



EGVIA Workshop: European funded project results -  
Reduction of CO2 emissions from Heavy-Duty Trucks

[www.ecochamps.eu](http://www.ecochamps.eu)



# General Information ECOCHAMPS

**Project full title:** European COmpetitiveness on Commercial Hybrid and AutoMotive PowertrainS: ECOCHAMPS

**Coordinator:** DAF Trucks

**Consortium:** OEM's, Tier1 Suppliers, Research Institutes, Universities


**Call:** H2020-GV.4 Hybrid Light and Heavy Duty Vehicles

**Budget / Funding:** 28.6 M€ / 21.1 M€


**Type of project:** H2020 Green Vehicle - Innovation Action


**Project number:** GA-653468


# Partners and location





A **PSA** COMPANY






















Research Partners






















Suppliers & Services






























SAMSUNG SDI BATTERY SYSTEMS







# Project Motivation & Objectives

## Motivation;

-  Increase the competitiveness of European vehicle manufacturers and component suppliers by gaining a leading position in hybrid powertrain technology
-  Enabling a future business case for hybrid light and heavy duty vehicles
-  Reduce CO<sub>2</sub> emissions and increase air quality

## Objectives;

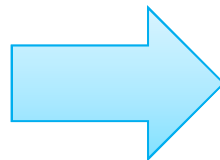
-  20% powertrain efficiency improvement
-  20% powertrain weight and volume reduction
-  Maximum of 10% cost premium
-  Compliant with Euro 6 / Euro VI regulations



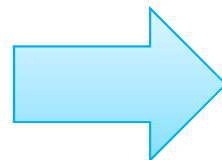
# Towards European Hybrid Technology Leadership

## Actions

Standardization &  
modularization



Optimal  
specification



## Benefit

Reduced cost  
premium

Improved fuel  
economy

Extended  
functionality




## Result

Increased Market  
Penetration of  
Hybrid Vehicles



# MSF Introduction

## Modular system and Standardisation Framework

-  Reduce cost of components for electrification of vehicles through standardization of interfaces
-  Industry first standardisation framework for heavy duty hybrid electric components
-  First time use of passenger car technology and knowhow in heavy duty vehicle applications

### Benefit for OEMs

- Reduce component and (proprietary) development cost
- Transferability of solutions
- Support scalability
- Reduced validation efforts
- Support competition

