sccer mobility

www.sccer-mobility.ch

In cooperation with the CTI

Energy
Swiss Competence Centers for Energy Research

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Commission for Technology and Innovation CTI

Non-propulsive Energy Demand of Passenger Cars

Gil Georges, LAV ETH Zurich – Capacity Area A3
✉ georges@lav.mavt.ethz.ch

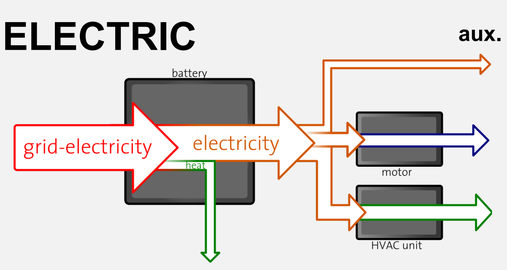
ETHZ-LAV Activities in CA-A3

In modern cars, there is a large array of non-propulsion relevant devices (lighting, entertainment, ...) that draw significant amounts of power. In conventional vehicles, heating is generally "for free" as the necessary energy can be drawn from the engine's waste heat stream. In battery electric vehicles, that is no longer possible. Heating (and cooling) thus impacts an EV's autonomy range (resp. increase its energy demand). Within CA-A3, ETHZ LAV investigates means of quantifying the resulting demand, as well as ways to reduce it.

INTRODUCTION

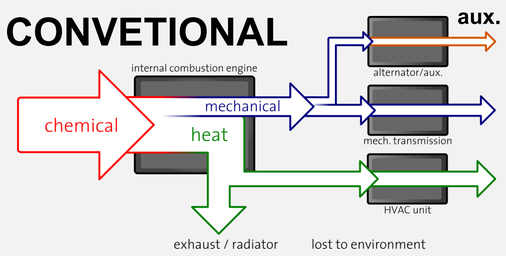
Heating: the issue with electric systems

ELECTRIC



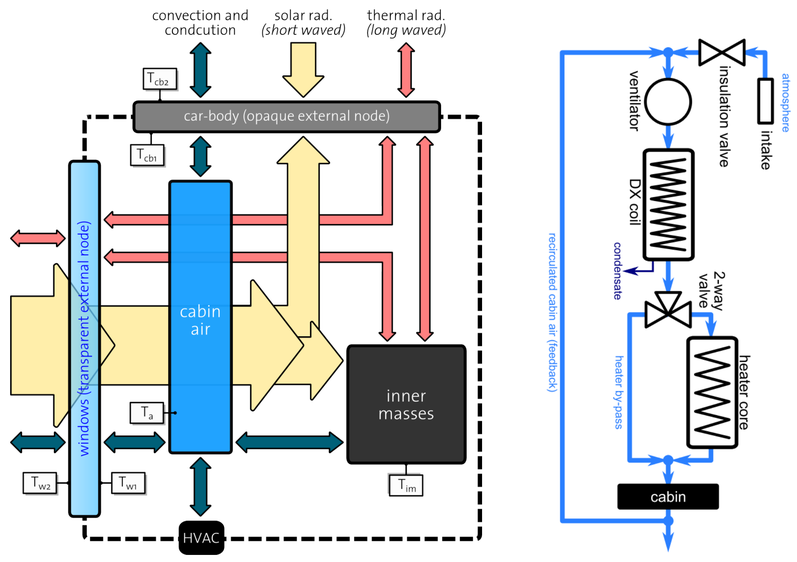
Auxiliaries → battery current
Heating → battery current
➔ *auxiliaries → higher consumption*
➔ *higher currents reduce efficiency*
➔ *Heating competes with propulsion system over battery charge*

CONVETIONAL



Auxiliaries → alternator
Heating → ICE's waste heat
➔ *auxiliaries → higher consumption*
➔ *higher load improves efficiency*
➔ *heating is "for free" (no feedback on ICE performance)*

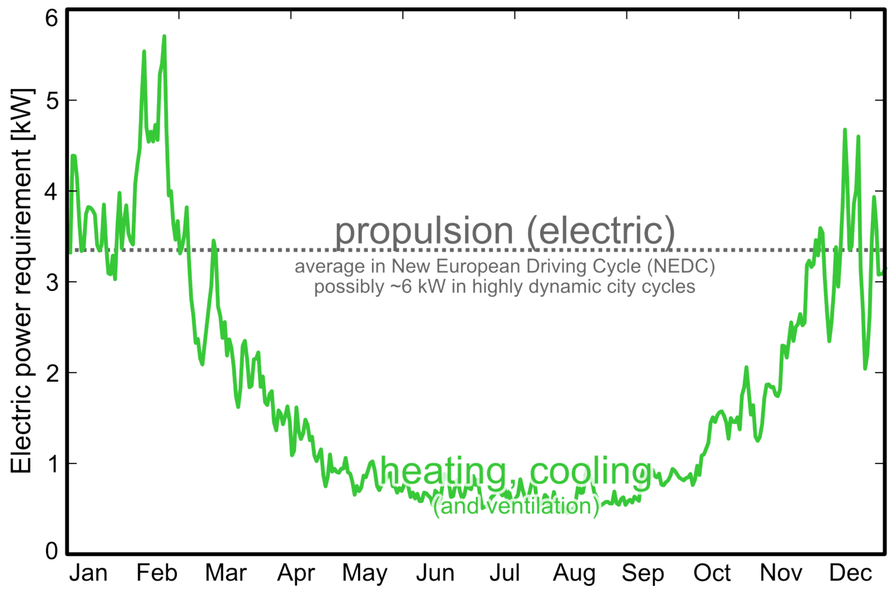
Thermal model of the cabin / HVAC system



