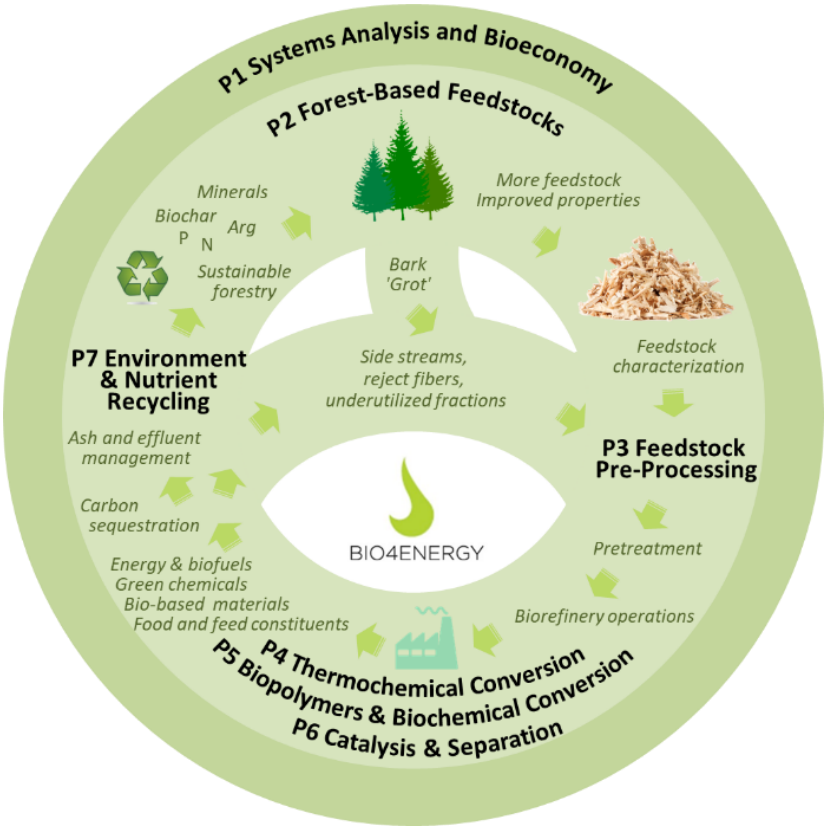
***Key numbers for Bio4Energy 2025**. Numbers marked with * are average values for the period 2016-2025. 'Degrees' here represents PhD degrees. 'Alliance partners' represents our external collaboration partners from industry, society and institutes, and 'Academic partners' our external collaborations with academic departments outside Bio4Energy.*

Research highlights from the platforms

Bio4Energy is organised into seven research platforms, each with its own special focus in the biorefinery value chain, as shown in the figure to the right.

The following pages are dedicated to highlights from the seven research platforms from the previous year, with brief descriptions of each platform's scope.

Particular focus is here placed on new scientific results and achievements – or in short, we here give to you the quick flyover and a selection of insights from the close to 150 scientific publications of 2025.



P1 Systems Analysis and Bioeconomy (SysAnaBio)

Biorefineries are inherently interconnected with existing industrial infrastructures and other sectors of the economy, and the related scientific-technological challenges are multifaceted and require a multi-disciplinary perspective.
In this platform, holistic and comprehensive methodological systems analysis approaches are used to address technological, economic, and social challenges and opportunities related to the development of biorefineries.

Platform leader: Robert Lundmark, LTU, robert.lundmark@ltu.se

- Developed a seven-stage assessment framework for circular and sustainable cities, based on urban metabolic rate and the circular performance of essential municipal services. The framework integrates bioeconomy and circular economy perspectives to assess (1) the environmental impacts associated with urban resource use, including food, electricity, heat, and water consumption, and (2) the potential of municipal services to reduce these impacts through improved circularity. The framework was validated using Umeå, Sweden, as a case study.
- Established a sawmill map of the Baltic Sea region using ArcGIS Online, enabling logistics analyses and transport-related calculations.

- Developed a tool for estimating the costs associated with ash spreading in forest environments as part of forest fertilisation and nutrient recycling efforts within the bioeconomy.
- Showed that restricting roundwood harvest in Sweden can lead to a harvest leakage effect of up to 70%, where reduced domestic harvest is partly offset by increased harvesting elsewhere. This significantly reduces the overall climate mitigation potential of lowering harvest levels.
- Explored the potential of hydrothermal carbonisation (HTC) of pulp and paper mill sludge to produce hydrochar and support industrial symbiosis with the Swedish steel industry. The study assessed environmental impacts, production costs, and the potential for large-scale implementation. The results indicate that hydrochar can reduce several environmental impacts. However, economic feasibility depends strongly on CO_2 pricing and hydrochar quality, and the overall production potential at the national level is limited compared to demand.
- Examined the role of green industrial policy in addressing market failures and enabling long-term, credible climate policy. The study emphasises the need for continuous evaluation and learning from implemented measures. The findings show that there is no scientific basis for rejecting green industrial policy; instead, such policies are important for supporting industrial climate transition efforts.
- Furthermore, demonstrated that spruce bark extract shows strong potential as a bio-based alternative to synthetic biocides in the pulp industry and wastewater treatment applications.

