



# COmplete Vehicle ENergy-saving Technologies

EGVI Workshop Brussels

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SP A3 – DAF Prototype Truck

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## Introduction CONVENIENT DAF XF proto truck (SP A3)



- Main deliverable: hybrid electric prototype truck
  - DAF XF EuroVI Tractor with Semi-Trailer (40 tonne)
  - Application area: Longhaul refrigerated transport
  - Target: 21-30% fuel savings\*
- Envisioned vehicle functions:
  - Hybrid electric powertrain
  - Electrified auxiliaries (enable full electric driving)
  - ePTO function (reefer supply) and battery charger (plug-in socket)
  - Smart Powernet (Complete Vehicle Energy Management and E-horizon)
  - Active friction reduction in driveline
  - Active aerodynamics package for tractor and semi-trailer



**\*Fuel savings w.r.t. suite of driving cycles**  
**Reference vehicle: DAF XF Euro V with MX13 engine**

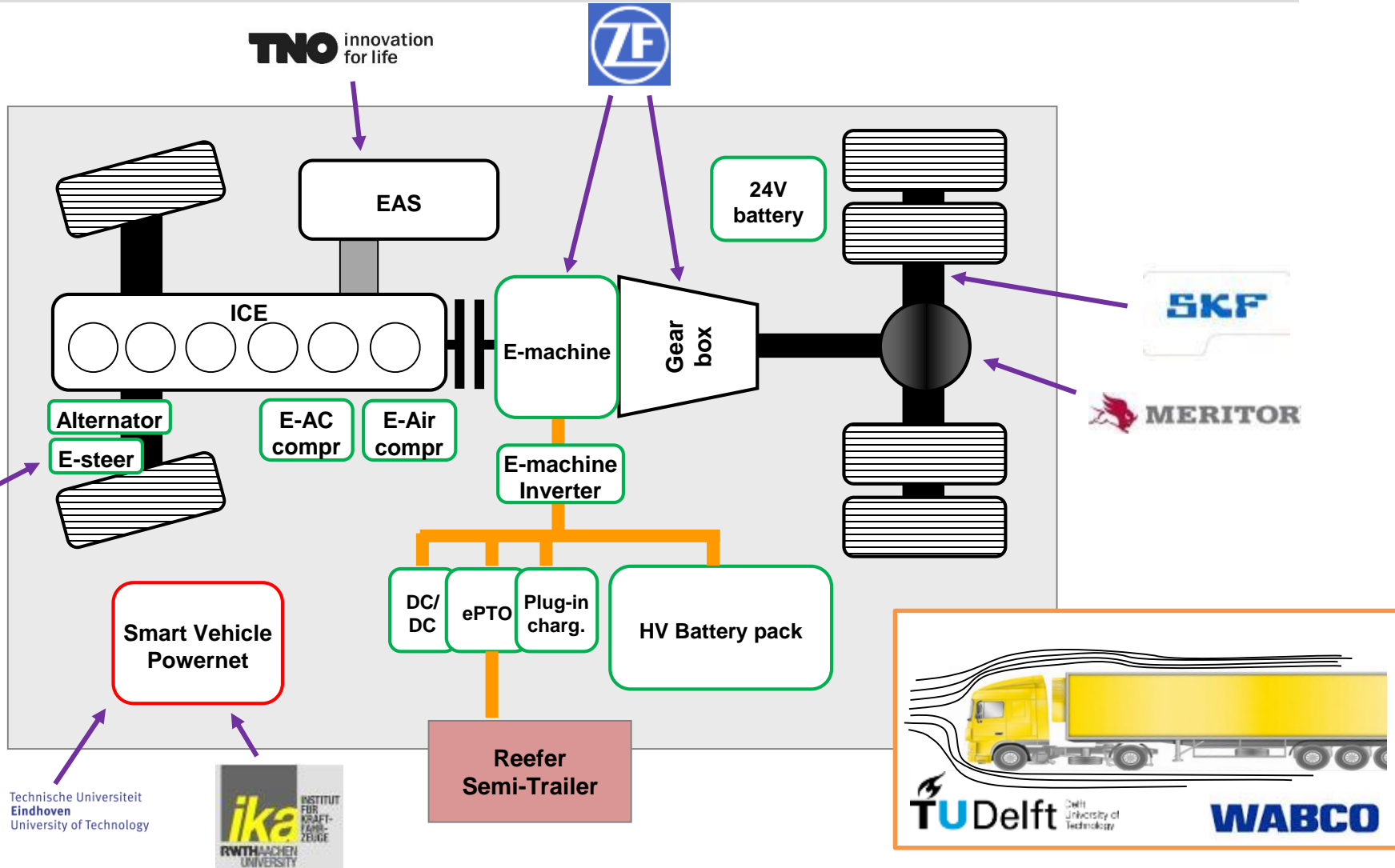
## Vehicle Topology & Partner Contribution

