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# **European Green Cars Initiative**

## **Impact assessment report presentation**

**Jean-Luc di PAOLA-GALLONI**

**Warsaw - 20<sup>th</sup> April 2016**



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# EGCI background and objectives

## ❖ EGCI facts & figures

- ❑ 3 pillars: Electrification, Long Distance transport, Logistics & Co-modality
- ❑ EU contribution to the initiative reached € 418 million - and a total budget of € 662 million
- ❑ 4 calls have been launched out of which 113 projects have been funded - gathering 1379 consortium partners (10,8% being SMEs)
- ❑ 2/3 of the budget has been dedicated to electrification

## ❖ Launched in 2008 at the peak of the crisis, EGCI aimed at :

- ❑ Supporting R&D activities on technology and systems able to bring breakthroughs to achieve a safe and reliable green road transport system
- ❑ Supporting the sector at a critical cornerstone and saving jobs in the EU
- ❑ Sustaining European competitiveness of the sector





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# EGCI Impact assessment

## ❖ Methodology

- ☐ Online questionnaire distributed to project coordinators (44 answers)
- ☐ Interviews with high level representatives of EGVI members
- ☐ Workshops organised with various European associations

## ❖ Key outcomes from the investigation

- ☐ 393 scientific publications
- ☐ 825 conferences organised
- ☐ 72 patent applications
- ☐ Leverage effect of EU financial contribution between 3 and 5
- ☐ R&D job creation has a multiplier effect of about 5 on employment within the region & a catapult effect on other sectors





## Main EGCI impacts

Added value of **collaboration at pre-competitive stage**

- **Avoid duplication of research activities and speed-up innovation uptake on the market**
- **Foster the sharing of common views and commonly shared R&D roadmaps leading to the development of an innovation eco-systems at EU level.**
- **Develop a multistakeholders community of practice and promote open research in the automotive area.**
- **Extend partners' network beyond their national value chain and strengthen cooperation at EU level.**
- **Sustain the competitiveness of the European industry**





## Main EGCI impacts

EGCI benefit for **R&D jobs & skills**

- **R&D job creation** has a multiplier effect of about 5 on employment within the region & a catapult effect on other sectors
- Identification of **future skills requirements** and adjustment of curricula offered in universities
- Contribute to prevent brain-drain and maintain a highly qualified workforce within the EU





## Main EGCI impact

### Financial benefit of the EGCI

- Support of partners with less financial capacities to **overcome the valley of death period of innovation**
- **Sharing the financial risk of R&D activities** was also an incentive for industry members to investigate promising technologies
- **Replication by several Member States**, offering an additional financial support:
  - ☐ Germany
  - ☐ France
  - ☐ UK
  - ☐ Sweden
  - ☐ Austria
  - ☐ Spain ...





# Outlook of the scientific & technological EGCI impacts

Significant breakthrough and incremental innovations, i.e.

❖ In **Battery technology**:

- ❑ Improvement in lifetime (up to 30% in realistic driving situations)
- ❑ Energy density (148 Wh/kg at system level demonstrated)
- ❑ Improvement of user acceptance thanks to the reduction of range anxiety and total cost of ownership
- ❑ Ultra High-Energy battery systems using alloy anodes, innovative O<sub>2</sub> cathode, and a novel system for harvesting O<sub>2</sub> from air

❖ Introduction of **lightweight materials**:

- ❑ Battery weight reduction for EV integration (23 kWh with a total mass of 155 kg (reduction in housing mass to just 8.5 kg).
- ❑ Novel Body-in-white architecture based on a Multifunctional-Rolling Chassis (MRC): Fully structural MRC underbody and customized non-structural upper body
- ❑ Cost reduction thanks to volume savings

❖ Improvements in the **safety** area,

- ❑ Development of directional acoustic sources for **warning signals**
- ❑ **Electromagnetic** compatibility issues
- ❑ New **procedures for testing** (also thanks to **modelling and simulation** tools)
- ❑ Functional Safety concept for EVs with safety requirements including High Voltage safety according to ISO 26262







# Outlook of the scientific & technological EGCI impacts

Significant breakthrough and incremental innovations, i.e.

- ❖ In the **optimisation in powertrain and vehicles solutions**
  - ☐ Vehicle demonstration of torque-vectoring controllers and demonstration of the significant stopping distance reduction achievable through ABS braking actuated through the continuous modulation of electric motor torques;
  - ☐ Power electronic and control performing energy conversion
  - ☐ Hybridisation of powertrain
- ❖ In **energy management and recovery**:
  - ☐ Better use of the existing heat rejection capacity when available
  - ☐ Better In-wheel eco-design, by reducing the thermal stress (by air cooled motor and innovative active wheel concept)
  - ☐ Innovative energy efficient systems and energy harvesting devices
- ❖ In **grid integration**:
  - ☐ Completion of the TTCN-3 based V2G conformance testing suite.
  - ☐ Prototyping of automotive side V2G interface adapters





## Next steps and lessons learned

- Following EGCI, the Commission has decided to launch the European Green Vehicles Initiative
  - **Larger scope** - including trucks, 2 wheelers and new vehicles concepts
  - Focusing on **energy efficiency of vehicles using alternative powertrains**
- Ongoing **review of the roadmap “Electrification of road transport”** used as a basis for the PPP content definition is ongoing and will provide a more detailed assessment of the level of achievement of 2016 & 2020 milestones.





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# LESSONS LEARNED FROM THE EUROPEAN GREEN CARS INITIATIVE

**Frédéric Sgarbi, European Commission**





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Development of an innovative low rolling resistance truck tyre concept in combination with a full scale simulation tool box for tyre performance in function of material and road parameters

November 2012/ April 2016



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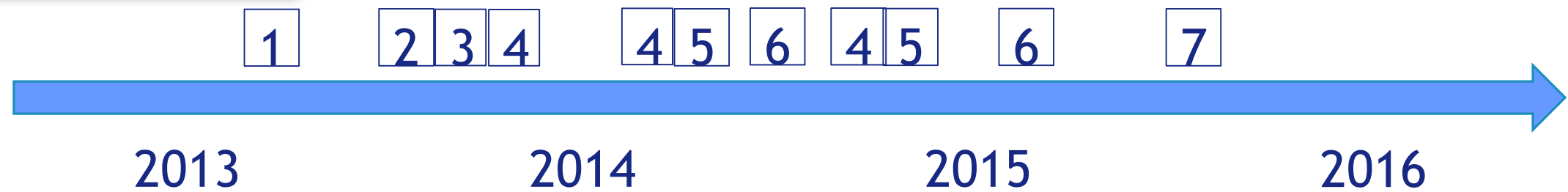
# Objectives

- **Combine new tyres concept and reliable tools for energy efficient trucks**
  - Reduce tyre RR by 20% (compared to specific ref)
  - Creation of a tool box for tyre performance assessment
  - Increase tyre mileage by 20% (compared to specific ref)





# Results



- **Compound development work (1)**
- **Formulations defined for tyre building (2)**
- **Mixing scale up to production conditions (3)**
- **3 plant mixing iterations (4)**
- **2 tyre builds iterations (5)**
- **Tyre testing (6)**
- **New iteration (7)**