*Photo from a study trip as part of the **Biocarbon Futures project**, involving researchers from the **SysAnaBio** platform. Photo: Sveaskog.*

P2 Forest-Based Feedstocks (ForFeed)

Feedstock is the basis of all other platforms, and optimised feedstock will influence the whole value chain. Research on feedstock production systems contributes to increased wood yield and allows engineering of wood characteristics. Within this platform, genetic and molecular control of properties that are important for feedstock biorefining are investigated, as well as how these properties are governed by environment and management practices.

Platform leader: Hannele Tuominen, SLU, hannele.tuominen@slu.se

- Produced data highlighting the importance of management and thinning practices in poplar plantations. Total stand-level biomass production in unthinned and lightly thinned plots was maximised with an 18-year rotation, with mean annual increment (MAI) reaching 33 m^3 per hectar and year (equivalent of 11ton dry matter per hectar and year). Management of understory vegetation was also shown to be crucial, increasing both growth rate and growth period.
- Revealed the influence of xylan chemical properties on tree growth, wood properties, and saccharification. A specific type of xylan modification was shown to enhance the growth of aspen trees, while also affecting wood development, particularly lignification. The gamma-ester linkage between glucuronoxylan and lignin was identified as a key target for genetic engineering to improve both growth and saccharification of lignocellulosic aspen feedstocks.
- Uncovered a previously unknown link between pectin (homogalacturonan) and cuticle biosynthesis. The cuticle is a lipidic cover of all aerial parts of plants, enabling their survival on land and being critical for drought resistance. Disruption of homogalacturonan prevented cuticle development by arresting the lipids in the cell wall. These findings indicate that pectate lyase plays a key role in regulating cuticle development, which is crucial for plants to colonize land and adapt to environmental conditions.
- Demonstrated that the application of wood ash and lime can almost double the growth of poplars compared to untreated plants, especially after three years of planting. The growth of poplars is equally affected whether the wood ash or lime is mixed into the soil or applied on the soil surface. These findings highlight the potential of using wood ash to improve poplar growth on sites with low soil pH and indicate that application methods can be adapted to different site conditions, supporting the early establishment of these fast-growing plantations on sites with suboptimal soil conditions.
- Revealed that certain nitrate and amino acid transporters are negatively correlated with stem diameter, indicating that excessive nitrogen retrieval from the xylem sap could suppress radial growth. Additionally, the expression of glutamine synthetase was correlated with the expression of these transporters, with increased plant growth observed in transgenic trees overexpressing glutamine synthetase. This research provides insight into the genetic basis of nitrogen uptake and assimilation, offering potential targets for improving nitrogen-use efficiency and growth in aspen trees.
- Elucidated the function of ribosomes, which are large RNA and protein complexes that all living organisms, including plants, need for protein biosynthesis and biomass formation. A new protein complex, called the OPENER complex, was identified and is required for ribosome assembly in plants. Ribosomes are important determinants of

feedstock yield and performance, and this work provides a new opening and tools to study this important topic.

- Reported on the interplay between growth and cold tolerance in plants, which can be harnessed to create resilient crops with maintained biomass. By understanding and enhancing the physiological and molecular mechanisms underlying plant responses to low-temperature stress, strategies can be developed to improve cold tolerance while maintaining growth.
- Concluded that breeding of Scotch pine for growth has led to increased drought tolerance, but at the expense of genetic diversity. This has important implications for forest management and climate change adaptation. These results highlight the importance of understanding the functional traits of Scotch pine seedlings to select ecotypes that are more resilient to drought stress. The findings further suggest that incorporating stress tolerance into silvicultural and breeding practices is essential for preserving forests in the face of climate change.

P3 Feedstock Pre-Processing (FeedPro)

Forest-based lignocelluloses are characterised by their structural and chemical diversity. Expertise in advanced feedstock characterisation and design and evaluation of tailored pre-processing technologies is critical for accelerating the development of biorefinery processes and products. This platform addresses challenges and opportunities caused by biomass heterogeneity, through research on characterisation, separation, and modification of bio-based materials.

