



Newsletter no. 14 | November 2024  
Climate Challenge Laboratory | Building 313

# Liquid Sun

Theme: Art and Knowledge sharing

DTU Campus Service  
The Technical University of Denmark

# Liquid Sun

In B313, also called the Climate Challenge Laboratory, microbiologists, electrochemists, robot researchers, and physicists are developing the cross-disciplinary collaborative culture that is key to creating research breakthroughs. In the common areas, contemporary art and research communication shall stimulate researchers to gain new insights and ideas.

The researchers have moved into B313, where they are developing new Power-to-X technologies—also known as “Liquid Sun”. The goal is to create an interdisciplinary research environment where researchers can spontaneously engage and inspire each other. Therefore, they are exhibiting their research in the kitchenettes and hallways. This gives insight into the activities taking place in the laboratories and offices, while the interior design of the common areas facilitates collaboration, knowledge sharing, and exchange of methods and ideas among researchers. This is supported by the transdisciplinary pioneer center, CAPeX, which connects all the research centers in the building through various collaborations and activities. Art has also moved in. The internationally renowned Danish artist Tue Greenfort has created four sitespecific artworks that emphasize the sun as the most important energy source. In the lobby, the artwork *Huset Brænder* (*The House is Burning*) reminds researchers that time is short, while two artworks in the atrium, *Helios* and *Photosynthesis*, place the sun at the center, connecting the macroscale of the universe with microscopic bacteria. The fourth artwork, *Climate Zones*, integrates

interior planting, where plants and trees are selected according to a vertical climate-zone index from temperate to tropical.

In this last newsletter about B313, you will meet the director of CAPeX, Professor Tejs Vegge, and artist Tue Greenfort. They share their perspectives on how art and ethics can inspire researchers to develop new models for understanding the climate challenges and energy – and, in doing so, make groundbreaking discoveries.

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– Tue Greenfort, Artist

## A Source of Inspiration

*What is the intention behind Helios and Photosynthesis?*

Tue Greenfort (TG): Both artworks emphasize that we already have a sustainable energy source outside: the sun. The sun itself represents energy, and the idea for *Helios* occurred when I was researching and encountered Solvognen (*The Sun Chariot*, ed.). The disk is an image of the sun. It has a classic mosaic on its surface, whose pattern reflects the chaotic and fierce processes occurring in the sun. The mosaic is constructed based on a Voronoi diagram, where each part of the pattern is different from the next. The disk rotates around its axis with speed and brightness controlled by the light intensity outside, creating a kind of 1:1 representation of the conditions outside. I created the disk in *Helios* from recycled ceramic-glass, a material consisting of worn-out solar panels. This choice of material adds



The internationally recognized Danish visual artist Tue Greenfort has created four works that bring new perspectives to the research taking place in B313. Tejs Vegge, professor and head of the pioneering center CAPeX, is a central figure in developing a collaborative culture where researchers share knowledge and inspire each other. Photo: Tue Greenfort/DTU

“We aim to develop a mindset where we find common ground despite our different scientific approaches. We need to create a shared language. This requires us to step beyond the ordinary and see the world in a new way – which art can inspire.”

– Tejs Vegge, Professor and Head of CAPeX

an additional layer of meaning, emphasizing the attitude towards sustainability. There is a lot of sun in *Helios*, both materially and technologically. *Photosynthesis* is an artwork that links the vast scale of the sun’s energy with the microscopic world of bacteria. I was inspired by cyanobacteria that can convert sunlight into energy through photosynthesis, as well as by the photochemical process, which can inspire researchers in the Climate Challenge Laboratory. *Photosynthesis* is created from recycled plastic, partly collected at DTU through the CAS Sustainability program. We 3D-printed the sculpture with a pattern resembling the structural designs of living organisms. This additive technology allows the pattern to build upon itself, becoming self-supporting. We built 80 cells across 80 modules, resulting in a structure that is 27 meters long.

Many cyanobacteria have a kind of tube containing chlorophyll, where photosynthesis occurs. We recreated that tube by weaving optical fibers into a net that holds the cells together.