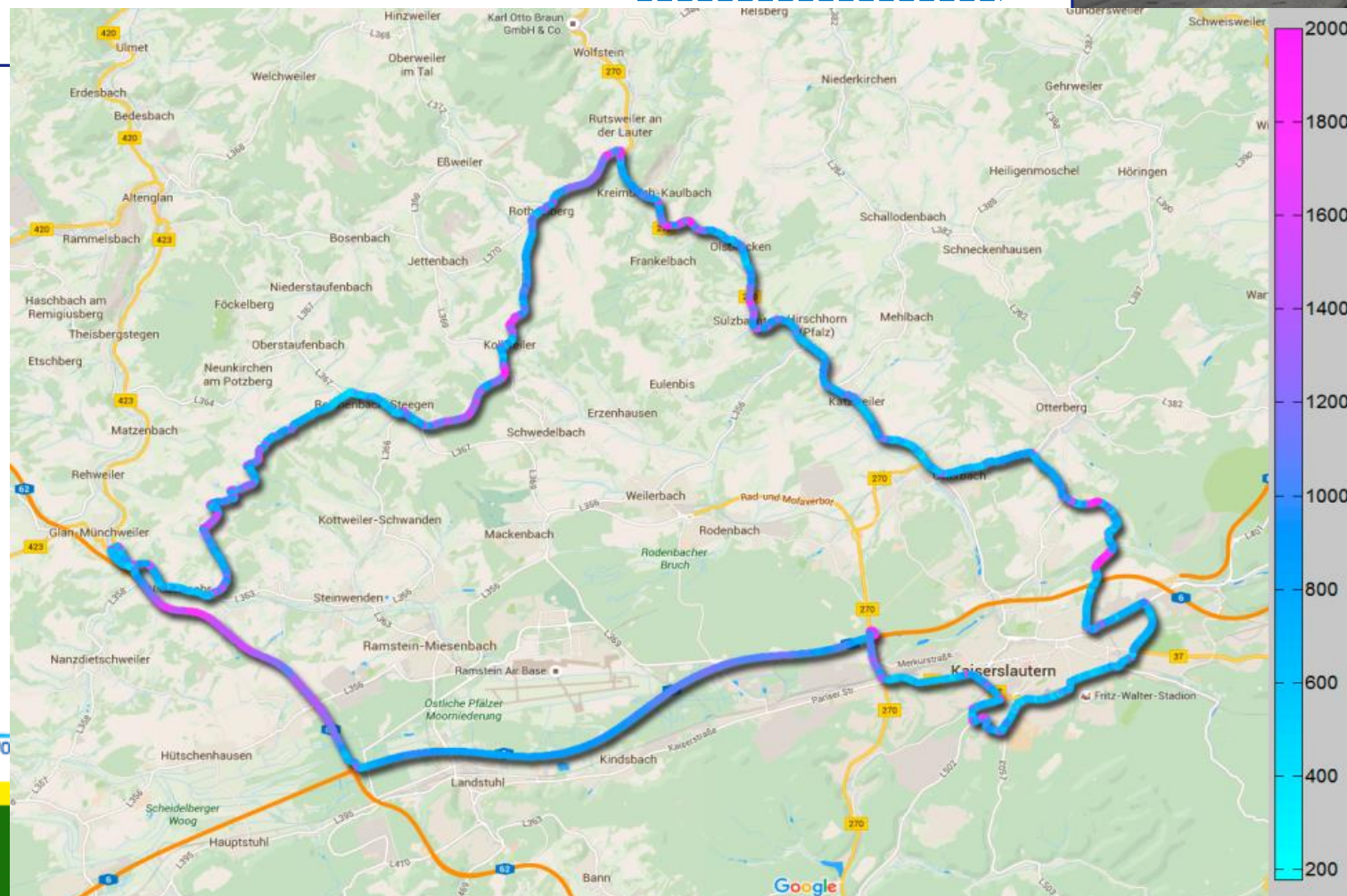
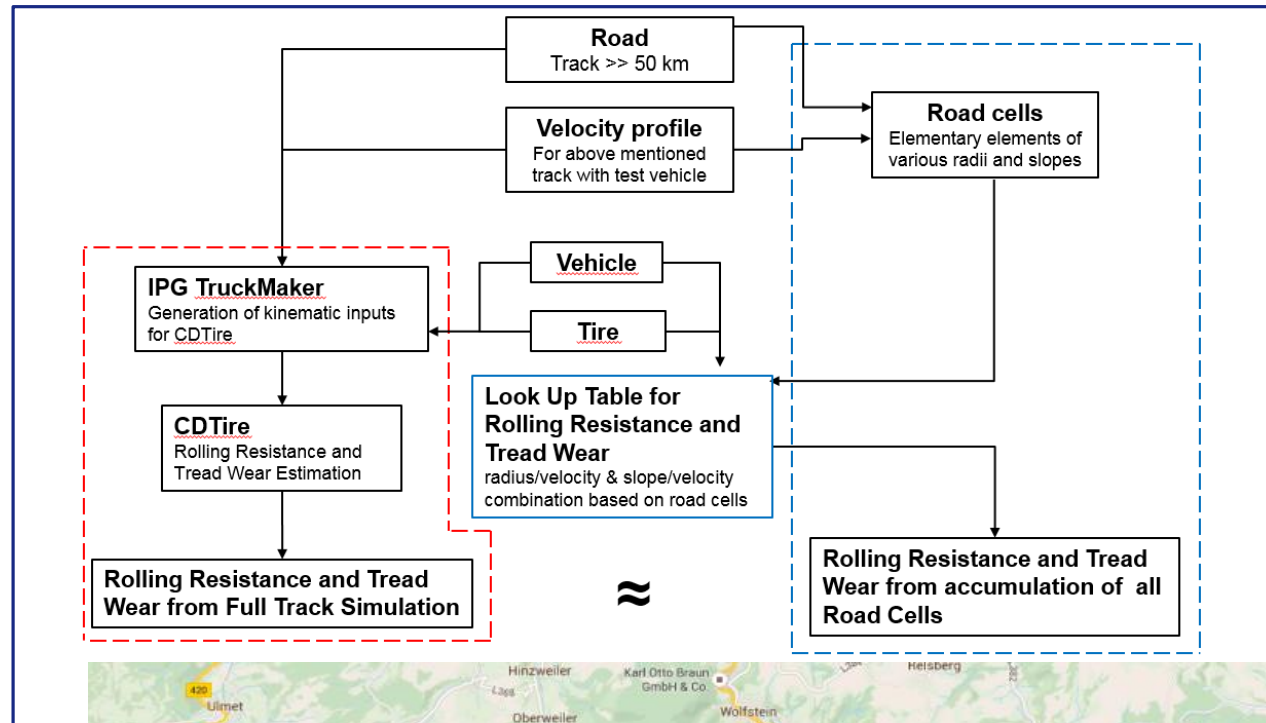
LHS II Ref	Steer Cpd Ref	Steer Gr4	Steer Gr5
100	-11%	-15%	-25%







# Results







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# Impact

- **Greenhouse gazes reduction**
- **Fleet management optimization**
- **Increasing road safety & energy efficiency for long haul trucks**







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# Next steps

- *Side projects created*
- *New possibilities for tyre development*
- *Proactive services for truck fleets*



***More information during LORRY Final Seminar  
Brussels –April 28***





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To learn more about the **LORRY** project

<http://www.lorryproject.eu/>





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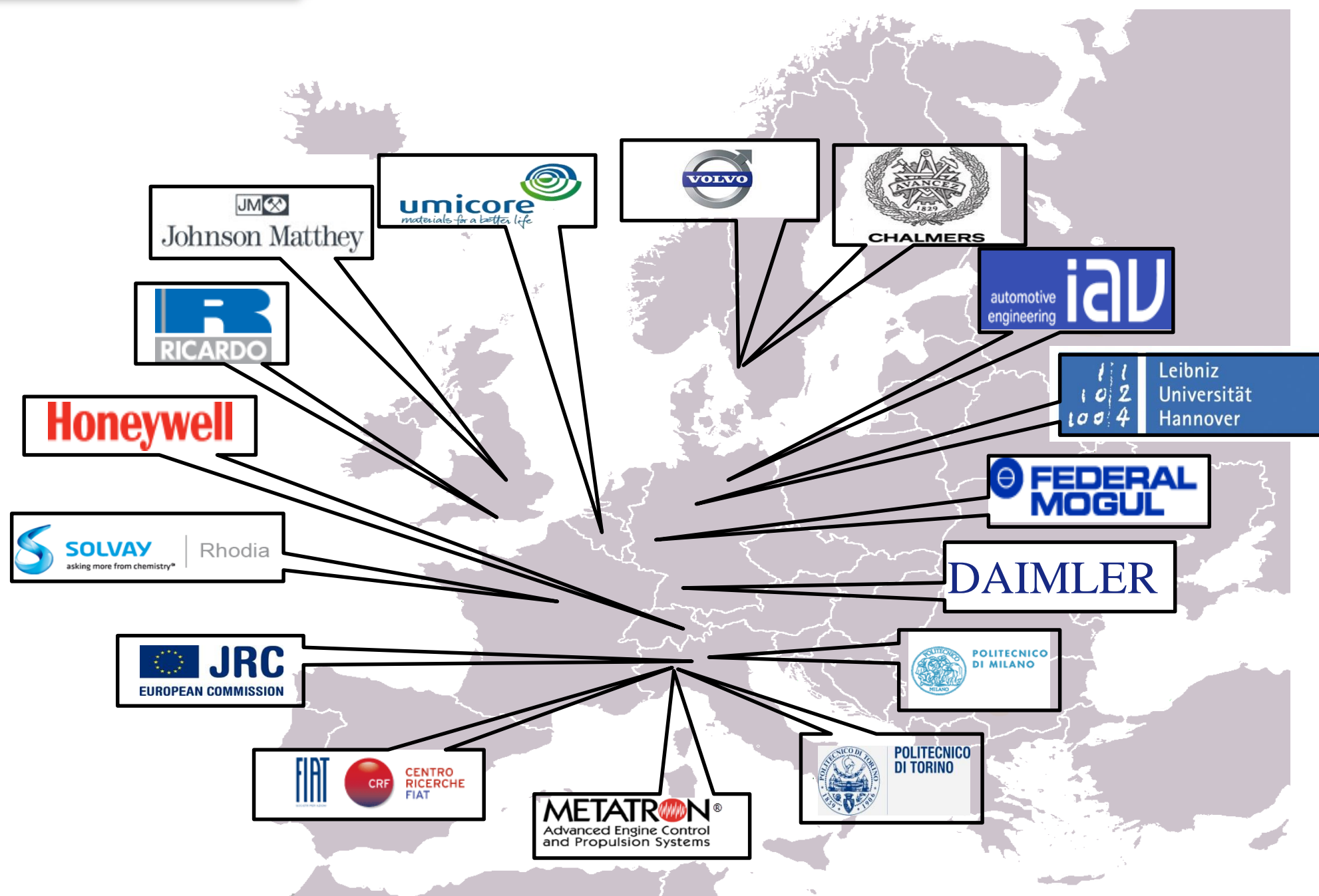
CO<sub>2</sub> Reduction for long distance transport