Platform leader: Mikael Thyrel, SLU, mikael.thyrel@slu.se

- Performed experiments at the ForMAX beamline at Synchrotron MAX IV, Sweden, focusing on biochar materials for battery applications. In-operando characterisation was carried out to understand the relationship between structural and electrochemical properties, using advanced X-ray-based methods (combined SAXS and µCT techniques).
- Conducted experiments at the BALDER beamline at MAX IV Synchrotron, Sweden, to study transition metals in ash fractions and biochars. Using advanced X-ray methods, the study examined how chromium, zinc, and copper behave in different materials and how this affects opportunities for element recycling.
- Demonstrated a novel approach to producing sustainable functional materials by harnessing fungal mycelium and mushroom-derived systems. The work shows how controlled fungal growth and processing enable bio-based composites with tunable mechanical, thermal, and functional properties, with potential applications in packaging, construction, textiles, and energy-related materials.
- Showed that controlled processing can yield a hierarchical pore structure and high electrical conductivity, enabling fast charge transport and structural stability. As a result, the material delivers high capacity, excellent rate performance, and long cycling stability in both lithium-ion batteries and supercapacitors. The work highlights biomass-derived carbon as a low-cost, scalable, and environmentally friendly electrode material for next-generation energy storage devices.

***FeedPro** platform participants visiting the MAX IV Laboratory, a world-leading synchrotron radiation facility in Lund, Sweden, used for advanced materials and structural analysis. Photo: Mikael Thyrel*

P4 Thermochemical Conversion Technologies (ThermoChem)

Through thermochemical conversion processes, widely different types of biomass can be converted into advanced fuels and chemicals. The overall challenge for this platform involves generating the fundamental understanding needed to support the technical development of thermochemical conversion of forest-based biomass, side streams, recycled fibres, underutilised fractions, and to make the corresponding technologies competitive to those for fossil fuels.

Platform leader: Markus Broström, UMU, markus.brostrom@umu.se

- Demonstrated steady full conversion of methane into H_2 (with a selectivity of 60 vol% in gas products) during 60 h of operation using molten metal NiMo/Bi catalysts in a ceramic tube reactor. In addition, non-catalytic methane pyrolysis was achieved in a pilot-scale furnace black reactor, producing carbon black with properties similar to commercial rubber-grade products.
- Conducted the first demonstration of oxy-fuel combustion of biomass in a 100 kW down-fired pulverised combustor using an artificial oxidiser (without flue gas recirculation), including the first in situ measurements of gaseous K, KOH, and KCl. The results showed that most potassium is volatilised during conversion and subsequently sulfated, with good agreement between measured

species and thermodynamic equilibrium. No major differences were observed between air and oxy-fuel combustion.

