Safe and Efficient Electrical Vehicle

EVS 27

19.11.2013

Barcelona, Spain

Agenda

- **eFuture outline**
- **Functional architecture**
  - Intedis
- **Vehicle and key components**
  - TMETC, Tata Motors European Technical Centre
- **Control unit architecture**
  - Hella
- **Data fusion and Green ADAS**
  - IFSTTAR, French Institute of science and technology for transport, development and networks
- **Driver integration**
  - WIVW, Würzburg Institute for Traffic Science
- **Conclusion**

eFuture outline

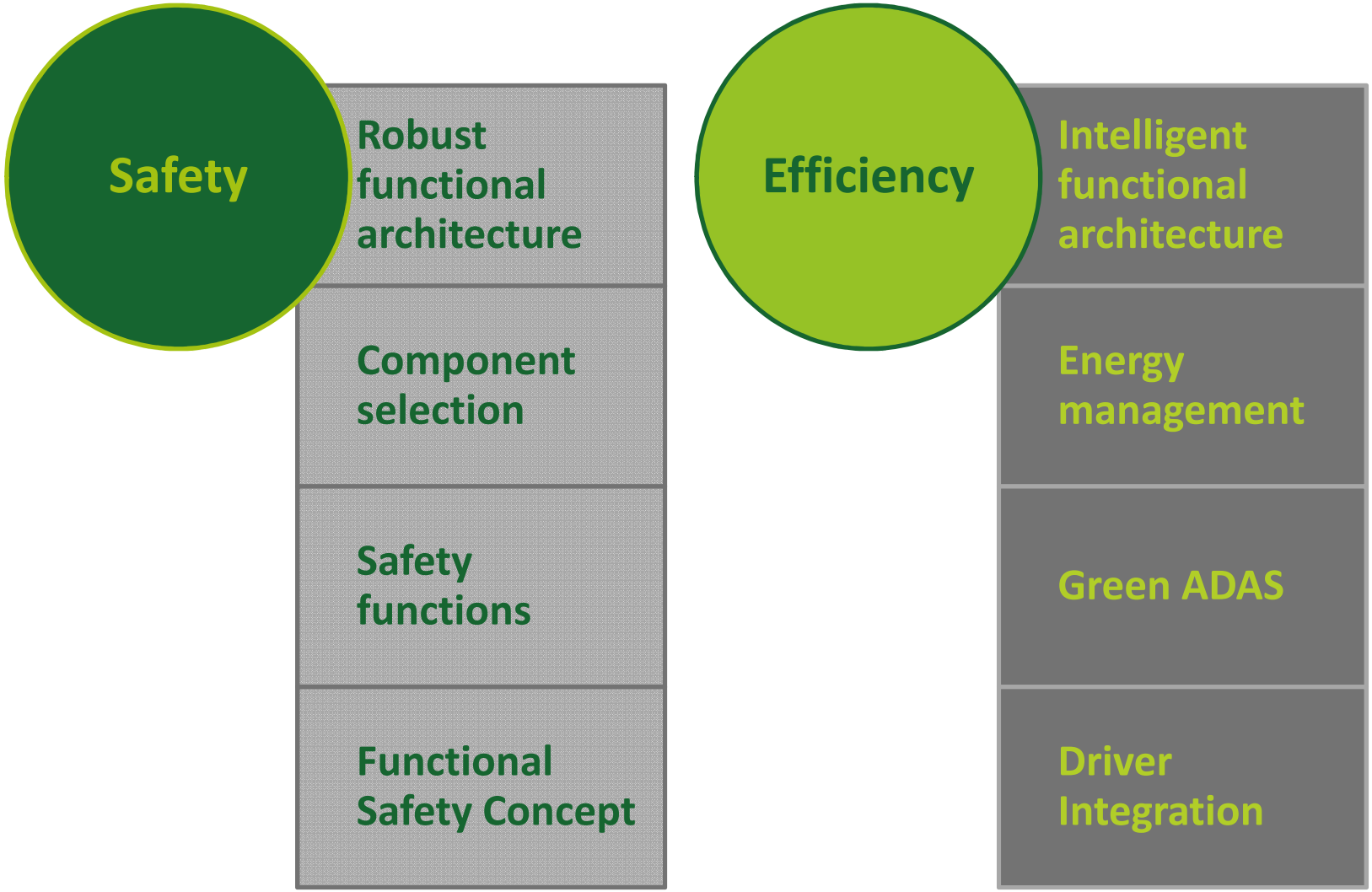
Outline of eFuture

„Safe and Efficient Electrical Vehicle“

- Funded by the European Commission (grant no. 258133)
- Duration 3 years (until October 2013)
- Budget ca. 7 Mio. Euro
