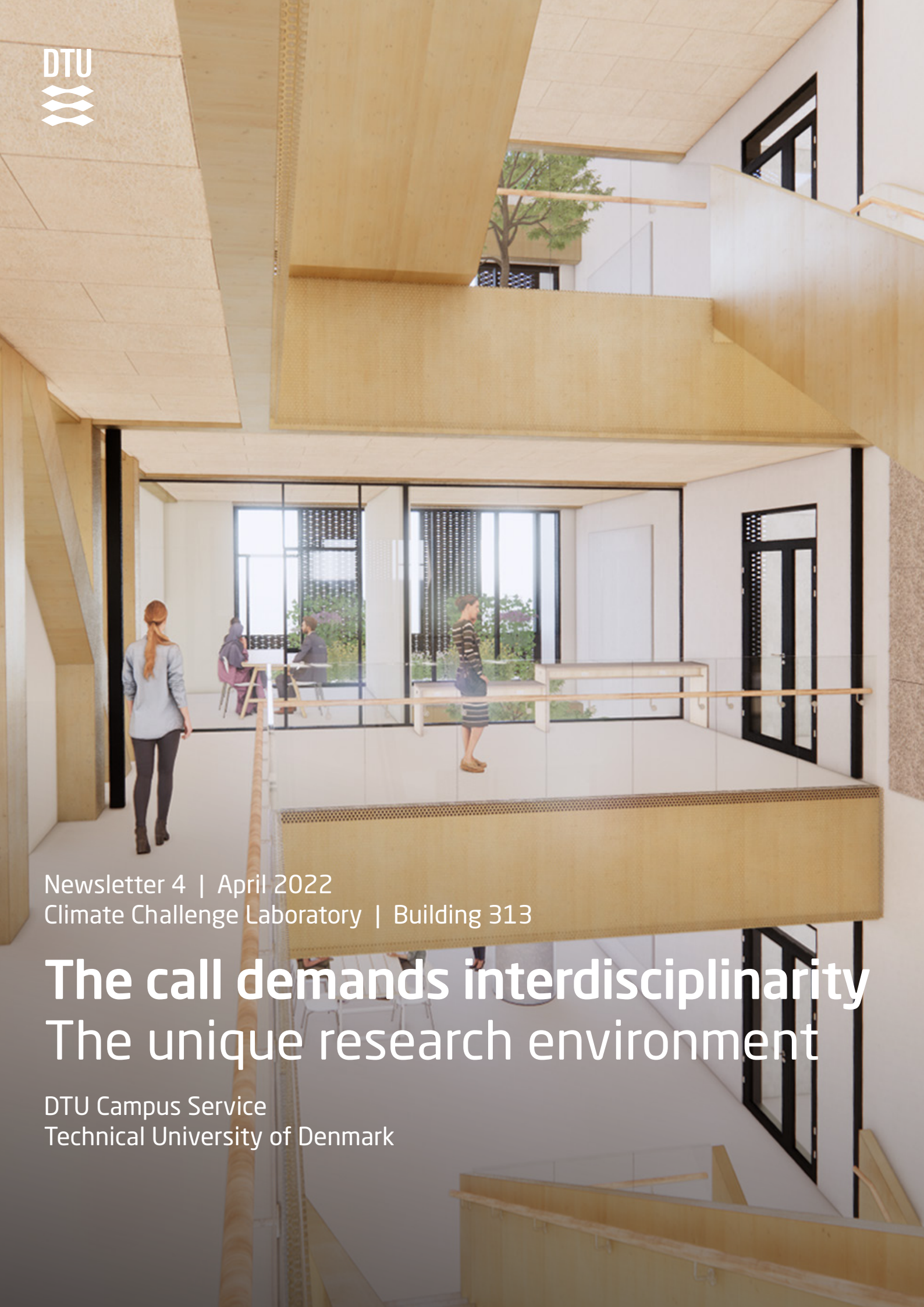


Newsletter 4 | April 2022
Climate Challenge Laboratory | Building 313

# The call demands interdisciplinarity
# The unique research environment

DTU Campus Service
Technical University of Denmark

# The call demands interdisciplinarity

## Physicists, chemists, energy engineers and biologists will exchange ideas, methods, and thoughts in the Climate Challenge Laboratory. Two top scientists are counting on an electron microscope and images of atoms to help create an environment where scientists get inspired and collaborate across professions to find new solutions to today's great challenge, climate change.

