

Press Release

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"LC R290" Project

Propane Heat Pumps for Multi-Family Houses – Fraunhofer ISE Develops Solution Concepts

Heat pumps can replace existing gas and oil heating systems in multi-family houses when the entire system is designed to match the building. This is the core finding of the "LC R290" research project, in which the Fraunhofer Institute for Solar Energy Systems ISE worked with a consortium of twenty companies from the heating industry and housing sector to develop typical solution concepts for heating system replacement. The project team used the refrigerant propane (R290) for this purpose.

In the first step, the researchers examined example buildings from the portfolio of the participating housing companies to derive the requirements for heat pump solutions. The heating loads of the buildings ranged from 23 to 93 kW, requiring a wide range of heat pump capacities. Some buildings had individual gas apartment heating, while others had a central heating system. There were also significant differences in potentially available heat sources: While row-type developments often have space for air-source heat pumps between buildings, other development structures require the use of different sources.

It became clear that there is no one-size-fits-all solution for heating replacement; instead, the concepts must be tailored to the respective building size, space constraints, heating system, hot water requirements, sound insulation, and safety requirements. The project team therefore examined several modernization variants – apartment-level as well as central heat pumps for indoor and outdoor installation. They focused particularly on approaches that require little structural modification and are space-saving.

"Due to the various challenges, such as the question of a suitable heat source or limited space, there is no single technological solution; rather, we have developed several solutions that can be applied," says Project Coordinator Björn Nienborg at Fraunhofer ISE. "What's important is a building-tailored system design including heat pump, storage, hydraulics, control, and heat distribution."

Demonstrators for Central and Decentralized Solutions with Propane

Many existing multi-family houses are already supplied via central heating. For decarbonization, central heat pump systems are well-suited for these. For the replacement of central outdoor heating systems, the research team developed a demonstrator in which the charge of the climate-friendly refrigerant propane (R290) was reduced by 20 percent compared to

comparable heat pump units, while efficiency was increased by 15 percent. Additionally, a compact model of an indoor brine-to-water heat pump using propane with a heating capacity of 28 kW (B0/W55) was developed. Particular attention was paid to reduction of charge, with the goal of limiting the requirements for the safety concept.

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Under certain conditions – for example, when apartments supplied by gas apartment heating are to be modernized independently of each other – apartment-level solutions can make sense. For a decentralized solution with a hydraulically connected heat source (e.g., geothermal, groundwater, or low-temperature district heating), the researchers built a demonstrator in the project (4.9 kW heating capacity at B0/W55) and measured it in the laboratory. A charge of 150 g of propane was used.

"The low charge of 150 g is an important value for minimizing the hazard potential when using the flammable refrigerant propane, thus enabling the use of heat pumps in kitchens or utility rooms – the typical installation locations," explains Timo Methler, Team Leader for Building Heat Pumps at Fraunhofer ISE.

Safety Concepts Investigated

Propane is a climate-friendly refrigerant due to its very low global warming potential, but it is flammable. For this reason, safety questions were analyzed for all solution variants. One project requirement was to investigate possible propane leakage cases for indoor heat pump installation. The team experimentally replicated such cases in discharge tests and conducted more than 100 tests with five different safety concepts. The measurement results fully confirmed the "ventilated enclosure" safety concept described in the safety standards (EN 378, IEC 60335-2-40). With the "chimney" and "drainage concept," the project team examined two additional innovative and potentially more cost-effective safety concepts that will be further developed in future research work. The extensive measurement data obtained in the project can be used by the participating manufacturers to further refine their safety concepts

