

Abstract number: EU-O.4.7

Thermoelectric Generators with High Potential for Waste Heat Recovery in Heavy-Duty Vehicle Applications: Validation by a Functional Prototype with up to 2.7 kW

Lars Heber (German Aerospace Center (DLR), Institute of Vehicles Concepts, Stuttgart, Germany), Julian Schwab (German Aerospace Center (DLR), Institute of Vehicles Concepts, Stuttgart, Germany), Timo Knobelspies (German Aerospace Center (DLR), Institute of Vehicles Concepts, Stuttgart, Germany), Hyunwoo Choi (LG Chem Ltd., Daejeon, Korea), Cheol-Hee Park (LG Energy Solution Ltd., Daejeon, Korea)

lars.heber@dlr.de

This research study demonstrates the engineering and measurement of a TEG prototype for heavy-duty vehicles applications. The thermoelectric module area corresponds to approximately 1370 cm² and consists of 144 segmented thermoelectric high-power modules based on bismuth telluride and skutterudite. The experimental setup enables the validation of the technology thermoelectric up to technology readiness level 5, which is rare in scientific publications on a 1:1 scale. The measured performance data of a functional prototype will be presented, as well as the electrical output power and compared with the simulated values.

As a result, the simulative holistic design method of thermoelectric generators developed at the DLR Institute of Vehicle Concepts is successfully verified. In the measurement points performed, the accuracy of the simulated temperatures reaches in average more than 98%. The accuracy of the simulated output power is in average more than 94% and the minimum deviation is only -0.5%. The maximum electrical output power of 2,700 W could be measured at hot gas inlet temperature of 745 °C, mass flow of 0.25 kg/s, coolant inlet temperature of 20 °C and volume flow of 0.5 dm³/s. A significant improvement in the system level of thermoelectric generators for heavy-duty vehicles could be reached and the power density of the system could be increased to 174 W/kg and 326 W/dm³ compared to the state of the art based on the experimental measured values.