FC4HD
Fuel Cell Technology Demonstrator Truck

WIVA P&G Jahresveranstaltung

René Steinek

Diesel Trucks to be challenged

State-of-the-art Diesel long-haul Truck in Europe

+ around 450 hp
+ up to 4.500 km range, refill <15 min
+ low TCO → low cost of transport
+ highly efficient
+ maximum transport volume and payload
+ universal application (-30°C … +45°C ambient)

but

- CO_2 emissions 33 gCO_2/tkm payload
  (32 t comb. weight, 21,6 l/100 km, 17,5 t payload *)
- Euro VI → Euro VII emissions

Diesel trucks are highly efficient, but not Zero Emission.

How to combine leading edge performance and zero emission?

→ A solution can be Fuel Cell Electric Drive.

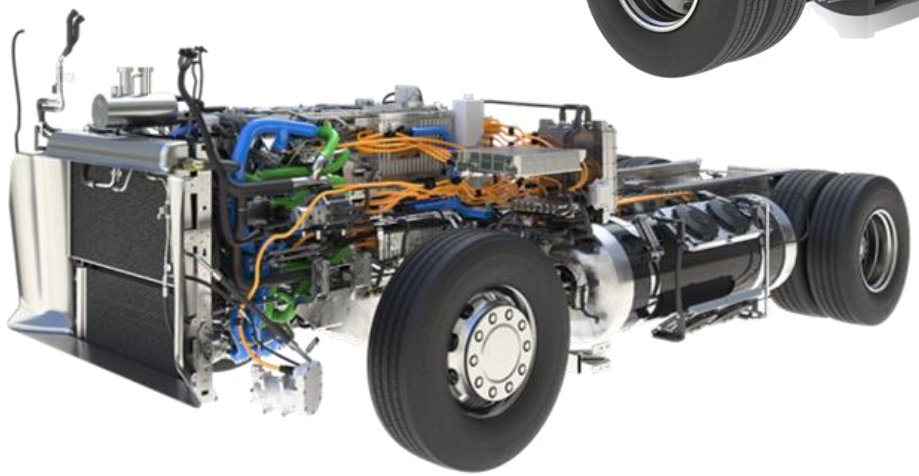
* reference: trucker 01/2023, SuperTest DAF XF 450

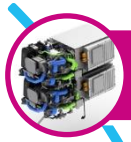
AVL Fuel Cell Technology Demonstrator Truck
Project Targets

Achieve Industry Ready Vehicle Usage

- 40 + 2 t Gross Combination Weight
- Real World Operation demonstrated with reference trip:
  typical demanding route in Austria (Graz – Wiener Neudorf – Graz)
- Range: 300 - 400 km
- Re-filling time: <15 min.
- Highway uphill driving w/o vehicle performance reduction
- **Same performance as standard EU diesel truck**

AVL Fuel Cell Technology Demonstrator Truck





FC System Integration — 308 kW

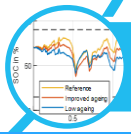
Battery System Integration — 72 kWh

Tank System Integration — 700 bar / 32 kg

eDrive Integration — 400 kW / 540 kWp

Thermal System Integration — 30°C ambient

EEA, FuSa, Security, EMC,
ECE R100, ECE R134 …

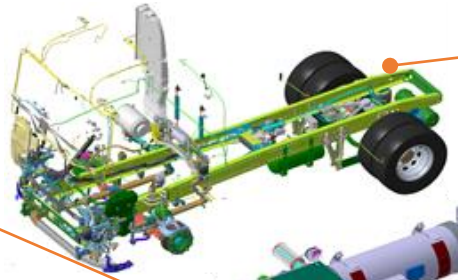


Energy Consumption — @40t GCW: <8 kg H_2 / 100 km

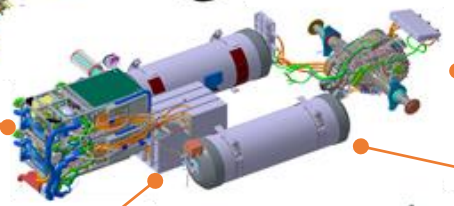
+ Single Type Approval

Vehicle Systems Geometrical Integration

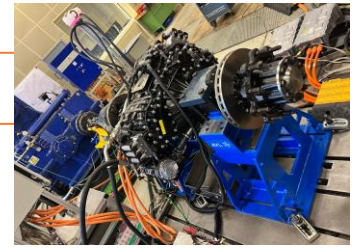
Donor Vehicle (DAF XF, 3.8m wheelbase, Diesel engine)



