Decarbonizing Transport - AVL Heavy Duty Fuel Cell Demonstrator Truck

International Mobility Days 2023
#imdays2023

Josef Macherhammer

PEM FC … Polymer Electrolyte Membrane Fuel Cell
SOFC … Solid Oxide Fuel Cell
PEM EL … Polymer Electrolyte Membrane Electrolysis
SOEC … Solid Oxide Electrolysis Cell

AVL Fuel Cell and Electrolysis Solutions H_2 Ecosystem Implementation

PEM FC

#Mobility and Power Generation

- Automotive
- Marine
- Rail
- Aviation

SOFC

#Combined Heat and Power

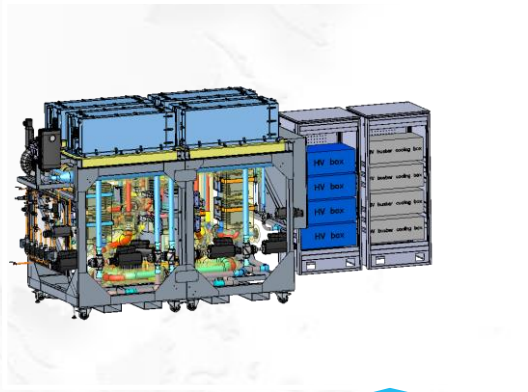
- Decentral Power
- BEV Charging stations
- Marine APUs