- Funding ca. 4 Mio. Euro
- 6 partners from 4 countries
  4 from industry
  2 research institutes
- Coordinator:
  Intedis, Würzburg

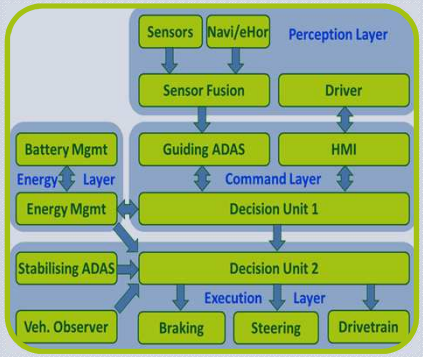
Addressing the main goals

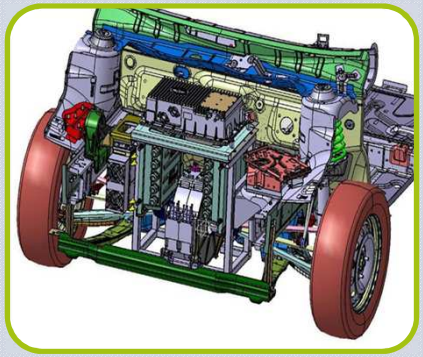
Overall results for Safety and Efficiency

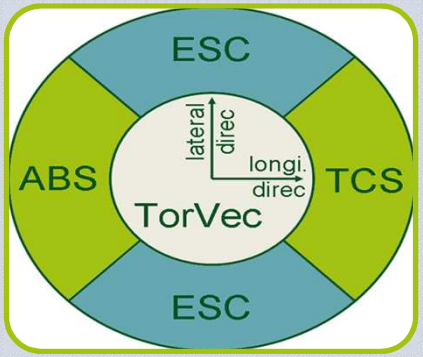


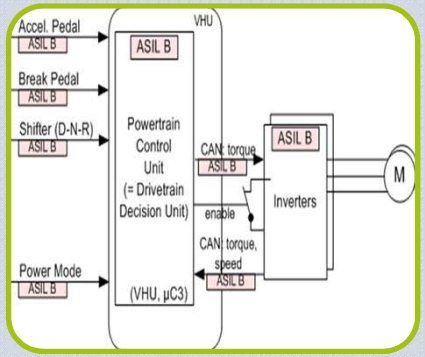
Safety achievements

Overall results for Safety and Efficiency









Robust functional architecture

- Function hierarchy
- Signal logic
  Decision unit concept

Component selection

- Inverters and Motors
- VHU
- Battery
- BMS unit

Safety functions

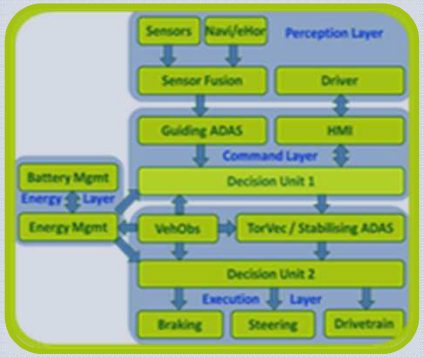
- Vehicle Observer
- Torque Vectoring
- Decision Unit 2

