



Integration of Overhead-line Technology in Battery-electric Series Heavy-duty Trucks

Gordon Witham
Institute for Automotive Engineering (ika), RWTH Aachen University

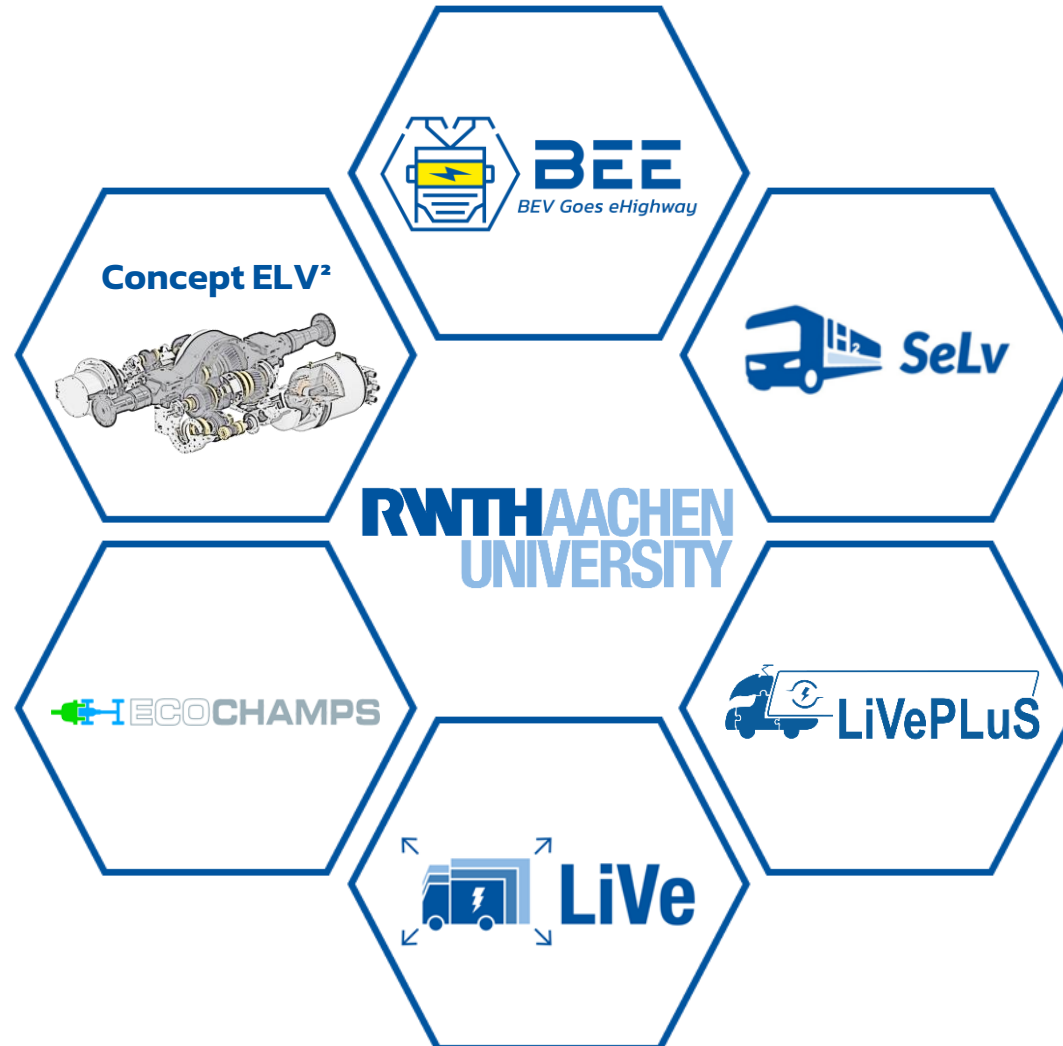
European Electric Road Systems' Symposium – Berlin, Germany – 15.02.2023

