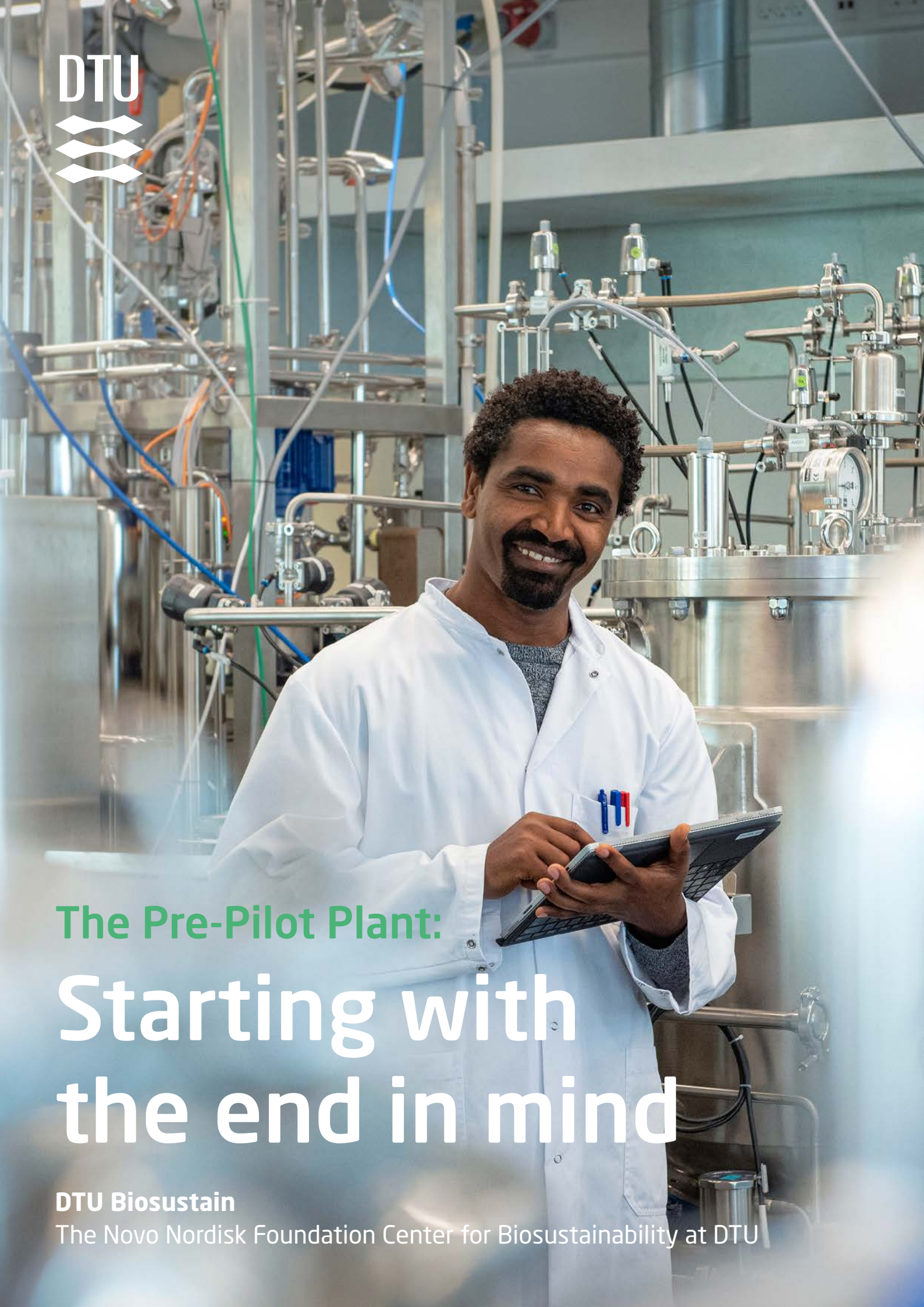


The Pre-Pilot Plant:

Starting with the end in mind

DTU Biosustain
The Novo Nordisk Foundation Center for Biosustainability at DTU

Welcome to DTU Biosustain

The Novo Nordisk Foundation Center for Biosustainability (DTU Biosustain) at the Technical University of Denmark (DTU) aims at developing new knowledge and technologies to help facilitate the green transition. We contribute to the development of a sustainable society by providing engineered microbes, but also knowledge, skills, technologies and education that can drive the transformation from the existing oil-based to a bio-based society in which chemicals are produced biologically.