PEM EL

#Hydrogen Production

- Renewable Power Plants
- Decentral Hydrogen Production

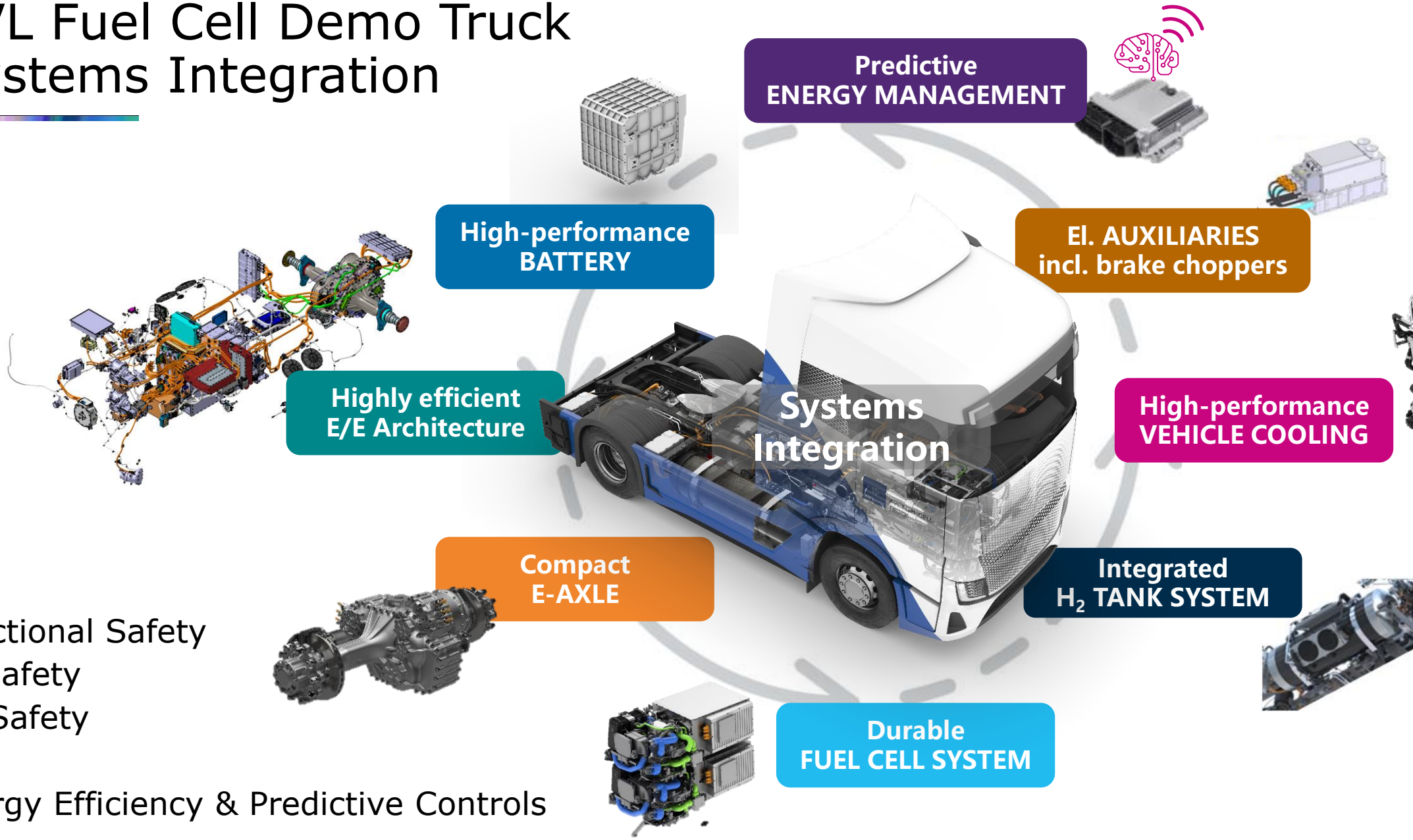
SOEC



#Hydrogen, Syngas and Power-to-X

- Industry
- Refining
- Synthesis
- Waste Heat Usage

AVL Fuel Cell Demo Truck Systems Integration

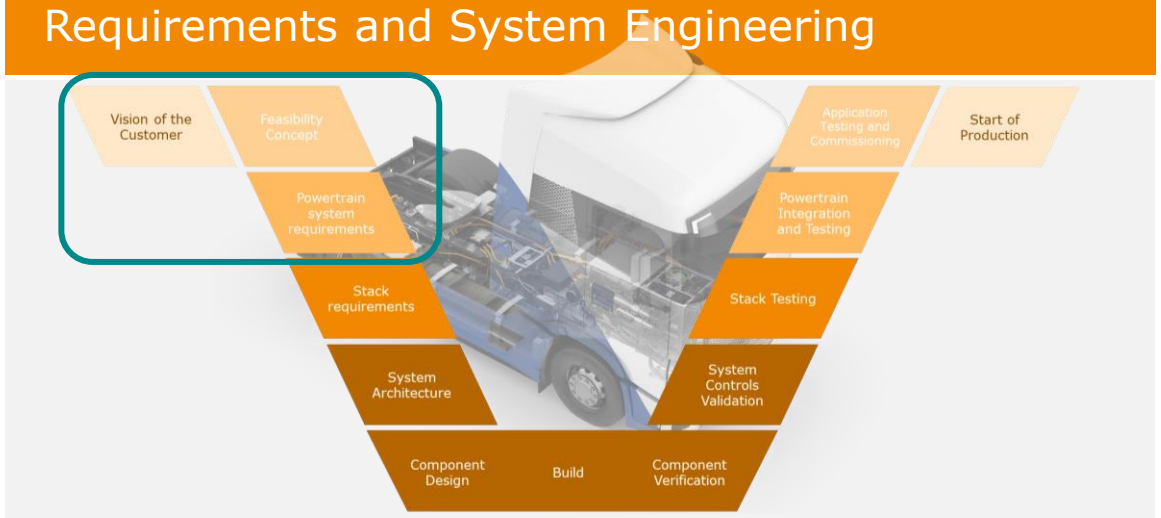


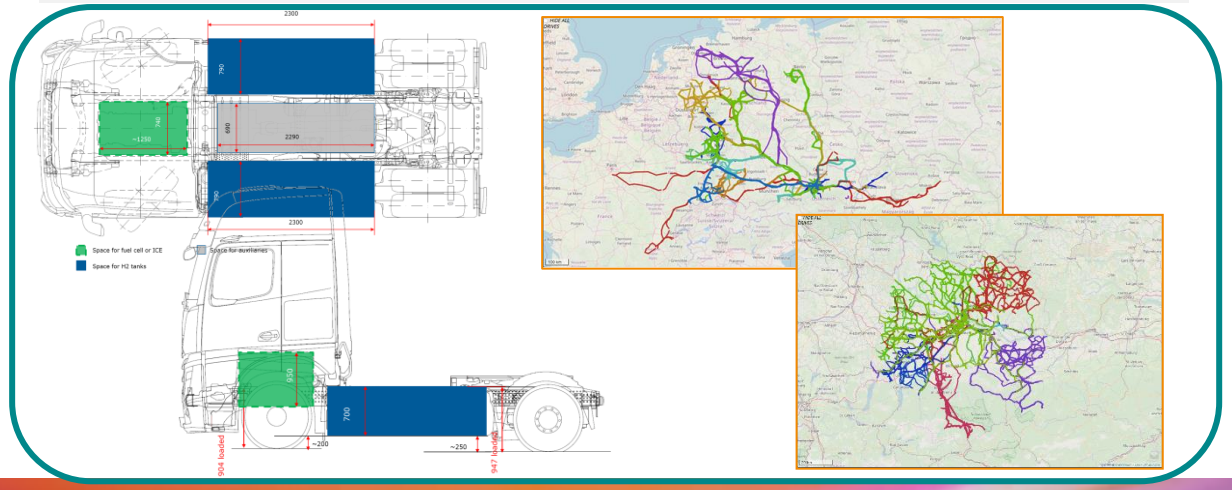
+ Functional Safety
+ H_2 Safety
+ HV Safety
+ EMC
+ Energy Efficiency & Predictive Controls