Agenda

- HDV and ERS Projects @ RWTH
- The BEE Project
- Project Outlook



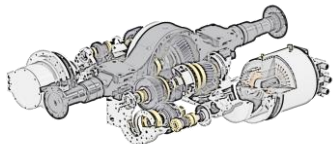
HDV and ERS Projects @ RWTH





Electric trucks in heavy urban distribution traffic

- **Application scenario:** Urban distribution traffic
- **Gross weight:** 26 t – 41 t
- **Research focus:** Battery-electric powertrain, user interaction, requirements of urban distribution traffic



European COmpetitiveness in Commercial Hybrid and AutoMotive PowertrainS

- **Application scenario:** Cars and HDV
- **Gross weight:** 3.5 t – 41 t
- **Research focus:** Efficient, lightweight, compact and durable hybrid powertrains



Development of test methods for electrified heavy duty powertrains for standardisation based on multi-physical hardware-in-the-loop test benches

- **Application scenario :** Long-haul
- **Gross weight:** 41 t
- **Research focus:** Purpose-designed electric drive axle with application-specific suspension system



Lifecycle cost reduction in electrical distribution transport by means of an adaptable drivetrain

- **Application scenario:** Urban distribution traffic
- **Gross weight:** 7.5 t – 18 t
- **Research focus:** Battery-electric, hydrogen and pantograph-based powertrains



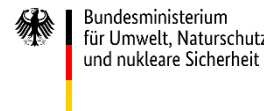
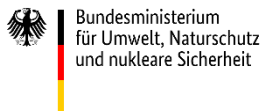
Life cycle cost reduction in electrical distribution traffic through catenary trolley based electrification systems for tractor units

- **Application scenario:** Long-haul
- **Gross weight:** 35 t
- **Research focus:** Pantograph-based tractor unit



Heavy goods vehicles for emission-free logistics in heavy goods traffic by means of an electrification kit and economical production system

- **Application scenario:** Long-haul
- **Gross weight:** 40 t
- **Research focus:** Hydrogen powertrain



The BEE Project

Project details

Duration: 01/2022 – 12/2024
Funding: ~ 5,9 Mio. €

- 2 university institutes (ika, PEM)
- 6 work packages
- 2 prototypes
+ 1 reference vehicle
- 4 test fields in Germany
- Several associated partners for user studies

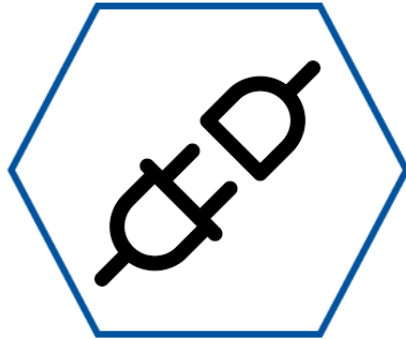


Associated partners:



The BEE Project

Project goals



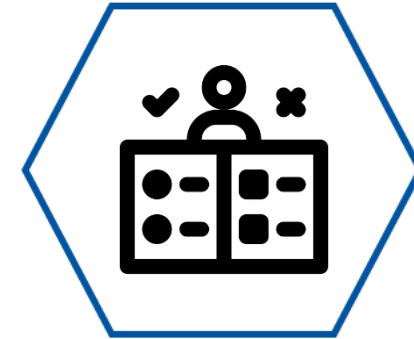
Interface development

Development of a system interface for the standardised integration of overhead-line technology together with vehicle and component manufacturers



Real-world testing

Test drives on public roads with vehicles of different powertrains for technology assessment in the field