January 2012 / December 2015



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# CORE's Partners



**CO<sub>2</sub>RE**  
CO<sub>2</sub> reduction  
for transport



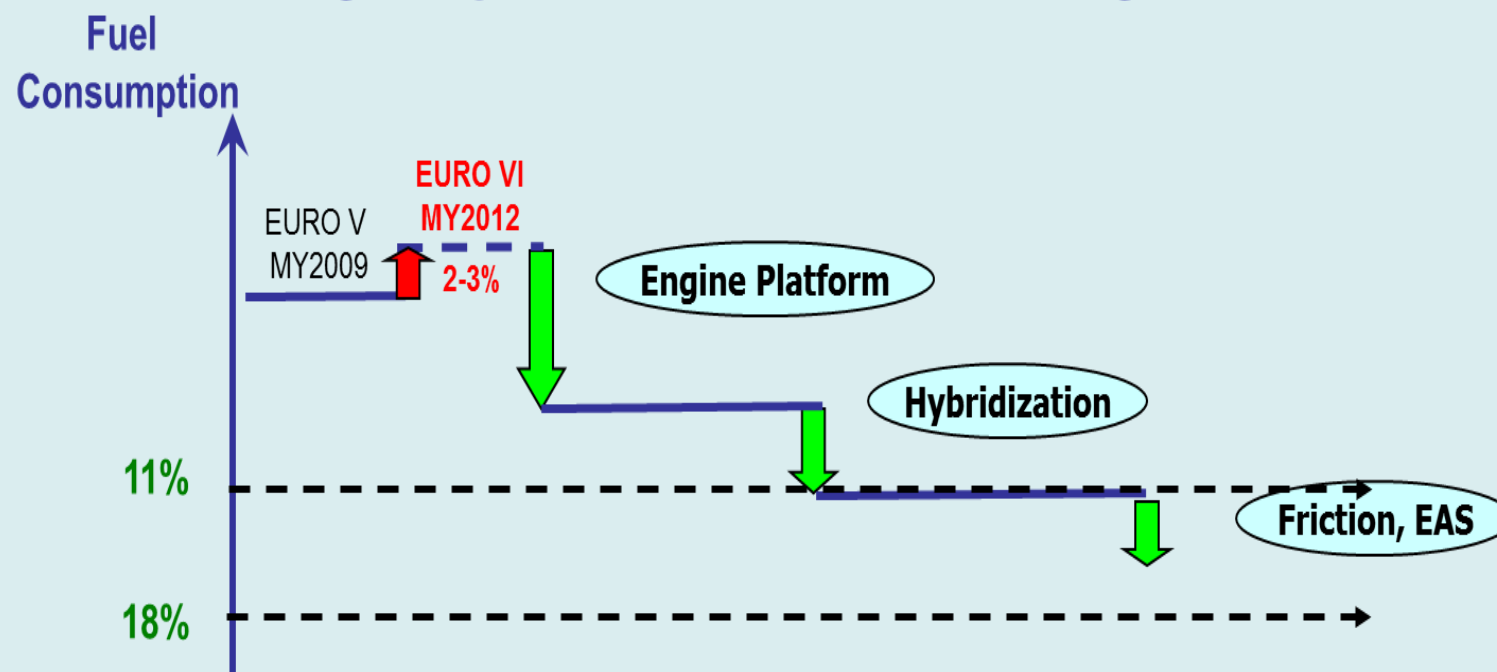


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# CORE's Objectives

- Developing highly efficient drivelines for long distance transport contributing to a **15% reduction in fuel consumption at EURO VI emissions standards**, reference engine is **EURO V**.
- Contribution from:

Reduce CO<sub>2</sub> emission by improved fuel efficiency







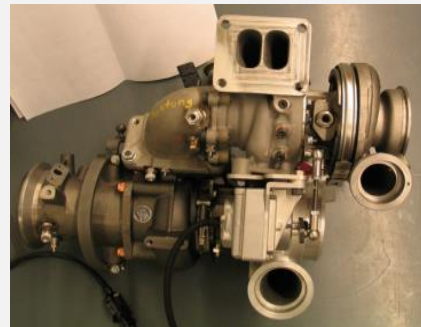
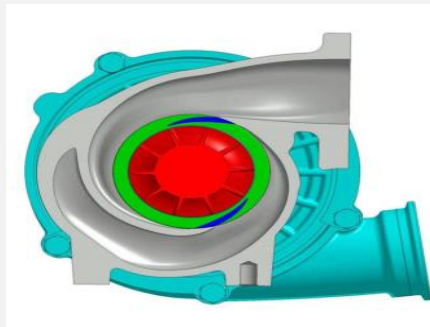
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# CORE's Results

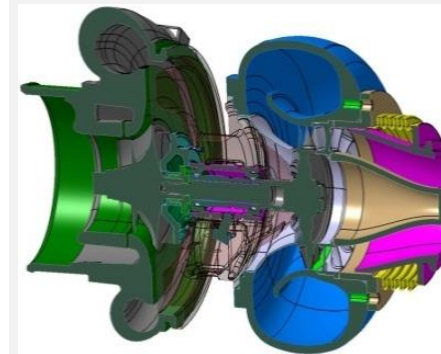
## Novel technologies for long haul truck demands

Improved engine efficiency on CORE engine with novel high performance turbo systems and flexible valve timing systems