Fuel Cell Demo Truck Development

Development Approach

Requirements and System Engineering





Vehicle & Powertrain

- Define of desired **functionalities** (function-based approach)
- Define **packaging boundaries** based on existing vehicle platforms, safety considerations, weight distribution, etc.
  - Identify the common denominator
- Analyze **real-world driving** needs
  - Define the requirements for powertrain and its elements
- Optimize **vehicle energy management** and hybridization strategy considering TCO and durability

European 4x2 semitrailer tractor w/ sleeping cabin and a wheelbase of 3.8 m – the ultimate challenge?

Fuel Cell Demo Truck Development

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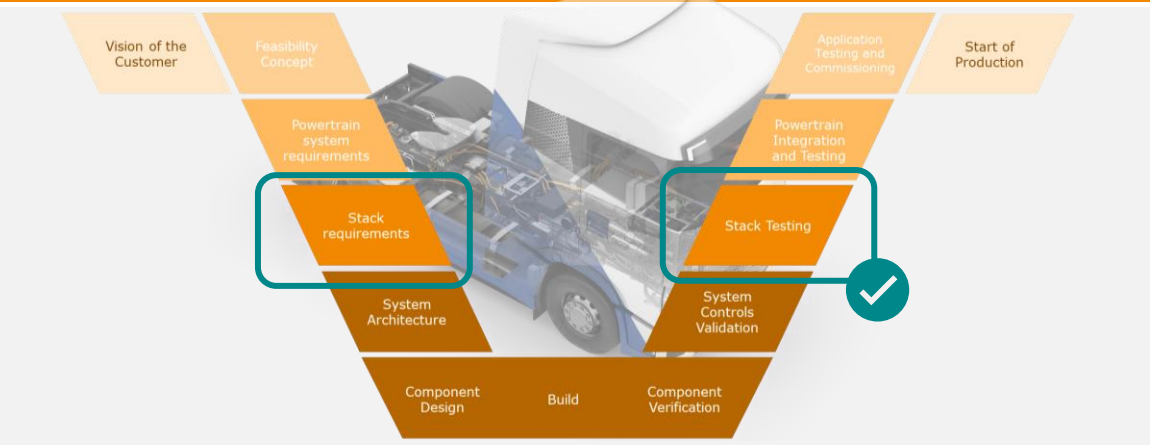

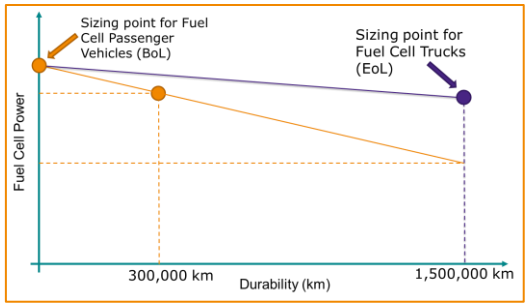

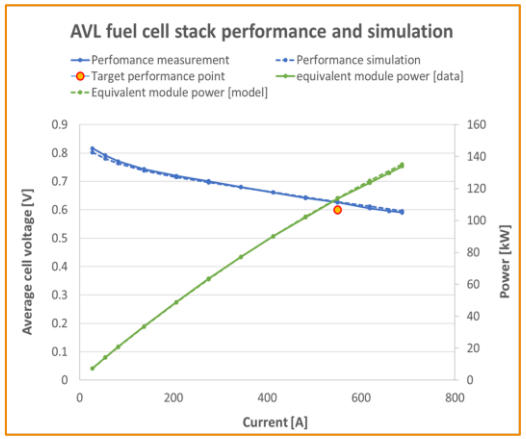

Fuel Cell Stack

Note: AVL offers only stack engineering services, AVL will not produce and sell stacks