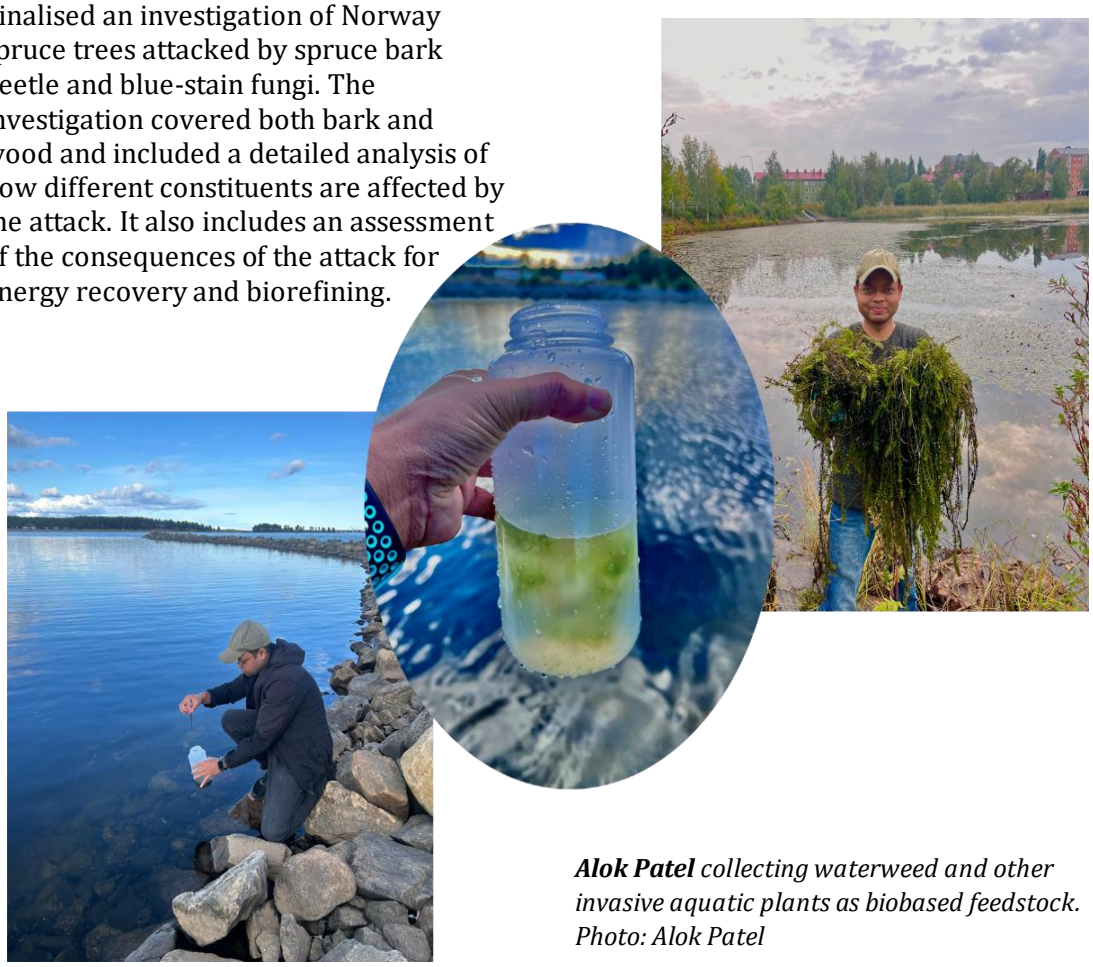
- Investigated the negative influence of feedstock water content on the yield and quality of carbon black in an electrified process.
- Showed that in twin shaft regenerative lime kilns, typically fired with oil or gas, enrichment of O_2 and/or H_2 can contribute to flame stabilisation and enable combustion of more difficult or low-calorific fuels, such as solid biofuels. Increasing the O_2 concentration is also relevant from a carbon capture perspective, as it raises the CO_2 concentration in the flue gas. A unique and validated CFD (computational fluid dynamics) model of such a kiln was developed by researchers from Umeå University, the Swedish Mineral Processing Association, and Cimprogetti S.p.A., enabling detailed simulations of flame shape, temperature, and gas distributions under different operating conditions.
- Evaluated in pilot scale the effects of electrification and removal of ash-forming elements from fuels (biofuels, coal, oil) on quicklime and cement clinker production.
- Investigated pulverised oxy-fuel combustion of softwood and forest residues in a 100 kW down-fired furnace with external flue gas recirculation. The results indicate that potassium is volatilised and sulfated, but not observed in the gas phase, likely due to rapid adsorption onto soot. Solid-phase potassium species and major compounds showed good agreement with thermodynamic equilibrium, and Ca-containing phases such as apatite were identified. No major differences were observed compared to air combustion.
- Presented a novel technique for quantitative wide-field imaging of K, KOH, and KCl in high-temperature environments, achieving detection limits below parts-per-million, 20 ms temporal resolution, and 0.13 mm spatial resolution. The technique enables mapping of potassium species distributions and provides potential for imaging reaction kinetics.
- Implemented the Balance Method using operational data from the Umeå Energi Dåva 1combined heat and power plant to determine the fractions of fossil and biogenic CO_2 in flue gas. The results showed good agreement with the C14 method, although neither method currently meets minimum uncertainty requirements. Higher time resolution (1–24 h) may be achievable with improved gas measurement accuracy.
- Compared two advanced measurement techniques for potassium monitoring in a single-pellet reactor; photofragmentation tunable diode laser absorption spectroscopy (PF-TDLAS) and surface ionisation detector (SID) techniques. The study confirmed challenges in quantitative potassium measurements, while CFD simulations supported interpretation of results. The techniques were found to complement each other, with PF-TDLAS measuring gas-phase species and SID primarily solid-phase potassium.
- Characterised the electronic structure of commercial rubber-grade and conductive carbon black particles using synchrotron soft X-ray spectroscopy at MAX IV (Species beamline, RIXS endstation).
- Investigated the chemical state of iron oxide nanoparticles during oxidation of carbon materials using APXPS at MAX IV (Species beamline, XPS endstation).

P5 Biopolymers & Biochemical Conversion Technologies (BioPolChem)

This platform focuses on bio-based polymers for advanced and sustainable materials, and conversion processes that involve microorganisms and enzymes. Both conventional forest-industrial processes and products, e.g. cellulose and cellulose derivatives, and novel polymeric bio-based materials are included. Exploitation of the inherent characteristics of the raw materials is central, incorporating the sustainability aspect to reduce, recycle, and reuse.

Platform leader: Leif Jönsson, UMU, leif.jonsson@umu.se

- Finalised an investigation of Norway spruce trees attacked by spruce bark beetle and blue-stain fungi. The investigation covered both bark and wood and included a detailed analysis of how different constituents are affected by the attack. It also includes an assessment of the consequences of the attack for energy recovery and biorefining.



