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Building the future: A special show by the Fraunhofer Building Innovation Alliance at BAU 2023 in Munich

What does it look like, the building of tomorrow? How can the challenges associated with climate neutrality, resource availability, and affordability be overcome? At the BAU 2023 trade fair in Munich from April 17 to 22, the Fraunhofer Building Innovation Alliance (Hall C2, Booth 528) will be displaying promising concepts and innovative solutions from its various member institutes.

Germany plans to be climate-neutral by 2045 - that is the German government's declared goal. To achieve this, emissions are to be drastically reduced as early on as by 2030: from 750 million metric tons of CO₂ equivalents in 2020 to 420 million metric tons in 2030. A great deal must also be done in the construction sector. After all, the construction and operation of buildings results in around 390 million metric tons of CO₂ equivalents. They are thus responsible for around 40 percent of Germany's greenhouse gas emissions. In particular, buildings in their operational phase - especially in terms of heating and energy consumption - have a large carbon footprint due to the use of fossil fuels.

But how can the road to climate neutrality and a circular economy in the construction and housing sector be shaped, and how can the necessary transformation be dealt with and implemented in a socially responsible manner? The Fraunhofer Building Innovation Alliance will be presenting solutions at the BAU 2023 trade fair in Hall C2 from April 17 to 22. Numerous exhibits will be showcased in the two-story Innovation Cube: This is a symbolic building for demonstrating innovative solutions not only for the building envelope, but also for the interior - for example, technologies for measuring humidity, for drying purposes or for acoustics. In general, the exhibits are divided into **four thematic islands: Energy and Heat, Resources and Recycling, The Future of Living and Working, and Digitization.**

Energy and Heat

One key aspect on the road to climate neutrality is heat generation. Heat pumps are a promising technology in this context. But on the downside, they use refrigerants that are harmful to the climate. How can more climate-friendly refrigerants be produced? How can additional heat sources be tapped for heat pumps, for example in façades? Geothermal energy also has great potential for the future. "In the long term, we expect to be able to cover 25 percent of the heat demand with geothermal energy," says Thomas Kirmayr, Managing Director of the Fraunhofer Building Innovation

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Alliance. "Via geothermal energy, we can produce a large part of the heat we need in Germany without being dependent on other countries." But to achieve this, more areas need to be developed geothermally. So far, the country has not been mapped sufficiently to identify areas where geothermal drilling makes sense. The Fraunhofer Building Innovation Alliance has set itself the goal of closing this gap and identifying suitable areas.

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Of course, the transition regarding heat cannot be considered alone, but must be closely coupled with how energy is generated. For example, with photovoltaics. One of the exhibits in this sector is MorphoColor® PV modules - photovoltaic modules that can be integrated into façades or roofs as colorful design elements. They have an efficiency of over 90 percent, compared to conventional black modules. Recently, the researchers optimized their angular stability to ensure a uniform appearance even when viewed from oblique angles. Such exhibits are supplemented by ones from the field of energy management: How can the building mass be used to store energy or heat? "The field of energy and heat is far from being fully developed; there is still a lot of exciting potential to be tapped," affirms Kirmayr.

Resources and Recycling

Another key aspect that needs to be addressed by the construction industry is the circular economy. On the one hand, in terms of resilience - resources need to be secured and our dependence on raw materials from other countries reduced - and on the other hand, in terms of climate neutrality. "We are pursuing two approaches: Process-driven innovations for extracting raw materials, and product innovations with recyclates or with a minimized environmental impact." In order to achieve a circular economy, the necessary processes must first be developed, such as sorting processes that turn building rubble into cleanly-sorted and thus valuable raw materials. "Downcycling, whereby building rubble is simply used as a filler for highways, is not a viable concept," believes Kirmayr. "That's why we see a great need for research in the field of processing." Examples include new technologies for separating building rubble because this contains coatings, sealants and other materials that prevent it from being used as a raw material. Which process technology can separate rubble effectively and how can such technologies be upscaled to cope with the large volumes that are generated? One possible approach from the Fraunhofer Building Innovation Alliance is electrodynamic fragmentation: The technology can be used to produce high-quality, or even higher-quality, new products from waste concrete. "This is one example of a solution where we demonstrate: it's possible!" says Kirmayr proudly. After all, the researchers are committed to turning recovered materials into new building materials of at least the same quality.