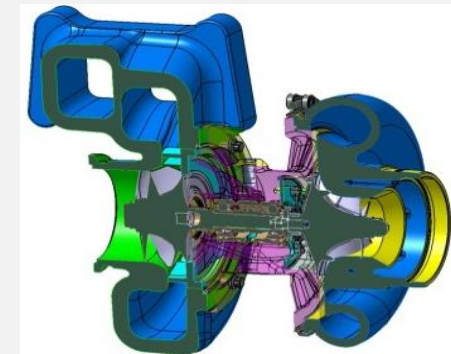
### Examples of two CORE Turbo systems



System 1: = Variable Rotary Turbine



Low Pressure



High Pressure

System 2: = Dual Stage Turbo





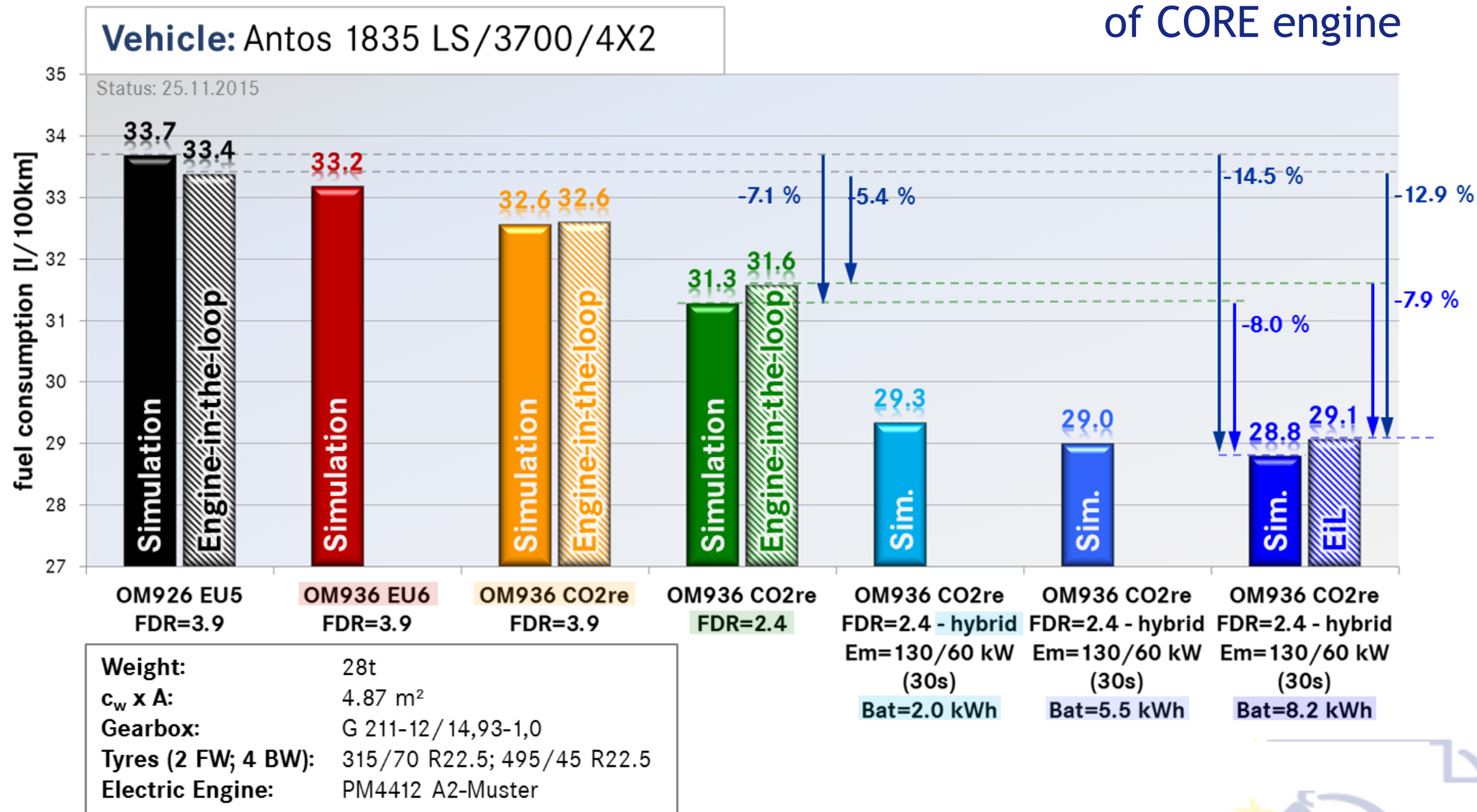
# Results

## Fuel consumption walk in CORE by Daimler

Ref. Engine

CORE engine

Hybridisation  
of CORE engine

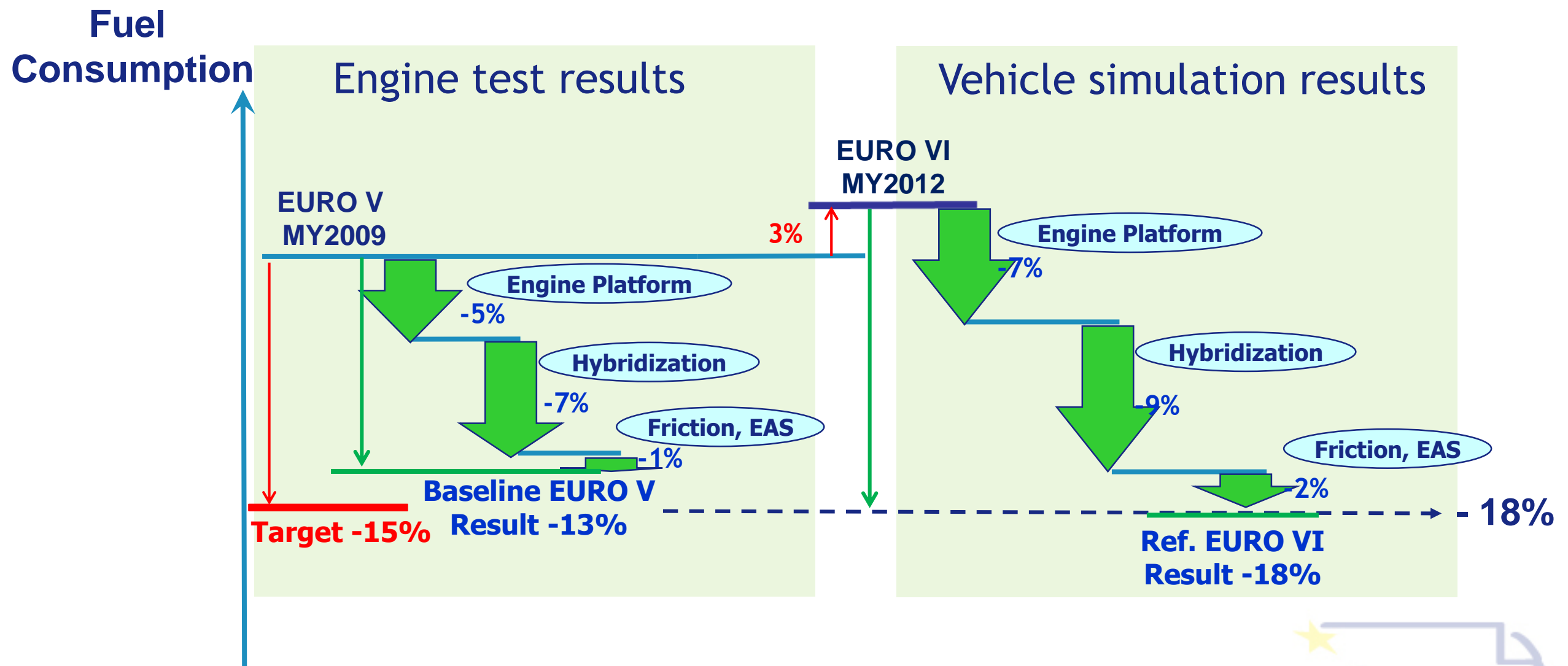






# CORE Results – improved fuel consumption

- The table show achieved CORE results of reduced fuel consumption.
- The best measured results was 13% lower fuel consumption compared to EURO V.
- In the assessment of CORE technologies the best combination was simulated to 18% reduced fuel consumption with EURO VI as reference.





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# Impact

- The presented CORE results show a substantial reduction in CO<sub>2</sub> emissions by improved fuel efficiency in the powertrain.
- The different developed and analysed concepts will support the new products for introduction on the market in 2020 in long haul applications.
- The hybrid potential exceeded the expectations in most of the investigated applications. However, as pointed out the relative benefits of each of hybridisation depends upon the vehicle application and its duty cycle.
- Furthermore in the cost analysis the results showed that the business case may not yet appeared in the investigated applications for long haul hybridisations.





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To learn more about the CORE project

**[www.co2re.eu](http://www.co2re.eu)**





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**SEAM**

# The SEAM-Cluster



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# The SEAM Cluster



**SEAM**



Safe small electric vehicles through  
advanced simulation methodologies

Coordinator: ViF



Enhanced lightweight design by  
advanced lightweight materials

Coordinator: Fraunhofer LBF



Advanced high volume affordable  
lightweighting for future  
electric vehicles

Coordinator: VW



Modeling and testing for improved  
safety of key composite structures in  
alternatively powered vehicles