*Tejs, how are the two artworks related to what you do at CAPeX?*

Tejs Vegge (TV): When we talk about sustainable energy, it’s difficult to imagine anything more universal and consistent than the sun. At CAPeX, we work on providing scalable, sustainable solutions for the future. We look to nature to find many of our solutions, drawing inspiration from the abilities of bacteria and enzymes to convert gases into chemicals – for example, turning CO<sub>2</sub> into formate and methanol, which can be used to fuel ships, or converting nitrogen into ammonia, which can be used as fertilizer.

In this way, the two artworks are a fantastic source of inspiration because they point to the universal scale and demonstrate the connection between the inorganic (such as the recycled solar panels) and the organic, where we need to find scalable solutions. They inspire individual researchers who work on specific tasks and also encourage interdisciplinary collaboration. The building itself really fosters this, both in its design and in how it brings together diverse research groups.



**Helios.** The kinetic light work *Helios* is a two-meter luminous disc made from glass ceramics – a material produced from repurposed solar cells and shaped to resemble a sustainable energy source: the sun. The disc lights up and rotates according to sunlight intensity, following the course of the day. Artist: Tue Greenfort. Photo: Anders Sune Berg



**Photosynthesis.** The 27-meter-long light work *Photosynthesis* winds down five stories, illuminated by optical fibers. *Photosynthesis* is constructed from 80 3D-printed modules in recycled plastic, designed using an additive technique inspired by microorganisms' building patterns. Artist: Tue Greenfort. Photo: Anders Sune Berg

## Interdisciplinarity as a Means of Innovation

*Now that you mention interdisciplinarity, is it correct to understand that CAPeX is intended to help create an interdisciplinary culture?*

TV: Yes, that is indeed a primary goal. We cannot fulfill our vision if we don't achieve that. CAPeX was established as a transdisciplinary pioneering center and has, from the beginning, invited research groups from DTU, other Danish universities, and even internationally. It often happens that a guest researcher from another floor joins us, or we interact with them. We can only succeed if we have the strongest integration across the center – from VISION in the basement to CatTheory on the fifth floor.

Our laboratory is also transdisciplinary, with molecular microbiology at one end, self-driving robots at the other, and surface physics and electrochemistry in the same space. In the basement, using VISION's electron microscope, we can observe how organic molecules interact with the solids designed by CAPeX and gain completely new insights into the interaction between the organic and inorganic. We are integrated with all the centers in the building and the design of the building supports this integration.

In the center of our office, we have an idea room with tables that you can draw on. I want to leverage the interaction between microbiologists, electrochemists, theorists, and robot builders so they come here and create spontaneous drawings. Additionally, the common areas are designed to be open and integrative across floors. For example, the coffee machines are only on the odd-numbered floors, encouraging people to move up or down during the day. On the 5th floor, we have facilities for smaller presentations and house meetings in the kitchenette. While we haven't fully utilized this space yet, everyone goes up to the 5th floor because the view is spectacular. You can see the Marble Church.

*Tue, in your initial project proposal, you presented an idea for the Science Club on the 5th floor. What was the idea behind that?*

TG: I thought it would be ideal to create a platform for interdisciplinary thinking and conversation—much like what Tejs and his colleagues do, but in a more playful, theoretical way. For example, we could conduct mind games where we imagine ourselves 10 years in the future and look back at selected technologies. You could try to take on a different perspective, perhaps as a different scientist or in a different field, to stimulate creative thinking.



**Collaboration.** CAPeX is a transdisciplinary pioneering center focused on delivering scalable, sustainable solutions for the future. The center has facilities on the third floor of B313 and is professionally connected to other centers within the building. The image shows the idea room. Photo: Tyra Dokkedahl



**The House is Burning & Climate Zones.** In the lobby, Huset Brænder (The House is Burning) references the destructive power of the sun and the increasing frequency of forest fires worldwide. The charred wood in this piece may remind viewers of pyrolysis, an ancient technology now considered a potential solution to climate challenges. The work and its title underscore the urgency of the research mission in B313: addressing global warming and the pressing need to avert future disasters, especially for the younger generations and those to come.