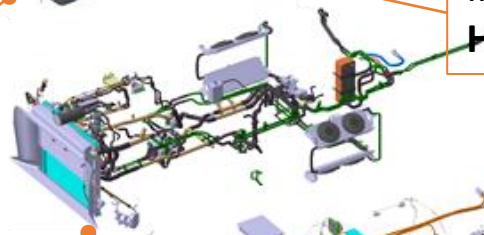
AVL **HD FC System**



Integration of AVL HD **E-Axle**



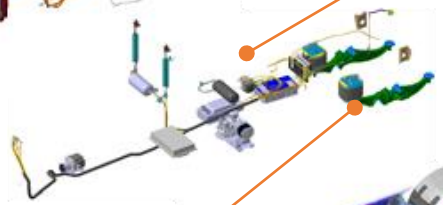
Integration of 700 bar **Hydrogen tanks**



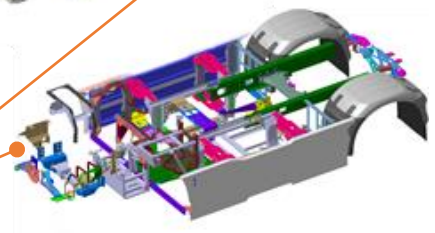
OTS Battery System

Advanced AVL **Thermal System**

Integration of **Brake Chopper**



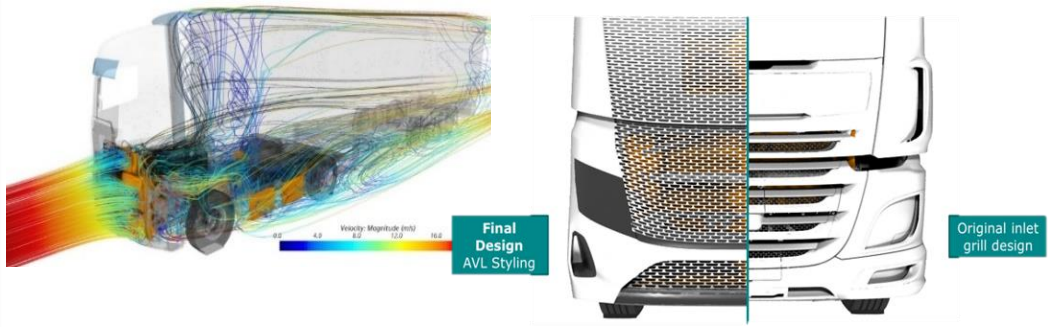
Power Electronics & E/E Integration



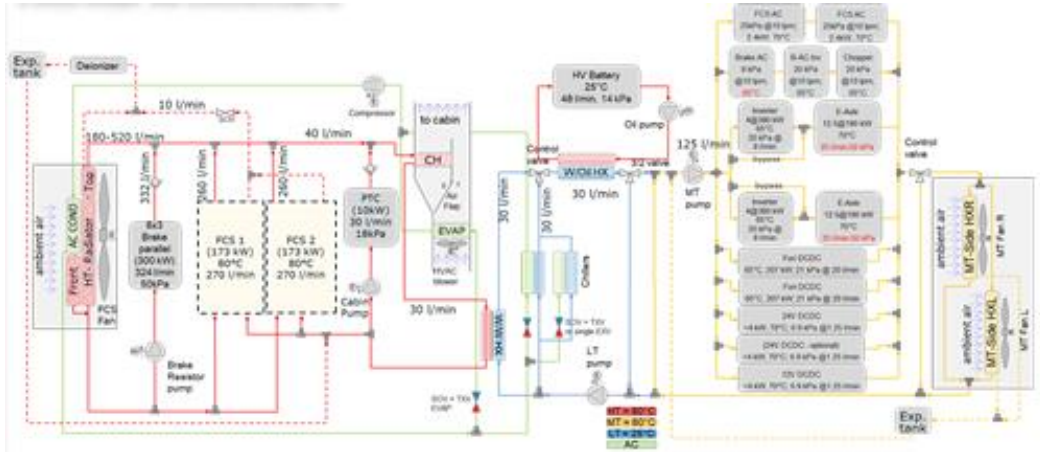
Adaption of Chassis Components (incl. Crash Simulation)

