

PRESS RELEASE

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Efficient Propane Heat Pump Replaces Gas and Oil Heating Systems in Apartment Buildings

The Fraunhofer Institute for Solar Energy Systems ISE is developing easy-to-use and reproducible solutions for replacing gas and oil heating systems in existing multi-family homes with partners in the project "LC R290". The research focus is on heat pumps that use the refrigerant propane (R290). With a consortium of twenty companies from the heating and housing industries, the research institute has developed initial implementation concepts for heating systems that will be presented to a specialist audience at the Chillventa trade fair in Nuremberg from October 8 to 10.

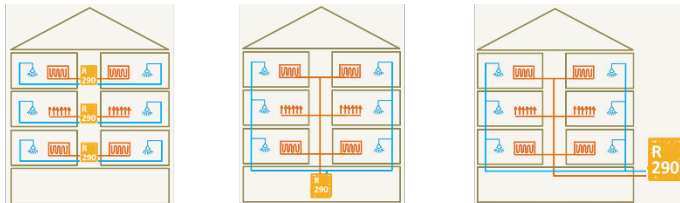
The concepts to be presented at the trade fair are based on sample buildings selected by the research team from the portfolio of the participating housing associations and reflect the diversity of the German building stock. These representative buildings serve as templates for the development of various propane heat pumps in existing multi-family houses. The heating load of the buildings, or design heating load, varies between 23 and 93 kW, which means that a wide range of heat pumps up to the high output range are required. A particular challenge lies in dealing with the systems for single apartments in which each has their own gas heating system. Solutions are necessary here predominantly for small apartments in the low rent segment. These new system solutions should require as little retrofitting and space as possible. The "LC R290" project compares various modernization options for each of the representative buildings and analyzes the advantages and disadvantages in terms of system efficiency, propane-related safety aspects and system conversion costs.

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LCR290
LOW CHARGE SOLUTIONS


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	indoor/ single-flat (MFH)	indoor/ cellar	outdoor
TYPE OF BUILDING	MFH/ decentral single-flat solutions, old buildings	SFH and MFH, central solutions, old buildings	SFH and MFH, new and old buildings
HEAT SOURCE	air (indirect), ground, LT-grid	air (indirect), ground, LT-grid	air (direct)
HEATING CAPACITY	up to 10 kW	10-80 kW	10-80 kW

Fields of application in the LCR290 project: floor heating, central heating in the basement, high-performance heat pumps for outdoor installation (LT-grid: low-temperature heating network). © Fraunhofer ISE

Solutions for three fields of application

In the "R290" project, the Fraunhofer ISE team is building several demonstrators to test the direct replacement of fossil fuel heating systems in apartment buildings with heat pumps. One of the three conceptual approaches involves a decentralized solution with a hydraulically tapped heat source such as geothermal or solar thermal energy, district heating, air collector or low-temperature heat grid. A first demonstrator with a refrigerant charge of 150 g propane (R290) has already been built and measured in the laboratory. "The low refrigerant charge of 150 g is an important value: It minimizes the hazard potential of the flammable refrigerant propane and permits the heat pump to be installed indoors in rooms where it is typically used, like kitchens or washrooms," explains project manager Dr. Katharina Morawietz.

The measured demonstrator achieved a heating output of 6 kW at a source temperature of 0 °C and a sink temperature of 55 °C and shows an efficiency of $SCOP_{55} = 3.8$ (Seasonal Coefficient of Performance) over the year, which is standard on the market for brine-to-water heat pumps. The SCOP determines the seasonal coefficient of performance of a heat pump under different operating states, which are weighted according to different climate zones. The latest version of the demonstrator will be presented at the Fraunhofer ISE stand (Hall 4A/Stand 318) at the Chillventa, the world's leading exhibition for refrigeration, in Nuremberg from October 8 to 10, 2024.

A second conceptual approach for multi-family houses demonstrated in the research project is a centrally installed heating system with the heat pump located inside the building in the basement. Also here, a hydraulically connected heat source such as geothermal or solar thermal energy, district heating, air collector or low-temperature heat grid is planned. An initial demonstrator has been built and measured for this centralized indoor implementation. The demonstrator achieved a heating output of 29.5 kW with a source temperature of 0 °C and a sink temperature of 55 °C. Over the year, an efficiency of $SCOP_{55} = 3.65$ was determined, with a moderate filling quantity of 830 g propane. Optimization calculations suggest that the filling quantity could be reduced to 800 g propane and the $SCOP_{55}$ could be increased to 3.7 by implementing optimized control strategies, for example overheating optimization. Achieving this goal is the next step in the research project.

The third conceptual approach is based on a centrally installed external heat pump for apartment buildings. The first prototype of such a system is currently being measured. Initial results are expected by the end of this year.



Demonstrator of a centrally installed external heat pump as a heating solution for apartment buildings. To date, there are only a few products with the natural refrigerant propane on the market for apartment buildings.

Outlook

Over the next few months, exciting results are expected from the project in another important field of research: "On Fraunhofer ISE's outdoor performance test field measurements are currently being carried out on the leakage behavior of propane. These results will provide information on how to further increase the safety of propane heat pumps," says Dr. Katharina Morawietz. Our aim is to keep the amount of propane

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refrigerant in these type of heat pumps to a minimum. (See results of the previous project "LC150").

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In the final phase of the "R290" project, system measurements are to be carried out under realistic conditions in order to determine the efficiency under standard operating conditions and provide comprehensive functional verification of the devices. The hardware-in-the-loop method, in which the inputs and outputs of an actual electronic or mechatronic component is connected to an emulated system, will be used for this work. The heat pump is available as real hardware. The underlying system - the building or the user and the hot water tank - is mapped virtually. With this method, it is possible to obtain meaningful results on system behavior over the course of a year and to evaluate the functional control models in the laboratory.

Visit us at the Chillventa 2024

In addition to our demonstrator, Fraunhofer ISE will be showcasing digital solutions for the installation of heat pumps for the trade. We also will be presenting our R&D services in the field of efficient large heat pumps for the industry. Visit us in Hall 4A/Stand 318.

Link: <https://www.ise.fraunhofer.de/de/veranstaltungen/chillventa.html>

The "LC R290" project is funded by the Federal Ministry for Economic Affairs and Climate Protection and will run until the end of June 2025.

Project page: <https://www.ise.fraunhofer.de/de/forschungsprojekte/lcr290.html>

Final report of previous project "LC150"

<https://www.tib.eu/de/suchen/id/TIBKAT:1887994033/LC150-Entwicklung-eines-k%C3%A4ltemittelreduzierten?cHash=4b9bd162e9e966b3f8555ab3a80e4548>