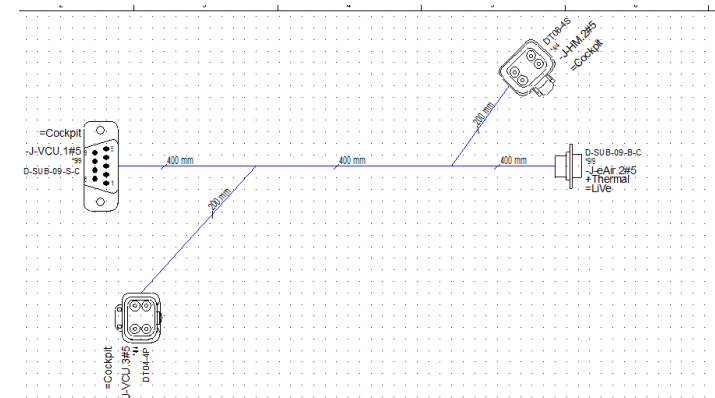
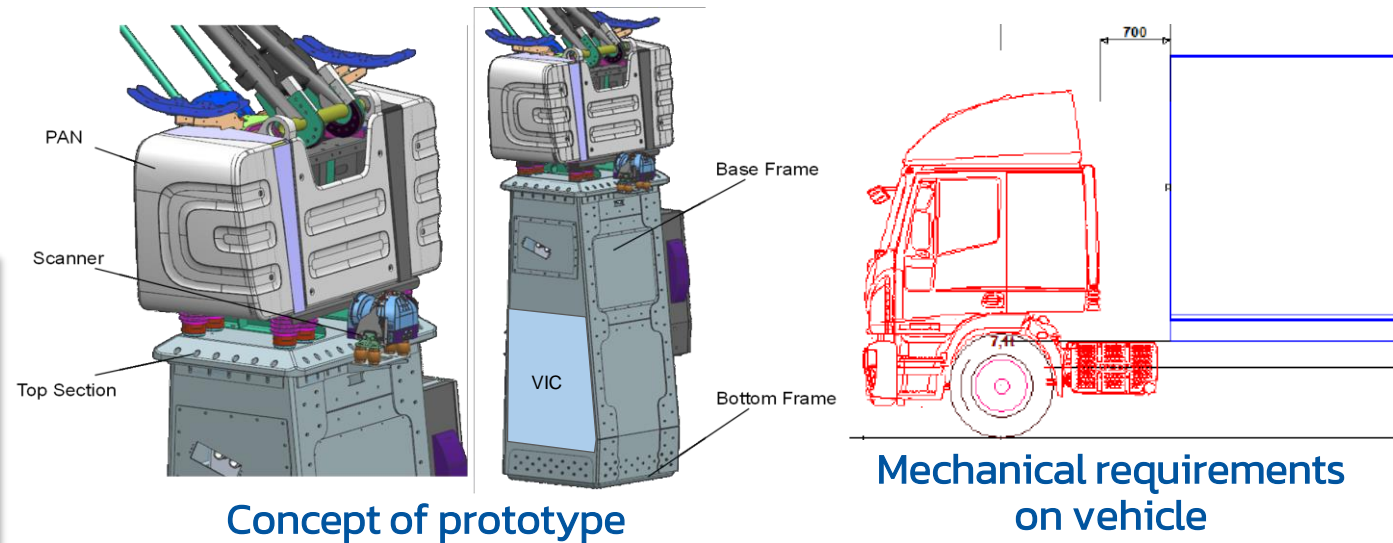
User acceptance

User studies with drivers from the logistics industry as well as additional stakeholders to complement the practical evaluation

The BEE Project

Interface analysis

- *Investigation of possible pantograph interfaces for integration into series vehicles*
- *Development of a mechanical concept*
- *Identification of required vehicle specifications (mechanics, software, E/E)*
- *Analysis of potentials regarding TCO, GWP and battery downsizing*



Interface selection and definition

The BEE Project

Real-world testing

Base vehicle: DAF XD FAN

Gross weight: 28 tonnes

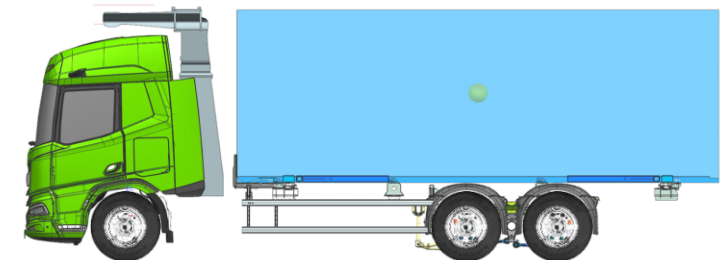
- ***3 powertrain technologies***
- ***Same platform and cabin***
- ***Testing at overhead-line test fields on public roads***
- ***Fleet data from real logistics trips***
- ***Development of a digital twin based on real driving data***