***Alok Patel** collecting waterweed and other invasive aquatic plants as biobased feedstock. Photo: Alok Patel*

- Initiated a new project on bio-based additives and fibres for 3D printing (Bio-2-Print). The project is a collaboration between Finland, Sweden and Ireland and includes both academia and industry. Residual bio-based streams are investigated as resources for constituents in 3D printing.

- Expanded research activities into the Blue Bioeconomy through the initiation and coordination of the EU-funded *ReSEAlience* project, focusing on sustainable marine bioresource valorisation and resilience. This expansion is also supported by two additional projects, including the use of invasive aquatic biomass.

- Extended research into sustainable textile recycling through innovative chemical recycling methods. The Formas project *Revitalising Mixed Textile Waste* addresses the global challenge of low recycling rates for mixed textile waste by developing scalable and economically viable processes that break down complex fibre blends into reusable components. The work supports interdisciplinary collaboration between biochemical process engineering and textile technologies and contributes to the broader understanding of circular textile waste valorisation.

P6 Chemical Catalysis and Separation Technologies (CatSep)

In order to make biorefineries successful, it is essential to develop suitable catalysts and energy lean separation technologies. The focus of this platform is fundamental research on novel integrated catalysis and separation processes designed for application in forest and other lignocellulosic-based biorefineries, encompassing both thermochemical and biochemical routes to fuels and chemicals.

Platform leader: Jonas Hedlund, LTU, jonas.hedlund@ltu.se

- Observed extremely high CO_2/CH_4 selectivity exceeding 2000, coupled with very high CO_2 permeability for ultra-thin DDR membranes (a type of zeolite membrane, i.e. an aluminosilicate mineral) at -30 °C.
- Unravelled the physical mechanism behind the surface barrier affecting mass transfer in microporous materials in collaboration with Linköping University. A combination of advanced experimental measurements in Luleå and advanced computer modelling (DFT, density functional theory) in Linköping was used to identify the origin of the surface barrier, first described in a publication from 1976. This resolves a long-standing question in the understanding of mass transfer in microporous materials.
- Demonstrated that DDR membranes are also useful for H_2 separation from CH_4, which is highly relevant for the production of renewable hydrogen via dark fermentation of biomass.
- Installed large-scale equipment for zeolite membrane scale-up.

P7 Environment and Nutrient Recycling (EnviroNut)

One of the key challenges when introducing new biorefinery concepts is to develop sustainable and resource-efficient utilisation routes of forestry biomass, industrial residues and organic waste streams, including closing the loops of nutrients and minerals, as well as minimising the potential environmental and health impacts. This platform aims at advancing the understanding related to critical research questions on the environmental aspects of sustainable forestry, bioenergy and biorefinery processes.

Platform leader: Nils Skoglund, UMU, nils.skoglund@chem.umu.se

- Developed and characterized a controlled-release Arginine Fe-HMP nutrition effectively incorporated the initial reagents in greenhouse experiments. The produced complex displayed significantly lower nitrate leaching but similar Scots pine seedling growth promotion of the novel Arginine Fe-HMP nutrition compared to commercially available inorganic nitrogen controlled-release fertilizers.
- Demonstrated that plant tannins stabilize organic nitrogen in forest soils by forming persistent tannin–organic nitrogen complexes. Mycorrhizal fungi, particularly ectomycorrhizal and ericoid types, degrade these complexes and mobilize nitrogen for plant uptake. This interaction links plant chemical traits with microbial processes and regulates nitrogen cycling and plant community dynamics in forest ecosystems.
- Showed that organic and inorganic nitrogen sources induce distinct plant phenotypes, with organic nitrogen promoting increased root biomass and root hair development. Plants supplied with organic nitrogen exhibited lower nitrogen uptake rates per unit root biomass but higher carbon use efficiency. These results indicate that plant growth strategies are adjusted to optimize acquisition of less mobile nitrogen forms.
- Reviewed particle emissions from biomass cookstoves, identifying organic carbon as the dominant component and substantial differences between laboratory and field measurements, with higher emissions observed under real-world conditions. The study highlights critical gaps in both scientific understanding and policy frameworks related to cookstove emissions.
- Showed that redox heterogeneity in acid sulfate soils governs iron and sulfur cycling, with microbial and hydrological processes driving distinct isotopic signatures across depths and seasons. Reactive Fe and S pools, though small in mass, dominate short-term biogeochemical dynamics, and combined isotope and phase-specific analyses are required to resolve these processes.

New strategic projects

Twenty percent of all funding to Bio4Energy is set aside as **Strategic Funds** used to create synergies and explore and address new and important avenues of research.