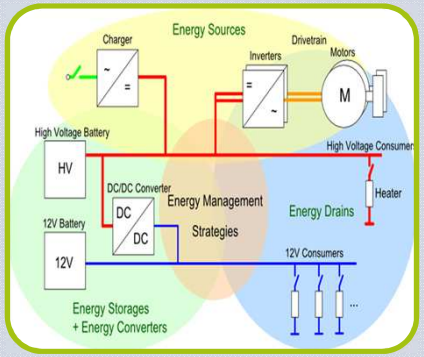
Functional Safety Concept

- Safety Goals
- Implementation strategy
- Hardware concept

Efficiency achievements

Overall results for Safety and Efficiency





Intelligent functional architecture

- Parameters for efficiency
- Scalability and plug'n'play approach

Energy management

- Centralised management function
- Efficiency concepts

Green ADAS

- Route prediction (eHor)
- Green concepts

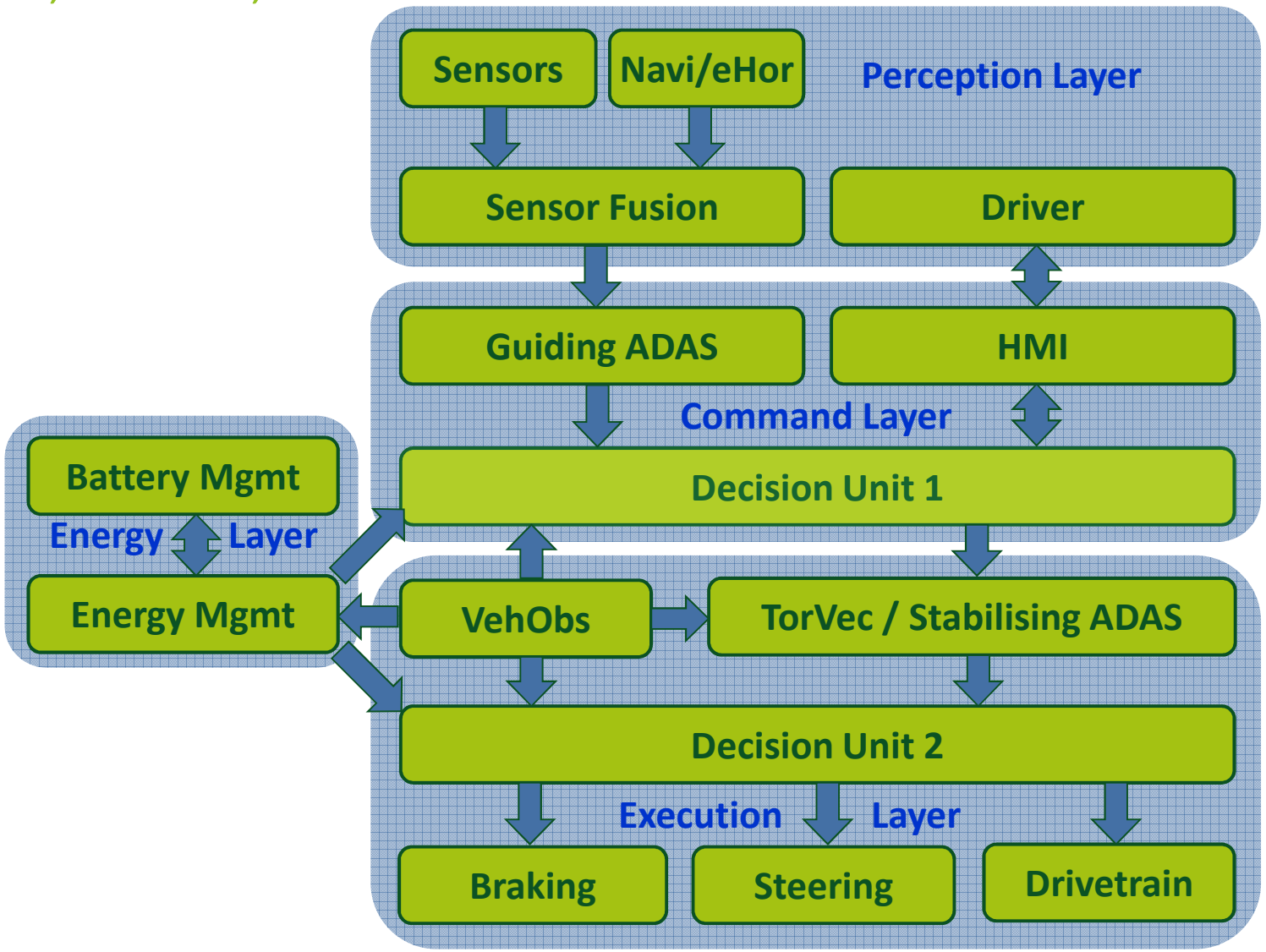
Driver Integration

- Driving style evaluation
- Driver Coaching
- Driver Feedback
- Energy Modes

Architecture (Intedis)

Functional architecture

Lean, scalable, domain oriented

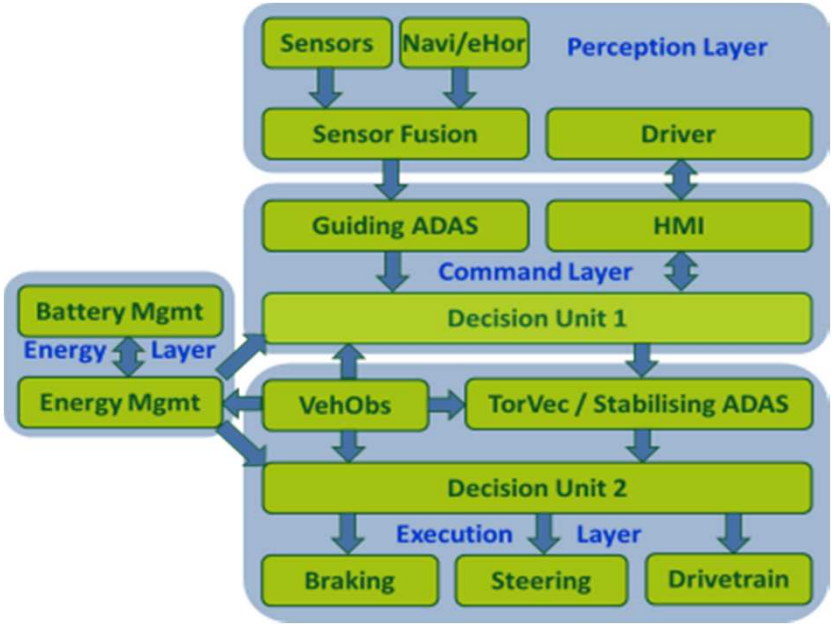


eFuture‘s compact functional architecture

