ECT-2017

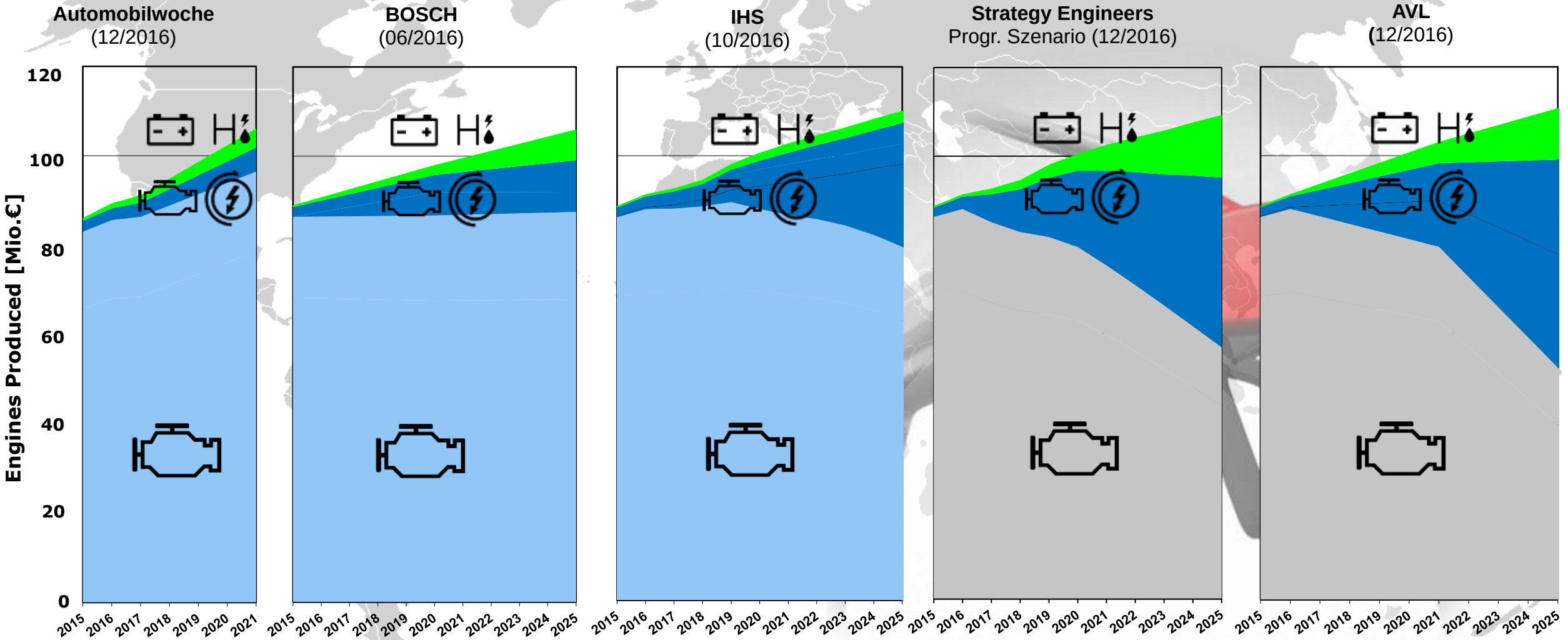
Technologies for Achieving BS VI Norms in India

AVL Technical Center
Private Ltd.