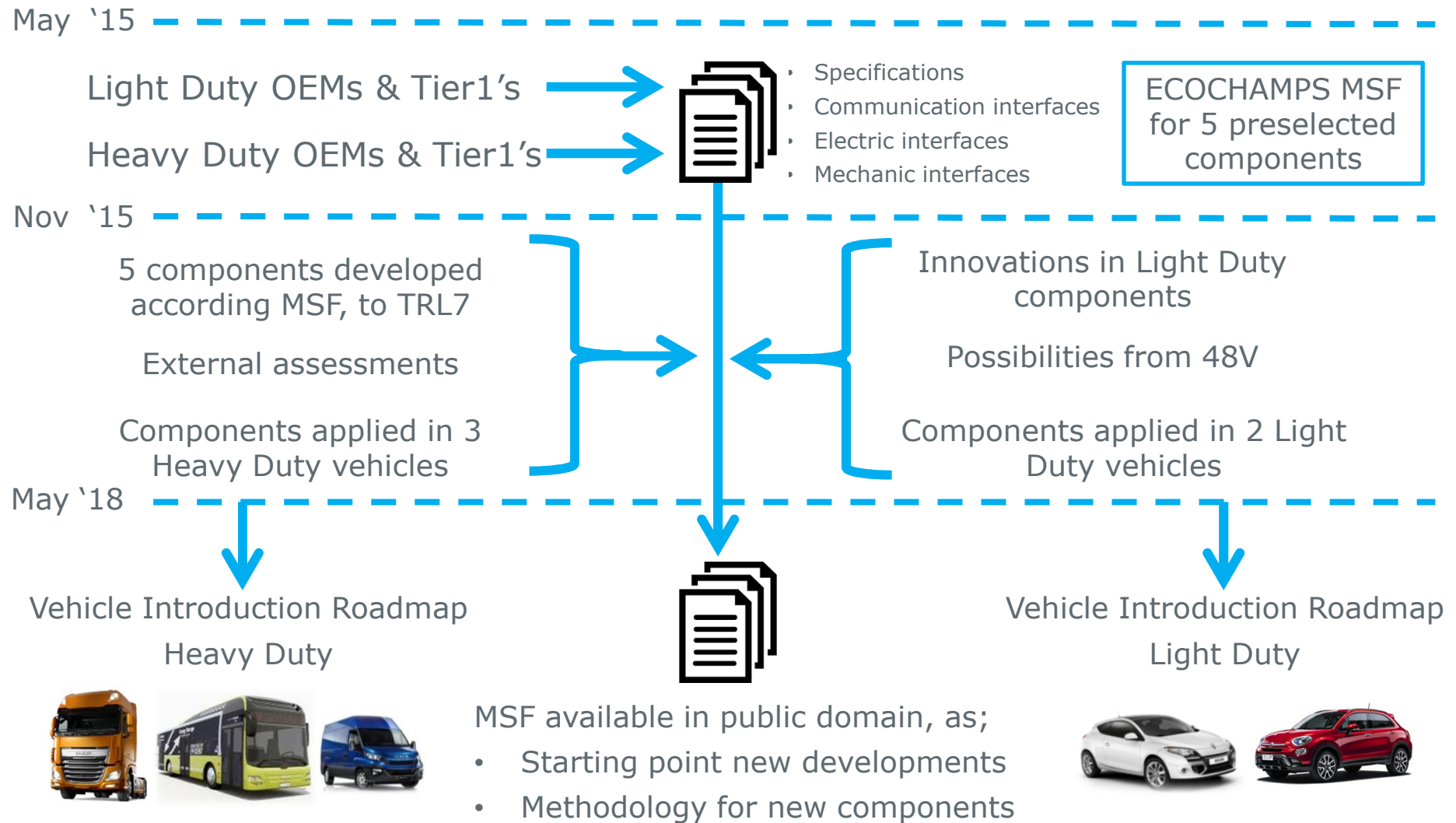
### Benefit for suppliers

- Reduce development and testing effort
- Higher volume base – economies of scale
- Better planning base for development
- Support competition

### Benefit for end-customers

- Improved offer for products
- Reduced premium cost
- Support competition

# WP 2MSF Approach



## WP2: Objectives

### Overall WP objectives

Develop a proposal for a Modular System and Standardization Framework (MSF) for hybrid drivetrain components and e-auxiliaries








Develop a set of components to TRL 6/7 based on MSF requirements



Assess the MSF acc. to component integration, demonstrator vehicles and simulation

### WP2 objectives for this period

-  Report on development of components including implemented MSF requirements (D2.3)
-  Investigate 48 V technology vs. HV solutions for HEV and P-HEV applications: today and future maximum technical capabilities and cost targets
-  Test feasibility of modular simulation system by simulation of specified component interfaces
-  Evaluate standardized components in virtual simulation environment
-  Assess the MSF from vehicle integration, testing and simulation including outlook

