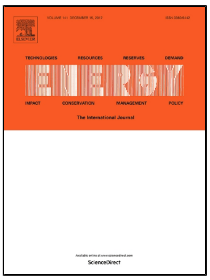
Accepted Manuscript



Modeling of a hybrid electric heavy duty vehicle to assess energy recovery using a Thermoelectric Generator

Nischal Muralidhar, M. Himabindu, R.V. Ravikrishna

PII:	S0360-5442(18)30251-2
DOI:	10.1016/j.energy.2018.02.023
Reference:	EGY 12323
To appear in:	*Energy*
Received Date:	03 July 2017
Revised Date:	25 January 2018
Accepted Date:	06 February 2018

Please cite this article as: Nischal Muralidhar, M. Himabindu, R.V. Ravikrishna, Modeling of a hybrid electric heavy duty vehicle to assess energy recovery using a Thermoelectric Generator, *Energy* (2018), doi: 10.1016/j.energy.2018.02.023

Modeling of a hybrid electric heavy duty vehicle to assess energy recovery using a Thermoelectric Generator

Nischal Muralidhar[a], M. Himabindu[a] and R. V. Ravikrishna[a,*]

[a]Department of Mechanical Engineering, Indian Institute of Science, Bangalore, India.
* Email: ravikris@iisc.ac.in

Abstract: Conventional internal combustion engines exhibit efficiency in the range of 30%-40%. A significant portion of the remaining energy is dissipated as exhaust heat, some of which can be recovered using thermoelectric generators to reduce fuel consumption and CO_2 emissions. The current study evaluates the benefits of using thermoelectric electric generators in hybrid electric vehicles over a prescribed drive-cycle. Specifically, a hybrid electric bus was first modeled over a realistic urban drive-cycle. Engine operating parameters such as torque and speed were extracted and provided as inputs to an engine simulation model. A virtual thermoelectric generator was then modeled using the Matlab/Simulink architecture to evaluate the quantity of energy that can be recovered based on inputs from the engine simulation model. Simulations were carried out to accurately assess the amount of fuel savings achieved due to the use of the thermoelectric generators system. From the analysis, it was observed that a fuel saving of 7.2% and 6.5% can be achieved with the use of Skutterudite and Silicon Germanium-based thermoelectric generator systems, respectively. It was also observed that the additional weight of the thermoelectric generator system had a negligible effect on the fuel consumption.

Keywords: Thermoelectric generator, hybrid electric vehicle, fuel savings, emission reduction, Skutterudites

List of Abbreviations

α - the Seebeck coefficient

$\overline{\alpha}$ – Average Seebeck coefficient over a given temperature rage

ANL - Argonne National Laboratory

ATEG – Automotive Thermoelectric Generator

CAT – Catalytic Converter

CO2 – Carbon Dioxide

DC – Direct Current

EMF – Electromotive Force

FOM – Figure of Merit