

# PRESS RELEASE

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## Creative heat-pump design heats and cools simultaneously

**As one of the leading R&D partners in the area of thin-film technologies, the Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP has teamed with Johnson Controls Systems & Service GmbH to co-develop and install an especially efficient heat pump for its R&D facility.**

The Fraunhofer FEP works on innovative solutions in the area of vacuum coating, surface treatment, and organic semiconductors. The foundation for this work is its core expertise in electron beam technology, sputtering, plasma-enhanced high-rate vapor deposition and high-rate plasma-enhanced chemical vapor deposition (PECVD), as well as technologies for organic electronics and IC system design.

Johnson Controls is a leading supplier of products and services in the area of heating, ventilation, air-conditioning, refrigeration, industrial refrigeration, building automation as well as security and fire protection. It has been serving as an equipment supplier to Fraunhofer FEP for Instrumentation, Control, and Automation (ICA) as well as for Building Management Systems through its branch office in Dresden since 1997.

As a result of the fields in which Fraunhofer FEP works, the experimental facilities require a very complex supply of water maintained at a constant temperature level of about 25°C. The cooling water warmed to about 28°C by the experimental facilities returns to an accumulator tank and from there re-enters the experimental facility after being cooled in a cooling tower. The current system handles 500 kilowatts during simultaneous operation of the present experiments.

The R&D facilities of Fraunhofer FEP are almost entirely located in the large engineering buildings. Temperature regulation in these buildings is controlled by means of centralized ventilation and air-conditioning (VAC). Local heating that has been converted from the district heating network is available as a thermal source for this purpose. The maximum thermal output from this VAC equipment is around 400 kilowatts.

Fraunhofer FEP is continuously searching for innovative technological solutions. Thanks to the technical knowledge in the Institute about the simultaneous amounts of waste heat and thermal input energy required, engineers had the innovative idea of developing a heat pump application that coupled these two elements in a beneficial way. Fraunhofer FEP and Johnson Controls had already jointly implemented a heat pump in a similar case for using waste heat (15 kW) from an IT server room to provide heating

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for the office building. The “waste product” of the heat pump process – the resultant lower temperature – is used for active cooling of the server room. This application was technologically and economically so successful that the next larger step was appropriate. The economic success was substantiated by the complete return on investment (ROI) in less than three years. Heat-pump applications usually achieve an energy efficiency ratio of about 4.5. However, the facility as designed exhibits an even higher energy efficiency ratio of around 7.5. This performance coefficient represents the ratio of thermal energy recovered to electrical energy expended.

The region of the performance envelope guarantying the highest possible number of hours at full capacity utilization versus the expanded scale of the new heat pump had to be determined. As a result of the various measurements, the heat pump was specified as follows: Heating capability 115 kilowatts, cooling capability 90 kilowatts.

There was no standard solution that could be drawn upon for this project. Johnson Controls, as supplier of the heat pump, installed a system configured from two compressors (each handling 50% of the work), one of which was designed to be infinitely adjustable and the other fixed.

The hot side of the heat pumps were connected to the ventilation/air conditioning feed circuit. Adaptation of the control and hydraulics was difficult, but was solved. Due to the way the Institute operates, sole supply to the VAC circuit would have led to shut-down of the heat pump at night and on the weekend. So an additional sink was found in the static thermal circuit (max. dissipation 50 kW), to take over part of the load, though smaller. Adding to this was the fact that the heat developed in the experimental facilities is very restricted on the weekend anyway.

Complete terms of reference – whether for regular operations of the Institute or during unusual conditions due to the demands of building alterations or extensions – were worked out cooperatively with Johnson Controls (Dresden office) in a spirit of partnership. It was clear to the project participants that this demanding project could only be carried out successfully in this way, and that adjustments are unavoidable even after successful commissioning.

Gerd Obenaus, head of Technical Management at Fraunhofer FEP, explains the necessary conditions for good outcome of the demanding project: “All of the project participants need understand that considerable expenditures are to be expected for commissioning and subsequently optimizing the equipment. In addition, the site operator must be very familiar with its facilities as well as the behavior of the periphery and proper operation of the equipment. The capability and determination of the operator to carry out operating improvements on its own are urgently needed and essential for success.”

Frank Rostalsky, head of the ICA service team for the Dresden office, describes the demands they faced: “We were expected to adapt to the policies and approach at the site and provide the operator with viable options. To do this, it was necessary to disclose all the variables of the equipment and permit optimizations.”

Weak points in the hydraulics and control of other equipment – that was now to be fed by the heat pump – were also identified and corrected during the comprehensive commissioning.

On-line operation of the equipment began in November 2016. A lot of additional measurement and control equipment was installed beyond the normal complement. This is meant to ensure and document smooth and economic operation of the facilities. First results with regard to operational experience and efficiency will be calculated in summer 2017. The engineers of the Fraunhofer FEP are ready to provide their know-how in designing environmentally friendly facilities for external clients as well.

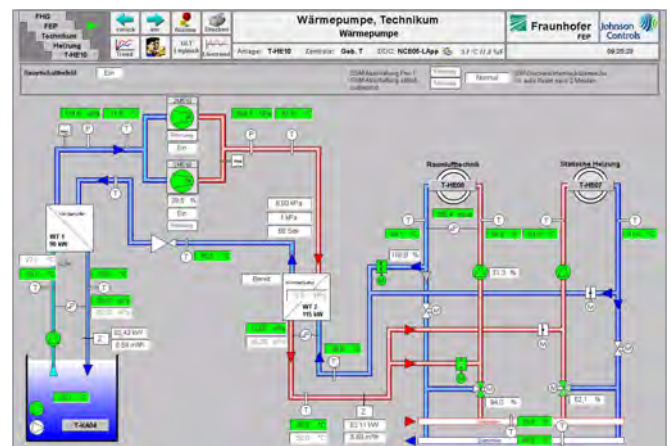
Fraunhofer FEP and Johnson Controls are planning to enter their completed heat-pump solution in the competition for the German Innovation Prize – Climate and Environment (IKU). The German Federal Environment Ministry (Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit) together with the Federation of German Industries (Bundesverband der Deutschen Industrie/BDI) award the German Innovation Prize for Climate and Environment (IUK) every other year to pioneering ideas in the field of climate and environmental protection.



**Technical center building of Fraunhofer FEP with efficient heat pump concept**

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**Section on heat-pump operation from the building engineering documentation**

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The **Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP** works on innovative solutions in the fields of vacuum coating, surface treatment as well as organic semiconductors. The core competences electron beam technology, sputtering and plasma-activated deposition, high-rate PECVD as well as technologies for the organic electronics and IC/system design provide a basis for these activities. Thus, Fraunhofer FEP offers a wide range of possibilities for research, development and pilot production, especially for the processing, sterilization, structuring and refining of surfaces as well as OLED microdisplays, organic and inorganic sensors, optical filters and flexible OLED lighting. Our aim is to seize the innovation potential of the electron beam, plasma technology and organic electronics for new production processes and devices and to make it available for our customers.