…supports energy efficiency and safety

- **Corresponding domains between SW and HW**
- **Introduction of decision units as central intelligence functions**
- **Allowing for various new functions**

Adv. Energy Mgmt. | Energy Modes | Driver Coaching | Smart & Green ACC | Vehicle Observer | Torque Vectoring



Vehicle and key components (TMETC)

Base vehicle for demonstrator

First generation EV

Donor vehicle

- 110 km/h maximum speed
- 9 seconds 0 - 60 km/h
- 165 km homolgated range
- 8 hours charging time
- ABS, Airbags
- Vista EV vehicles running on limited customer release as part of CABLED fleet

eFuture modifications

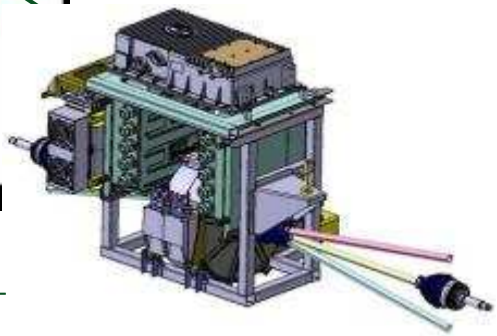
- Independent wheel motors
- Updated energy system
- HMI
- New VHU
- ADAS