Coordinator: fka

joint dissemination

**Liaison Team**

CRF, VW, fka,  
ViF, LBF, ika,  
B&W



**epsilon**

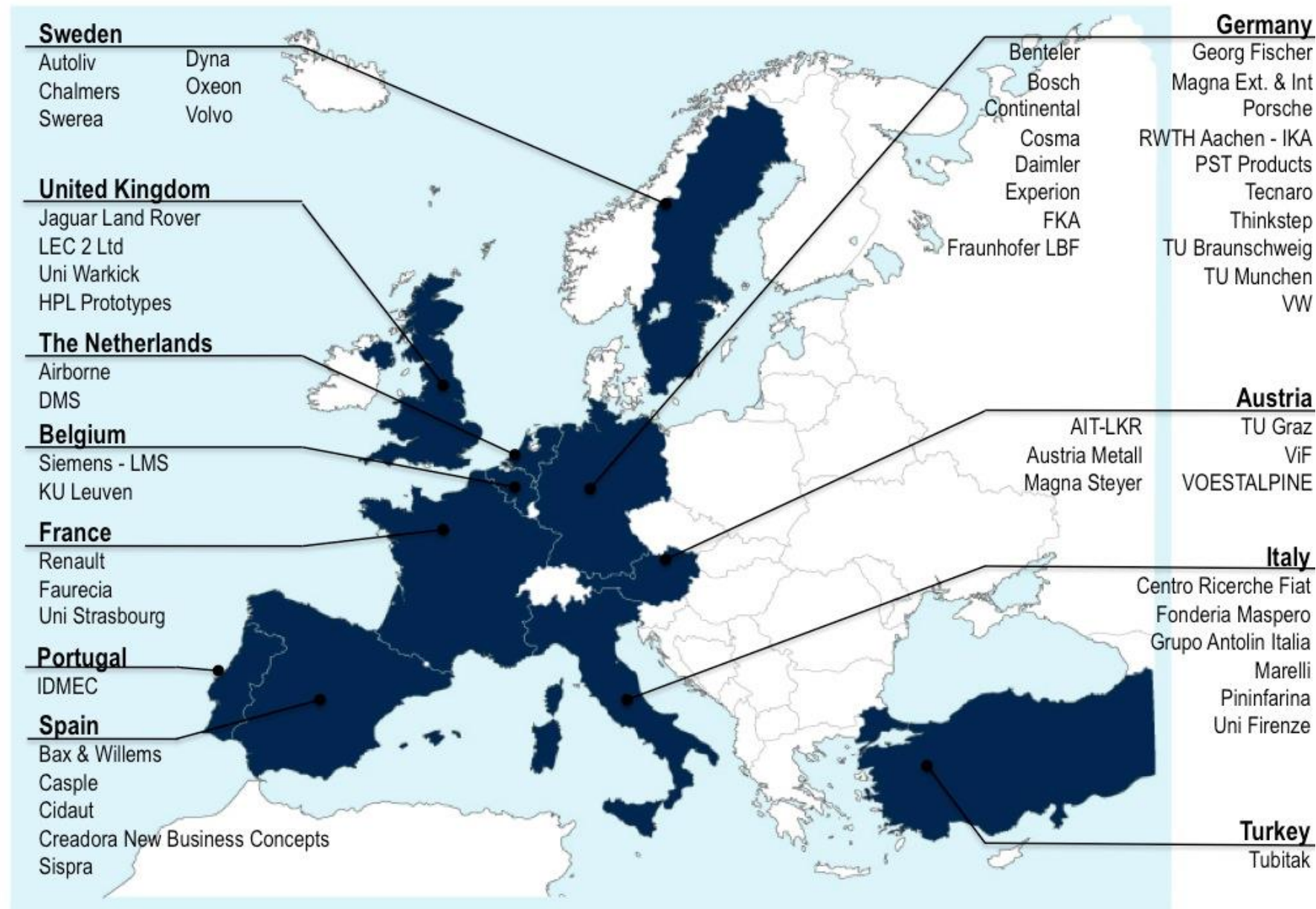






# The SEAM Cluster

6 projects, 54 partners, 11 countries





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# Objectives

- **The SEAM cluster facilitates common dissemination and exploitation activities between the 6 projects**
  - Exchange of results
  - Joint newsletters and leaflets
  - Communication of relevant events / information to partners
  - Providing best practices for exploitation activities and coordinating them





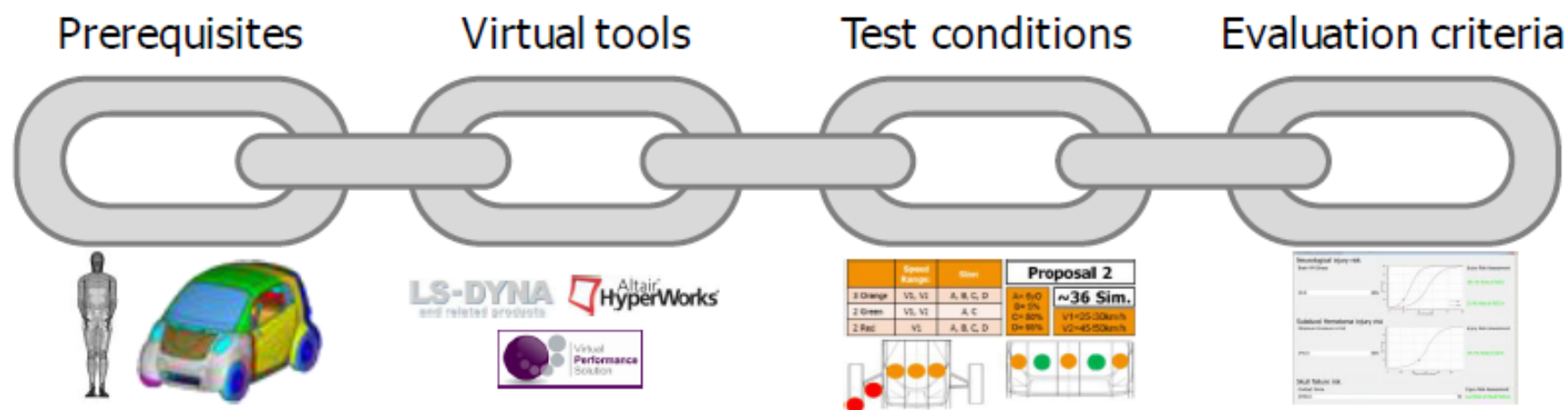


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# SAFE-EV Results

## A Virtual Tool Chain has been developed with

- **Prerequisites:** type approval exist
- **Virtual Tools:** Release of codes and models versions
- **Test Conditions:** Full HBM simulation body parts (2nd impact)
- **Evaluation Criteria:** model based criteria exist as well as IRA tool