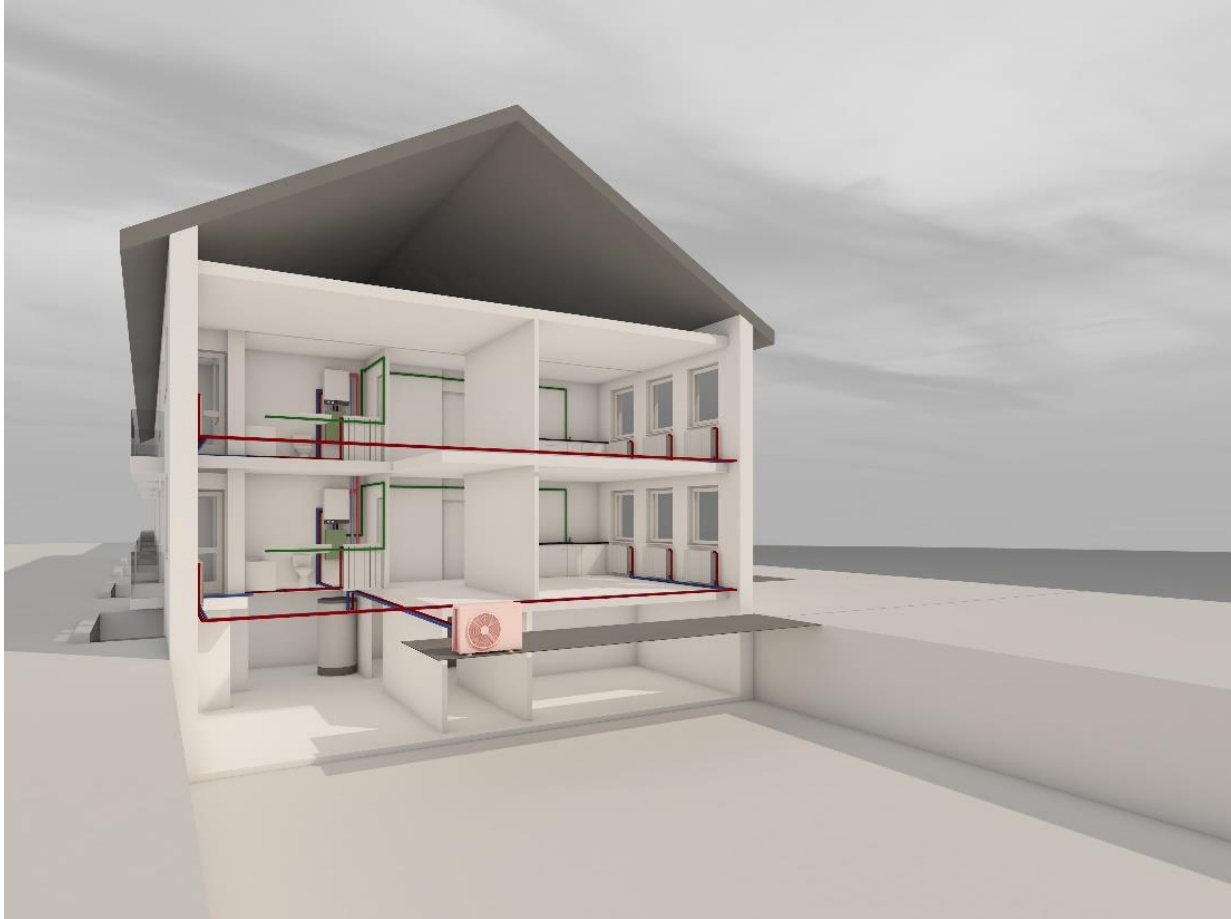
From Research to Practice

To accelerate the decarbonization of existing multi-family houses and simplify planning processes, Fraunhofer ISE will incorporate the solution approaches developed in the project into the new [MAMMUT project](#). This aims to develop a software tool for decision-making and design of heat pump systems in multi-family houses with directly linked quote generation – particularly for HVAC installers.

Fraunhofer ISE also aims to accompany the use of heat pumps in multi-family houses with detailed monitoring to support quality assurance in practice. The institute benefits from more than two decades of expertise in monitoring heat pumps in single-family houses.

The project was funded by the German Federal Ministry for Economic Affairs and Energy (BMWi).

The final report is available for download here: [LCR290 – Development of Heat Pump Solutions with Propane for the Replacement of Gas and Oil Appliances - Fraunhofer ISE](#) (German language only)



Visualization of an example building with a central air-to-water heat pump and decentralized domestic hot water reheating. © Fraunhofer ISE

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