Vehicle changes - eFuture

Updated HMI

Front and rear cameras

Super Polymer Li-Ion Traction battery modules and battery tray



Twin independent Motors – delete gearbox

Radar

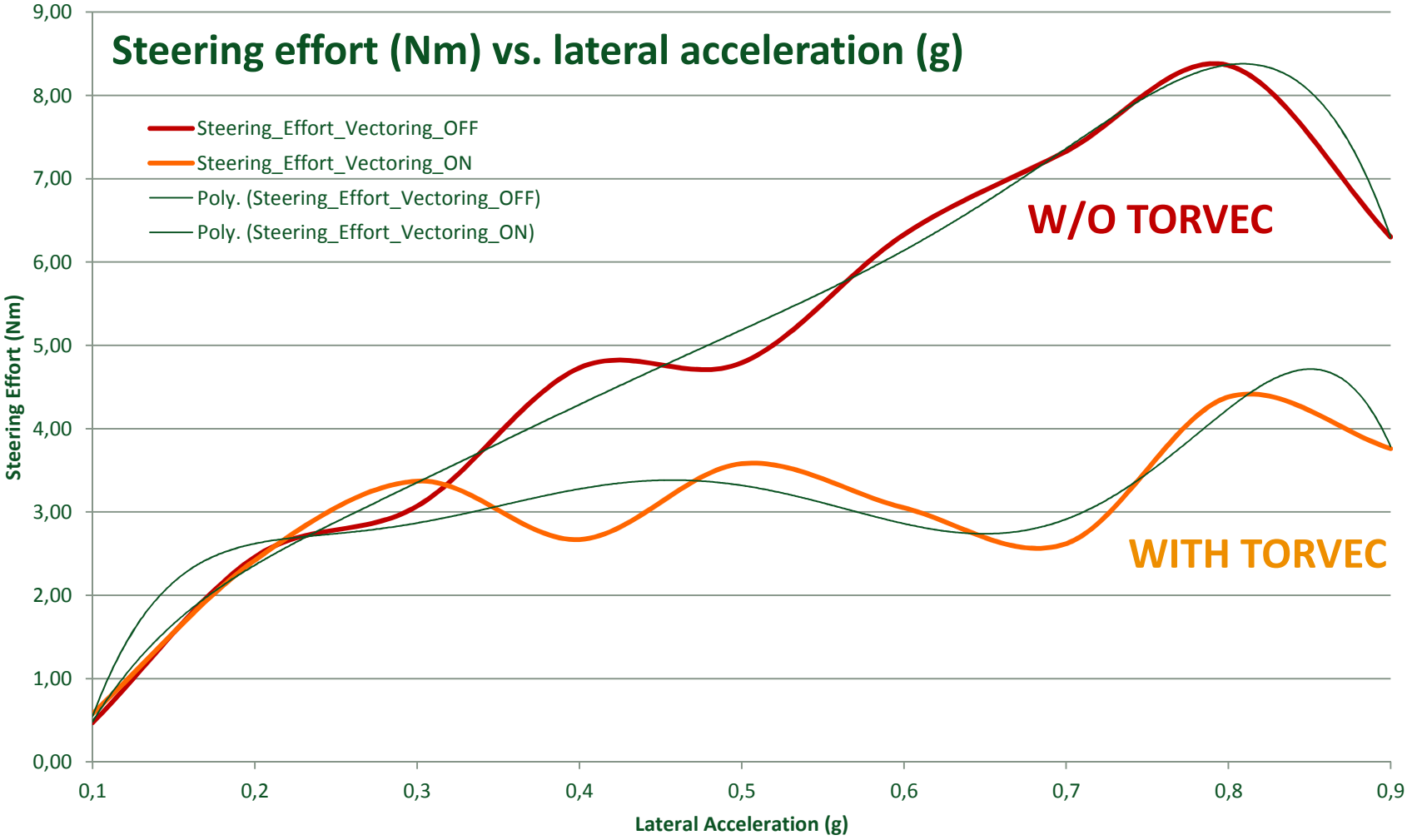
New Hella VHU

The electric motor

Electric Motor: YASA-750	
Type	PM, synch.
Peak/continuous torque	750/400 Nm
Peak/continuous power	100/55 kW
Peak system efficiency	> 95%
Motor weight	25 kg
Speed range	≤ 2000 rpm
Max. voltage	380 V