Vehicle Systems Thermal Integration

Thermal Simulation and Intake Optimization

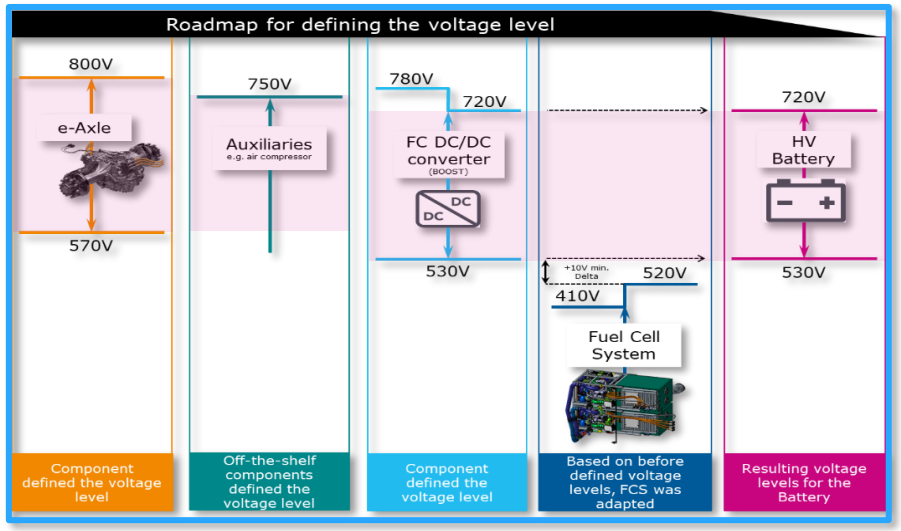


Thermal Architecture

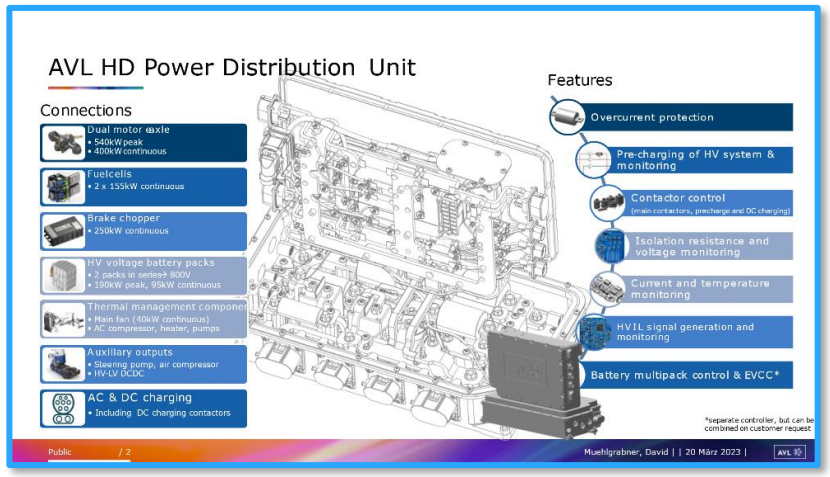


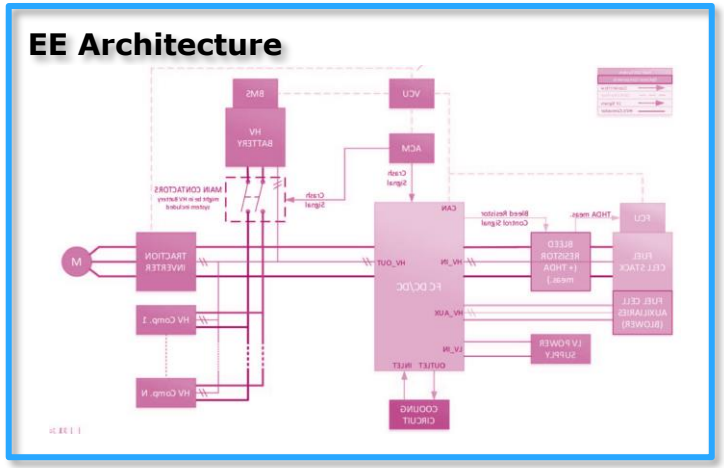
- Balancing of Heat sources and heat sinks
- Definition of relevant use cases and load cases for dimensioning of thermal components
- Definition of Thermal System and –Components Requirements
- Determination of cooling system capabilities and gap analysis to requirements

