Newsletter 6 | November 2022
Climate Challenge Laboratory | Building 313

A building with the optimal energy solutions

Theme: Process energy and heating

DTU Campus Service
The Technical Univesity of Denmark

A building with the optimal energy solutions

DTU expects to significantly reduce the CO_2 emissions of the researchers' laboratory work in the Climate Challenge Laboratory. This is because DTU CAS has focused on process energy from the start and planned the optimal solutions in the building. Here in the newsletter, expert in process energy Erik Krøll tells how.

Research work in laboratories can consume large amounts of energy. Up to 80% of research buildings' energy consumption goes to the ventilation system alone, so there is both money and CO_2 to be saved if ventilation solutions are included in the building's design from the start.
Therefore, process energy is a design parameter when the Technical University of Denmark (DTU) develops and builds the Climate Challenge Laboratory. The engineers behind it have devised and planned a ventilation system that can supply the building for many years to come - without the energy consumption increasing much, even when new researchers move in over time.
In this newsletter you meet Erik Krøll, who is a project manager and engineer at MOE. He explains how to plan the optimal laboratory building and the new heating principle that DTU is installing in the office part of the building. . At the end of the newsletter, you will get information about the status of the construction of the building and the work that will be done in the near future.

Expert in process energy. Erik Krøll, who is project manager and engineer at MOE, has many years of experience in developing research buildings. As a former employee in the pharmaceutical industry, he learned that there is a lot of money and a lot of CO2 to save if you consider process energy from the beginning of the project. In B313, Erik Krøll strives to create the optimal energy solution in collaboration with the client, the facility management, and the contractor. Foto: MOE

Innovative new energy solutions
Although neither the DGNB system nor the building regulations require process energy, it is the focus of the Climate Challenge Laboratory, also called B313. Here, the ventilation system has been given extra space and it has left its mark on the building's appearance, interior, and functionality.

Erik, you have many years of experience with process energy. Why does it concern you?
I have seen how much energy the pharmaceutical industry had to use to make drugs. Research is the first step in production, so I think it is an important part to work with.

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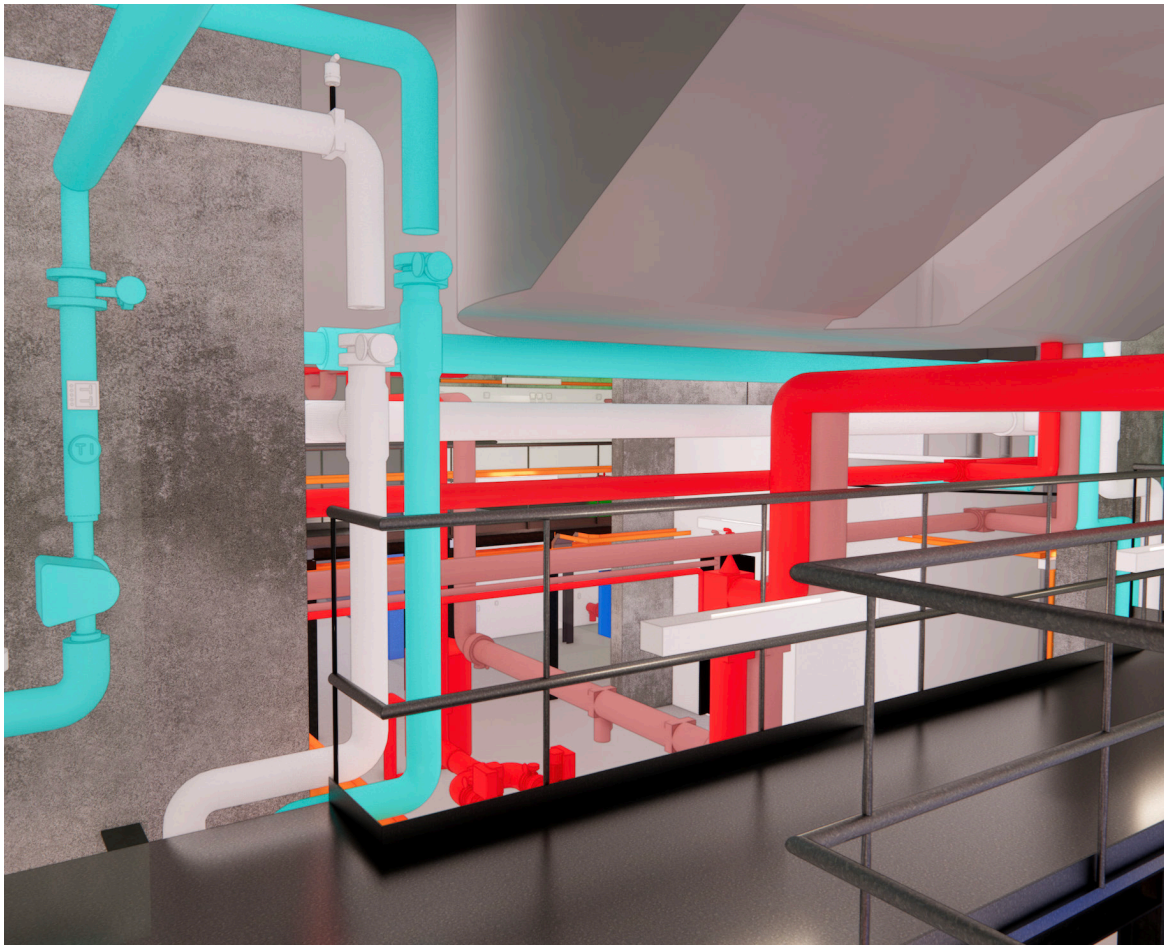
>
> – Erik Krøll, expert in process energy, MOE