**DAF**  
A **PACCAR** COMPANY

**TNO** innovation  
for life



**MAGNA**

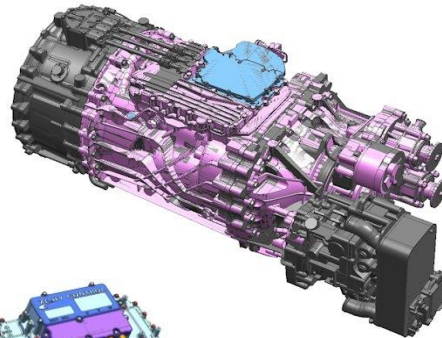


## Overview Main Powertrain Components

Downsized engine  
(MX11 EuroVI)



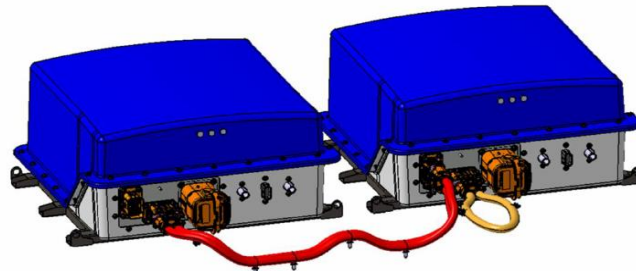
Transmission with hybrid module  
(AMT, 12 speed)



Inverter



Li-ion battery  
(650Vdc)