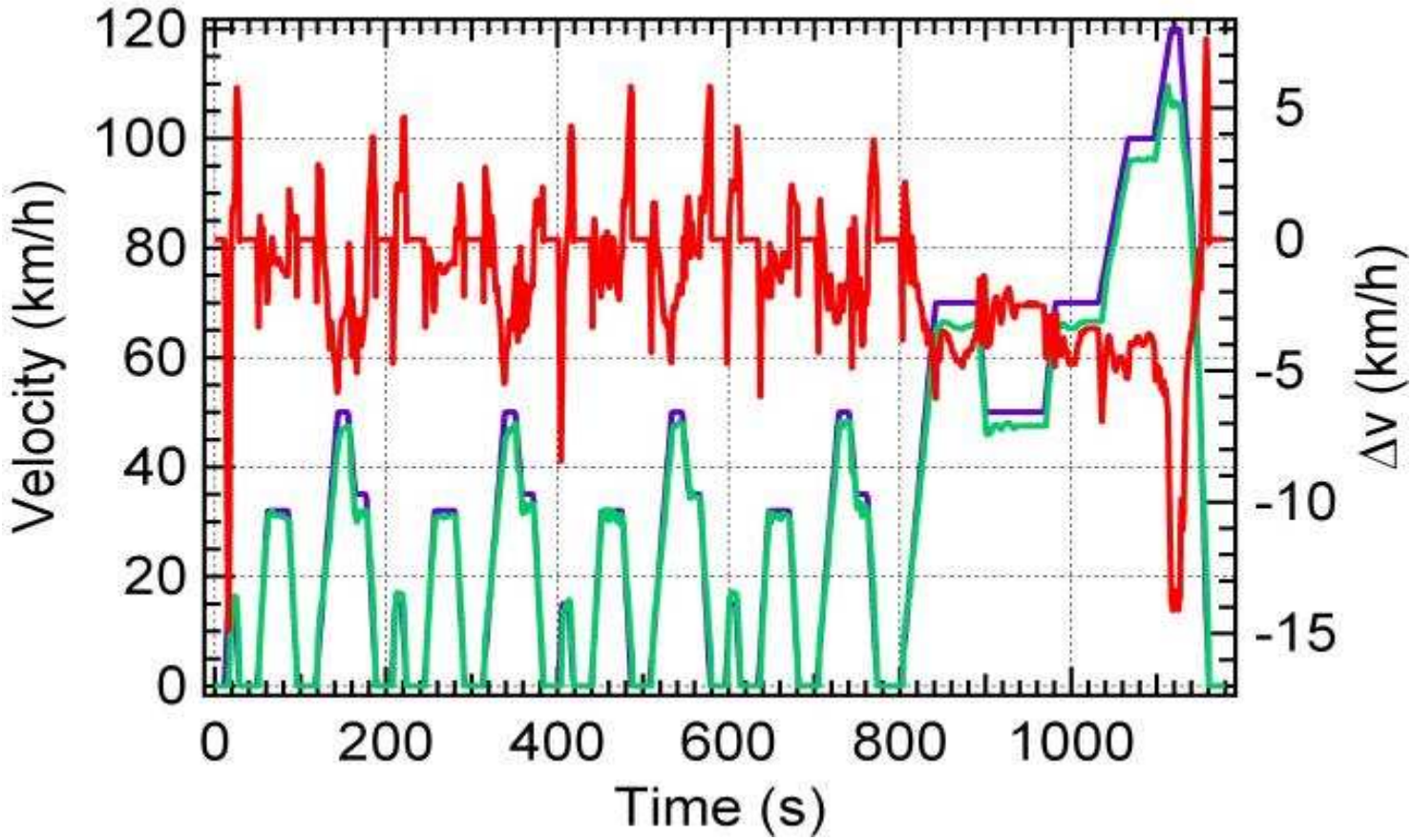
Torque Vectoring

Reduced steering effort



Hella tests

NEDC @ Lippstadt roller test stand



energy consumption during NEDC: 15.6kWh/100km
resulting range (based on 26kWh HV battery charge available): 172km

