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Improvement potentials for user-centrically designed electric vehicles: The QUIET Project

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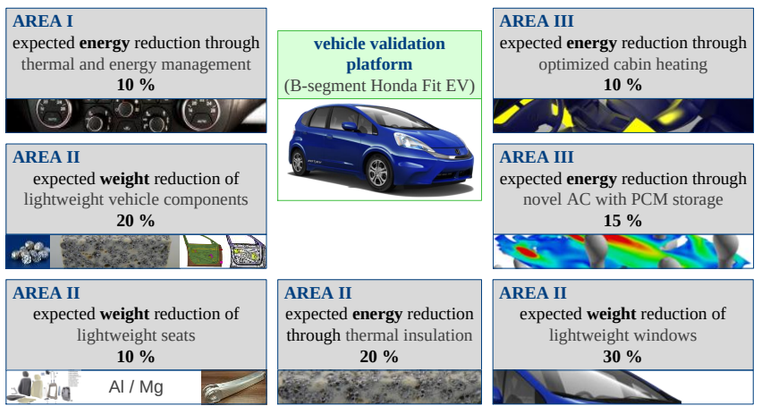
Introduction

In order to achieve higher market shares, electric vehicles must deliver better performance by overcoming the limited driving range due to the still limited capacity of the battery systems.

To enhance the driving range, synergies in the areas of optimized vehicle energy management, lightweight materials (incl. better thermal insulation) and user-centric design (incl. passenger comfort and safety) have to be exploited.

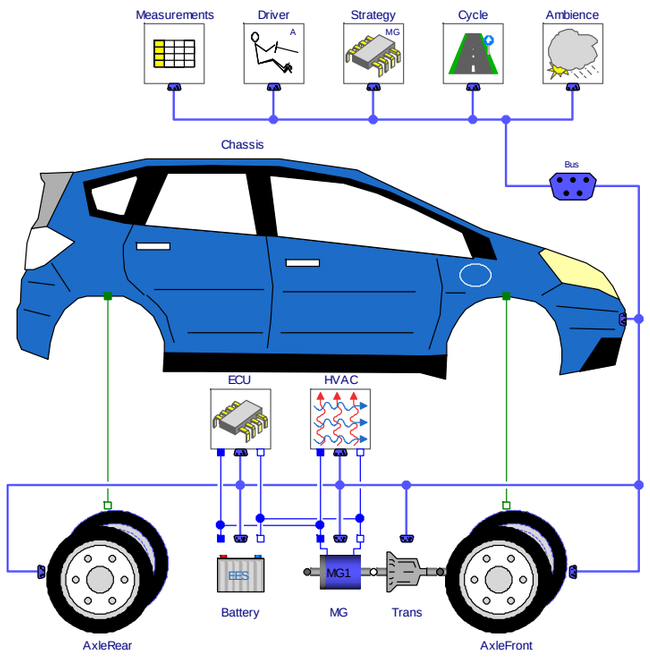
Motivation

- Reducing the energy required for the thermal management system for all weather conditions
- Developing novel, innovative components and lightweight materials
- Increasing thermal passenger comfort