"It is in the interfaces and refractions between the disciplines that many of the great discoveries will happen," said Rasmus Larsen, DTU Executive Vice President, in the previous newsletter. That is why DTU is designing and constructing the Climate Challenge Laboratory (CCL) as the framework for an interdisciplinary research environment within sustainable energy technology.
In this newsletter, you will meet two top researchers who have helped DTU Campus Service in the design process. Jane Hvolbæk Nielsen, Professor and Head of Department of DTU Physics, has contributed with ideas, experiences, and requests for what the best generic research building could be. Professor of Physics Stig Helveg has given ideas on the structure of the Basic Research Center VISION's special laboratory and the environment around it.
In this newsletter, they talk about their expectations for what the Heart Room, the electron microscope, and images of nanoparticles can do for the founding of a unique research environment. An environment where researchers exchange knowledge, methods, and experiences across disciplines – and hopefully make new discoveries and realizations that pave the way for technological breakthroughs in the future.
At the end of the newsletter, there is information on when there will be noisy construction activities, a status on the construction project, and contact information.

Jane Hvolbæk Nielsen (left), Professor of Physics and Head of Department at DTU Physics, has provided DTU CAS with insights in the design process as part of an interdisciplinary research group. Stig Helveg (right) is a Professor of Physics and Head of the Center of Excellence VISION, which will be moving into the Climate Challenge Laboratory. Photo: DTU

**A building after the scientist's mind**
Uniquely, the Climate Challenge Laboratory is designed and built around a theme, climate change, as the framework for interdisciplinary research collaboration. It aligns with the researcher's methods and thinking, which typically involves working across professional as well as geographical borders.

*CCL is not linked to a specific department but is built for interdisciplinary research collaborations. What potentials do you think this offers?*
JHN: For researchers, it is quite natural to think across disciplines and departments. We look for inspiration internationally, for example at conferences, and we are used to thinking in terms of competencies and collaborators to solve concrete problems. So, in our method, we already work across borders. That's why, in this laboratory, it makes sense for us to think across disciplines and ask, "what physical surroundings do we need in order to solve this challenge we're facing?" In this case, a very big challenge.

SH: The questions that scientists are looking for answers to and that we need to solve as a society are so complex that several disciplines and departments are involved. To solve the puzzle, we need intersections where we meet and talk to each other. We must create tension fields where we researchers find inspiration, are challenged in our knowledge, or see an opportunity to contribute in a different way than we could imagine. This helps develop our own research.

*Can it be said that CCL is designed according to the researchers' method?*
JHN: Yes, that's very apt. That's what we and Campus Service are trying to create. We need excellent laboratories. We need seminar rooms where we can meet and tell each other what's going on – and we need coffee makers. Just like at the conference. It's during the breaks – when you're having coffee – that you meet and get ideas from someone with a slightly different professional background.
The building is even designed so that the spaces for spontaneous meetings are located where the light comes in. It's pretty amazing – almost symbolic. When you look at the building now, you can understand exactly what we're doing. This is very much in line with the method that we researchers have been using for many years. It's going to seem completely natural.

SH: It's like a physical manifestation of interdisciplinarity. It's easy enough to say that you work across disciplines, but where do you see it? In the building, it is clearly in the Heart Room that theory and experiment meet and different disciplines come into play.

The Heart Room connects the Climate Challenge Laboratory's office part and laboratory part. Each floor has a kitchenette from which there is a view to the green façade as well as the knowledge sharing rooms, ad-hoc spaces, and the other floors, so it becomes a natural meeting place for the users. Illustration: Christensen and Co Architects

*How will VISION contribute to creating an interdisciplinary research environment in CCL?*
SH: VISION is getting a new type of electron microscope, which is one-of-a-kind and can take images at atomic level and uncover how nanoparticles catalyze chemical reactions. However, the microscope is exceptionally sensitive to its surroundings. Usually, you would place such a laboratory in an isolated building, preferably far away where it is quiet and calm. But we will benefit more from the microscope if we place it in an active research environment. If we create complementary activities around VISION, we get a strong tension field. This is when we develop new knowledge. This is an experience, that I draw from my 20 years at Topsoe.

JHN: Yes. Recently, I thought about how the microscope you had at Topsoe was right next to the canteen. It's not the ideal place because people walk by and make noise – but it was the best place it's ever been, because everyone stopped by. It was really in the heart of it.

SH: That's true. It made everyone with an interest in research take ownership and have a greater understanding of what the facility can be used for and how it is a part of the food chain. The way I see it, this is critical to our success. It's easy to make some nice images, but having the microscope make a difference in science, in research – for that, we need some people to bring that knowledge with them – they need to take ownership. And they won't if it's something they merely visit once in a while.

