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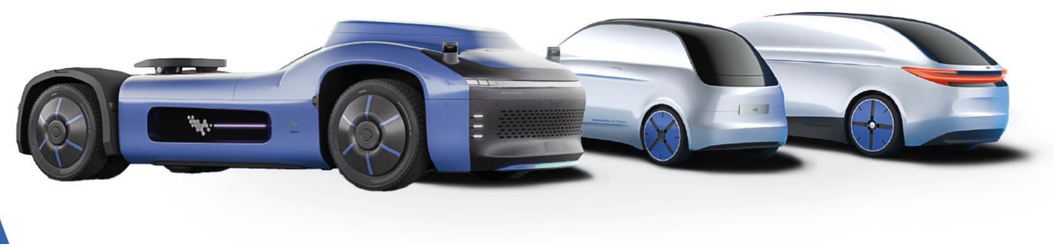

Poster No. 2-3

Expanding existing Vehicle-to-Everything (V2X) Communication to transmit Electric Vehicle Data to Local Energy Management Systems

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Motivation

Challenges in renewable energy integration:

- Volatility of energy resources
- Timing mismatch with energy demands

Solution through sector coupling: The available infrastructures that contain energy resources can be utilized by integrating electricity, heat and transport sectors [1].

Electric vehicle (EV) for sector coupling: Excess energy from renewable energy can be used to charge EVs. In addition, EVs can supply energy to a local energy system with the aim of increased flexibility [2, 3].

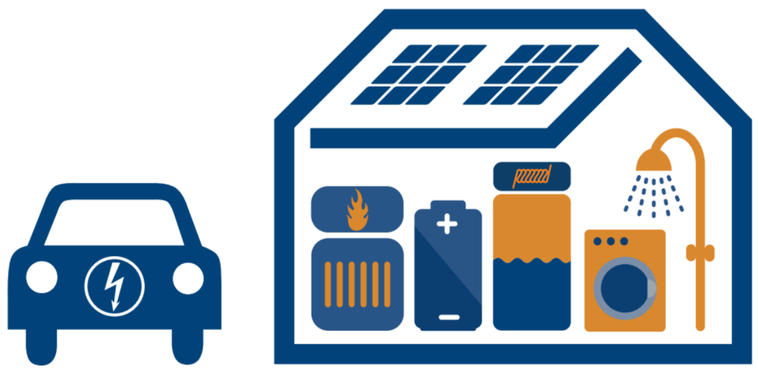

Figure 1. Use of electric vehicle to supply energy to a residence (local energy system).

Main research question: How to communicate relevant data from an EV to a local energy management system (EMS) ?