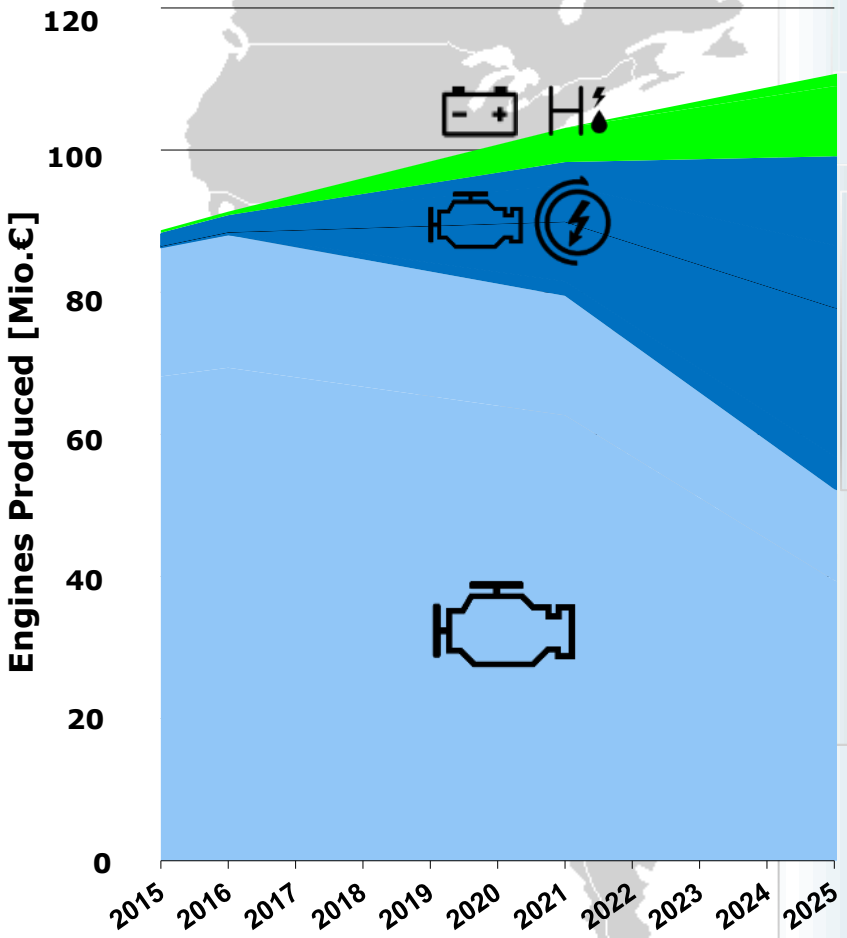
SOME HEADLINES WORLDWIDE

SOME HEADLINES INDIA

GLOBAL TECHNOLOGY SHARE DIFFERENT PREDICTIONS



FUTURE TECHNOLOGY IMPACT ON ENGINEERING DEMAND



Connected & Autonomous

New EV / Fuel Cell

Huge variety of new complex xEV systems

Significantly higher effort for emission compliance (RDE, China 6b, SULEV xx, …)

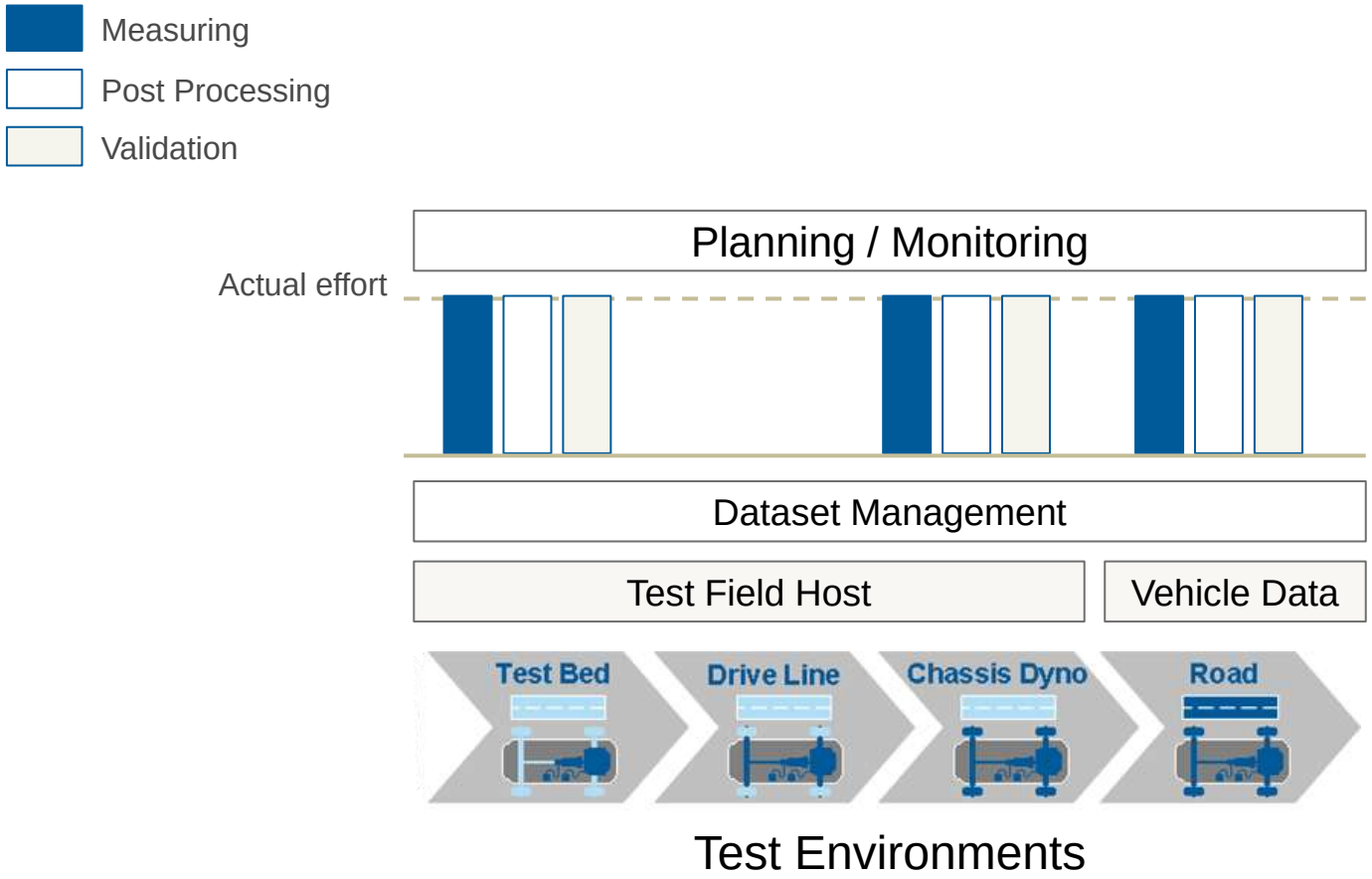
→ **Dramatically enhanced engineering demand**

