Karlsruhe Institute of Technology

Division III – Mechanical and Electrical Engineering

Light Technology Institute (LTI)

Microenergy Supply without Battery or Cable

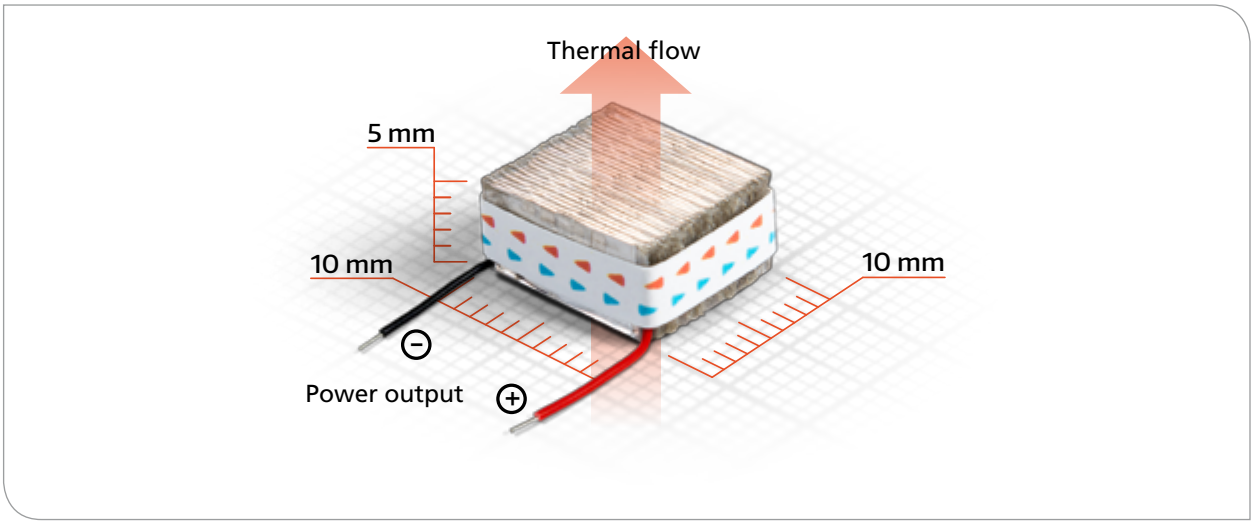
Miniaturized Power Plants not Larger than a Sugar Cube Made by otego

Thermoelectric generators are a real alternative for supplying small autonomous consumers in the Internet of things (IoT) and Industry 4.0 applications. Instead of battery storage systems or cables, the generators made by otego directly extract electrical energy from surrounding heat sources and, in this way, ensure continuous power supply. This reduces not only maintenance expenditure, but also the consumption of natural resources. Heavy metals are not needed at all. The thermoelectric generators are highly robust and reliable due to their compact design, the absence of moving parts, and the use of plastics as base materials.

A Large Range of Applications

The energy produced can be used to operate various sensors, measurement electronics, and wireless systems, from simple products, such as an electronic radiator thermostat, to sensor nodes. Thermoelectric generators not only are an ideal energy source for comfort applications in the domestic environment, they can also be used for the power supply of a number of autonomous industry sensors in larger facilities. In this way, a reliable power supply of electronic systems for condition-based maintenance applications can be ensured.

Thermoelectric generators are semiconductor components based on the Seebeck effect (also called thermoelectric effect). The temperature gradient in the semiconductor material induces a diffusion and a separation of charge carriers, resulting in an electric voltage. This effect is very small and voltages are in the range of some microvolts only. As the voltage builds up in the direction of the temperature gradient along the material, it can only be increased further when another semiconductor material generating a complementary voltage is used. In a so-called thermocouple, these two materials are connected such that the electric current in one material flows from the warm side to the cold side and in opposite direction in the other material. Consequently, heat flow dissipates over both materials, whose thermoelectric voltages add up. Due to the additional serial connection of many thermocouples, a voltage in the single-digit voltage range can be built up over the entire thermoelectric generator, as it is required for the operation of microelectronics. In order to produce such a high number of thermocouples quickly and cost-effectively, otego prints them onto thin plastic foils using printing machines. The usable electric power of each generator is in the microwatt to milliwatt range depending on the generator's size and the applied temperature difference. The setup of otego's generators in principle corre-