Our strategic projects:

- Concern high-quality research dedicated to the biorefinery field;

- Involve collaboration between research and development platforms and research groups;
- Are targeted at finding solutions to global problems and strengthening the development and competitiveness of Sweden and Swedish industry and;
- Support young Bio4Energy researchers in a critical phase of their academic career.

In the 2025 call for **targeted strategic funds (2026-2027)**, eight 2-year projects were granted, according to below.

From Forest Damage to Resource: Converting Resin-Rich Diseased Pine into Renewable Chemicals and Energy (RESET)

Leonidas Matsakas (LTU, P5), Dan Bergström (SLU, P1)

Rising from the ashes – exploring seedling development utilizing L-arginine and P-rich ashes as fertilizers

Henrik Böhlenius (SLU, P2), Nils Skoglund (UMU, P7)

High temperature woody residue conversion in high CO_2 gas environments

Per Holmgren (UMU, P4), Henrik Wiinikka (LTU, P4), Fredrik Weiland (RISE, P4)

Unlocking the value of oat husk residues through sustainable catalytic biorefinery pathways for a circular Swedish bio-economy

Santosh Khokarale (UMU, P6), Leif Jönsson (UMU, P5), Chandani Singh (RISE Processum)

Sustainable, bio-based and safe Na-ion batteries

Kristiina Oksman (LTU, P3), Xiaoyan Ji (LTU, P6), Stina Jansson (UMU, P7), Anna Strandberg (UMU, P3), Mikael Thyrel (SLU, P3), Fredrik Forsberg (LTU, P4)

Advanced bioremediation of heavy metals by Nordic microalgae using ashes and effluents from the forest industry

Christiane Funk (UMU, P5), Sarah Conrad (LTU, P7), Markus Broström (UMU, P4)

Agent based modelling of the integrated value chains of biogenic CO_2, biochar and green methanol

Joakim Lundgren (LTU, P1), Kentaro Umeki (LTU, P4), Robert Lundmark (LTU, P1)

Development of a method for frost damage assessment using SilviScan images of increment cores and its genetic analysis in Norway Spruce

Rosario García Gil (SLU, P2), Kathryn Robinson (UMU, P2), Robert Nilsson (RISE, P2)

Bio4Energy Graduate School

The **Bio4Energy Graduate School** currently hosts three courses for PhD students and early-career researchers. These courses are given every second year and together attract more than 30 participants. Most of the participants belong to the Bio4Energy research environment.

During 2025, Bio4Energy had 68 active PhD students. Eleven doctoral theses and four licentiate theses were defended in 2025. Big congratulations to you all!

PhD theses

Özer Erguvan, SLU, Dept. of Forest Genetics and Plant Physiology (P2)
Ultrastructural and molecular basis of cell-cell adhesion in plants
Main supervisor: Stéphane Verger

Léa Bogdziewiez, SLU, Dept. of Forest Genetics and Plant Physiology (P2)
Quantitative Imaging and Mechanics of Single Plant Cell Adhesion
Main supervisor: Stéphane Verger

Mikko Luomaranta, UMU, Dept. of Plant Physiology (P2)
Decoding lignin in Swedish aspen: paths to better feedstocks and resilient trees
Main supervisor: Hannele Tuominen

Katarzyna Olovsson, UMU, Dept. of Applied Physics and Electronics (P4)
Thermochemical properties and quality measures of limestone and quicklime
Main supervisor: Markus Broström

Natxo García-López, UMU, Dept. of Applied Physics and Electronics (P4/P7)
Toward cleaner cooking and energy security in rural sub-Saharan Africa: assessing sustainable bioenergy systems, biomass cookstove emissions, and particle properties
Main supervisor: Britt Andersson

Yagmur Bas, LTU, Wood and Bionanocomposites (P5)
From wood to advanced materials: Multifunctional TEMPO-oxidized wood nanofibril networks as wound dressings and energy storage device separators
Main supervisor: Linn Berglund

Anna Renström, Dept. of Forest Genetics and Plant Physiology (P2)
Physiological and molecular responses to nitrogen-stimulated cambial growth in aspen
Main supervisor: Hannele Tuominen

Iliana Kyriazidou, LTU, Chemical Engineering (P6)
Adsorption and Separation in Small-Pore Zeolites: From fundamental studies to membrane process design for biogas and natural gas upgrading
Main supervisor: Liang Yu

Van Minh Dinh, UMU, Dept. of Chemistry (P6)
Valorization of Biomass Byproducts: The Potential of Chitin and Lignin through Solid Catalysts
Main supervisor: J-P Mikkola

Nadin Al-Jariry, LTU, Chemical Engineering (P6)
Vacuum Membrane Distillation for Desalination: Experimental and Theoretical Investigations Using Inorganic Membranes
Main supervisor: Josefine Enman

