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# Trade-off in Thermoelectric Generator design for vehicle application

Kerstin Oetringer M. Eng.*, Martin Kober Dipl. Ing.

*Institute of Vehicle Concepts, German Aerospace Center (DLR), Pfaffenwaldring 38-40, 70569 Stuttgart, Germany*

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In designing a Thermoelectric Generator (TEG) there is a trade-off between thermoelectric power generation and additional effort to operate a TEG in automotive environment. This publication examines the influence the choice of the design point has to this trade-off.

The institute of vehicle concepts in Stuttgart belongs to the research field "Traffic and Transportation" in the German Aerospace Centre. The activities at the institute contribute to the sustainable development of technological systems for future generations of vehicles. In the field of alternative energy converters, exhaust waste heat recovery by means of Thermoelectric Generators is one of the research areas aimed to raise energy efficiency.

Since 2005 a promising TEG-development is taking place at the institute of vehicle concepts. Many successful projects in this topic have led to the third generation of Thermoelectric Generators for vehicle applications. One of the possible applications of this TEG is a Range-Extended-Electric-Vehicle (REEV). The less transient exhaust properties along with the increase of load of the operating points for the combustion engine promise an even higher potential for thermal recuperation in these vehicles.

Even though materials and modules are basic fundamentals for thermoelectric energy conversion in vehicles, the DLR demonstrated the immense potential of a purposeful design. This is because, beside the positive effect of electrical feed-in, a TEG has negative effects as well. It will for example cause backpressure in the exhaust system and additional weight. The result is a trade-off between TEG power output and additional effort to operate the TEG.

A key point in facing this challenge is the choice of the design point, consisting of temperature and mass flow of the exhaust gas, on which the development of the TEG is based. Along with the invention of a highly integrated design the DLR was able to increase the power density of the TEG and move the trade-off curve to be more suitable for the application. Our procedure of selecting the design point assuming a REEV as application will be presented and the influences of varying design points will be discussed.

**Keywords**: Thermoelectric Generator; waste heat recovery; vehicle application; design point