Rear axle with active  
oil level control



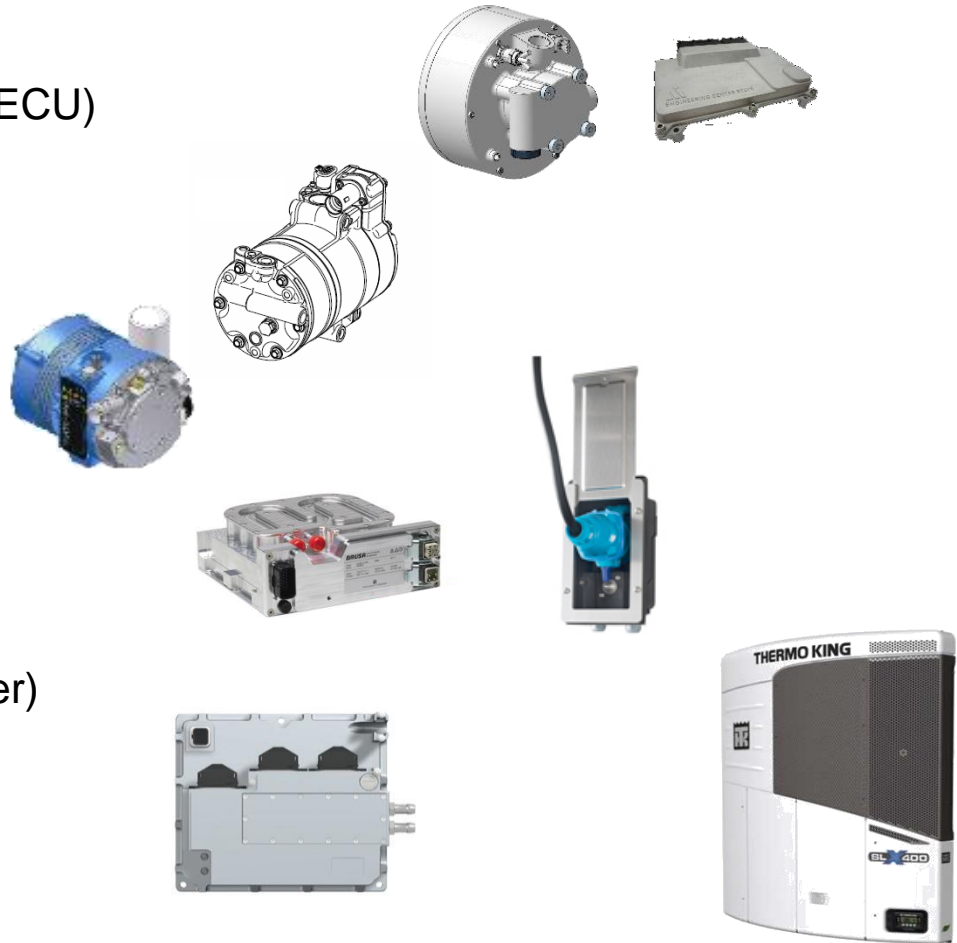
Low friction bearings



## Overview Electric Auxiliaries

- Integrated electrified auxiliaries on proto truck:

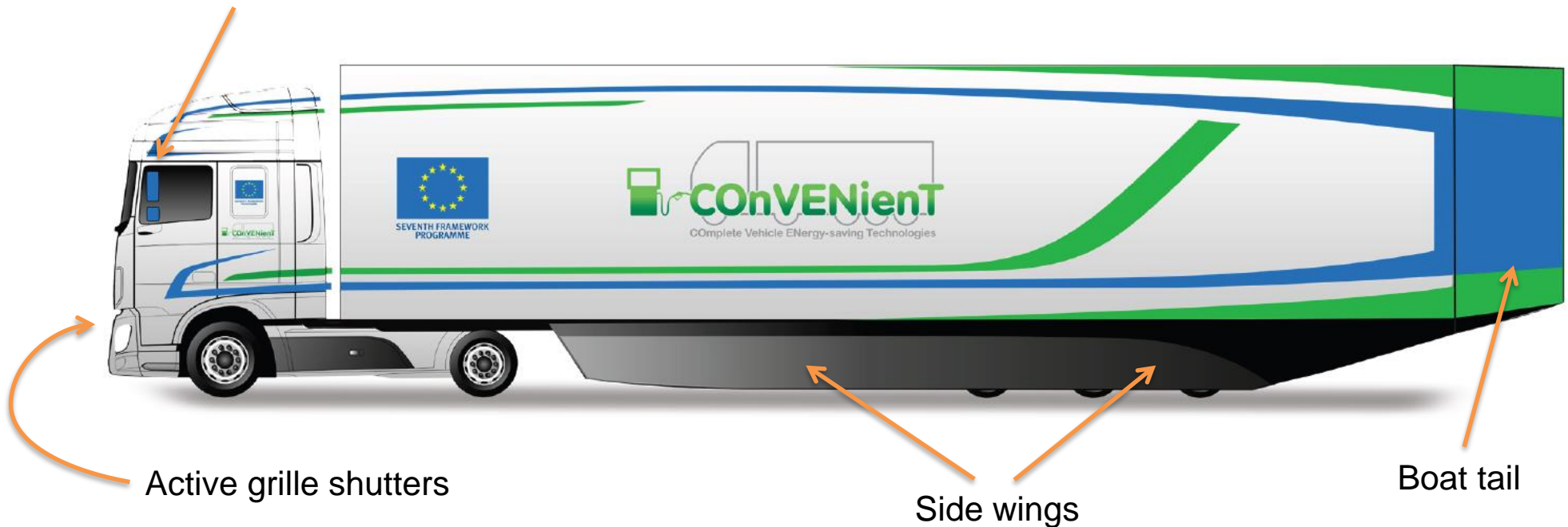
- Electric hydraulic steering pump (with ECU)
- Electric A/C compressor (scroll type)
- Electric air compressor (vane type)
- Plug-in charger (400VAC; 3 Phase)
- ePTO 400VAC inverter (for reefer trailer)
- DC/DC converter



## Adaptive Vehicle Aerodynamics

- Aerodynamic package:
  - Integrated approach for tractor and trailer
  - Combination of active and passive drag reduction measures