BS VI EAS SYSTEMS CONVENTIONAL ENGINE

	ROUTE 1	ROUTE 2	ROUTE 3
NOx After treatment	**SCR + DPF LNT + SCR + DPF**	**LNT only + DPF**	**no DeNOx**
Evaluation	• Positive market acceptance (main route for RDE in Europe) • Proven in SOP • No engine HW modification • Max in efficiency • FC neutral/beneficial • Packaging challenge • Higher system costs	• Positive market acceptance in Europe before RDE • Proven in SOP • No engine HW modification • Limited efficiency • Advantage packaging • Higher calibration and validation efforts • FC increased • Sulphur in Fuel • RDE India 2022 • Worse durability	• was seen for EU6 market introduction • Image like EU4 w/o DPF in the past • Risk market acceptance • No RDE solution • Not for heavy vehicles
Comment	**Main route for RDE**	**Interim solution before RDE with correct vehicle weight and engine load ratio**	**Not recommended by AVL**

= Critical

GASOLINE-DIESEL CALIBRATION METHODOLOGY AND TOOLS
FOR A MORE EFFICIENT CALIBRATION



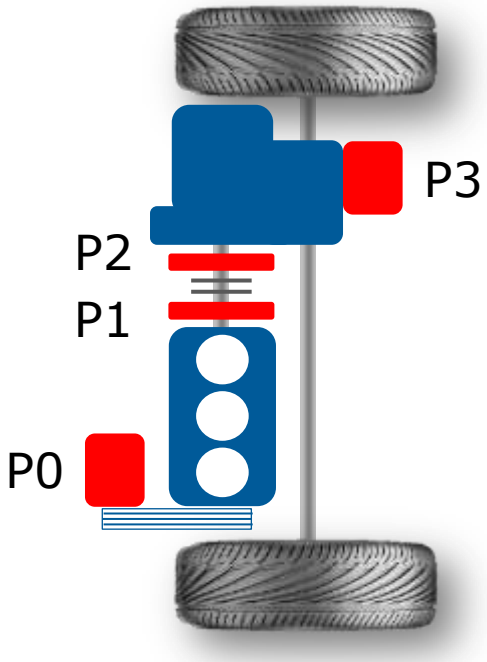
KEY TECHNOLOGY TOWARDS THE FUTURE

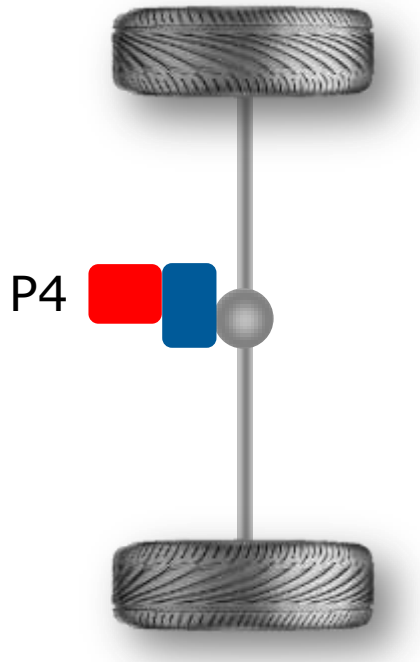
12V - 48V		450V		Up to 800V	Up to 800V
Mild HEV	Full HEV	PHEV	Range Extender	Battery Electric	Fuel Cell Electric