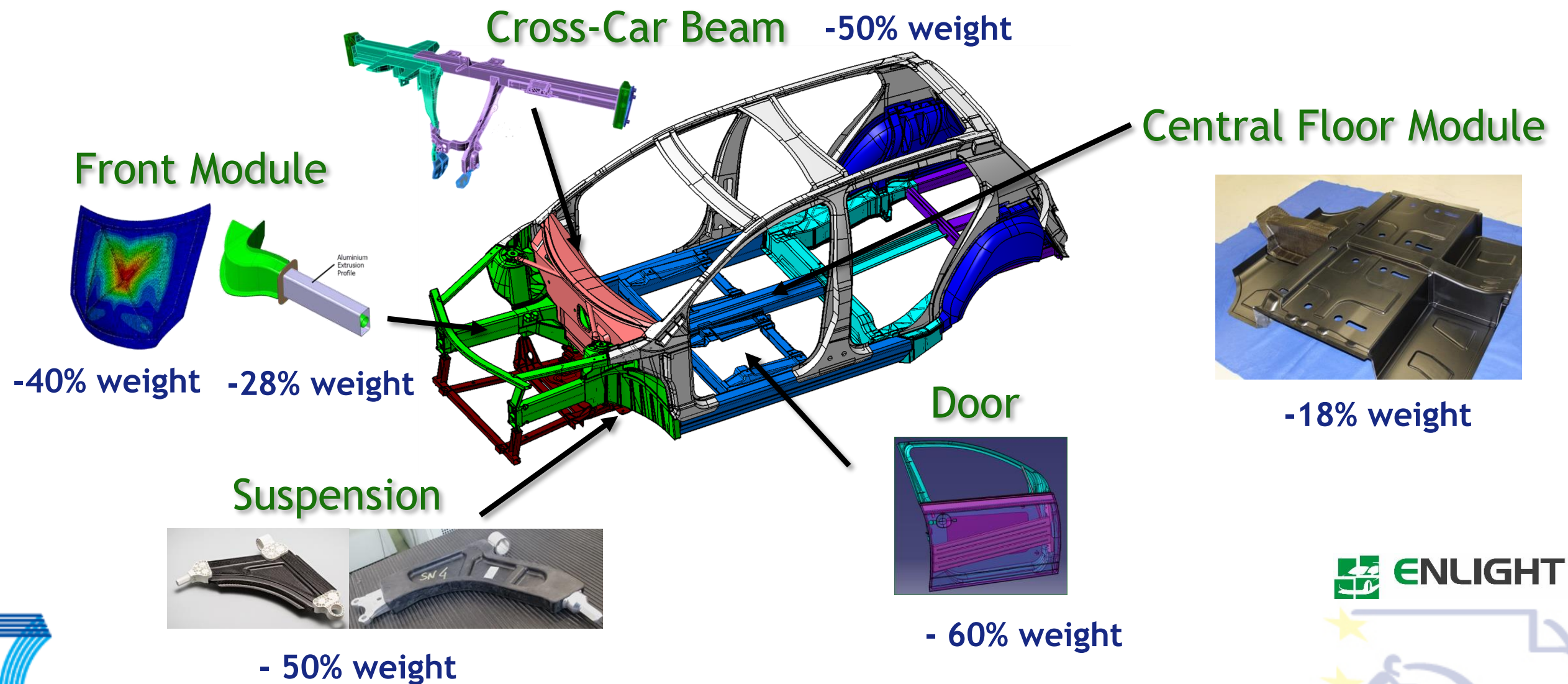




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# ENLIGHT Results

**Significant weight reductions have been achieved for the selected modules**



 **ENLIGHT**

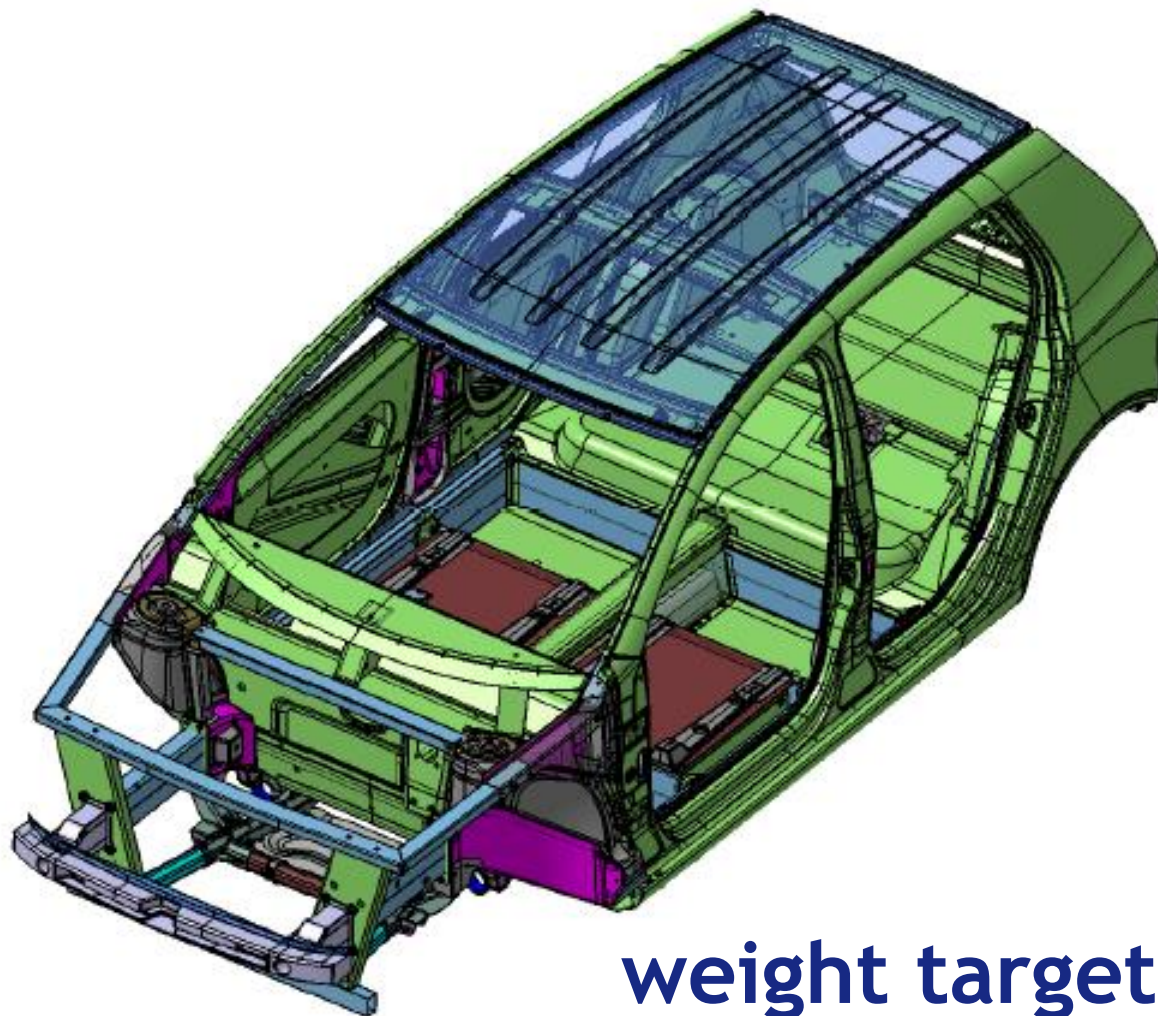




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# ALIVE Results

## Multi-material design of a 4-seated EV-BiW



Material	Colour
Al-Extrusion	Blue
Al-Sheet	Green
Al-Cast	Orange
St-Sheet (cold)	Grey
St-Sheet (warm)	Magenta
FRP	Brown
Magnesium	Dark green