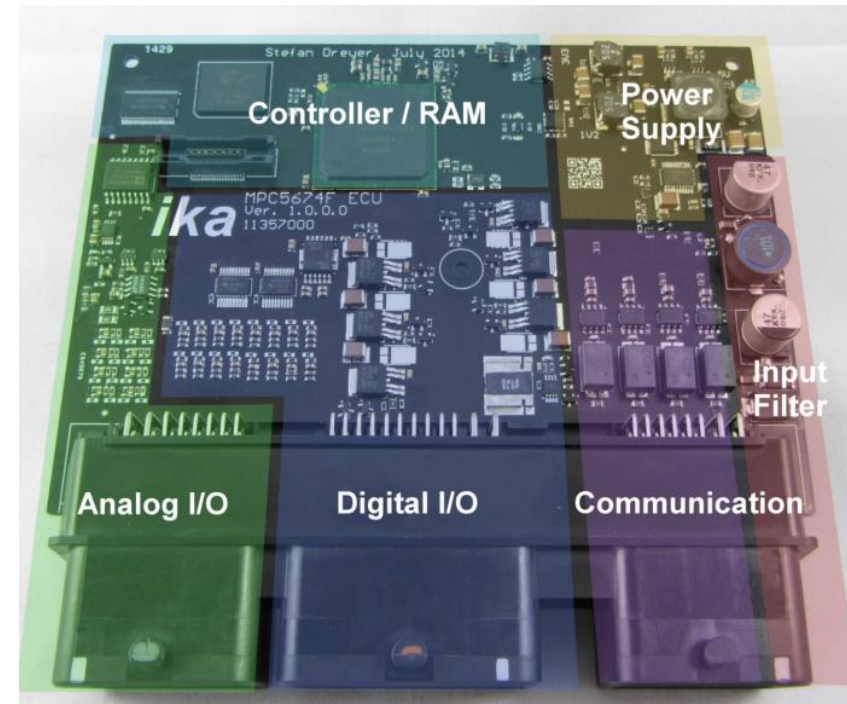
Active mirror flow guides



## Smart Vehicle Powernet

- Algorithm development by TUE
  - Concept refers to Smart Grid technology from national electricity grid
  - Decentralized energy management strategy
  - Two realizations evaluated: Game theory and Dual Decomposition
  - Implementation with and without preview
- ECU platform development by IKA
  - Freescale MPC5674F Controller
  - 264 Mhz, 4 MB Flash, 256 kByte RAM
  - Analog inputs / outputs
  - Digital inputs / outputs
  - CAN, LIN and FlexRay communication