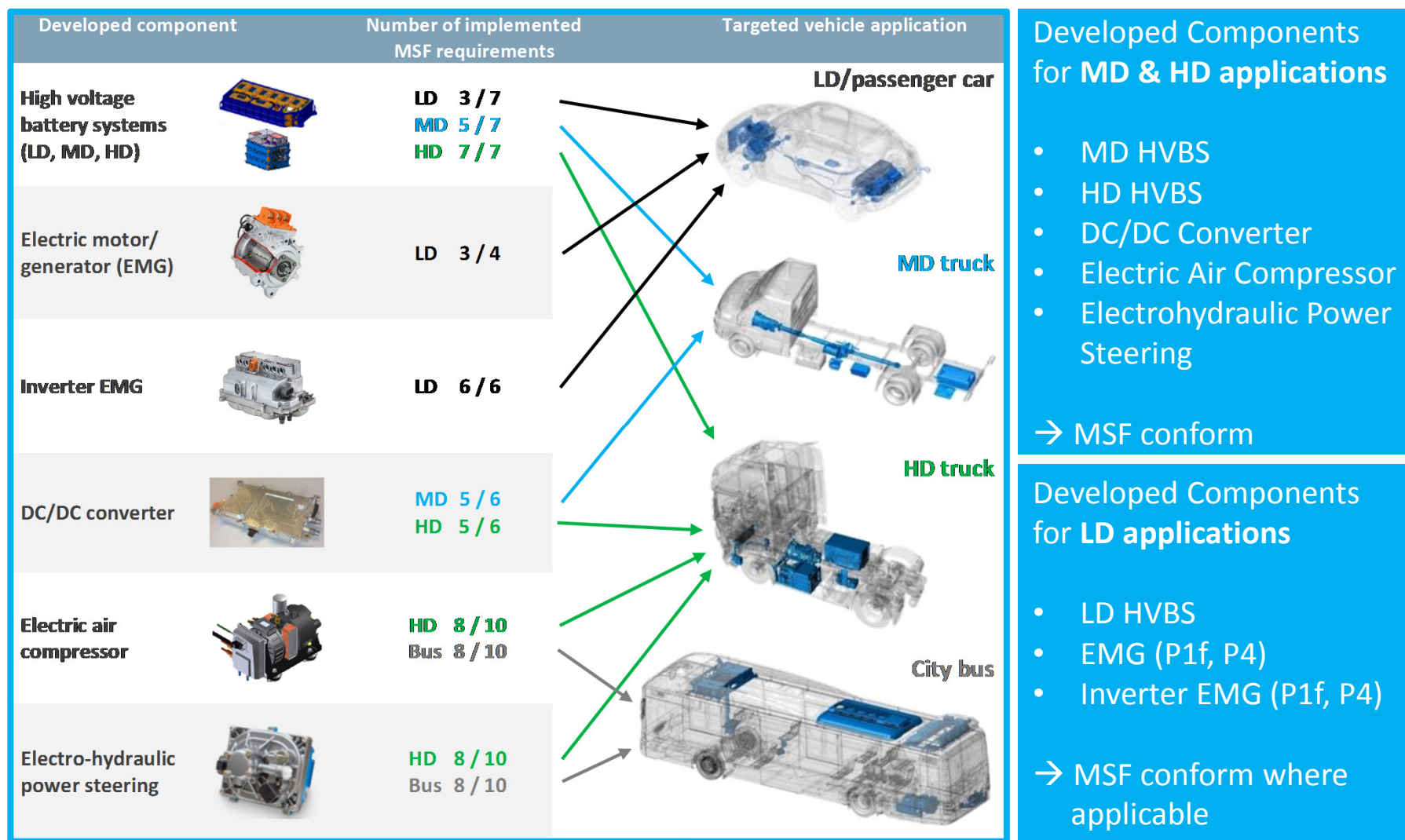


## WP2: Tasks and Deliverables














 Overview of all WP2 tasks and deliverables incl. responsibilities and milestones

| ID                     | Description   | Lead           | When         |   |
|------------------------|---|----------------|--------------|---|
| <b>Task 2.1</b>        | Modular system and Standardization Framework (MSF) for hybrid CV components as baseline for standardization   | DAI            | M1-M18       | ✓ |
| <b>Deliverable 2.2</b> | Report on the interaction with the mirror group   | DAI            | M7           | ✓ |
| <b>Deliverable 2.4</b> | Modular system for hybrid CV components as baseline for standardization. First <b>draft report</b> for component development @ M7 (CO) and <b>final report for publication</b> @ M36 (PU).  | FHG<br>FHG     | M7<br>M36    | ✓ |
| <b>Task 2.2</b>        | Implication of 48 V systems for component development based on standards  | CRF            | (M1) M22-M36 | ← |
| <b>Deliverable 2.1</b> | 48 V technology vs. HV solutions for HEV and P-HEV applications: today and future maximum technical capabilities and cost targets   | CRF            | M36          |   |
| <b>Task 2.3</b>        | Component development based on standards  | Suppliers, FHG | M4-M21       | ✓ |
| <b>Deliverable 2.3</b> | Summary report on component development incl. description of the component and an assessment of the conformity with the standards (LD: existing ones, HMD/HD: MSF incl. outlook) and component test results of standard functional- and performance tests | FHG            | M22          |   |
| <b>Task 2.4</b>        | Assessment of the MSF from testing and simulation and outlook   |                |              |   |
| <b>Subtask 2.4.1</b>   | Results from integration of standardized components into vehicles   | DAI            | M32-M35      |   |
| <b>Subtask 2.4.2</b>   | Simulation of specified interfaces, virtual demonstrator, modular simulation  | ViF            | M13-M33      | ← |
| <b>Subtask 2.4.3</b>   | Overall assessment of MSF, outlook and communication  | DAI            | M32-M36      |   |
| <b>Deliverable 2.5</b> | Final assessment  | FHG            | M36          |   |

## Task 2.3: Component Development – Overview



## Task 2.3: Status of Component Development

|   | Component   | Supplier | Status  |
|---|---|----------|---|
| <b>MSF conform MD, HD, bus components</b> | High Voltage Battery System (MD truck)                                | BOSCH    | Delivered to IVECO               |