Source: Meschke, Volkswagen Group Research, K-EFFG/L, 2015

**weight target of 200 kg. incl.  
battery case almost achieved**





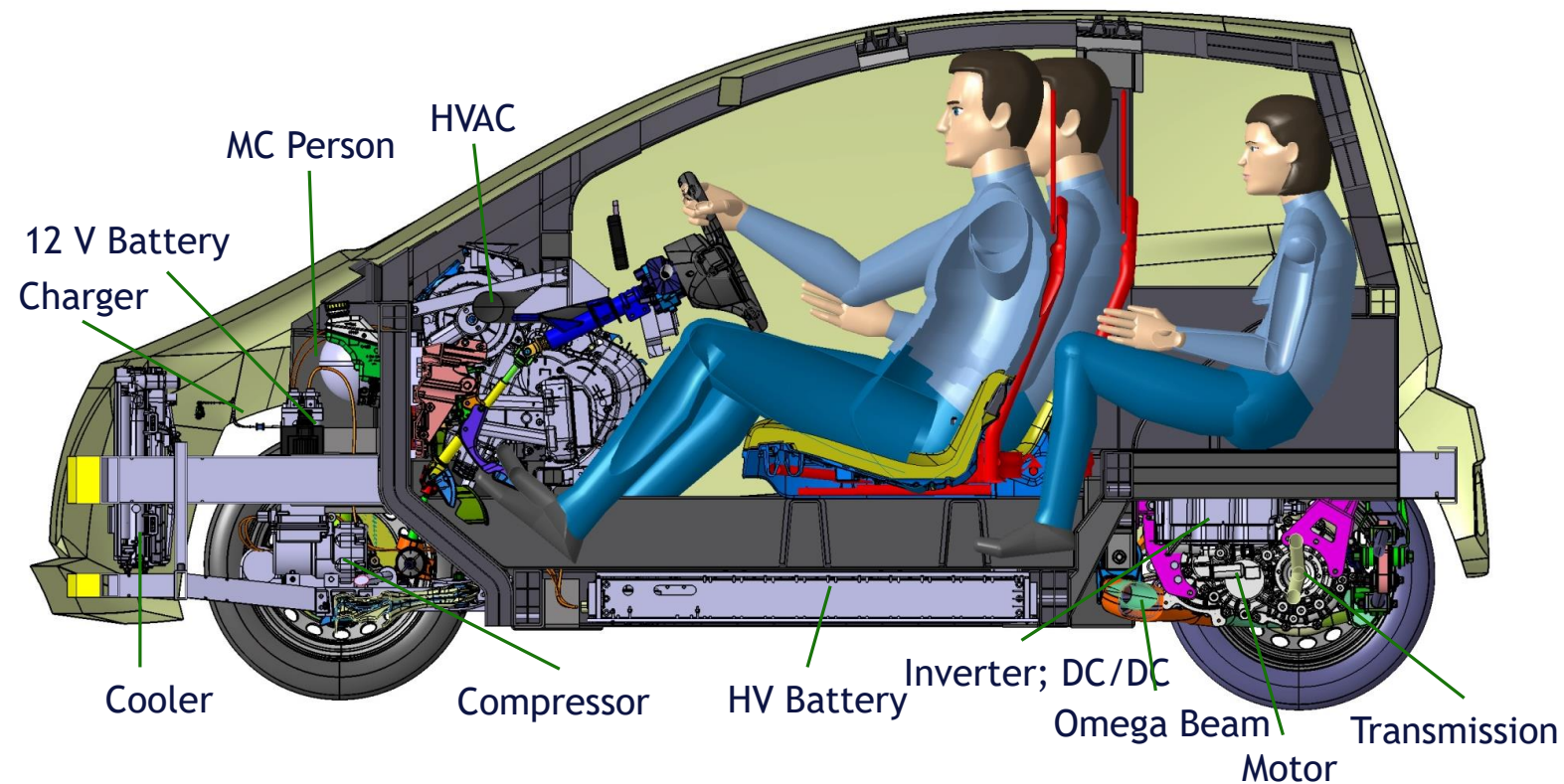




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# epsilon Results

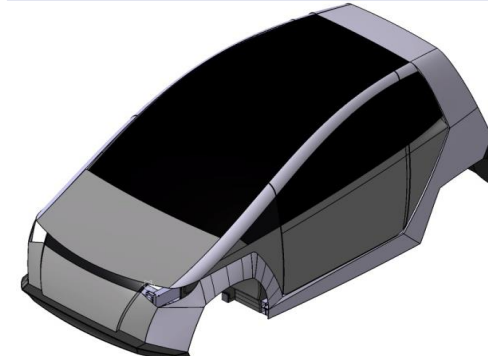
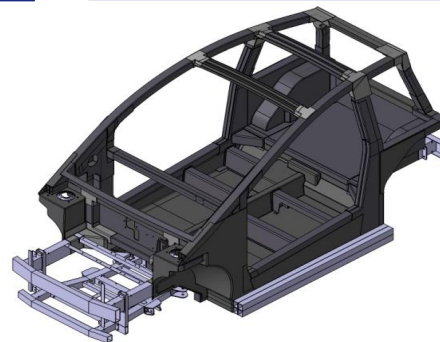
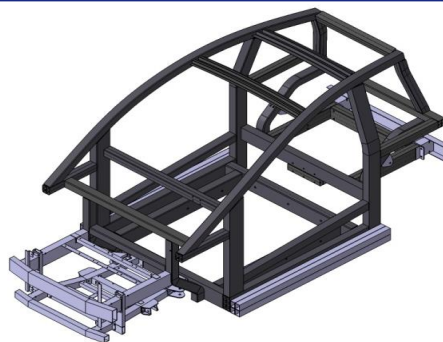
## The epsilon vehicle concept



CFRP Space Frame + Al front and rear end

Tailored sheer panels

Exterior skin panels are not structural





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# Impact

- **Leveraging of results through a much wider basis for dissemination & exploitation**
  - Providing a holistic approach on vehicle lightweight design covering material, design & simulation, manufacturing, testing & validation as well as demonstration
  - Addressing not only researchers & professionals but also managers
  - Bringing together all stakeholders
- **Accelerating the market uptake of results**
  - Use of results across projects
  - Exchange of best practices
  - Exploiting synergies among projects
  - Initiating of follow-up projects (European & national)







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To learn more about the SEAM-Cluster

[www.seam-cluster.eu](http://www.seam-cluster.eu)







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# Eco-design and Validation of In-Wheel Concept for Electric Vehicles

September 1st 2012 / August 31 2015



# Objectives

- **Development of a Motor in Wheel concept for B-class segment vehicles to enable future EV architectures:**
  - High power and torque density for ICE comparable performance
  - With maximum simplicity for OEM, air cooling and integrated power electronics
  - Enhance vehicle control by adopting torque vectoring capabilities





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# Results

## Main risks to be faced by Motor in Wheel concept and how we have addressed them!

- **Thermal management:** MiW concept will have to evacuate efficiently all the heat generated during system operation
- **Endurance:** MiW concept will have to withstand the severe conditions that occur at the wheel
- **Vehicle dynamics:** MiW concept will have to be optimized in terms of weight and power

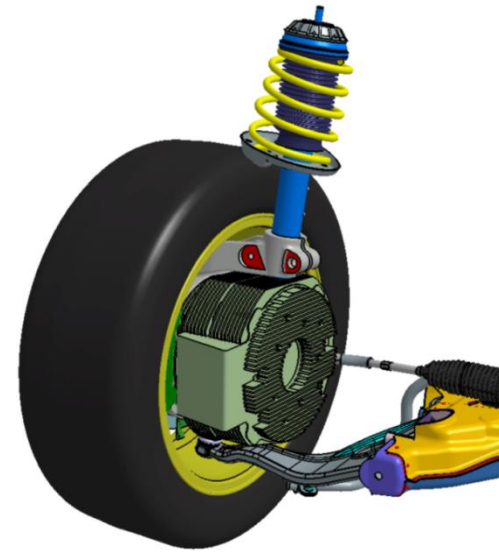




# Results

## Technical results have demonstrated feasibility of the solution

- Axial flux machine with integrated gear evacuates heat efficiently and allows increase of peak power up to 80kW/wheel for 20s (50% more than DoW)
- Effective integration on new suspension allows effective ride and handling characteristics, with minor detrimental effects
- Enhanced torque vectoring control offers significant benefits for urban and sporty use of vehicle

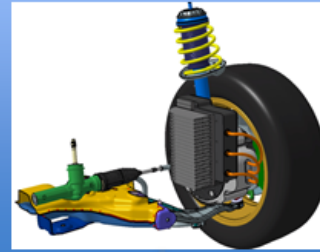






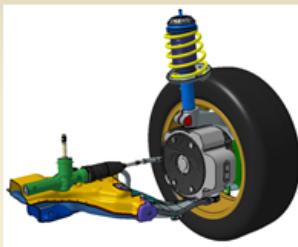
# Results

## Eunice Solution



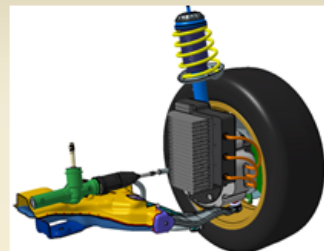
Full air cooled  
With inverter

Full air cooled  
Without inverter



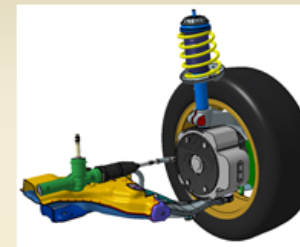
$2 \times 26 = 52$  kW average  
Low weight / size  
A/B segment  
Straightforward integration

Full water cooled  
With inverter



Up to  $100 \times 2 = 200$  kW  
mid weight  
A/B/ C segment  
FWD/ RWD

Full water cooled  
Without inverter



Up to  $100 \times 2 = 200$  kW  
mid weight  
A/B/ C segment  
FWD/ RWD  
Enhanced dynamics

Full water cooled  
Without inverter



Up to  $100 \times 2 = 200$  kW  
Low weight  
A/B segment  
RWD



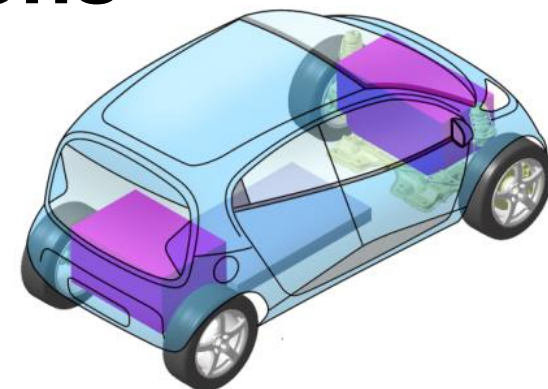


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# Impact

**The outcome of Eunice project will enable the development of a new generation of B segment electric vehicles that maximize design freedom for OEM's with a «plug and play» concept**

- **Vehicles can reduce footprint, migrate to flat & simple platform and maximize space, while providing performance and enhanced control**
- **In addition to the B segment application, a Eunice family tree has been defined for future applications**





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# Next steps

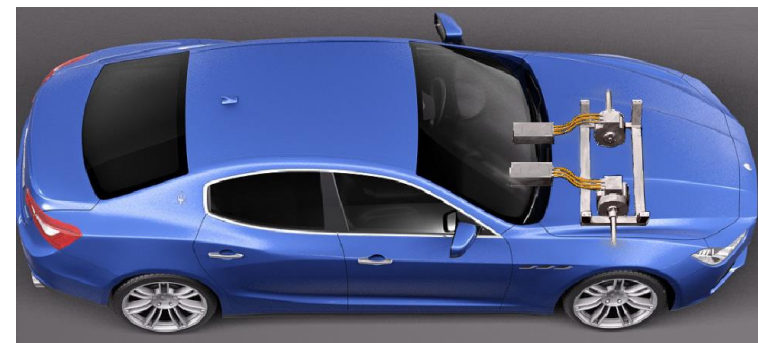
***Eunice prototype has been introduced to OEM's with positive feedback***