Tinkara Bizjak-Johansson, SLU, Dept. of Forest Genetics and Plant Physiology (P7)
Some aspects on boreal forest microbiotas and nitrogen
Main supervisor: Torgny Näsholm

Some of our new PhD graduates. *Top row (left):* ***Anna Renström*** *(Hannele Tuominen research group, UMU); photo: Hannele Tuominen. Top row (right):* ***Mikko Luomaranta*** *(Hannele Tuominen research group); photo: Pál Miskolczi. Bottom row (left):* ***Natxo Garcia Lopez*** *during his PhD defense (Marcus Broström research group, UmU); photo: Christoffer Bohman. Bottom row (right):* ***Yagmur Bas*** *(Linn Berglund research group, LTU).*

Licentiate theses

Eduardo Arango Durango, LTU, Energy Engineering (P4)
Biocarbon Production in Fluidized Bed Reactors
Main supervisor: Kentaro Umeki

Qiangbing Shi, LTU, Energy Engineering (P6)
Development and Identification of Amine-based Deep Eutectic Solvents for CO_2 Capture
Main supervisor: Xiaoyan Ji

Zhida Zuo, LTU, Energy Engineering (P6)
Modeling Transport Properties of Ionic Liquids based on ePC-SAFT
Main supervisor: Xiaoyan Ji

Yangshuo Li, LTU, Energy Engineering (P6)
CO_2 electrochemical reduction to CO with ionic liquids: evaluation and technology exploration
Main supervisor: Xiaoyan Ji

Communication and outreach activities

Bio4Energy's external communication activities include a website, newsletters, social media, and participation in scientific, industrial, and outreach events. The communication highlights research results, Bio4Energy researchers, and our role in the bioeconomy sector. In 2025, particular emphasis has been placed on strengthening international visibility, engaging with stakeholders across sectors, and contributing to policy-relevant dialogue at both national and European levels.

Topics that received notable attention in news and media during the year include:

- Gasification technologies and biocarbon supply for fossil-free steel production
- Resource recovery and circular solutions for sustainable cities
- Bio-based and functional materials from renewable resources
- Forest productivity and ecosystem restoration
- Advanced characterisation and modelling of biomass-based systems

Bio4Energy also communicates research findings through other outreach activities. A few examples from 2025 are:

- Christoffer Boman and Nils Skoglund contributed to an EU peer-review meeting at Umeå Eco Industrial Park – Center of Excellence, supporting the development of a Circular Hub in Umeå and strengthening collaboration between academia, industry, and policy actors.
- MR García Gil moderated a high-level policy event on multifunctional forests in Brussels, organised by the ProFor Network. The event brought together European policymakers, industry representatives, and academic stakeholders to discuss forest multifunctionality.
- Nils Skoglund contributed to the organising and scientific committees of Nordic Flame Days and to the scientific committee of the IFRF Conference. He also organised the Infranauts event in Lund and was an invited speaker at the Circular Futures Conference in Vienna.
- Robert Lundmark participated in the SNS seminar *"Skogen – vägen framåt"*, addressing forest policy in relation to climate, biodiversity, and the economy.
- Christiane Funk contributed through press releases on the ReSource grant and research published in *Nature Communications*. She was also featured as an expert in *Svenska Dagbladet* and in an SVT report.
- Linn Berglund presented at the EPNOE 2025 International Polysaccharide Conference in Sundsvall and gave an online seminar for industry through Packbridge. She also co-authored a popular science article in *Kemisk tidskrift*, delivered a docent lecture in Luleå, and participated in Forskarveckan with presentations for school students in Stockholm and Umeå.
- Mikael Thyrel communicated research through a popular science post on social media (SLU Skog), focusing on battery-related research.
- Leif Jönsson, Johan Börjesson, Chandani Singh, and Pooja Dixit participated in a seminar with Stiftelsen Nils och Dorthi Troëdssons forskningsfond together with representatives from RISE, FSCN, and Bio4Energy.

Awards and recognitions. *Top row (left):* ***Io Antonopoulou****, recipient of the Royal Skyttean Society's Award for Young Promising Researchers (2025). Top row (right):* ***Chaojun Tang****, awarded at the Bio4Energy Researchers' Meeting, Umeå (November 2025). Bottom row (left):* ***Yiolanda Vergou****, Young Speaker Prize, Nordic Algae Symposium, Copenhagen. Bottom row (right):* ***Diego Alejandro Miranda****, first prize in the Science Slam at ECCE 15 / ECAB 8 / CIBIQ, Lisbon (8–10 September 2025).*