|   | High Voltage Battery System (HD truck)                                | SDI      | Delivered to DAF                 |
|   | DC/DC-Converter for low voltage boardnet supply (MD truck & HD truck) | BOSCH    | 12V DC/DC delivered to IVECO     |
|   |   |          | 24V DC/DC delivered to DAF       |
|   | Electrohydraulic Power Steering (HD truck & city bus)                 | ECS      | Delivered to MAN                 |
|   |   |          | Delivered to DAF                 |
| <b>LD components</b>                      | Electric Air Compressor (HD truck & city bus)                         | HYDRO    | Delivered to MAN                 |
|   |   |          | Awaiting shipment to DAF (M22)  |
|   | High Voltage Battery System (passenger car)                           | JMBS     | Delivered to FIAT              |
|   | Electric Motor/Generator (EMG) (P1f & P4) (passenger car)             | BOSCH    | P1f delivered to FIAT          |
|   |   |          | P4 delivered to FIAT           |
|   | Inverter EMG (P1f & P4) (passenger car)                               | BOSCH    | P1f delivered to FIAT          |
|   |   |          | P4 delivered to FIAT           |

## Task 2.3: Benefit in component development by MSF requirements for MD/HD truck and bus application

| Developed Component                            | Predefined Application | Major benefit by implemented MSF requirements   |
|--|------------------------|---|
| High Voltage Battery System                    | MD truck               | <ul style="list-style-type: none"> <li>• Parallel connection of complete battery packs</li> <li>• Increase in energy content and power</li> </ul>   |
| High Voltage Battery System                    | HD truck               | <ul style="list-style-type: none"> <li>• Highly scalable battery system for different voltage levels</li> <li>• Utilizing parts from passenger car battery systems</li> </ul>   |
| DC/DC-Converter for low voltage onboard supply | MD & HD truck          | <ul style="list-style-type: none"> <li>• Scalable 12 V/24 V DC/DC converter</li> </ul>  |
| Electro-hydraulic Power Steering               | HD truck & city bus    | <ul style="list-style-type: none"> <li>• Demand-based steering assistance</li> <li>• Fuel saving by controlled steering support achieved by varying the hydraulic oil volume flow dependent on driving situation</li> </ul> |
| Electric Air Compressor                        | HD truck & city bus    | <ul style="list-style-type: none"> <li>• 40 % reduction in weight</li> <li>• Air supply pressure and rate</li> </ul>  |