**Diesel
(Series)**



**Battery-electric
(Series)**

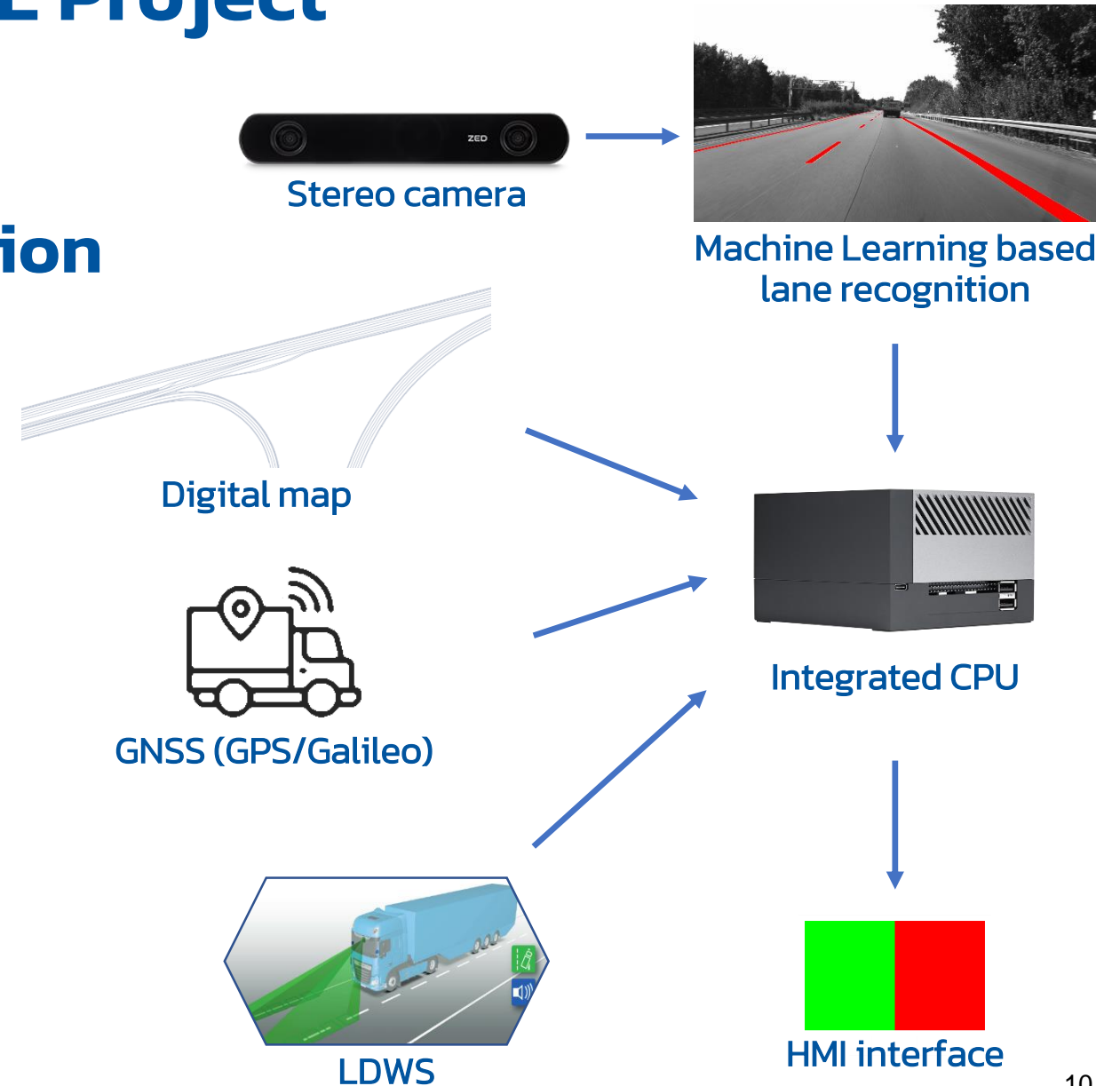


**Battery-electric with pantograph
(Prototype)**

The BEE Project

Lane and overhead-line detection

- **Automated lane (change) and overhead-line detection**
- **Cost reduction through in-house development**
- **Integration of lane departure warning system (LDWS) for redundancy**
- **Connection to HMI interface**
- **Computing performed fully in vehicle**