- Power (modular): 30 – 150 kW
- Power Density: 4.1 kW/L
- Lifetime: >15,000 h
- Efficiency: 48% (@0.6V)
- Freeze Start Up: > -30 °C
- Single cell row, carbon plates

Fuel Cell Demo Truck Development

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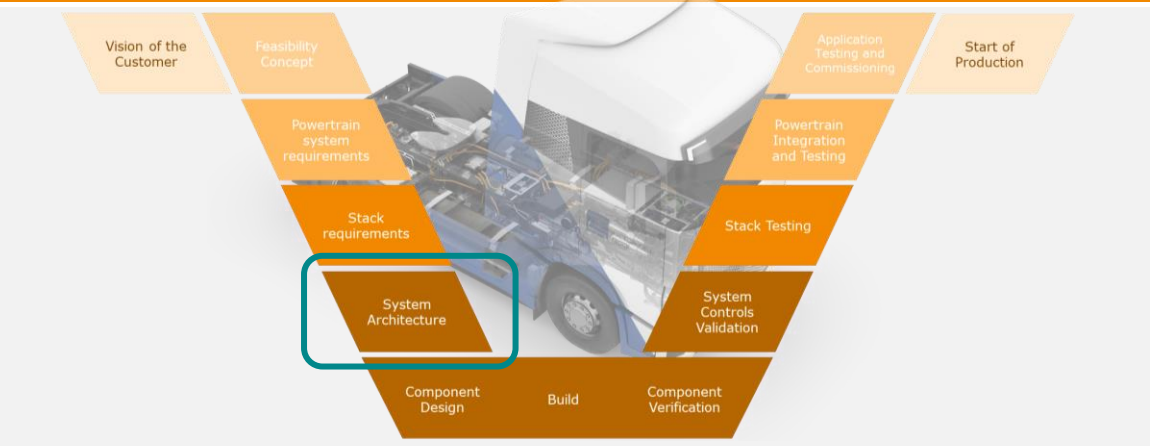
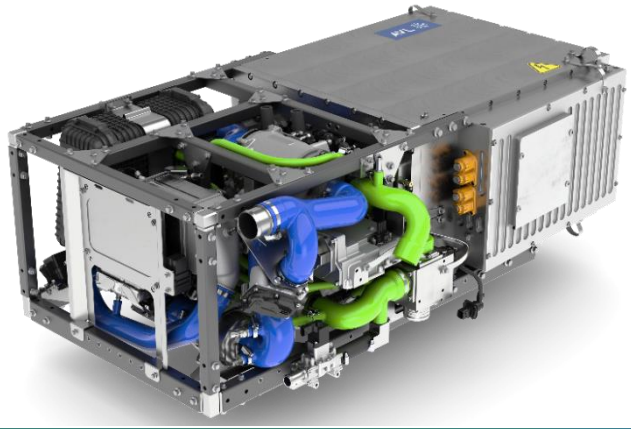
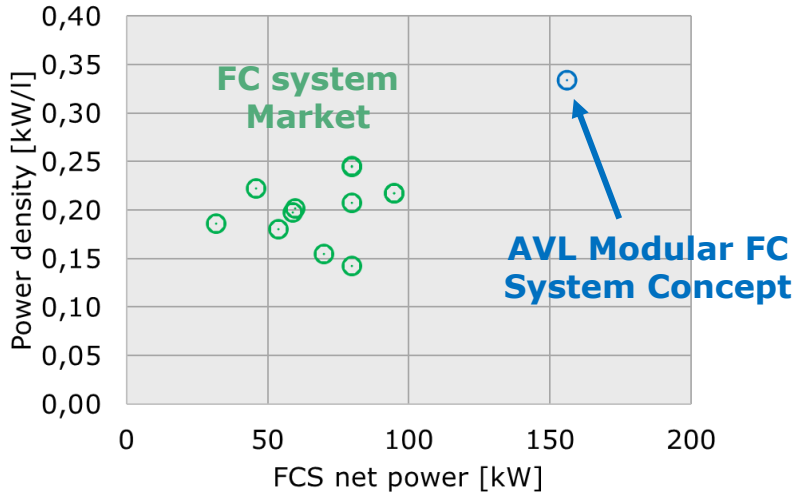