Climate Zones is a commentary on the concept of "greening," with plants and trees chosen for B313 arranged according to a vertical climate zone index—from temperate to tropical. These plants and woods in the building symbolize their respective habitats and climate zones, highlighting a global biosphere in the midst of rapid transformation. Photo: DTU

TV: That would be incredible, and the space itself really encourages it. Many different people already visit from outside, most recently, science journalists and bankers, so it makes sense to bring together diverse perspectives, both from outside and from research groups here at DTU. It's a way to introduce new ideas, drawing on history, other sciences, or the arts. It could be a place where we can think in broader, more open-ended ways.

*How can researchers benefit from the reflection that art provides?*

TV: We aim to develop a mindset where we find common ground despite our different scientific approaches to a problem. We need to create a shared language. It might sound "geeky," but we work on developing common languages to enable us to share ideas, for instance, using artificial intelligence to search across fields and inspire one another. This requires us to step beyond the ordinary and see the world in a new way, something that art can really inspire.

There's also an ethical aspect. Many of the technological solutions we hope to develop here could potentially be used for dual purposes. What might that mean? What are the potential consequences? Art can inspire us to engage in these discussions. The works in the building already contribute to this. When I enter the lobby, I'm reminded of the urgency of the climate crisis, embodied in the ground-floor piece *Huset Brænder* (*The House is Burning*).

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**Cutting back on energy use seems like an obvious solution, yet, paradoxically, we keep using more."**

– Tue Greenfort, Artist

### **Beauty, Truth and Morality**

*The artworks relate to the sun as a natural phenomenon that we can experience and sense. How do they interact with the technical scientific approach to nature?*

TG: In my work, I question the romanticized understanding of nature, which influences much of what we do in Western societies. The concept of nature is not neutral but ideologically rooted, so we can discuss it from different angles and reach different conclusions. Much of the science we rely on has emerged from accidents, coincidences, or fundamental research, so perhaps we could think about research in a fundamentally different way than we do today. I'm not an advocate of the Gaia model, but it offers a holistic idea that there is a biosphere and biodiversity that we, as humans, are fundamentally connected to. This model has been



Tue Greenfort watches *Helios*. Foto: Tyra Dokkedahl

criticized because we often prefer to analyze things in isolation, driven by the idea that we are superior beings who can think our way out of problems and devise solutions. What interests me is inspiring people to think in a more refined and interconnected way.

Science faces challenges in this area, too. We have become modern, yet we don't act like it. We've become highly specialized, and huge breakthroughs have occurred, like AI and robotics, but we don't fully grasp the energy we consume. It's unsustainable. Cutting back on energy use seems like an obvious solution, yet, paradoxically, we keep using more. Many inventions in sustainable energy are also not suited to a large scale; they can't yet replace fossil energy on the scale required. So, how do we deal with this? We need a new way to approach our energy use. We must rethink some of our assumptions and change how we've learned to live.

#### ART AT DTU

DTU integrates art on the DTU Lyngby Campus to create dynamic, attractive study and learning environments with a strong professional identity and an open campus that invites the broader community into its fascinating technical universe.

For DTU's founder H.C. Ørsted, art and science were deeply interconnected. In his worldview, truth could be understood through natural science, art, and poetry. Today, idea-based contemporary art, in addition to offering immediate sensory experiences, also serves to question established understandings. Both intuitively and intellectually, art can inspire researchers with fresh perspectives on scientific practice, thought, and method.

The vision for the art program, *Art, Nature & Technology - Art Program for DTU Lyngby Campus*, is for art and science to mutually inspire one another, challenging our perspectives on people, nature, and technology and providing new insights into the future we face. The art program, developed by Empathic Environments by Stenka Hellfach & Tyra Dokkedahl, also includes their consultation with Campus Service on the art installations in B313. The art works for B313 is donated by the New Carlsberg Foundation. They will be inaugurated 20 November 2024.

**"We need to deliver solutions that are scalable globally. Many of these solutions will involve scaling down energy-intensive processes and ensuring that they are implemented locally to minimize energy lost in transportation."**

– Tejs Vegge, professor and Head of CAPeX

TV: This approach also describes what we aim to achieve in the pioneer center. On the material side, we must ensure that our technologies respect planetary boundaries. This can be done by recycling materials or by using resources that are abundant worldwide, so that the resulting technologies can be scaled sustainably. This mindset is embedded in our work, which is why we're called CAPeX with a lowercase "e." The lowercase "e" represents a sustainable electron.