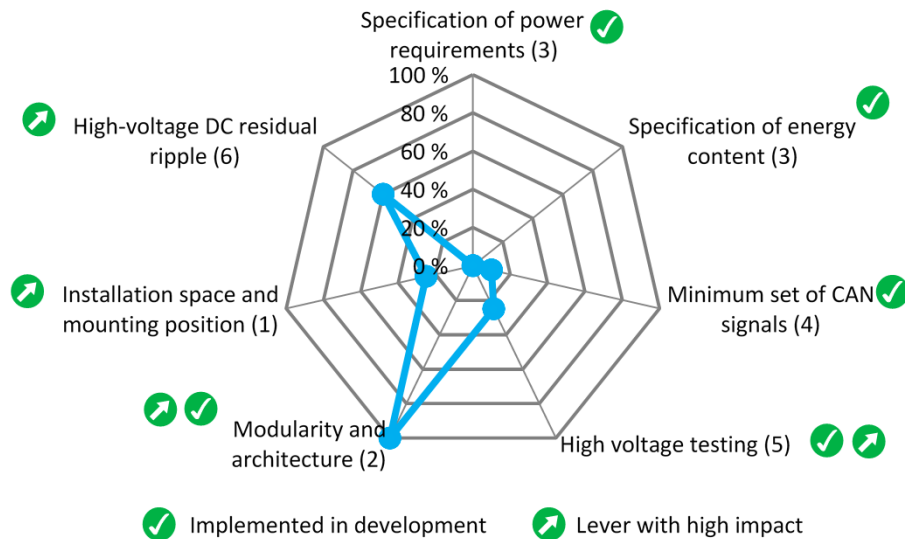
## Task 2.3: Future potential for component development by transfer of requirements from LD application

| Developed Component                                    | Predefined Application   | Future potential according to MSF requirements  |
|--|--------------------------|---|
| <b>High Voltage Battery System</b>                     | LD/passenger car class B | <ul style="list-style-type: none"> <li>• Power/energy density, improved PHEV performance as per demonstrator vehicle requirements</li> <li>• Scalable modular technology</li> <li>• Reduced battery pack weight</li> <li>• Integrated cooling system</li> </ul> |
| <b>Electric motor/generator (EMG) and inverter EMG</b> | LD/passenger car class B | <ul style="list-style-type: none"> <li>• Scalable motor/generator for passenger car and MD trucks</li> </ul>  |

# Task 2.3: Benefit for components by implemented MSF requirements – HV battery system

## High voltage battery system

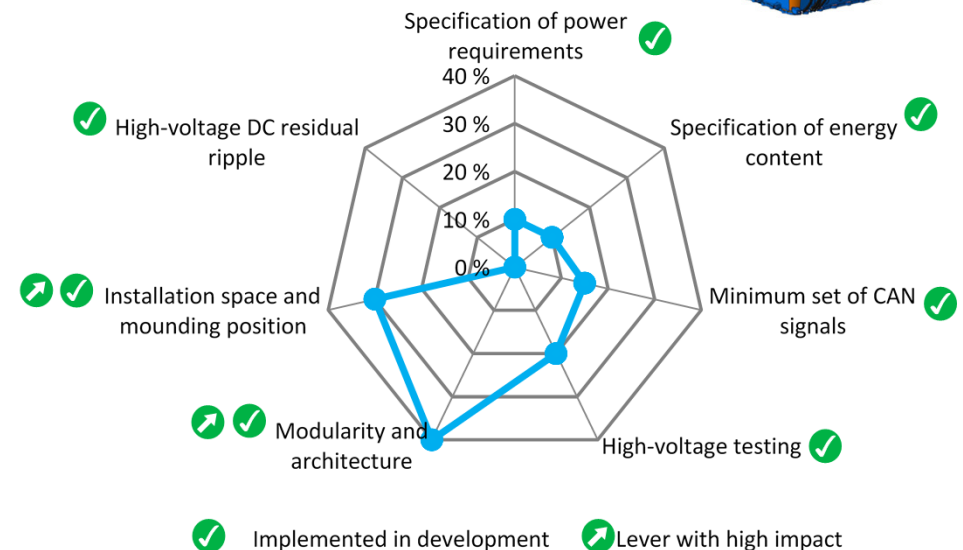
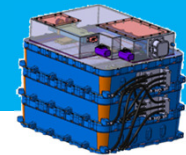
MD truck app. [BOSCH]