Improve Efficiency

Displace Petroleum

48V POWERTRAIN ARCHITECTURES





FEATURES AND FUNCTIONS VS. ARCHITECTURES

Function	P0	P1	P2	P0/P3	P0/P4
Advanced stop start	●	●	● 2)	●	●
Charging at standstill	●	●	●	●	●
Charging at driving	●	●	●	●	●
Recuperation	◑	◑	●	●	●
Boost	●	●	●	●	●
Sailing	◔	◑	●	● 1)	● 1)
Coasting	● 1)	● 1)	●	● 1)	● 1)
eCreep	◔	◑	●	● 1)	● 1)
Electric drive	○	○	●	● 1)	● 1)
Engine shutdown assist	●	●	◔	●	●
Engine stall protection	●	●	●	●	●
eAWD	○	○	○	○	●

1) MT with eClutch
2) P2 with SSM

VEHICLE ATTRIBUTES VS. ARCHITECTURES

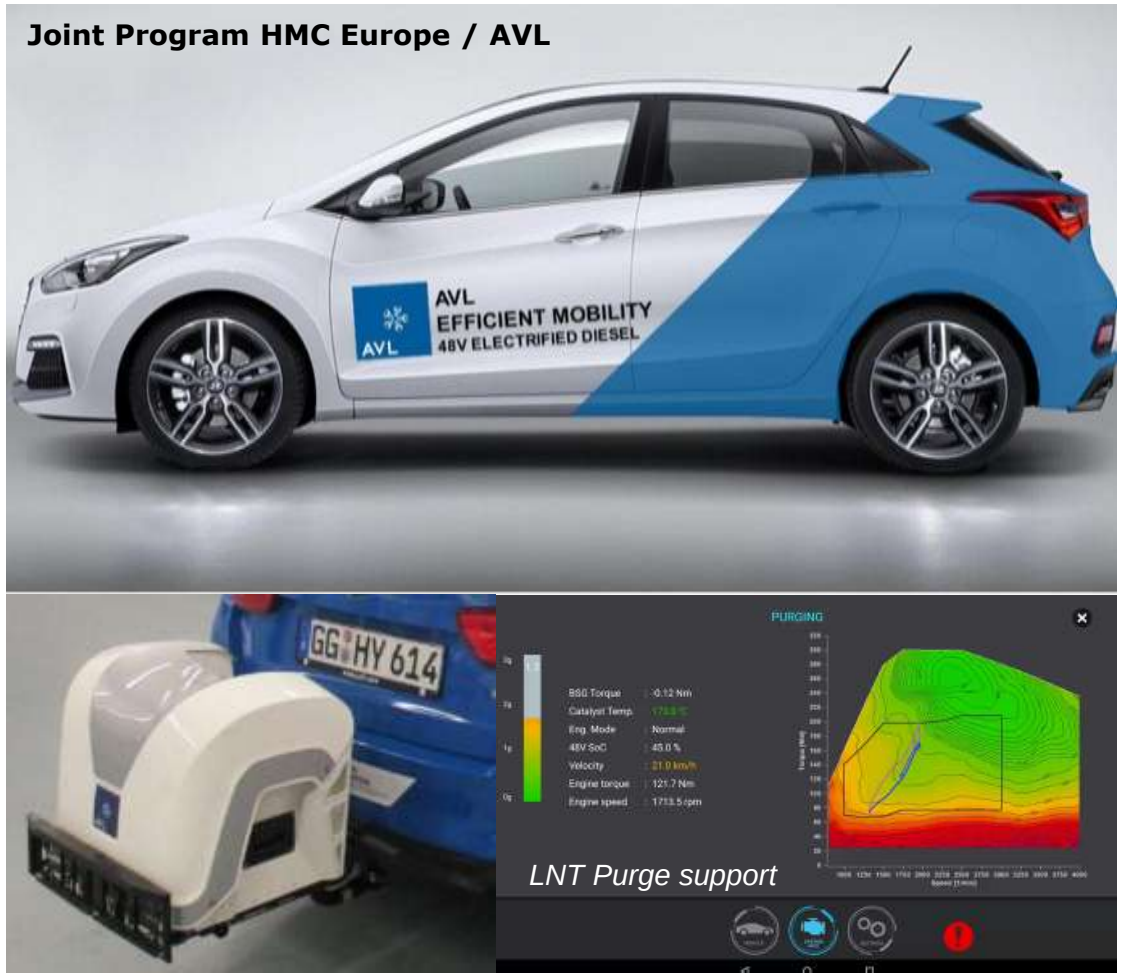
Attribute	P0	P1	P2	P0/P3	P0/P4
Fuel Consumption	+	+	++	++	++
Performance	0	+	++	+	+/0 [1)]
Emissions – Gasoline	0	0	0	0	0
Emissions – Diesel	+	+	++	++	++
NVH	+	+	0	+	+
Drivability	+	+	+	+	+
Ride Comfort	0	0	0	0	0
Handling	0	0	0	0	+/- [1)]