JHN: I also think that the location of the lab is a good compromise. The laboratory should be in a calm area, which is why it's in the basement in the corner of the building, but it's not isolated. The microscope facility is at the bottom of the Heart Room staircase with access to the garden. You won't feel like you're in the basement, because you're level with the green garden space. It's the art of the possible. You want to be in a quiet place far away from everything and, at the same time, you want life around you and to be in the middle of it all. This was solved nicely in the building.

**Images everyone understands**
Catalysis, which is the science and technology to control chemical reaction rates, is the key to producing sustainable chemicals, fuel, and energy. With the electron microscope, VISION can visualize the catalytic materials and processes as they are taking place at an atomic level in 3D. Besides this the facility can also benefit the research of other physicists, chemists, and biologists.

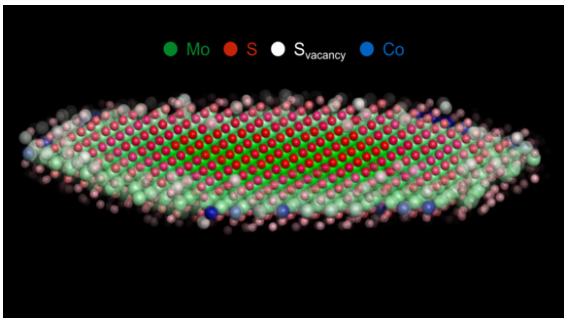
*DTU aim to make results that will create a paradigm shift in the green transition. What expectations do you have for the results you can achieve with the CCL?*
JHN: There are many levels to it. The expectation is that some significant contributions will be made that make a difference in the green transition. Usually, it takes many years from a research breakthrough until it matures, becomes technology, and gets industrial value, but within VISION's field, there may be a shorter way to technological breakthrough. It is the hope

for our field that there will be significant breakthroughs on the catalyst front.

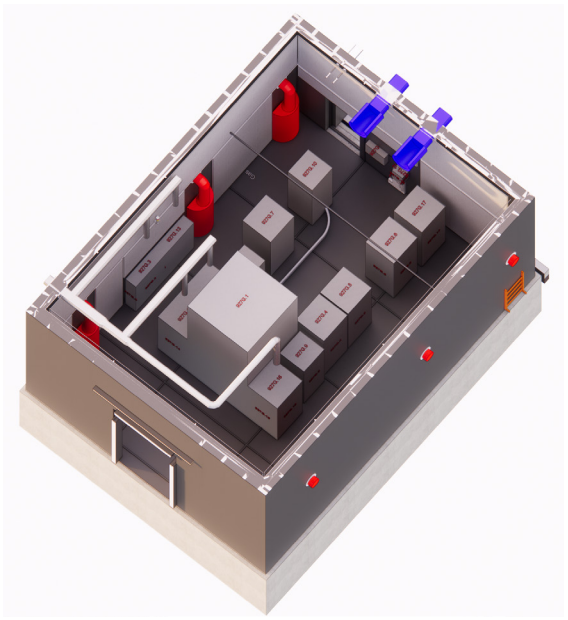
SH: It's inherently hard to predict what will come out of the research. But experimenting within relevant issues and creating these tension fields is the only sure way to get a deeper understanding and new ideas.

*Which disciplines and/or research fields are particularly interesting for VISION to interact with?*
SH: VISION's work is a natural extension of SURFCAT's (one of DTU Physics' research departments, ed.) activities. Here, the catalytic properties of nanoparticles and surfaces are investigated at an atomic level with other techniques. You can regard VISION's research as an extension of that field of research.
If we look at the electron microscope alone, it can appeal to many researchers at DTU with an interest in the structure and dynamic behavior of materials on the atomic level. In this regard, the microscope can do something, which is otherwise unavailable to us. The instrument is the extreme of what technology can do today. It is in the very front. What you get here is 'pole position'.

JHN: It can be relevant to physics, chemistry, materials, chemical engineering – and even biology and life science.
Occasionally, we (physicists, red.) must let ourselves be inspired by the solutions that nature has developed. Life science and biology have processes such as photosynthesis at room temperature and normal pressure conditions, while in the industry you run processes under very expensive conditions – high pressure, high temperature.
It's almost 20 years ago that Professor Jens Nørskov (Head of the Center for Theoretical Catalysis, ed.) was inspired by how the natural enzyme, nitrogenase, works. Jens Nørskov, whose field is theoretical catalysis, investigated how the biological catalysts and enzymes work. In this work, knowledge from biology was used. You would read other journals, go to other conferences, and get PhD students with a different professional background. From this, there came a field of research on metal sulfides and metal nitrides, which did not exist in the industry.
We shall inspire ourselves to try new methods, and nature has different solutions for materials than the physics engineer usually has. Therefore, we are also establishing laboratories for microbiology. Whether this succeeds in the house, we'll see.