Prototype validation

- Safety tests
  - Motor failure – other motor did not go into limp home.
  - Wheel speed sensor failure. No impact during acceleration, causes system derate during regen
  - SAS failure
    - Implausible value.
      - System ignores values of +770 deg. Pass
      - Does not ignore -760 deg.
    - Lost signal (wire cut)
      - System does not react. Stays in TV mode at last value.
  - Software updated

BMS assembly and contact springs

Battery by Miljobil	
Cell chemistry	$Li(NiCoMn)O_2$
Cell configuration	2p6s10s3p
Weight	255 kg
Energy content	26,1 kWh
Energy density	103 Wh/kg
Nominal voltage	220 V
Discharge power	44 kW
Discharge current (cont./peak)	200 / 400 A

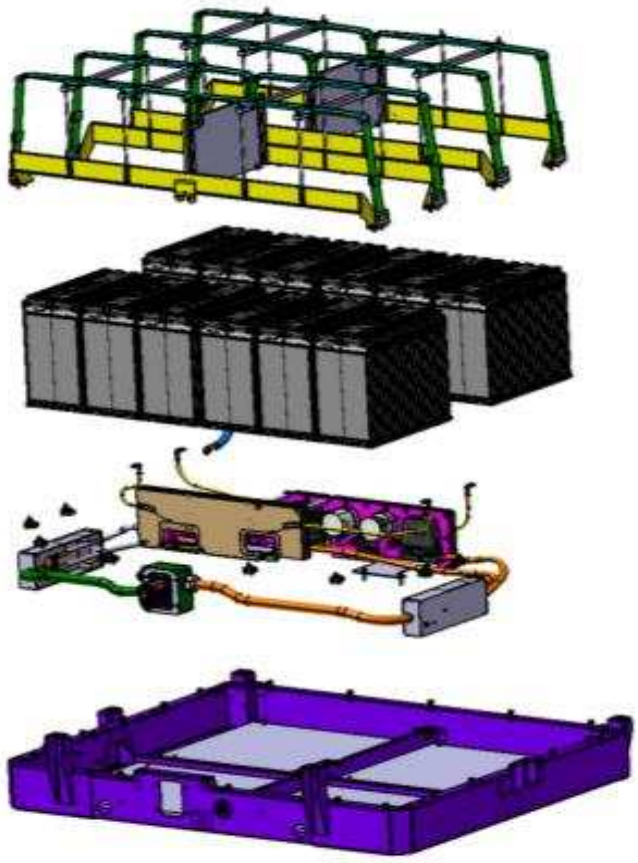
Retention design

Modules retention allowing individual replacement of modules

Modules with BMS integrated, arranged in two equally shaped strings

HVJB and Main BMS between the two strings

Flat bottom tray with reinforcement structure



Battery assembled, ready for lid and sealing

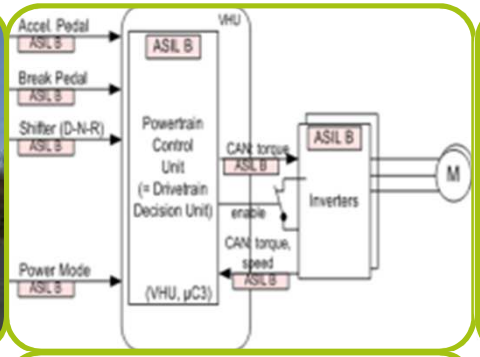
Control unit architecture (Hella)

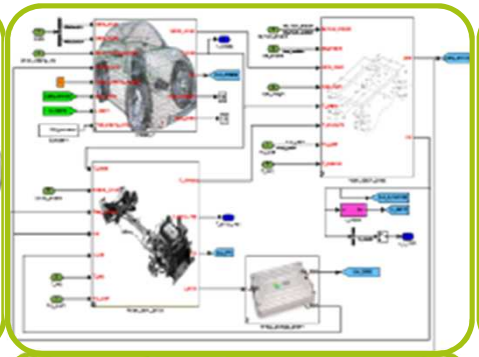
Data fusion and Green ADAS (IFSTTAR)