The Pre-Pilot Plant:
A place for optimization and scale-up

The Pre-Pilot Plant (PPP) is the translational research and development core section of DTU Biosustain. The facility and its people are focused on bioprocess development and commercialization of bio-based products from ideation to first prototype production. Our primary goal is to provide consumers with the option to choose sustainable products that leave greener footprints on Earth than what we currently have – and we hope you will join us in this endeavour.

At the PPP, we utilize various operational units that are capable of accelerating and developing cell-factories and bioprocesses towards early commercial-level performance (TRL 4-6*) in a short period. We apply industrial standards, compliance, mindset and workflows in an integrated and agile design-build-test-learn environment. Our international and interdisciplinary staff consists of technicians, engineers and natural scientists, many with an industry career background.

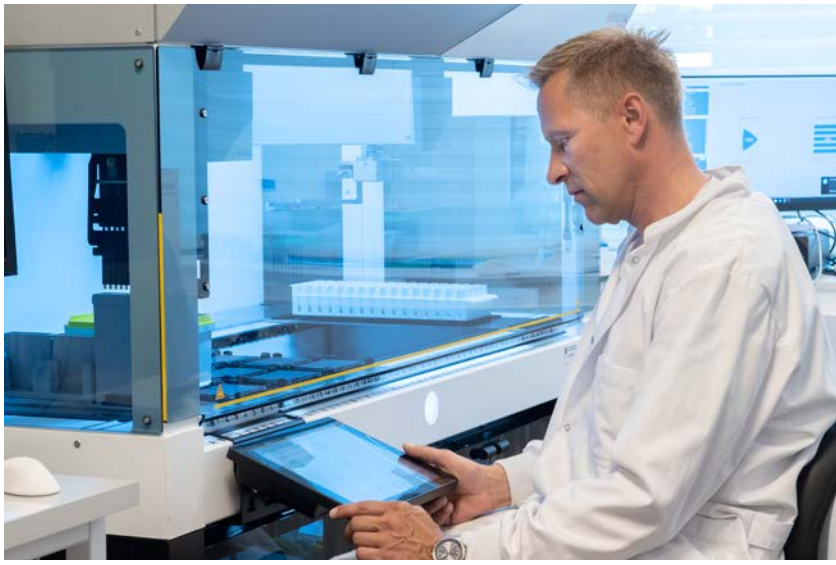
DTU Biosustain relies on excellence partnerships with technology providers who have decades of production and manufacturing experience – so that the Pre-Pilot Plant provides scalable solutions, which can be implemented at industrial scale or at CMOs.

*Expanded Technology Readiness Level (TRL) Definitions for the Bioeconomy. Biofuelsdigest.com.

*Technology readiness levels (TRL); Extract from Part 19 – Commission Decision C(2014)4995" (PDF). ec.europa.eu.

Upstream development

At DTU Biosustain, we employ a broad range of innovative technologies – including automated liquid-handling robotics, bioinformatics solutions on design, data capture, management, monitoring and visualization, as well as a broad range of In-Process-Control (IPC) analytics for both online and offline measuring. Our fermentation and cultivation platforms span the whole range from plate-based primary and secondary screening technologies to automated high-throughput cultivation platforms and various stainless steel scale-up and scale-down bioreactor systems.



"With the Pre-Pilot Plant, DTU has created a unique integrated multi-disciplinary facility in biotechnology. Here scientists, engineers and technicians can advance together with partners from industry and academia, applying novel processes and technologies for biosolutions and biomanufacturing."

Dr. Andreas Worberg, Chief Commercial Officer

Downstream development

The downstream suite for separation and purification of desired products or co-products is equipped with various unit operations from laboratory scale to pilot scale.
We operate solid-liquid separation, the whole range of cross-flow filtration techniques, liquid-liquid separation, evaporation and simple distillation, homogenization, multiple chromatography columns and screening units.
For prototype formation and product development, we deploy crystallization and precipitation or freeze- and spray-drying.