The aim is to produce new high-quality products from these recyclates. Which material resources can be replaced by recyclates? In particular, it makes sense to replace materials that have a high environmental impact, such as cement, or which require a lot of energy to produce. Can these ideally be replaced by recyclates from secondary processes with lower energy requirements?

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Another fascinating topic is carbon capture. We know it from wood: these building materials bind CO₂. "We now have other solution processes where we take CO₂ out of the atmosphere and store it in building materials. If these building materials are then recycled, the CO₂ is not released back into the atmosphere at the end of a building's life, but remains captured," explains Kirmayr. "It will be quite exciting to see how industry takes up these approaches - because it turns waste into a viable and ecological source of raw materials."

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The Future of Living and Working

Regions where coal was mined face a huge challenge: an attractive environment needs to be recreated under changed conditions. The focus is on the development of districts and new ways of working in the context of the pandemic. In the wake of the New European Bauhaus - a cultural policy initiative with the goal of climate neutrality - this is not to be done in the conventional way with the city or an investor building on vacant land. Instead, the aim is to shape the future of housing through a participatory process. In other words, a process in which the citizens are included in the planning and take an active part in the future of their city. "This is precisely where the Fraunhofer Building Innovation Alliance comes into play. With our expertise, we provide solutions that ensure more participation and give an overview of recent innovations so that a vision of the future can be developed collectively," says Kirmayr. At the same time, the researchers are also addressing sociocultural issues: How can users be integrated into operational processes? "Technology must always be thought of in combination with the user," adds Kirmayr.

Digitization

The fourth theme island of the exhibition stand is dedicated to the topic of digitization. How can digital solutions be used to achieve a circular economy and climate neutrality? Digitization can also help when it comes to participatory processes: With a view to citizen participation, for instance, three-dimensional models can be generated before anything is built, thus creating a better basis for entering into discussions with the people involved. The Elbedome in Magdeburg is an example of this: There, viewers stand in a 360-degree cave, in other words, practically in the middle of the model. "As a result, people can be included in planning and decision-making processes in a completely different way that was previously almost impossible to convey," says Kirmayr. The researchers are currently working on integrating other features such as acoustics, lighting conditions or temperature perception, which will make planning an even more tangible experience. "Based on planning data, such as decibel specifications, it is really hard to imagine the impact of new technologies. But if you can experience for yourself how soundproof windows, for instance, affect your perception of road noise, it soon becomes understandable," explains Kirmayr. One interesting use case is the office: Does the façade get too hot in the summer? Is the air

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conditioning sufficient? How is sunshading perceived? It might make things cooler, but it also prevents you looking outside. “Via the digital twin, we want to simplify decision-making processes that are difficult for building owners to understand from plans and technical data,” summarizes Kirmayr. Such a digital twin is important not only for new buildings, but also for existing ones, in order to gain a clear picture of renovation measures.

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Position paper

A description of how the researchers of the Fraunhofer Building Innovation Alliance envision the building of the future can be found in the position paper “Building the Future”. This document takes current and future changes in the construction industry into account. “With the position paper, we don’t so much want to raise awareness of the problems,” says Kirmayr, “but rather to recommend how the necessary transformation can be achieved over the next ten years, linked to an action plan.”

Information on the Fraunhofer Building Innovation Alliance can be found at www.bau.fraunhofer.de.

Information on the Fraunhofer Building Innovation Alliance booth and exhibits can be found at www.fraunhofer.de/de/presse/pressemappen/pressemappe-zur-bau.html.

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The Fraunhofer Building Innovation Alliance will show products and system solutions for a sustainable, digital and affordable construction industry at the BAU 2023 trade fair.

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The **Fraunhofer Building Innovation Alliance** clusters resources and competences of several Fraunhofer research institutions relating to building construction, thus providing the market with a single, central contact for integral system solutions in the areas of design and construction. The extensive portfolio addresses both medium-sized enterprises and large construction companies. The Fraunhofer Building Innovation Alliance sees itself as an indicator and Initiator of new and innovative topics relating to building research, assuming the function of an interface between economy, research and politics. Clients' inquiries are centrally collected in the head office, from where they are forwarded to a member institute specializing in the respective issue. International contacts and partnerships enable Fraunhofer to advise companies with global operations.

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