- Two Li-Ion battery packs acc. to PHEV2 cell format
- Master-Slave solution
- Parallel connection of complete battery packs
- Increase in energy content and power

## High voltage battery system

HD truck app. [SDI]

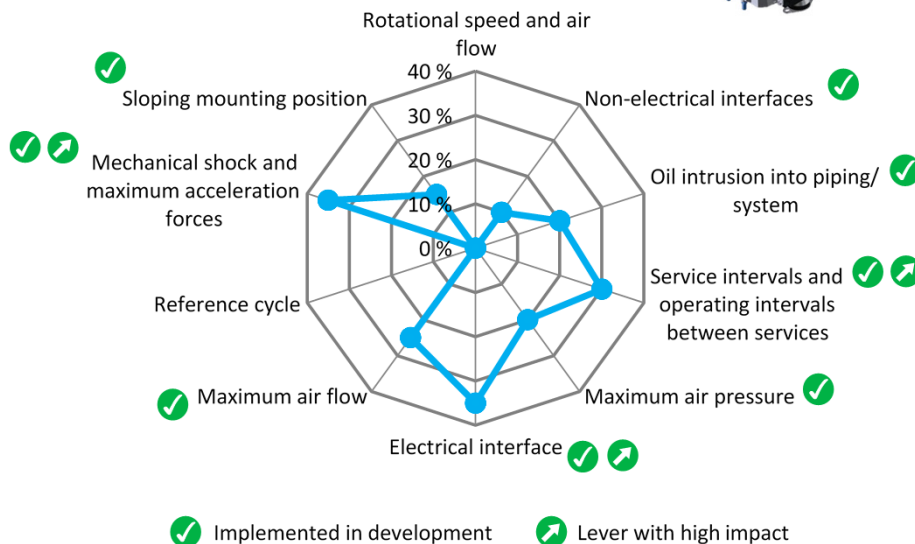
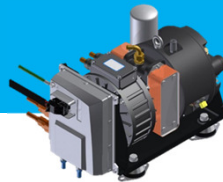


- 12 cells acc. PHEV2 format per module
- Possible configurations: 12s1p (48 V module) or 6s2p (24 V module)
- Serial connection of modules lead to fully scalable system for different applications (48 V – 800 V)

# Task 2.3: Benefit for components by implemented MSF requirements – Auxiliaries

## Electric Air Compressor

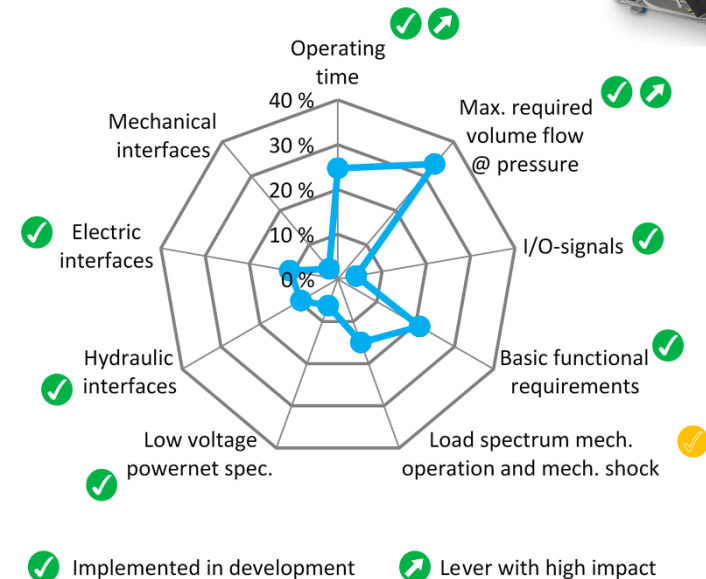
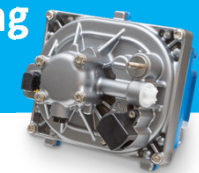
HD truck & city bus app. [HYDRO]