See the full PPP equipment inventory by scanning the QR code.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"We have a huge selection of equipment that we can use to make almost any kind of product – as well as the opportunity to work with transferring biosustainable research into business opportunities."

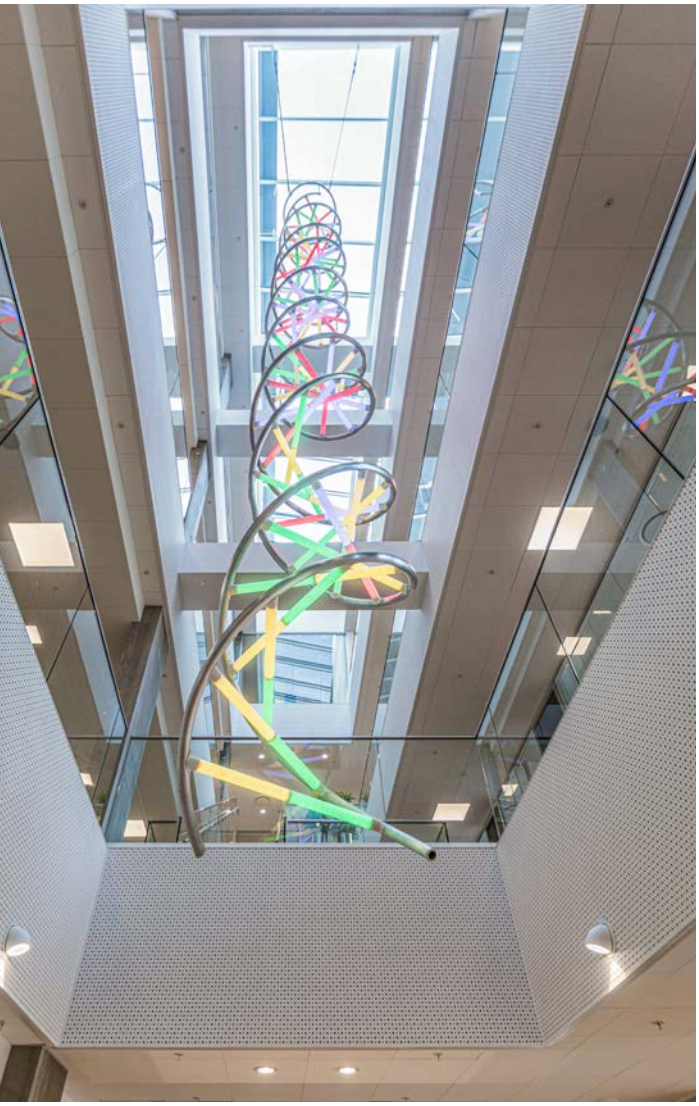
Ann Dorrit Enevoldsen, Pre-Pilot Plant Manager

We are the stepping stone to commercialize new technology

Our Pre-Pilot Plant works with all aspects of bio-processes from cell performance optimization, best-practice fermentation strategies, scale-up and -down, as well as in-process control analytics, separation and purification. All this in our quest to bring exciting new technology to the next stage.

Compliance, confidentiality, operational health and work safety are key principles to our operations. At the Pre-Pilot Plant, we work with data security, locked and restricted access laboratories, as well as data and material storage. We are also firewalling our projects on high standards towards other collaborations, students or researchers. Your strains, documents and data are handled separately and securely from other center operations, as we have implemented industrial standards.

Over the past years, DTU Biosustain has accomplished various projects and developments with its multi-purpose pilot facility – three of these scale-up stories are presented here.



Cysbio

Amino acids via fermentation

Serine is a non-essential amino acid that has wide and expanding applications in industry with a fast-growing market demand. The most common processes for serine production are extraction and enzymatic catalysis. Such approaches limit the industrial-scale applications of this important amino acid. Therefore, the process of direct fermentation holds great promise for the industrial-scale production of serine and has received increasing attention in recent years.

Project objectives: To develop an induction system free lead strain and fermentation process to achieve commercially acceptable titer.

Key accomplishments: Two lead-producing strains, high double-digit titer, optimized media, advanced analytics and more.

"Support from the Pre-Pilot Plant was instrumental to scale the process and deliver the results required to obtain the first investments into Cysbio and to commercialize the process."