Three-dimensional, atomically dissolved image of a catalytic Co-Mo-S nanocrystal. Atomic positions and types are indicated by the colored balls. The image was published in the journal Nature Communications 12, 5007 (2021). Foto: VISION



In the basement, VISION will get a special laboratory with a new electron microscope. The space is located strategically after requirements for vibrations, electromagnetic fields, temperature stability, noise, and proximity requirements for 3DIM in B310. Illustration: Christensen and Co Architects

SH: There is a world of difference between biologists' and physicists' terms, language, and forms of work, but it is in this difference that it gets interesting – in the fields of tension. Just like the conferences out in the city, where the focus is not on whether you are a physicist or a chemist, but on the scientific issues. These are places where you expand your mindset with new ideas that you might not have had otherwise.

JHN: VISION can also inspire other researchers, as their research with the microscope is visual, and images can do something when interacting with humans. This has always been the strength of microscopes – that their output can set some thoughts in motion.
Biologists are crazy about images. It's beautiful to look into a subcellular world – and even though Stig's work starts in a place that is much smaller, you will meet on some level and talk about where the reaction and the chemical processes take place. This is really the image that both VISION and life science researchers are trying to bring out – for VISION at an atomic level and for biologists at a molecular level.

**The call unites scientists**

*VISION and other research groups need to collaborate and interact with each other in the everyday. How will they fall into conversation?*

JHN: I think it's more a matter of avoiding too much conversation in the Heart Room. When moving up and down and across in the building, you are met by these areas and spaces where you are exposed to inspiration. We need to figure out how to organize it, but the setting for dwelling is certainly there.
Here, the images from VISION also play a part. They should be allowed to seep up from the basement. We need to have images of what's going on up on the wall. If we want to make it vibrant, it almost needs to be real-time. Here, the microscope will be able to contribute with incredibly inspiring images that we can use in the building.

*Is there anything besides the physical setting that is important for creating this research environment?*

JHN: It requires that researchers have an interest in going into the field of tension, into the meeting with a different discipline than the one they have mastered. It's a necessity for it to succeed, yet I'm not really worried about it, whether it will happen. The green transition is such a big and important issue. The motivation for collaborating lies in buying into the challenge – believing that it is meaningful. When you have a calling or you see a meaningful challenge, I think you dare to expose yourself more. You dare more when you think it is important that you reach the goal.

SH: When I think back to my time at Topsoe, it was exactly 'the call' that I and other colleagues were there for. It wasn't just because you thought that electron microscopy and scientific work at the highest level was interesting, it was also something else. There was a higher meaning that drove people – and so does working with the green transition. Scientists choose that field because they want to make a footprint on the world – they want something meaningful.

*In addition to VISION and CATTHEORY, E-MAT is moving in. E-MAT will also reach out to researchers from different disciplines, as I understand it?*

JHN: Yes, E-MAT is a Danish publicly funded infrastructure that makes itself available for collaborations. E-MAT will also invite in, show off its work in the Heart Room to and inspire visitors. When entering the building, you need to see opportunities. It's important that all researchers, students, and other users also want to be inspired and spend time on the dialogue, curiosity, and "not understanding".
We must cherish dwelling. This is very important for the university culture. As a physicist, it's important that you dare say that you don't understand the biologist – and that you are then willing to learn and understand. It takes courage, curiosity, and a common goal of making a difference.
It is also a very DTU-like approach. It's so meaningful that we have our old purpose and vision of being a benefit to society. Now we have identified the climate challenge – and the building can be a catalyst to solving some of our problems within sustainability.

E-MAT's facilities and instruments are unique in Northern Europe. The goal is to develop a state-of-the-art research center with users from all over the world, from both industry and academia. E-MAT will get a specialist laboratory on the ground floor. With an open façade and direct access to the Heart Room's common areas, it is expected that E-MAT's activities will inspire to conversations and meetings across research fields. Illustration: Christensen and Co Architects

# Who will use the building?

Climate Challenge Laboratory's laboratories and office areas can be used by researchers from different fields, particularly physics, chemistry, energy and microbiology.
Moreover will three research centres move in and contribute to establishing a unique research enviroment through own research and interdisciplinary collaborations.

## VISION

The Center for Visualizing Catalytic Processes is led by Professor of Physics Stig Helveg.

VISION aims to create scientific breakthroughs within thermal catalysis and electrocatalysis

In the lower floor of the building, VISION will have a special laboratory. It will have a completely new type of electron microscope whch can visualize chemical processes as they take place.