Fuel Cell System

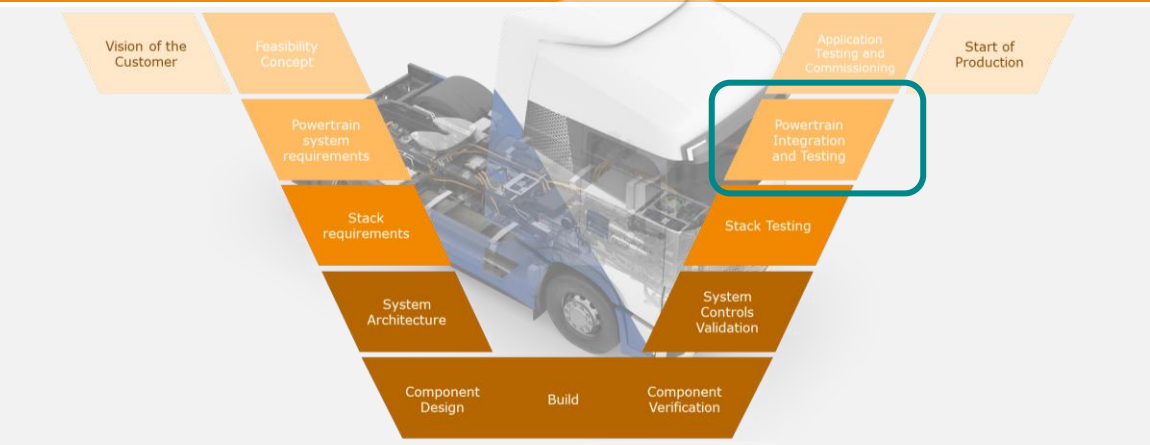


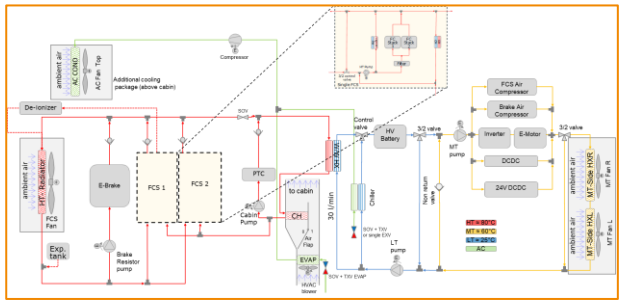
- Rated Power (per module): 156 kW
- Power Density: 0.33 kW/L
- Lifetime: >15,000 h
- Efficiency: 45% (@ Rated Power)
- Freeze Start Up: > -30 °C

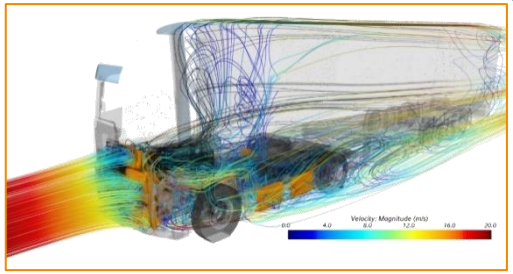
Fuel Cell Demo Truck Development

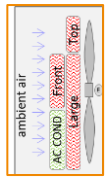
Development Approach

Requirements and System Engineering



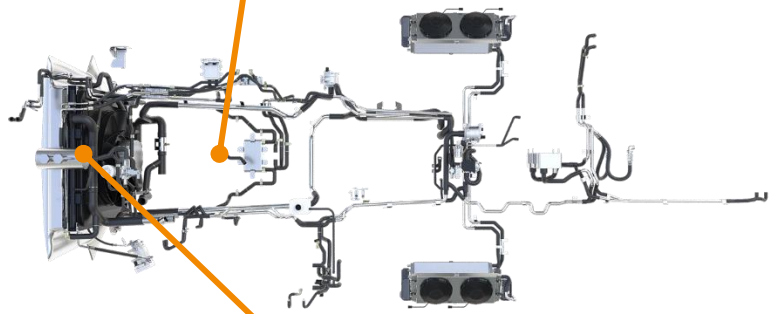






Fuel Cell Truck Integration

AVL Thermal Management System
- 3 optimized cooling circuits (LT, MT, HT)
- Integrated in standard assembly space