Methods

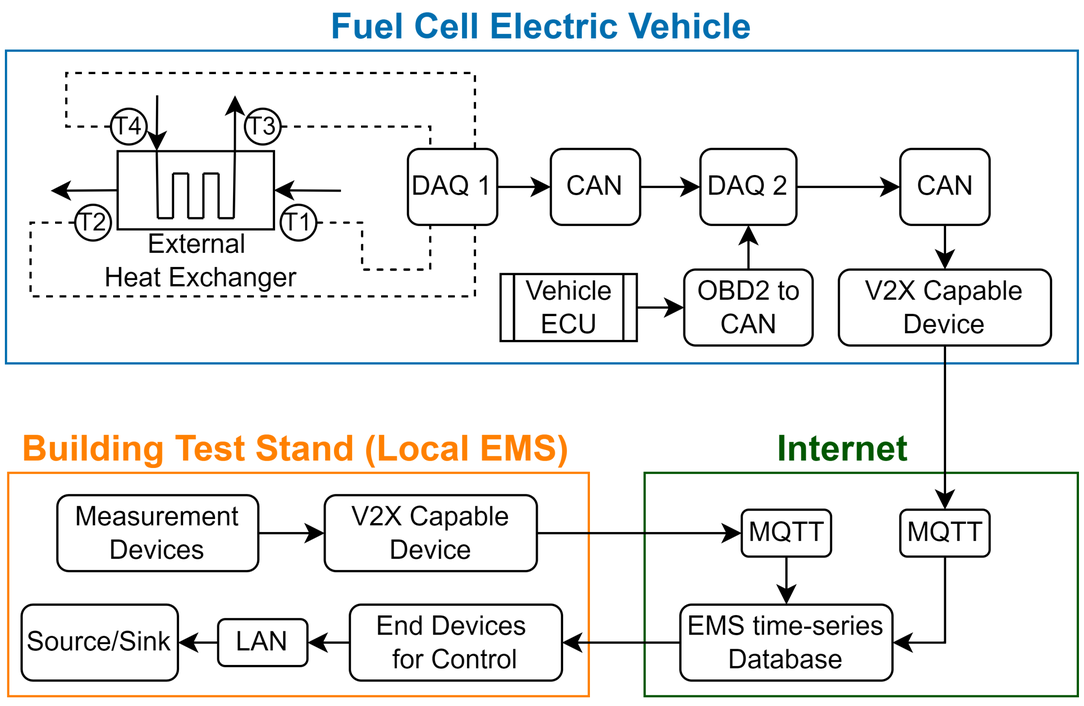

Figure 2. Planned, installed and tested interface for communication between the vehicle and the building test stand (local EMS). CAN: Controller Area Network; ECU: Electronic Control Unit; OBD2: On-board Diagnostics; MQTT: Message Queuing Telemetry Transport; LAN: Local Area Network.

A fuel cell electric vehicle (FCEV) was used as a stand-in for a battery electric vehicle. An external heat exchanger and an electrical coupling was mounted in the vehicle for heat and electricity supply to the building test stand.

Temperatures (T1, T2, T3, T4) measurements from sensors were sampled to the Data Acquisition Module (DAQ) 1. DAQ 2 sampled signals from the vehicle's ECU. A V2X capable device and communication protocols (CAN, OBD2, MQTT) were used to send data to the energy management system (EMS), which controls and decides on optimal energy flows.

Results

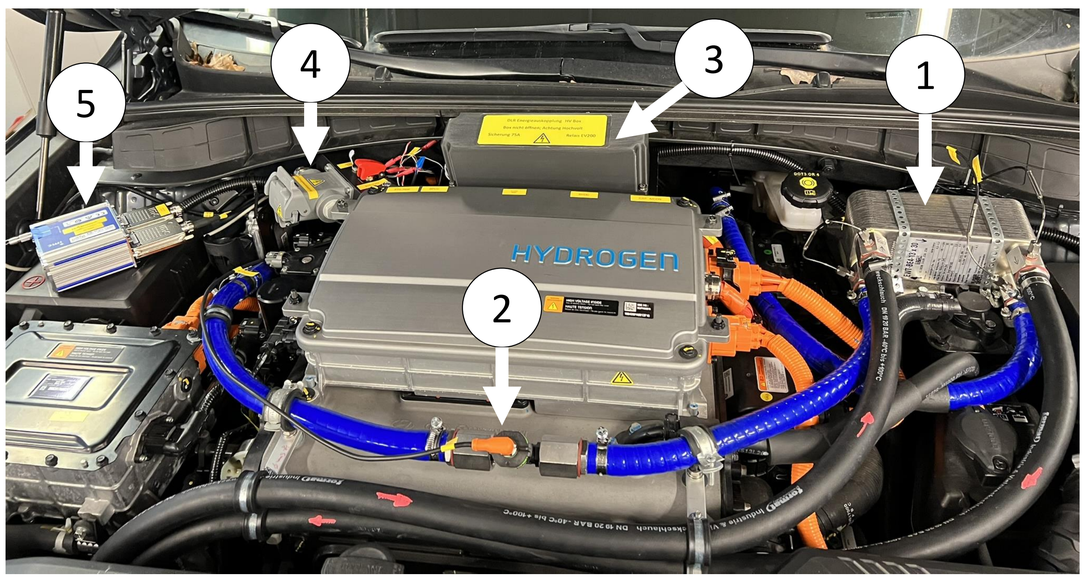

Figure 3. Overview of the installed components under the bonnet of the FCEV: (1) heat exchanger; (2) volumetric flow sensor; (3) electrical switch box; (4) high-voltage connector; (5) data acquisition module.