## CATTHEORY

Catalysis Theory Center is a research center led by physicist Jens Kehlet Nørskov, who is a Villum Kann Rasmussen Professor.

CATTHEORY strives to build a theory of hete-rogeneous catalysis for a broad spectrum of catalysts, including both thermal catalysts and electrocatalysts.

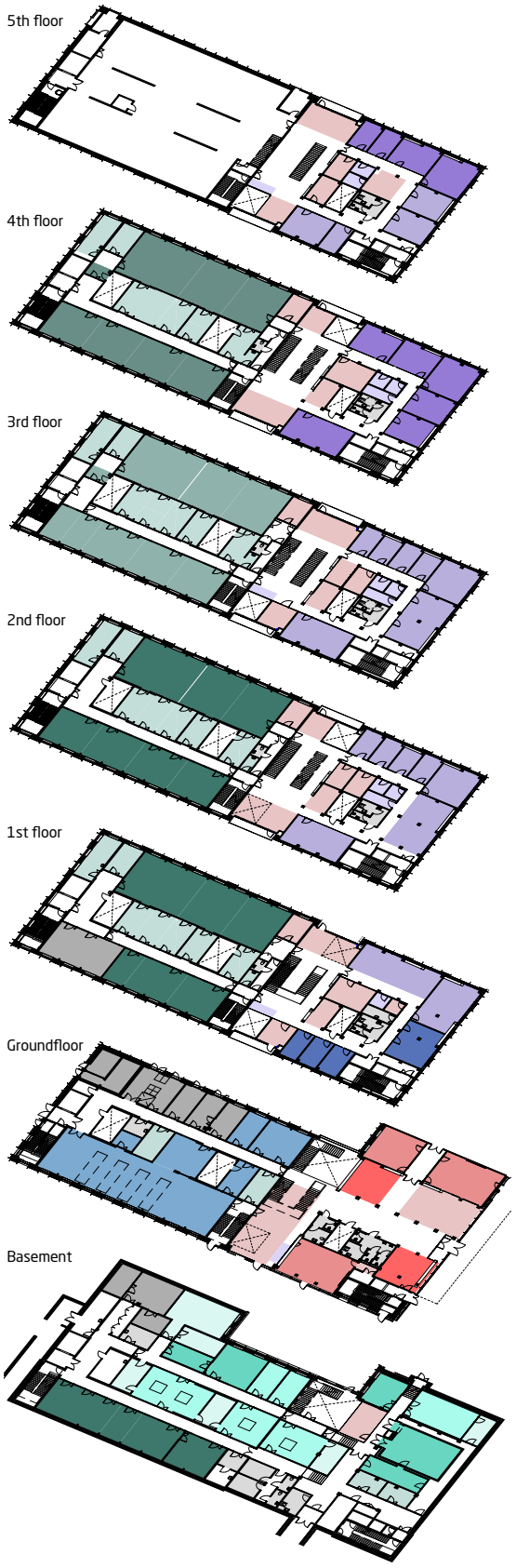
CATTHEORY is moving into the office part on the 4th and 5th floor.

## E-MAT

In 2020, DTU received a grant of 33 million DKK from the National Committee for Research Infra-structure for the creation of E-MAT for research into new functional energy materials focused on energy conversion and energy storage.

E-MAT is a national facility anchored in DTU Energy. SDU, KU, AU and a number of industry partners participate in the consortium.

E-MAT will get a special laboratory on the ground floor as well as offices on the 1st floor.




The three research infra-structures VISION, E-MAT, and CATTHEORY are mov-ing into the Climate Chal-lenge Laboratory, which will have seven active floors and one technical floor (6th floor). On the ground floor, there is a seminar room, a canteen, and an informal study environment. Illustration: Christensen and Co Archi-tects/Tyra Dokkedahl

# Basic information

**Construction work**
The project has obtained a building permit. Work on casting the foundation is being carried out at the construction site now. This results in increased traffic from the cars delivering concrete to the construction site. The next thing that happens on the site is that the contractor establishes sewers and drains.

**Status on the project**
The consultants will hand over the implementation plans for review by contractors and the client in early May. The next step is for DTU CAS to approve the plans, that the building will be built after, and for the main contractor to submit the final proposition just before the summer holidays.

**Contact information, DTU CAS' project team**
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**Time schedule**

| Winter 2020/2021 | Spring 2021 | Late summer 2021 | Autumn 2021 | Winter 2021/2022 | Spring 2022 | Summer 2024 |
|---|---|---|---|---|---|---|
| Project Start-Up | Program | Outline proposal | Project proposal | Execution project | Construction on site | Users move-in |

**Byggeplads**