Legend:

0 … similar to baseline vehicle
+ … better than baseline vehicle
- … worse than baseline vehicle

[1)] Baseline vehicle with mechanical AWD

AVL 48-VOLT ADVANCED HYBRID CONTROLS ELECTRIFIED DIESEL - HMC I30 48V BSG+DCT



48V P0 Concept Car

System Description

- ❑ Updated 1.6-liter Diesel Engine
- ❑ 48V Belt Starter Generator, LiIon Battery
- ❑ Double clutch transmission
- ❑ Reduced fuel consumption & NOx

AVL Contribution

- ❑ System Definition & Integration
- ❑ Engine update for BSG
- ❑ Controls development

➔ **48V BSG focused on Emissions**
➔ **Option for RDE India with LNT only**

ELECTRIFICATION AT AVL

Energy Management

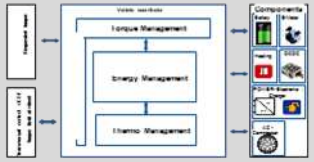
System Design

System Simulation

Battery Development

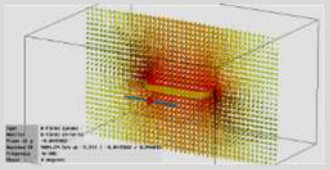
Battery Management System

Vehicle Controls



Power Electronics

EMC Simulation

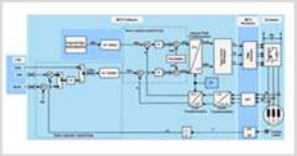


Range Extender Dev (ICE & FC)

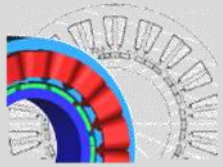
Transmission Control

Transmission Development

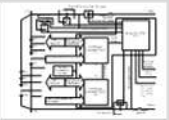
Emotor control



Emotor development



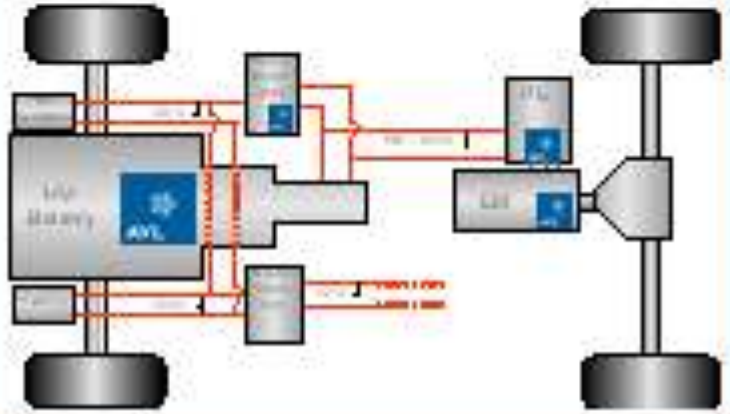
Range Extender Controls (ICE & FC)



R&D: 2012 COUP-E VEHICLE TECHNICAL DATA

Battery

Powernet



Powertrain

AVL HV-Battery

- 180s/1p pouch cells: 41 Ah
- Energy usable: 22 kWh
- Energy installed: 27,6 kWh
- Gravimetric energy density: 108Wh/kg
- Weight (cells/pack): 180 / 250 kg
- Liquid cooling system
- Foamed frames for cell protection
- Self carrying module blocks
- Cell tab clinching
- AVL MCU and BCU controls
- Serviceable E/E box

AVL E-Motor

- P_out: 210 kW (10 s) 140 kW (S1)
- T_out: 750 Nm @2700 rpm
- Dimensions: Ø 245 x 390 mm
- Weight: 104 kg
- Direct fluid cooling

AVL Inverter

- Operating voltage: 250 – 980 V
- Continuous power: 250 kW
- Peak current: 600 A
- Dimensions: 472 x 280 x 182 mm

THANK YOU

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