And what is process energy?
Process energy is the energy that the industry uses to produce. It has been decided that laboratories and pilot plants' energy consumption also is considered as process energy so when DTU start a laboratory, process energy is the energy the researchers use when they conduct experiments.
We differ between process energy and building energy where the latter one designates the energy used in office buildings and housing. It concerns, among other things, which tax you must pay. While building energy is very strictly regulated in the building regulations, there are no such strict requirements for process energy because the focus is on the fact that we in Denmark must also be able to produce and export.



A double-height technical room. On the top floor of the building is a two-storey technical room, where air is produced, which is transported out in ventilation ducts and via vertical shafts to the individual floors. Illustration: Christensen & Co Architects

Generic laboratory with special facilities. On the 4th floor, space has been made for a HEPA filter next to the fume hood. The facility is for a specific research group moving into B313. Illustration: Christensen & Co Architects

How have you worked with process energy in B313?
The researchers have a tradition for being very close to their research. In the past they may even have had an office space in the laboratory. Today working conditions are central, so it is not an option. In B313 we separate research and administration. In the building you will have to walk from the place you conduct research to the place where you analyze your results. Concretely, this means that we are making 2/3 of the building into laboratory-mini-production, an atrium in the middle 1/3 into officesbuildling with a wooden superstructure. Because of this we can create the optimal solution for building energy in the office part and for process energy in the laboratory part of the building. It is a new way to think. And it leaves another imprint.

How so?
B313's footprint will be much larger than, for example, Koppel's buildings, which are around 15 meters deep. In B313 we are up to 24 meters in depth. The gable is much wider, but when we build in height, the proportions are connected.
The depth is partly due to the ambition to create a good working environment in the laboratory. In B313, you will be able to go directly from a laboratory to your noisy or heat-emitting equipment in the support areas which we have placed in the middle, they must have a certain size for the facilities that are needed.
In addition, more space must be used for the technical room than was planned in Koppel's buildings. This is where we produce the air – and if we are to make that air cheaply, we must have a low pressure loss. It requires space. Therefore, the technical room above the laboratory part is on two floors, with one floor above the office part.

How do you ensure the building can be adapted into different kinds of research?
B313 is intended as a generic house that can be changed over time as researchers move in and out. You must be able to connect different types of facilities to the ventilation system, some of which are very energy-intensive, and there must be room for the air to move around. Therefore, we have created ring ventilation with shafts at each end of the laboratory section and ventilation ducts of a certain size that you can connect to. So when a researcher needs a lot of air, the ventilation duct is large enough and leads up to the technical floor.
It must be considered very early in on, because it takes up a lot of space and has a major impact on the appearance of the building and the building's floor plan. It also affects what research can be conducted in the building in the future, but we have made room in the technical room for users with greater ventilation needs. It is typically chemists who use the most process air.