Henrik Meyer, CEO, Cysbio ApS

Conarium Bioworks

Human melatonin

Melatonin is the natural hormone released by the pineal gland in humans that controls the sleep-wake cycle. Conarium Bioworks is behind the first fully integrated bioprocess development from the cell-factory to the product and the design of an economically feasible bio-based process applicable to large-scale operations.

Project objectives: Demonstration of the close collaboration between strain engineering, fermentation, downstream process, in-process control analytics and the sustainable innovation office at DTU Biosustain. Complete involvement in process optimization and scale-up to make the product. Further, launching a successful start-up based on *E. coli* hosting the human hormone expression pathway as a cell factory and its integrated bioprocess.

Key accomplishments: Several high-performing lead-producing strains, scalable robust process, pharma-grade product purity, competitive product specification.

"Based on the solid and robust lead strains and downstream process developed by DTU Biosustain, Conarium was able to quickly move towards scale-up of the process and focus on commercialization of bio-manufactured melatonin."

Steen Nissen, CEO, Conarium Bioworks Inc.

EvodiaBio

Aromatic innovation in beer

Fermentation-based natural and environmentally friendly aromas for the beverage industry. Particularly non-alcoholic beer struggles with taste experiences for consumers – certain key aromatic compounds produced in yeast, using fermentation, provide a superior, consistent brewing product. One of these aromatic compounds is called monoterpene.

Project objectives: Scale-up of the production of monoterpene from laboratory to pre-pilot scale.

Key accomplishments: Successful technology transfer with scale-down followed by scale-up of the cultivation. Advanced analytical method. Downstream with high recovery achieved.

"Thanks to a smooth technology transfer between EvodiaBio and DTU Biosustain, we were able to identify key parameters for our process optimization and successfully demonstrate its scalability to pre-pilot scale and thus validating the feasibility of our approach."

Simon Dusséaux, CSO, EvodiaBio ApS

"There is an innovative atmosphere and a "can-do" attitude, which makes PPP a fun and inspiring place to work - I have helpful and skilled colleagues that are committed to solving the various scientific and practical issues we may face during a project. "

Ann Dorrit Enevoldsen, Pre-Pilot Plant Manager

Technology for people – and the people behind it all

At DTU Biosustain, we enable innovation and problem-solving by bringing together people of diverse backgrounds and skillsets. We offer a truly interdisciplinary and interconnected environment and are of the stalwart belief that the facility is only as good as the people working in it. We strengthen our teams by embracing our differences as we aim to find the solutions of the future.

Nemeh Bani Odeh
Analytical Chemist

What lead you to DTU?
"In March 2020, PPP needed an Analytical Chemistry Technician to support the analytical team, which was a good opportunity for me. I applied for the job and since then I have worked there and developed a lot."

What drives and motivates you?
"As an Analytical Chemist, a lot of troubleshooting is required when working with analytical instruments, e.g. High-Performance Liquid Chromatography (HPLC). Troubleshooting is not an easy undertaking, and these kind of challenges motivate me a lot. Besides that, responsibility and supporting the rest of the team is also something that drives me to work more efficiently."

What is the most fascinating thing about working at the PPP?
"The environmental atmosphere is one of the most fascinating thing about PPP for me. I have very nice and helpful colleagues, and we work together as one group despite our vastly different backgrounds. Working at PPP also gives me the opportunity to develop and constantly experience new knowledge."

Gossa Wordofa
Lead Scientist – Biochemistry

What lead you to DTU?
"Its multi-disciplinary research and world-class facilities that allows you to learn and apply knowledge and skills to solve real-life problems."

What drives and motivates you?
"I get motivated by challenges, so I enjoy working in a creative environment where I'm able to think openly. This allows me to use my creativity, which keeps me motivated and energized."

What is the most fascinating thing about working at the PPP?
"The most fascinating thing about working at the PPP is getting the chance to work with innovative and diverse people around the world to bring research ideas to the market."

"In PPP we have the solution, that will elevate the entire industry to a new level."

René Thrane, Pilot Plant Technician

We are constantly looking for interesting collaborations and new talent to join us in our work to accelerate the green transition and support sustainable lifestyles. Feel free to reach out with any questions and ideas!

Dr. Andreas Worberg, Chief Commercial Officer

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