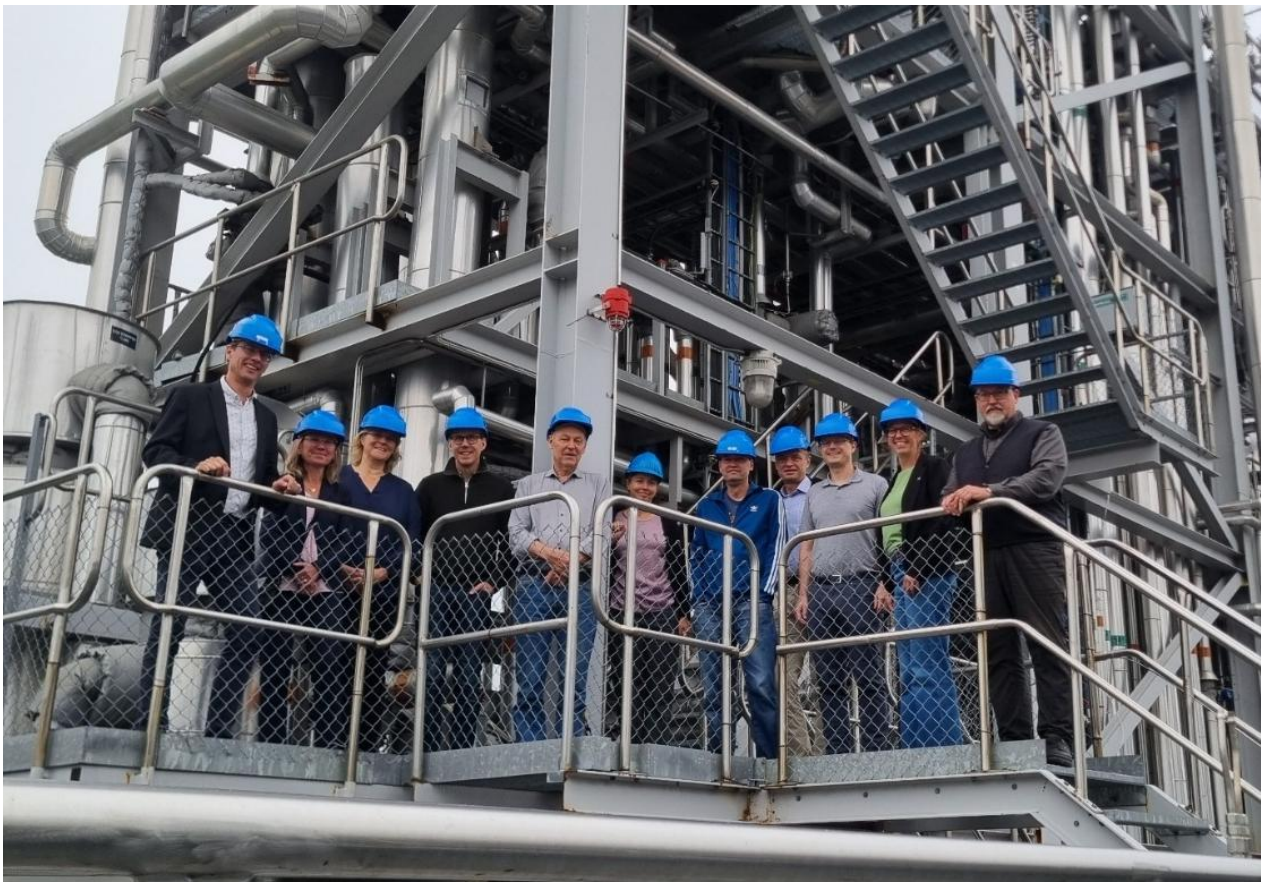
Bio4Energy Advisory Board

During 2025, we have had two meetings with Bio4Energy's external Advisory Board:

- A meeting in February at Skogforsk, Uppsala, on the theme *"Energy preparedness and security of supply"*
- A second meeting in September at RISE, Piteå, on the theme *"Pyrolysis and gasification"*

In addition to presentations from several Bio4Energy researchers representing different platforms and from our Advisory Board members, the meetings have also included presentations from invited external speakers.

Both meetings included site visits and demonstrations at the host organisations.



Bio4Energy Advisory Board Meeting held at RISE in Piteå in September 2025

Advisory Board members 2025

Peter Axegård
C-Green Technology AB
Senior Advisor

Charlotte Bengtsson
Skogforsk
CEO

Erik Dotzauer
Stockholm Exergi
Policy expert

Alice Kempe
Kempestiftelserna
Chair

Björn Fredriksson-Möller
Öresundskraft
(formerly at St1 Biogas)

Anna Karlberg
Stora Enso
VP Forest R&D

Urban Svensson
Perstorp
Director Procurement

Torgny Persson
Swedish Forest Industries
R&I director

Marlene Burwick
St1
Director Public Affairs

Martin Wimby
Valmet Recovery Business Unit
Technology Director