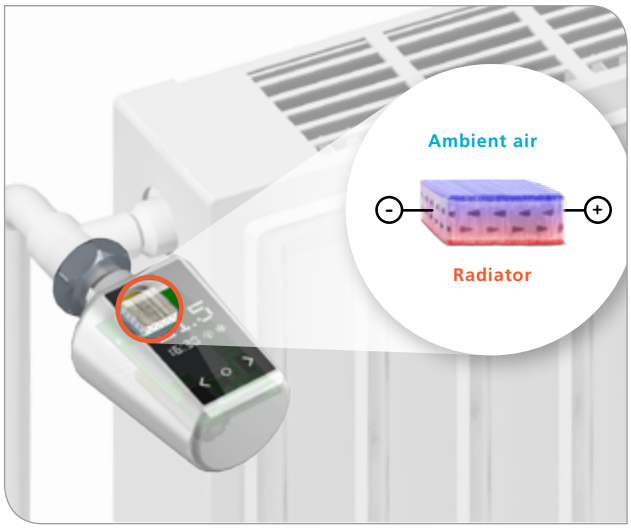


Thermoelectric generator made by otego

sponds to that of the known Peltier elements, but without their typical drawbacks of a high content of heavy metals, e.g. tellurium, or their sensitivity to mechanical stress.

Patented Technology

The patented thermoelectric generators commercialized by otego are the result of several years of research and development at the Light Technology Institute (LTI) of Karlsruhe Institute of Technology. otego GmbH was established last year and currently works on the commercialization of the generators. Work of otego's interdisciplinary team covers the complete value chain from the development of materials to generator production and its electronic connection.



Thermoelectric generators for the autonomous supply of measurement electronics, such as a smart radiator thermostat

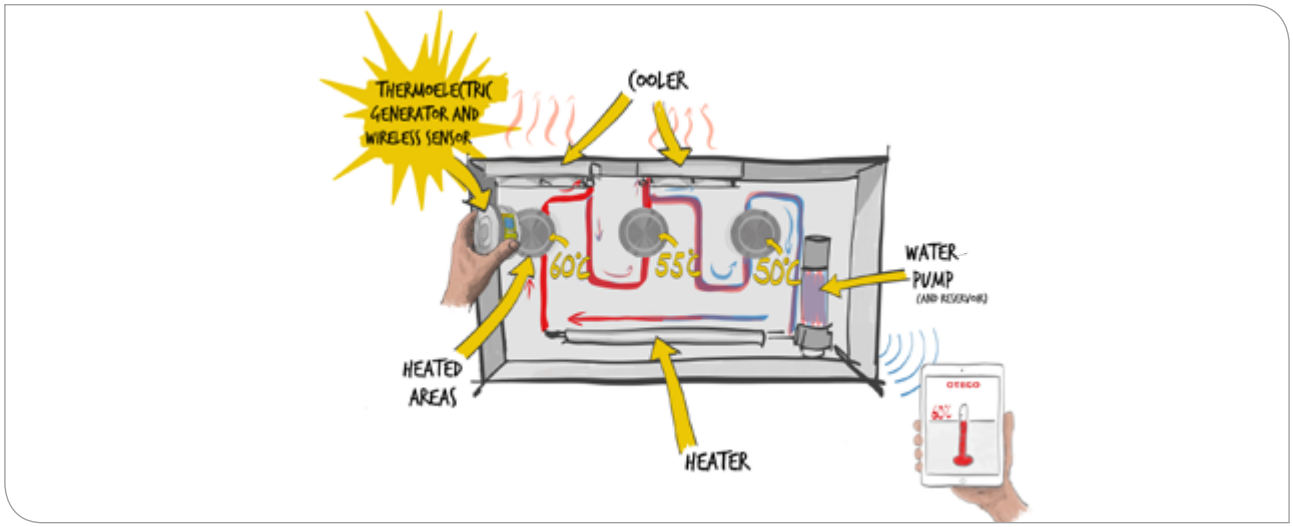


Exhibit at Hannover Messe 2018: A water circuit as heat source supplies sensor pucks with energy. This is enabled by otego's thermoelectric generators that directly convert waste heat into electric power

Karlsruhe Institute of Technology (KIT)
Light Technology Institute (LTI)
Frederick Lessmann
Engesserstraße 13
76131 Karlsruhe, Germany
Phone: +49 721 981 923 0
Email: info@otego.de

otego GmbH
Haid-und-Neu-Straße 7
76131 Karlsruhe, Germany
www.otego.de/en/

OTEGO

Karlsruhe Institute of Technology (KIT) · President Professor Dr.-Ing. Holger Hanselka · Kaiserstraße 12 · 76131 Karlsruhe, Germany · www.kit.edu