

## Heating Apartment Houses Sustainably

**Project Alliance of Research, Heating Manufacturers, and Housing Industry Develops Sustainable Energy Concepts and Heating Systems for Existing Apartment Houses**



*Facade elements that do not only contain thermal insulation, but also heating and ventilation components are in the focus of LowEx-Bestand. (Picture: Fraunhofer ISE)*

**For the energy transition to be successful, it will also be important to secure heat supply of the housing stock by sustainable technologies. About half of the apartments in Germany is located in apartment buildings. However, backfitting with modern building shells or heat pumps lags behind. The cooperation project “LowEx-Bestand” coordinated by KIT and Fraunhofer ISE is aimed at developing commercially viable concepts and demonstrating their operation quality. It is funded with about EUR 5.3 million by the Federal Ministry for Economic Affairs and Energy.**

“The two most important keys to reaching a nearly climate-neutral housing stock are thermal insulation and low-carbon dioxide heating technology,” emphasizes project head Professor Hans-Martin Henning, Holder of the Chair for Technical Energy Systems of Karlsruhe Institute of Technology (KIT) and Coordinator of the Business Area of Building Energy Technology of the Fraunhofer Institute for Solar Energy Systems ISE, Freiburg. “At the same time, the measures have to be economically efficient.” The cooperation project “LowEx-Bestand” focuses on the further development and demonstration of



*KIT Energy Center: Having future in mind*

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measures to reduce energy consumption of existing apartment houses and is aimed at developing new, viable solutions in close cooperation with industry partners.

As regards the energy saving potential, past activities mostly focused on technology rather than on building-specific framework conditions and compliance of new technology with the building in need of refurbishment. This is where the project “LowEx-Bestand” starts. So far, complexity of construction and refurbishment processes has prevented wide implementation of new solutions. The cooperation project is now aimed at finding user-compatible refurbishment approaches that improve building quality and enhance and facilitate workflows.

Heat pumps are already widely used to supply many single- and two-family houses with heat with low carbon dioxide emissions. However, heat pumps are hardly applied in apartment houses, although they are among the heating technologies that contribute most to a significant reduction of the emission of climate gases in the supply of room heat and hot water, in particular when power from renewable sources is used. Use of heat pumps in apartment houses, however, is associated with several challenges that will be addressed under “LowEx-Bestand,” in particular in the area of hot water production, legionella protection, and use of alternative heat sources, i.e. geothermal heat or heat from outside air. In this connection, gas-driven heat pumps that are driven by natural gas instead of electricity are a promising alternative. Compared to pure gas boilers, they are associated with reduced specific carbon dioxide emissions. Gas-driven heat pumps require a smaller heat source than electric heat pumps, which is a big advantage in buildings in urban regions. These buildings mostly are connected to the gas grid. For this reason, gas-driven heat pumps will be evaluated as another technical option for existing apartment houses.

In the area of thermal insulation, “LowEx-Bestand” will focus on refurbishment solutions that affect the inhabitants to the smallest possible extent. For this, pre-fabricated facade elements will be developed and used. They do not only contain the thermal insulation, but also heating and ventilation components. As a result, construction work inside the apartments is reduced. At the same time, a high degree of pre-fabrication promises to increase economic efficiency of refurbishment.

Under the “LowEx-Bestand” cooperation project, research institutes, technology companies, and the housing sector cooperate closely in the areas of thermal insulation and heat pump. New building energy concepts are developed, implemented, demonstrated, and evaluated

with the help of measurements. The project is aimed at further developing new concepts in the area of energy-oriented refurbishment of the building shell and use of heat pumps for existing apartment houses, at enhancing their economic efficiency, securing the operation quality, and contributing to an accelerated introduction and commercialization on the market. In this way, the project will make a significant contribution to reaching the climate policy objectives envisaged in Germany in the area of heat supply of buildings. The cooperation project has a budget of EUR 6.4 million, of which EUR 5.3 million are funded by the Federal Ministry for Economic Affairs and Energy (BMWi).

The cooperation project is headed by the Professor for Technical Energy Systems of the KIT Department of Mechanical Engineering, Professor Hans-Martin Henning. Other research partners are the KIT Institute for Industrial Production (IIP) of the KIT Department of Economics (Professor Wolf Fichtner), the Building Science Group (fbta) of the KIT Department of Architecture (Professor Andreas Wagner), and several groups of the Fraunhofer Institute for Solar Energy Systems (ISE) in Freiburg.

#### **The LowEx Concept:**

Temperature conditioning of rooms on comfortable level cannot only be achieved by locally high temperatures reached by burning fossil fuels. Sustainable systems rather work with low temperature differences between the heating medium and room temperature. In this way, also regenerative energy sources, such as ambient heat in combination with heat pumps, can be used much better. The term LowEx (Low Exergy) stands for systems needing a small amount of “valuable” energy, so-called exergy. Exergy means the usable part of total energy of a system that can perform work and does not exist in the form of diffuse heat.

#### **The “LowEx” Project:**

The “LowEx-Bestand” cooperation project is part of a large-scale project alliance covering several technology projects for the further development of systems and devices in cooperation with manufacturers. The cooperation project of KIT and Fraunhofer ISE also covers several demonstration projects in the area of thermal insulation and the use of heat pumps. These projects are planned to be carried out in existing apartment houses in cooperation with the housing sector. They include measurements and their evaluations as well as processing of the results for users and the interested public.

### **About Fraunhofer ISE:**

The Fraunhofer Institute for Solar Energy Systems ISE was established in Freiburg im Breisgau in 1981. With a staff of about 1100, Fraunhofer ISE is the largest solar energy research institute in Europe. It develops technological fundamentals for efficient and environmentally friendly energy supply in industrialized as well as in threshold and developing countries. In the areas of energy production, energy efficiency, energy distribution, and energy storage, it contributes to a wide application of new technologies.

More about building energy technology of Fraunhofer ISE:  
<https://www.ise.fraunhofer.de/en/business-areas/building-energy-technology>

More about the KIT Energy Center: <http://www.energy.kit.edu>

**Karlsruhe Institute of Technology (KIT) pools its three core tasks of research, higher education, and innovation in a mission. With about 9,300 employees and 25,000 students, KIT is one of the big institutions of research and higher education in natural sciences and engineering in Europe.**

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