What significance does your work with process energy have for the sustainability of the building?
Energy consumption drops very dramatically. Where lighting is around 7% of the electricity consumption, laboratories use around 80%, so we try to create a balance. But everything I talk about here is only the preparatory work.
The execution is of enormous importance. The choice of tender form, the composition of components and the cooperation with the contractor have an influence on whether you get the right result. So we are not on target in B313 either, because we are not above basement level yet. But we have the right prerequisites.

What do you expect to achieve?
The benefit will be that you will have a changeable building in the future - without a large energy consumption and without the building running out of ventilation, because it is dimensioned so that researchers can connect different facilities. The possible savings are of great importance to DTU, which after all operates its own buildings and therefore has a great interest in keeping costs for energy consumption down. There has therefore also been talk of using 313 as a research project, i.e. installing loggers that measure consumption.

Requirements and recommendations

B313 is the first building at DTU to be constructed based on *DTU's Requirements and recommendations for laboratory construction* from 2020, which is a further development and adaptation of the Danish Building and Construction Authority's guidelines from 2013. The tool is used for programming and project planning of laboratory buildings, and B313 is the first building which is designed accordingly.

Requirements for process energy are described in a separate chapter with the aim of *minimizing the energy consumption required to operate process equipment such as ventilation, cooling, and compressed air, without compromising on the necessary process energy for laboratory operations and thus the research and teaching that is carried out.*

Baffles that can cool or heat

DTU CAS strives to achieve DGNB Heart. As something new at DTU, the offices in B313 therefore get comfort cooling in principle that can be regulated.

What is special about the heating principle?

The building regulations set very strict requirements for heat consumption in the wooden house. We have super low-energy windows, and the walls are one meter thick, so it only takes a single person or the start-up of a computer to heat up a room. If the heat load in an office is too much, we need cooling, so we have combined that with the ventilation in the offices. Heat loads can be very different in the rooms you sit in. We solve this with baffles in the ceiling, through which we can blow cold and warm air, and where we blow air in, we set up local sensors and a control panel which provide the possibility to control the temperature in every room.

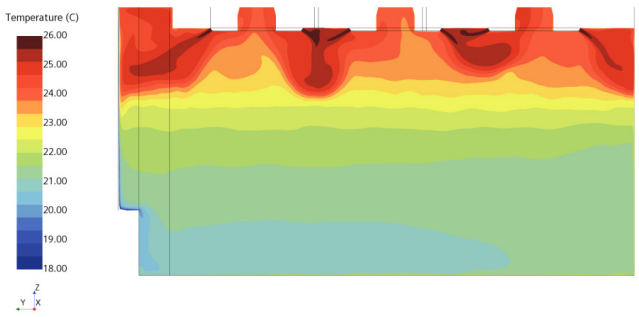
What is special about the components you have chosen?

Here in the design phase, we are in dialogue with the contractor about the choice of components. The integrated collaboration we work towards allows far greater flexibility and we advisers value, among other things, the lifetime of the component.

At DGNB Heart, we also look at the indoor climate for the individual user, so we consider whether the baffles create drafts, where they are placed in the room in relation to the office space, etc. As a points system, DGNB gives us some guidelines to follow, but it does not do it alone. When the building is built, you get a proof, but you can destroy it in a flash after you have handed over the building, which is why it is important to have the facility management involved.

Office with individual heating system. As something new, the employees are given the opportunity to change temperatures per office. A baffle (red) hangs from the ceiling, which can blow air into the room. On the door frame is a control panel (white). Illustration: Christensen & Co Architects

Cooling baffles. With DTU's model for integrated collaboration, advisers and the client can choose components in consultation with the contractor. The selected cooling beam Plexus from Lindab can add heat or cooling to the room as needed. Illustration: Lindab



Computational Fluid Dynamics. The illustration shows room temperature in a vertical section in a corner office with three baffles in the ceiling. The visualization is based on CFD calculations that simulate the effect of temperature distribution in a heating situation where it is -12 C outside. Visualization: Rambøll

Basic info

Construction work
All in-situ casting work is well underway, i.e. off-road decks and vibration-proof decks in the laboratory part of the building. Next the contractor sets up concrete elements, which will make up the basement walls and the load-bearing walls in the building.

Status of the project
The advisers are finalizing the user process and the layout of the laboratories. After this, the project transitions to being solely about getting the house built. The advisers will carry out ongoing supervision and follow-up on the construction to ensure the quality and high standard of the construction.

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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

Construction site