***Extensive winter testing carried out in GKN  
Winter testing 2016 test with great success***



***Application of axial flux machine with  
reduction gear is proposed for advanced 4WD  
hybrid architecture with FCA group on H2020  
ADVICE proposal***







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To learn more about the **EUNICE** project  
<http://www.eunice-project.eu/>

**eunice** Eco-design and Validation of  
In-Wheel Concept for Electric Vehicles

**CONSORTIUM**

tecnaia Inspiring Business  
infineon  
CIE Automotive  
pininfarina  
aic AUTOMOTIVE INTELLIGENCE CENTER  
HAYES LEMMERZ  
MAGNETI MARELLI  
AIT AUSTRIAN INSTITUTE OF TECHNOLOGY  
DENN  
CLEPA European Association of Automotive Suppliers  
IVL  
EVO ELECTRIC





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# Optimal Energy consumption and Recovery based on system network

May 2011 / July 2014

 **BOSCH**  
Invented for life  
Robert Bosch GmbH, Chassis Systems Control

**PSA PEUGEOT CITROËN**

 **BOSCH**  
Invented for life  
Robert Bosch Car Multimedia GmbH





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# OpEneR's Objectives

- **Create an overall energy management system for EV that merges on- and off-board data together to run energy optimal driving strategies**
  - yielding an increased driving range
  - providing driver information and instruction
  - guaranteeing safe driving



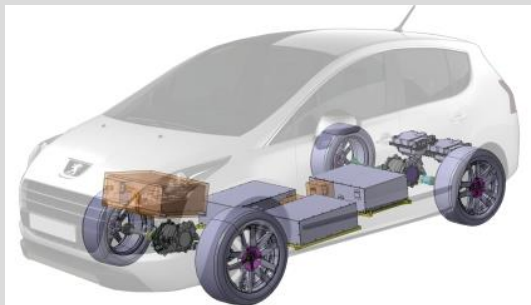


# OpEneR's Results

## OpEneR Prototypes for early real testing



Peugeot 3008 Diesel Hy4



Peugeot 3008 FEV



Intensive high- $\mu$  and  
low- $\mu$  testing

## OpEneR Human Machine Interface



Development methodology

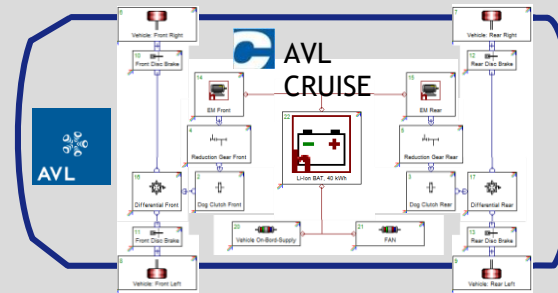


Haptic acceleration pedal



Final Human Machine  
Interface

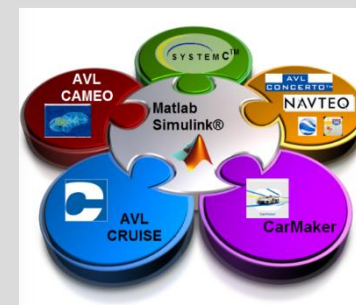
## OpEneR Simulation Environment



E-PT simulation



Text

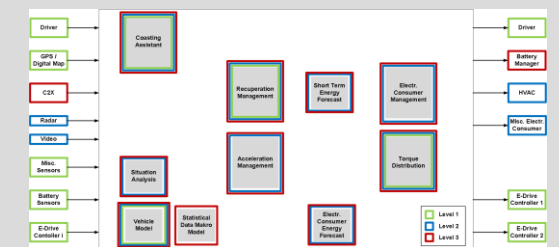


Seamless simulation  
environment

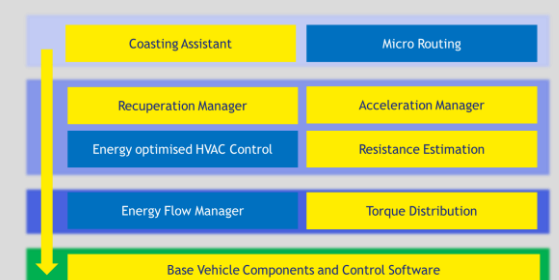
## OpEneR Energy Management (EM)

- Energy efficient route calculation
- 2-channel cooperative regenerative braking
- Torque distribution
- Coasting assistant
- Energy efficient ACC
- Acceleration/deceleration assistant
- Energy efficient auxiliaries
- Distributed traction control

EM functions



EM Architecture



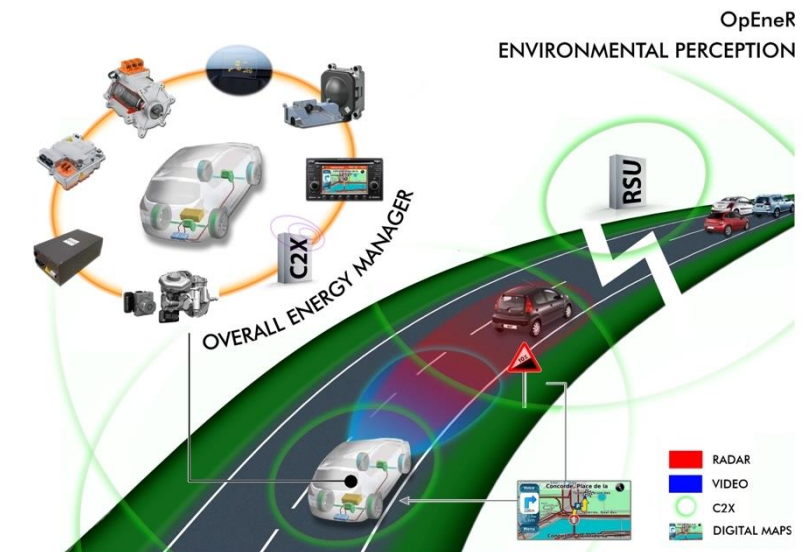
EM function hierarchy





# OpEneR's Results

Feature	Simulation		Measurement
	Energy gain	Time penalty	
Energy Efficient Route	0...29 %	0...23 %	30.9 % (with iMiev)
ESP <sup>®</sup> hev	25...42 %	0 %	42 %
Torque Distribution	+1...+9 pp	0 %	36 %
Coasting/Acceleration Assistant	0...40 %	0...20 %	
Eco ACC	5...25 %	0...10 %	23 %
Traffic Light Assistant	0...29 %	-4...0 %	-
Traffic Light/Lane Change Assistant	0...29%	-12...0%	-



- Overall reduced energy consumption of 12.1% at a time penalty of 2.8% is expected for the OpEneR driving cycle definition
- Measurements have shown that for increased time penalty the energy consumption can be significantly increased (40% and more at 20% time penalty)
- Additional benefit due to Eco-Routing of up to 30%







# OpEneR's Impacts

- Follow-up activities related to driver assistance systems also between industry partners
  - Further cooperation between PSA and Bosch wrt
    - Recuperation via (haptic) acceleration pedal
    - Distributed traction control system
  - Ongoing use of OpEneR prototypes for internal R&D, e.g. on distributed ABS control
- Improvements in terms of knowledge & skills regarding Energy Management systems
  - Difference between recuperation strategies for hybrid and fully electric vehicles
  - Transfer of knowledge into platform and series development departments, e.g. for
    - 2-channel cooperative regenerative braking
    - Distributed traction and ABS control





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# Next steps

- An increased consortium submitted COASTER (COoperative Assistance Systems & Thermal management for Extended Range) under H2020 GV-02-2014 focusing on advanced energy management systems for FEV; unfortunately this new proposal was rejected
- Follow-up work therefore limited to internal R&D work
- Use of network for further collaboration also wrt to public funding





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To learn more about the OpEneR project  
[www.fp7-opener.eu](http://www.fp7-opener.eu)





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# Thank you for your attention!

More information? [www.egvia.eu](http://www.egvia.eu)

Contact: [info@egvia.eu](mailto:info@egvia.eu)