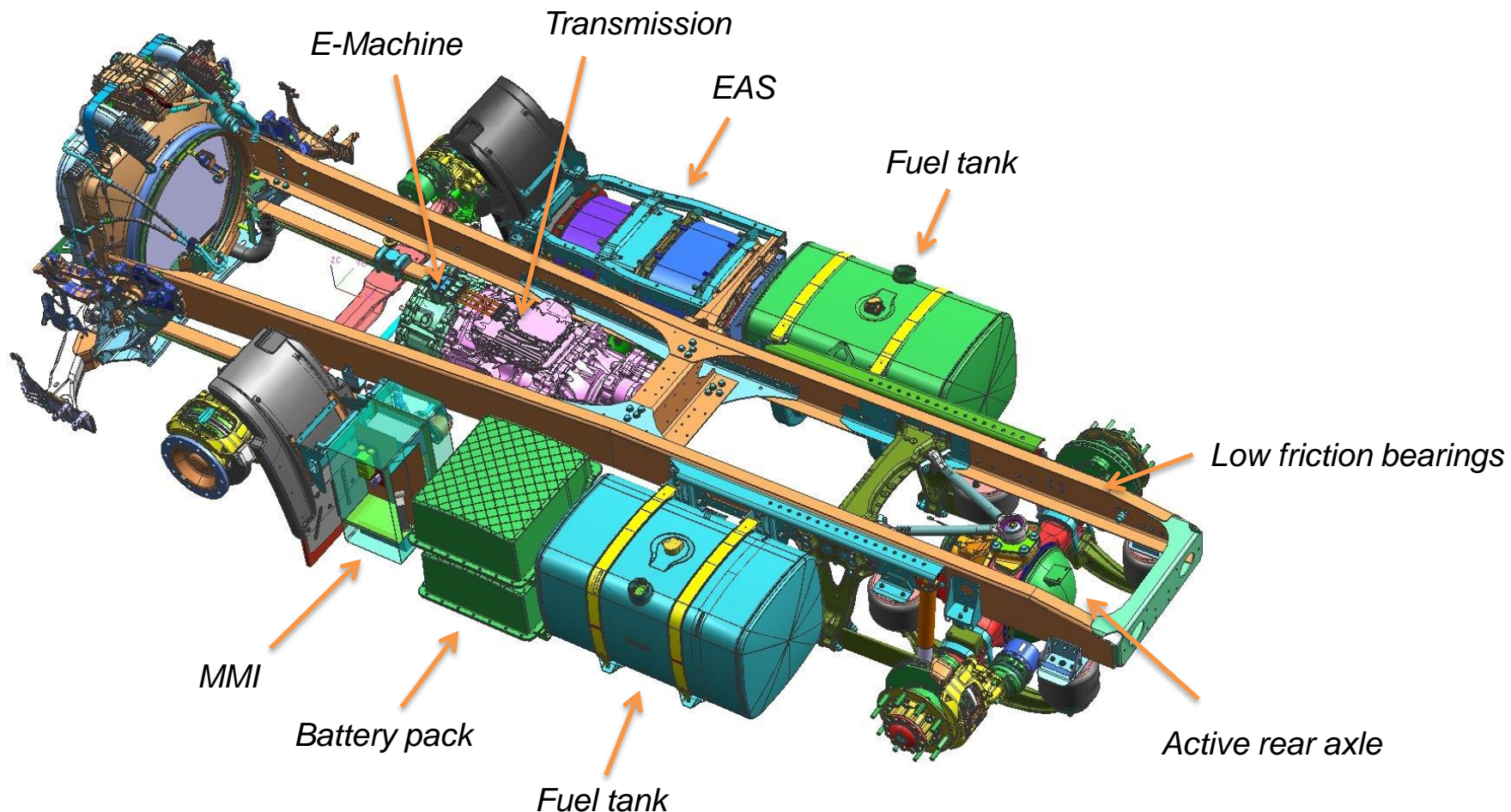
TU/e





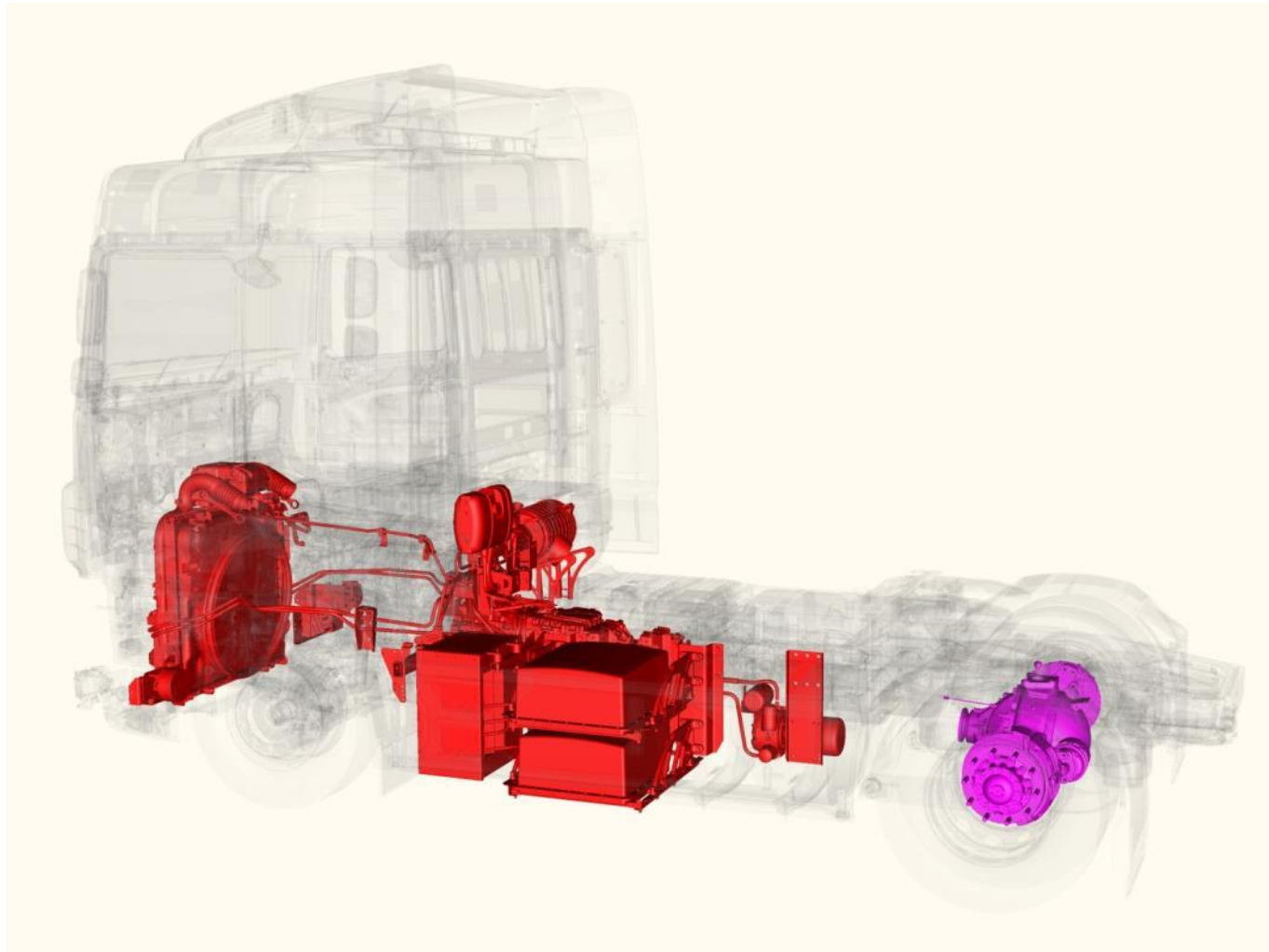
## Layout and packaging

- Overview picture of layout study (main powertrain components)



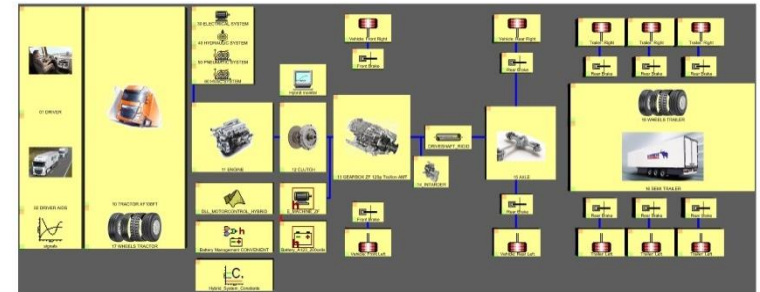


## Truck Build-up – CAD visualization



## Evaluation Fuel Savings Potential

- Simulation model developed to evaluate fuel saving targets
  - Simulation model validated with measurement data from components and vehicle tests
  - Comparison between reference truck and CONVENIENT truck



*AVL Cruise*

Reference: DAF XF Euro V



CONVENIENT proto truck Euro VI



- Simulated driving cycles
  - ACEA Regional Delivery
  - ACEA Longhaul

## Fuel Saving Results

TECHNOLOGY	Project Target	ACEA RD	ACEA LH
Smart vehicle powernet	0.5 ÷ 1.0 %	0.6 – 0.8	0.6 – 0.8
Predictive energy management (Predictive Smart auxiliaries)	1.0 ÷ 1.5 %		
Thermal management	0.5 ÷ 1.0 %	-	-
Programmable auxiliaries or Electrified auxiliaries	3.0 ÷ 4.0 %	3.5 – 4.8	3.5 – 4.7
Predictive Eco-driving	3.0 ÷ 5.0 %	2.7 – 4.8	1.5 – 2.9
Electric hybrid transmission	5.0 ÷ 6.0 %	6.4 – 8.0	5.7 – 7.1
External power supply	1.0 ÷ 3.5 %	-	-
Complete vehicle aerodynamics (including semitrailer)	5.0 %	3.0 – 6.0	3.0 – 6.1
Friction reduction (Rear axle)	2 ÷ 3 %	2.3 – 2.7	1.8 – 2.2
Friction reduction (HEV enabled engine downsizing; transition Euro5-Euro6)		3.3 – 4.2	3.3 – 4.2
Friction reduction (Low friction tyres)	-	5.0 – 7.0	5.0 – 7.0
<b>Integral reduction</b>	<b>21 ÷ 30 %</b>	<b>22 – 25.5 %</b>	<b>24 – 27.5%</b>



## Movie