G. Georges, Investigation of the Propulsive and Non-Propulsive Energy Demand of Passenger Cars with Emphasis on Electric Propulsion Systems, Diss. ETH No. 22057, doi: 10.3929/ethz-a-010284214

Average HVAC energy demand

Accounting for average weather conditions and driving behavior in Zurich City, the daily average heating/cooling energy demand was calculated (cf. above reference)



About us

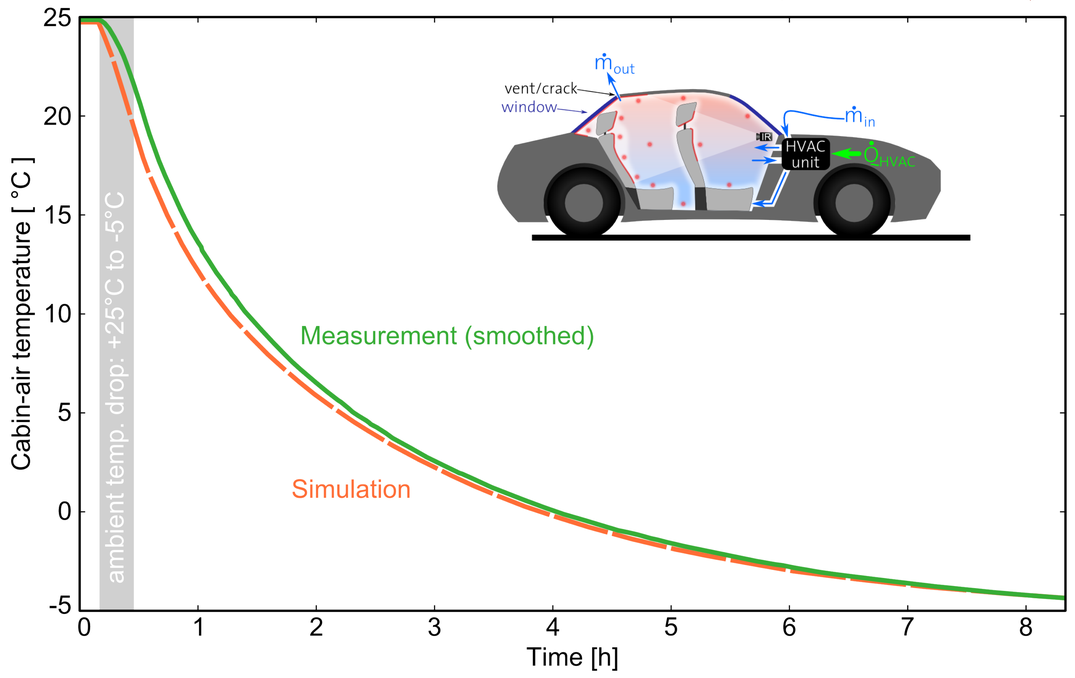
Energy Systems Group @ LAV,
Aerothermochemistry and Comb. Syst. Lab.
Institute for Energy Technology
ETH Zürich
Prof. Konstantinos Boulouchos

LAV energy systems group ETH zürich

LAV's energy systems group specializes in the technology assessment of energy conversion technologies and the analysis of interconnected energy ecosystems, including mobile systems and their supporting infrastructure(s). Further activities revolve around stationary power generation, in particular decentralized, biogenic CHP plants.