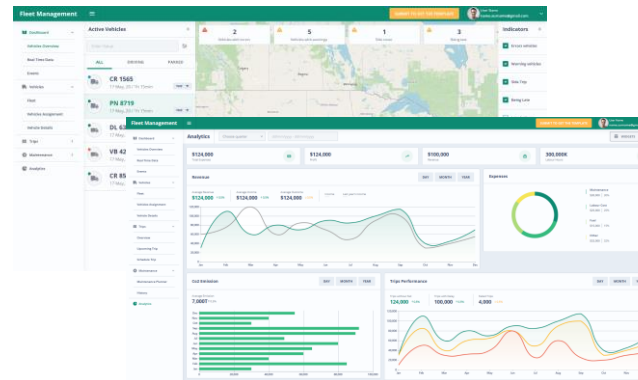
The BEE Project

Route planning and fleet management

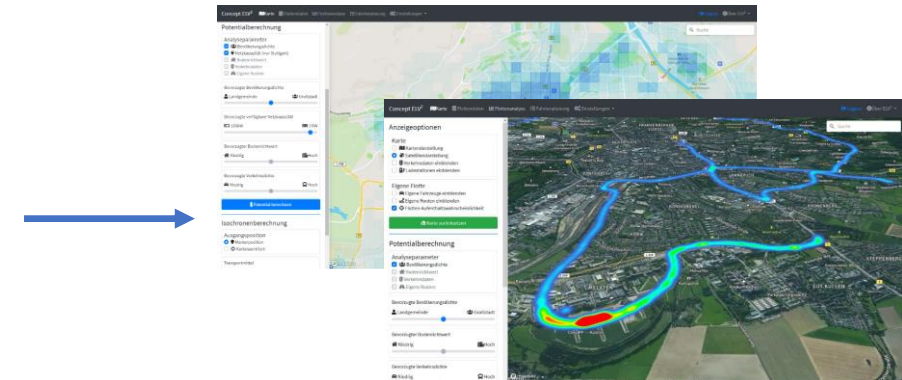
- *Analysis and comparison of route planning and fleet management solutions available on the market*
- *Design of a Fleet Management System (FMS) tailored to alternative drives*
- *Early consideration of the logistics industry's requirements*



Analysis of available tools



Design of FMS and optimisation of fleet



Further development of an existing approach

Project Outlook



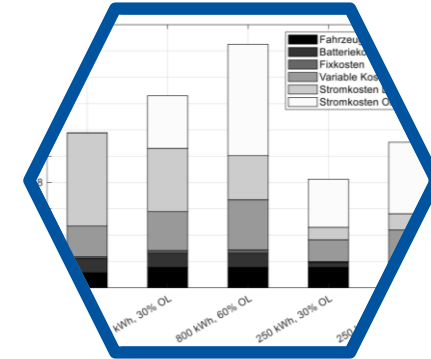
Building the prototypes 2023

Mechanical construction of the pantograph frame, integration into the vehicle powertrain, installation of measurement equipment



Real-world testing 2024

Test drives on closed test field first to qualify for operating license, measurements on public roads afterwards



Evaluation of technology 2024

User studies with drivers from the logistics industry as well as additional stakeholders to complement the practical evaluation

One more thing ...

To support our user studies, we are looking for interested stakeholders:

- To contribute to answering relevant research questions regarding overhead-line systems (experience with overhead-line systems required, online interview, approx. 1 hour),

Or:

- To participate in an online survey on technology acceptance and improvement possibilities regarding BEV trucks with and without overhead-line systems (experience with overhead-line systems not required).



**Interested? Contact us:
bee@ika.rwth-aachen.de**

Thank you for your attention!

Visit us at:
www.bee-ehighway.de



Gordon Witham M.Sc.



Institute for Automotive Engineering (ika), RWTH Aachen University

Email gordon.witham@ika.rwth-aachen.de

Internet www.ika.rwth-aachen.de

Supported by:



on the basis of a decision
by the German Bundestag