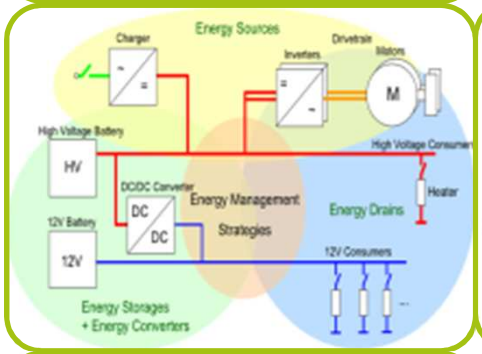
Driver integration (WIVW)

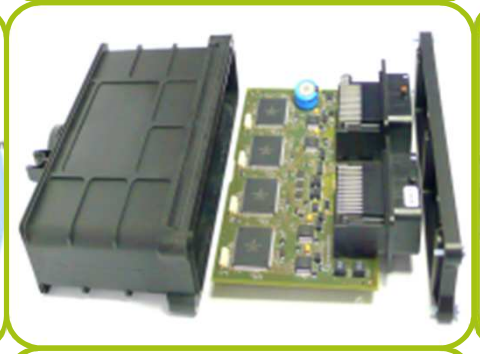
Conclusion

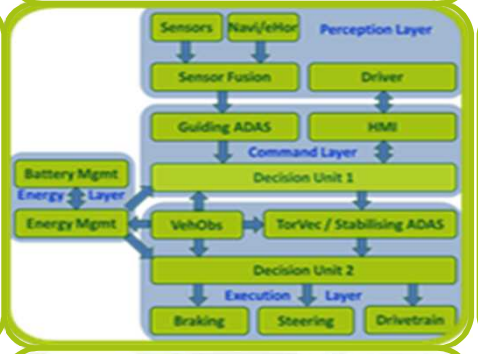
eFuture results on one page

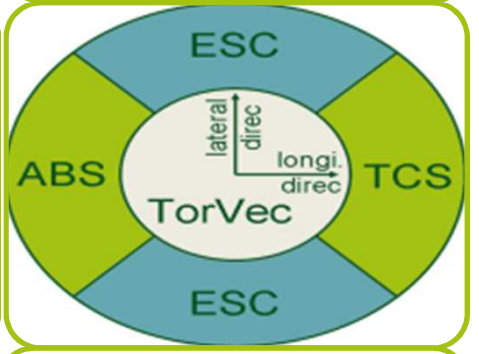


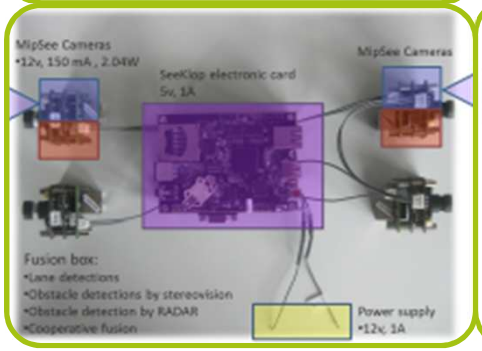


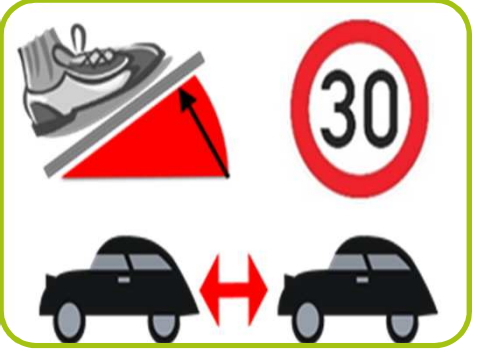












Conclusion

- **Achievements**
  - Proposal for a lean and scalable architecture
  - Proof of a safe two front motor drivetrain
  - Efficiency gain by Green ADAS
  - Driving style improvement by driver integration
- **eFuture proposed many pieces of the puzzle for an affordable and accepted full electrical vehicle**

Thank you for your attention.