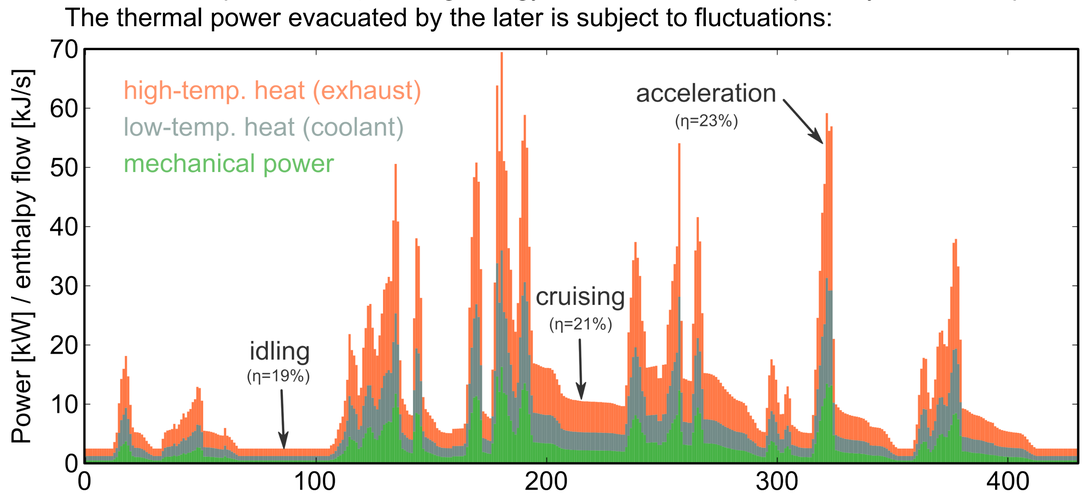
HIGHLIGHTS

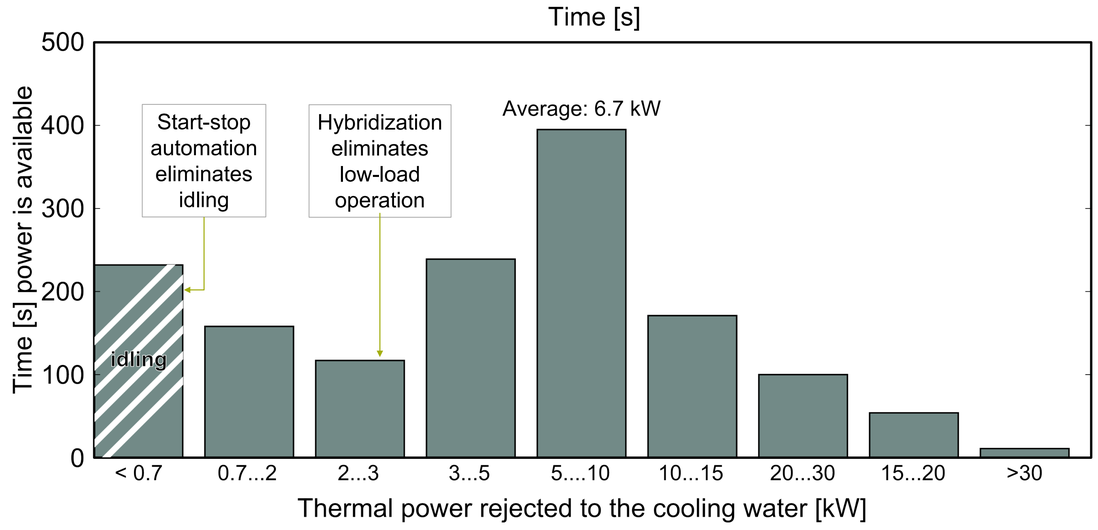
Experimental validation



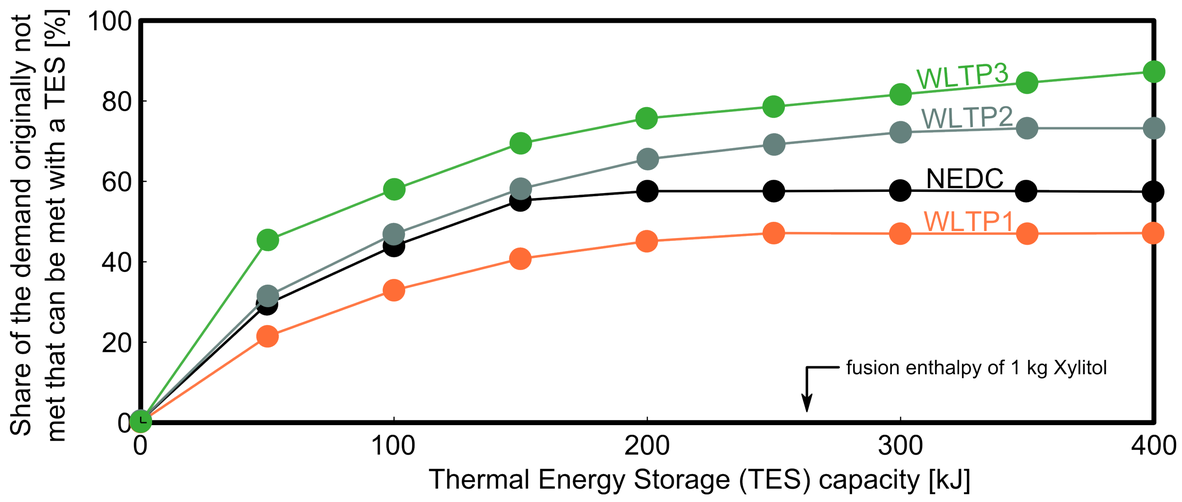
Heat rejection in a conventional powertrain

In ICE-based powertrains, heating energy is extracted from the primary coolant loop. The thermal power evacuated by the later is subject to fluctuations:





To compensate for gaps in energy provision, a phase change material can be used as Thermal Energy Storage (TES). This allows to quickly achieve and then maintain thermal comfort within the cabin, even if the ICE is operated transiently.



OUTLOOK

- Joint project with EMPA-ICEL → real-world energy demand of (alternatively propelled) passenger cars, incl. HVAC
- Extension to other vehicle types (incl. busses)
- Passive demand reduction (intra-CA-A3 cooperation)