Methodology of the QUIET project

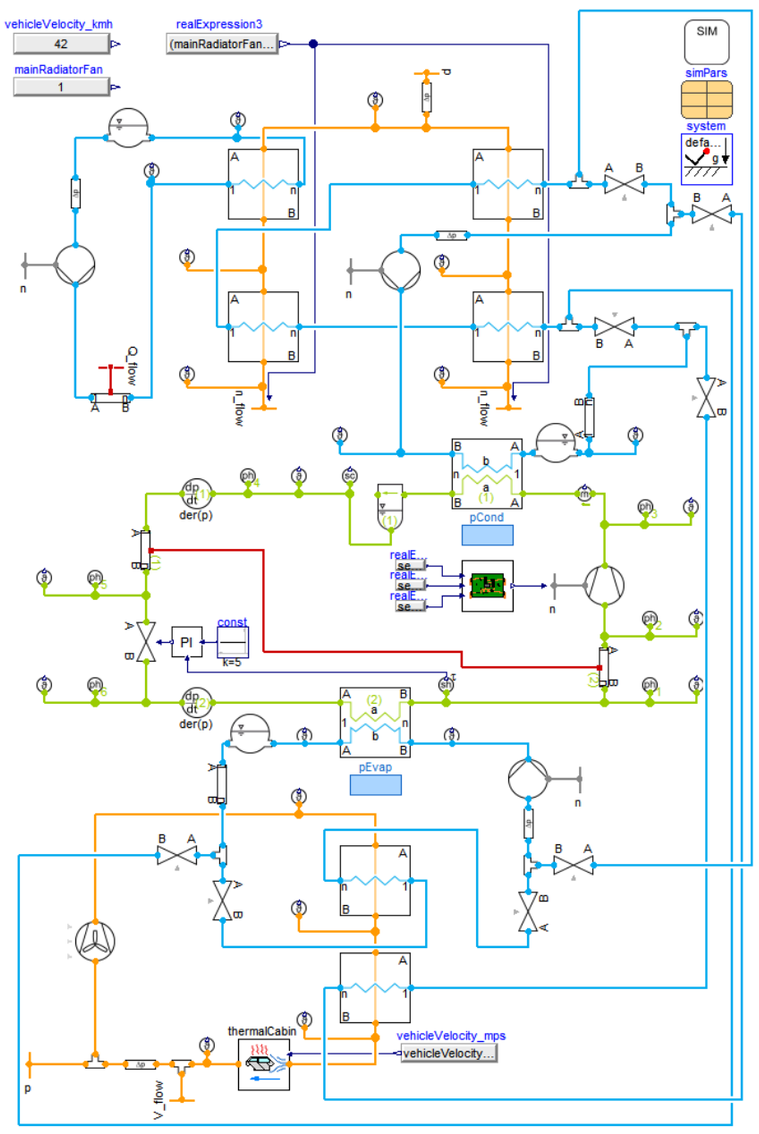
Simulation models are the basis for analysing the synergetic effects of different subsystems, and to estimate the entire EV's energy consumption.



Simulation approach

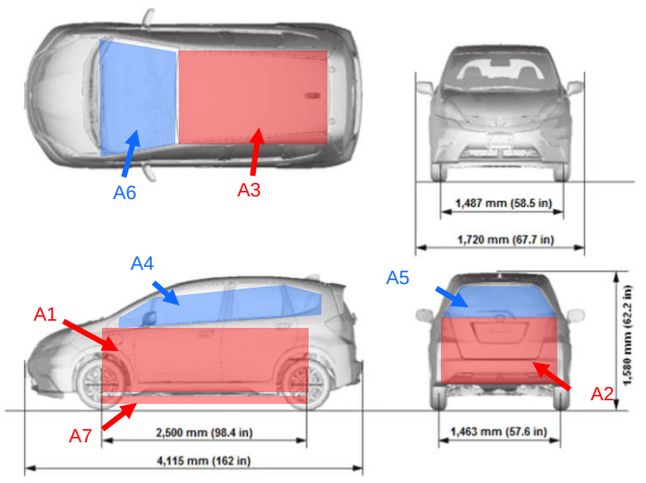
The baseline measurements of a Honda Fit EV were the benchmark for determining optimization potentials and for quantifying the targeted efficiency improvements of the vehicle.

To find improvement potentials of the vehicle, a virtual analysis of the potential of the proposed innovations was performed by means of an entire 1D vehicle model and a Propane-based (R290) HVAC model (both implemented in Dymola / Modelica, using components from the Modelica Standard Library and TIL Suite).



Improvement potentials

To identify the energy flows of the reference EV and the improved QUIET vehicle, the Modelica models were validated and used to fine-tune various key parameters (e.g. the weight of vehicle components). By systematically varying the key parameters, the outperforming impacts on the maximum driving range became visible.



Results and discussion

The validation showed that the models can reproduce the real operating behaviour of the vehicle. Furthermore, the correlation of expected enhancements to possible improvement potentials for the reference EV was elaborated by carrying out variation simulations.

The improvement potential by using polycarbonate instead of glass windows indicated, that the cabin temperature could be reduced by approximately 0.5 K compared to the baseline car, when using the same air conditioning power of the baseline vehicle.

Under the assumption of a weight reduction of the vehicle of about 75 kg the simulation results show that reducing the cooling energy by 45 % (in hot weather conditions: +40 °C) would lead to a driving range increase of about 10 % (baseline driving range is 137 km). Reducing the heating energy by 40 % (in cold weather conditions: -10 °C) would lead to a driving range increase of about 27 % (baseline driving range is 68 km).

Get in touch with QUIET!
www.quiet-project.eu

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