Vehicle Systems Electrical Integration



800 V DC Link
… more than 20 systems being connected





- Definition of HV-Requirements incl. HV Safety (ECE R 100)
- Definition of relevant use cases and load cases for dimensioning of electric components
- Sizing of electrical components (DC/DC, Batteries, Cables, PDUs)
- Calculation of overall ISO-Resistances, Y-Capacities, …
- Definition of required additional safety measures

Targets of Predictive Energy Management

Targets of Energy Management

- **Max. Vehicle performance**
- **Optimize H_2 efficiency / Range**
- **Optimize Component aging**

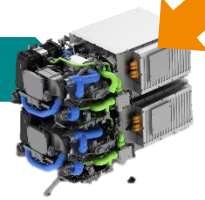
Predictive ENERGY MANAGEMENT

Power split between
- Fuel cell systems
- Battery system

Integration of Predictive Lifetime Management
- Integration in energy management
- Optimize component lifetime
- Keep high H_2 efficiency and vehicle performance

→ Reduce TCO for customer

Fuel cell characteristics

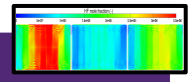


- System efficiency
- Component limits

→ Influenced by aging over lifetime

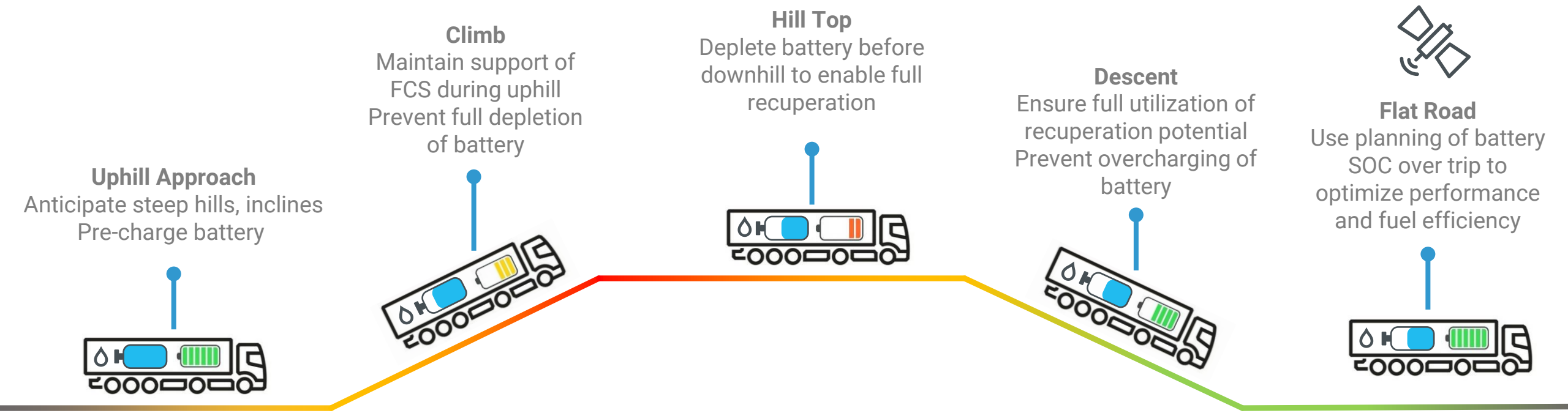
Battery characteristics
- System efficiency
- Battery capacity
- Component limits

→ Influenced by aging over lifetime



Predictive LIFETIME MANAGEMENT
- Optimization and balancing of component lifetime
- Ensure high H_2 efficiency and vehicle performance
- Optimization of TCO for customer

Pred. Energy Mgmt. - Use of digital 3D road maps and GPS



Sensors & Actuation

- Preview of route characteristics (altitude, speed limits, curvature, traffic, …)
- Powertrain states (actual gear, torques, battery SoC, etc.)
- Outputs power split between available energy sources (e.g. fuel cell & battery)
- Controls thermal system for efficient cooling and component health

* expected fuel savings depending on use-case and powertrain specification

Certified and on the Road by **mid of 2024**

Thank you!

Questions?