The first three thesis students we've had at CAPeX all graduated with a top grade of 12. One of the things they focus on is creating affordable, scalable solutions inspired by the advanced research equipment we have here. For instance, they might design a self-driving lab that costs a fraction of traditional labs, or ensure that universities with fewer resources than DTU can access research equipment so their students' ideas can contribute to finding globally scalable solutions.

*You mentioned the ethical aspect. Could you envision involving an ethicist, perhaps a historian of ideas or a theologian, to bring new perspectives to the technical scientific approach? Maybe through a study group where you explore different conceptual models and view things in a broader context?*

TV: Yes. We already collaborate with Mette Birkedal Brun, who heads the transdisciplinary basic research center at Kirkehistoriebladet. She helps ensure diversity in our students and in the richness of ideas they bring in.

TG: It could be fascinating to introduce ways of thinking that students may not have connected to their own fields. And also to empower them, so they aren't just passive students moving toward a degree but rather co-creators of the university community. After all, universities have certain traditions. We shouldn't be afraid of those; we should open up to them. It may be challenging, but the university should embrace that challenge and live up to its responsibility for self-reflection.

# Sharing knowledge in common areas

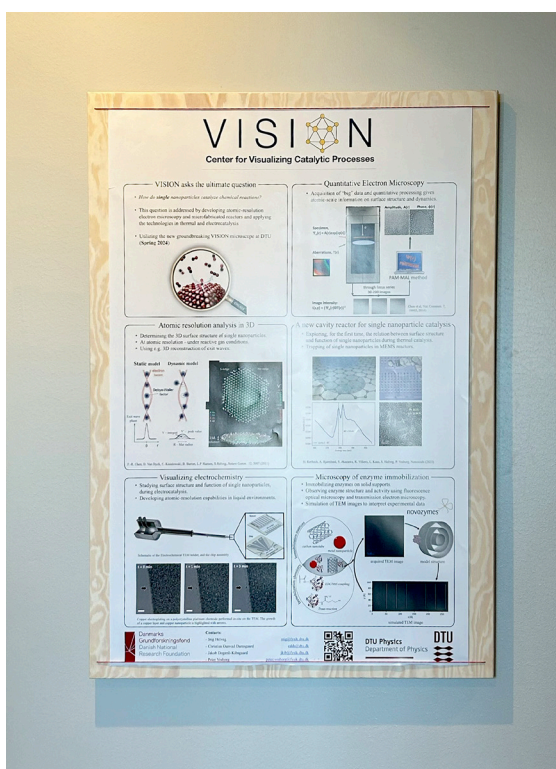
Serendipity is the guiding principle in the design and interior of B313. The goal is for researchers across physics, chemistry, and microbiology to inspire each other, exploring new ideas, testing novel methods, and developing technologies that could become sustainable energy technologies.

To facilitate this, Campus Service has developed spaces for knowledge sharing in the building's common areas. Small exhibitions introduce each of the eight centers, while recent research can be showcased in corridor spaces. Five information screens present the researchers' work through short films, PowerPoints, and text. These screens are connected to a program, LiveConnect, enabling the individual centers to exchange content continuously and keep each other updated on news and recent research.

The dissemination project was developed by Tyra Dokkedahl. The fourteen newsletters, of which this is the last, contribute to the knowledge sharing initiative that explores how Campus Service can sustainably construct a laboratory for climate research, supporting DTU's goal of promoting sustainable change in society.



**Info screens.** Five information screens are installed in B313's common areas, where researchers can share knowledge and updates. For now, a video introduces the eight centers and provides insight into the ideas behind the building's design and layout. Photo: Tyra Dokkedahl



**Introductions.** Eight research centers are moving into B313, creating a network for sharing knowledge and mutual inspiration. Each floor hosts small exhibitions introducing these centers and the newest research, and in October 2024, a number of prototypes were installed. Photo: DTU