AVL Thermal Management System
- Cooling package frontal area remained unchanged
- Total front radiator surface was increased to 1.8 m² (180% of initial radiator size)

Fuel Cell Demo Truck Development

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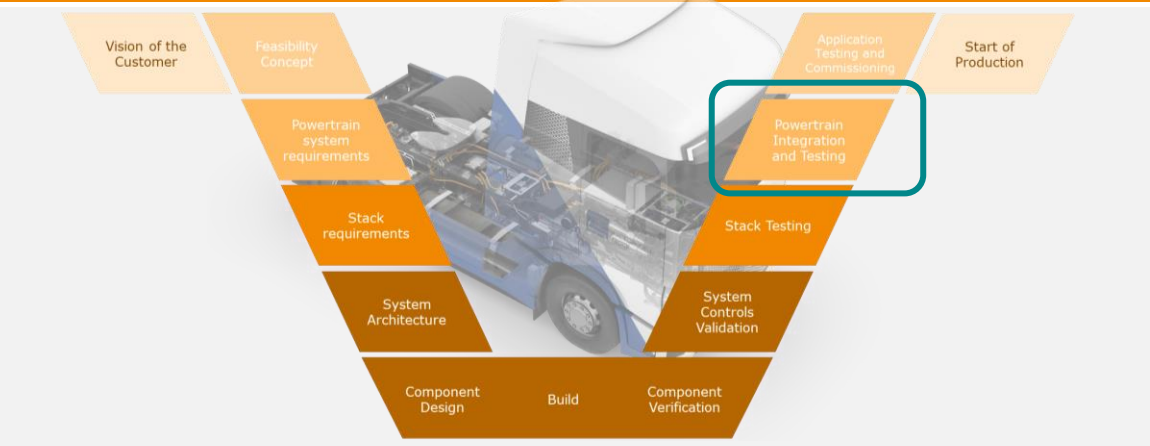
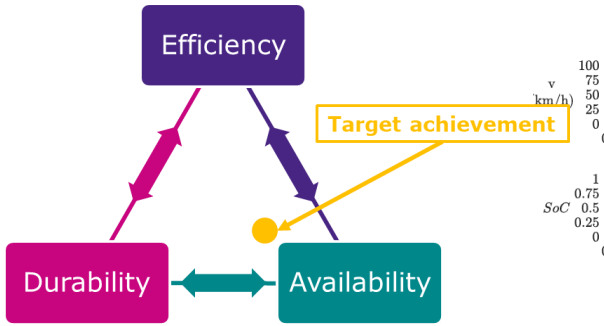
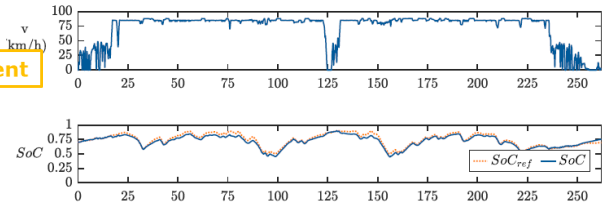


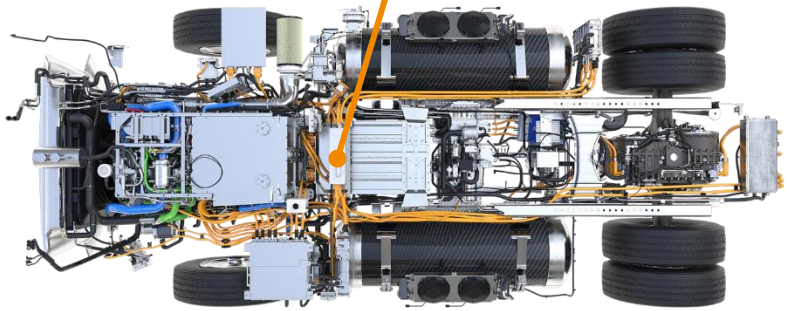




Fuel Cell Truck Integration

AVL Predictive Energy Management

- Optimizer based strategy
- Long range optimizer to maximize efficiency while maintaining system performance and state-of-health of FCS and battery
- Short range power split optimization considering short term events (e.g. traffic, temporary speed limits)



AVL Fuel Cell Demo Truck will be certified and on the road in **Q2/2024**


Thank you
AVL
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