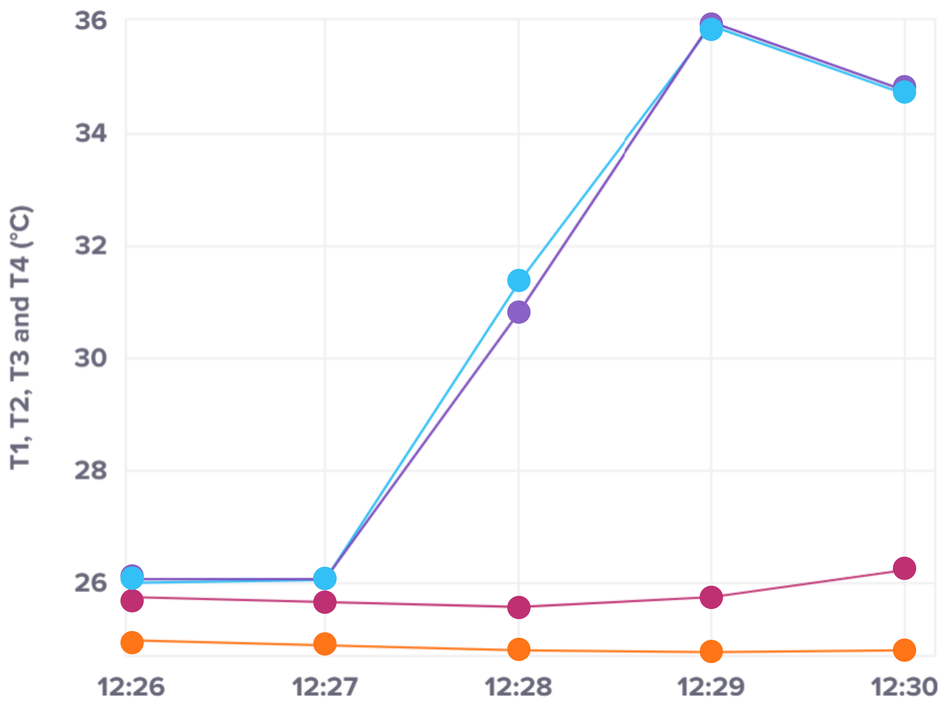

Figure 4. Measurements of temperatures T1 (cyan), T2 (purple), T3 (pink), and T4 (orange) at the heat exchanger. Graph from InfluxDB (EMS time-series database). Measurement performed on 17.10.2024. Data transferred from FCEV to the EMS.

Conclusions

- The proposed communication scheme enables the transfer of real time data from the vehicle to the building test stand
- The use of Vehicle-to-Everything devices and an EMS creates opportunities to increase flexibility in the local energy system

Acknowledgments

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[2] N. Reininghaus, T. Tiedemann, M. Kröner, and M. Vehse, "Exploring the Feasibility of Battery Electric and Fuel Cell Electric Vehicles as Peaker Plant Substitutes at Low Wind and Irradiation Conditions," *Transportation Research Procedia*, vol. 70, pp. 292–298, 2023, doi: 10.1016/j.trpro.2023.11.032.
[3] T. Tiedemann *et al.*, "Supplying electricity and heat to low-energy residential buildings by experimentally integrating a fuel cell electric vehicle with a docking station prototype," *Applied Energy*, vol. 362, p. 122525, 2024, doi: 10.1016/j.apenergy.2023.122525.

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