- Oil flooded sliding rotary vane compressor
- Max. pressure: 13.5 bar, max. power 4.6 kW @ 450 l/min and 13.5 bar
- 40 % reduction in weight

## Electro-hydraulic Power Steering

HD truck & city bus app. [ECS]



- Complete new development
- Highly integrated electrohydraulic steering pump that allows demand-based steering assistance for HD & bus applications for the first time
- Fuel saving owing to demand based steering support

# Outlook

## Ongoing Task 2.2:

Implication of 48 V systems for component development based on standards (D2.1)

## Ongoing Subtasks 2.4.2:

Virtual Demonstrator and Modular Simulation

## Additional assignments ongoing:

WP2 input (presentations) for EcoChamps mid conference

Feedback on Adv. Board questions'

## Start Subtasks 2.4.1 & 2.4.3 in M32:

Assessment of the MSF from testing and simulation and outlook (D2.4 & D2.5)

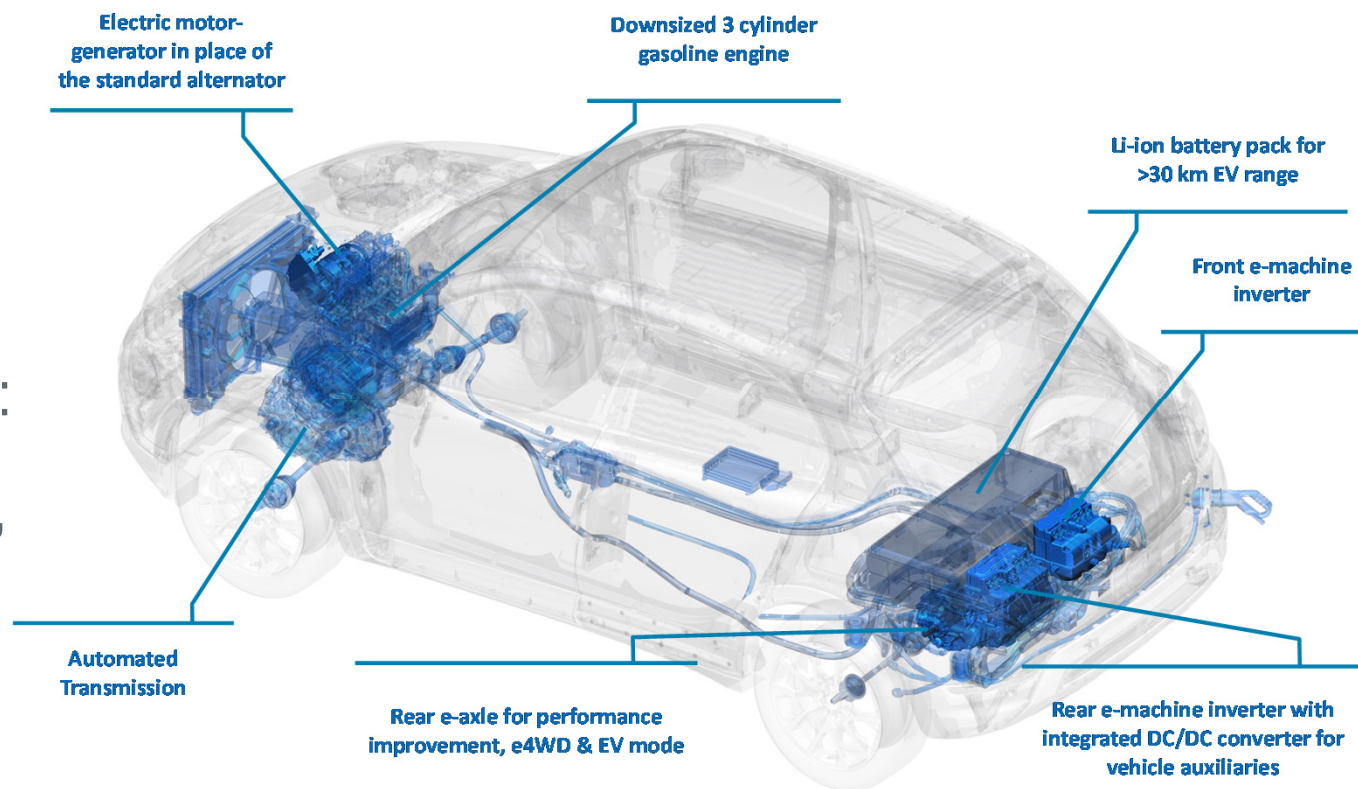


## Research Vehicles & status

# Class B Hybrid Powertrain

## Achievement

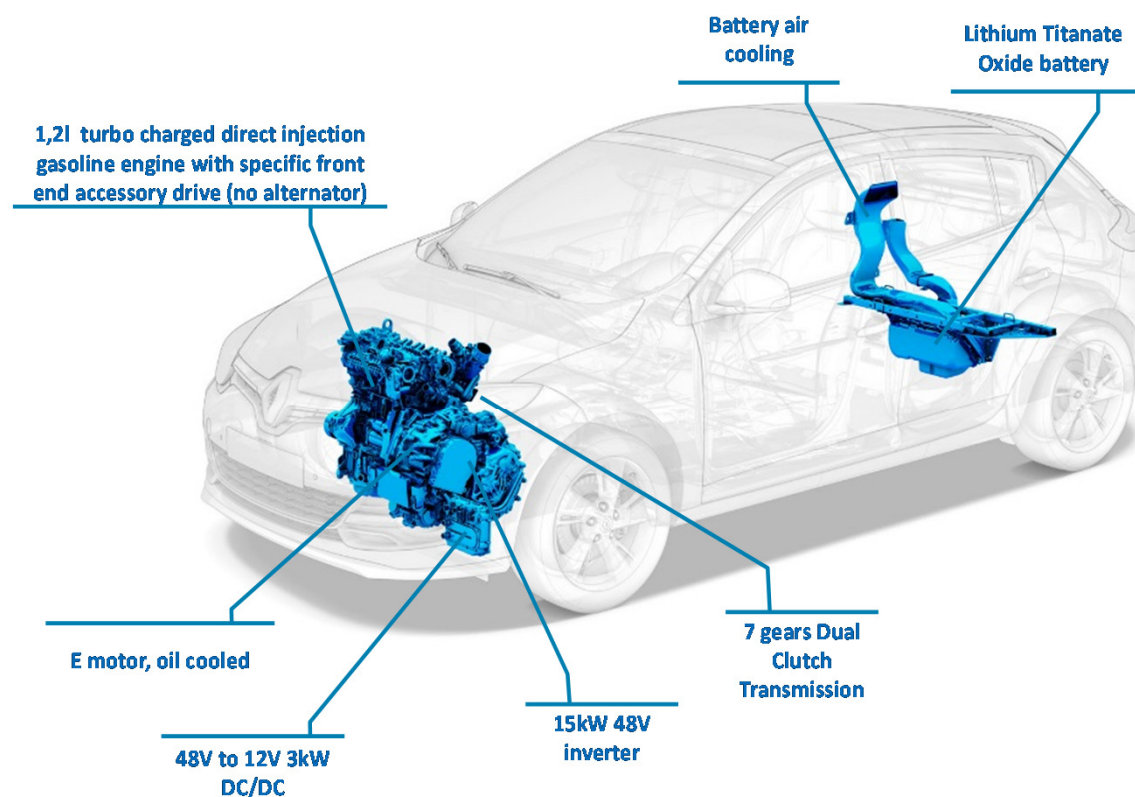
“EV mode range (target: 30 km) and electric-AWD”



# Class C Hybrid Powertrain

## Achievement

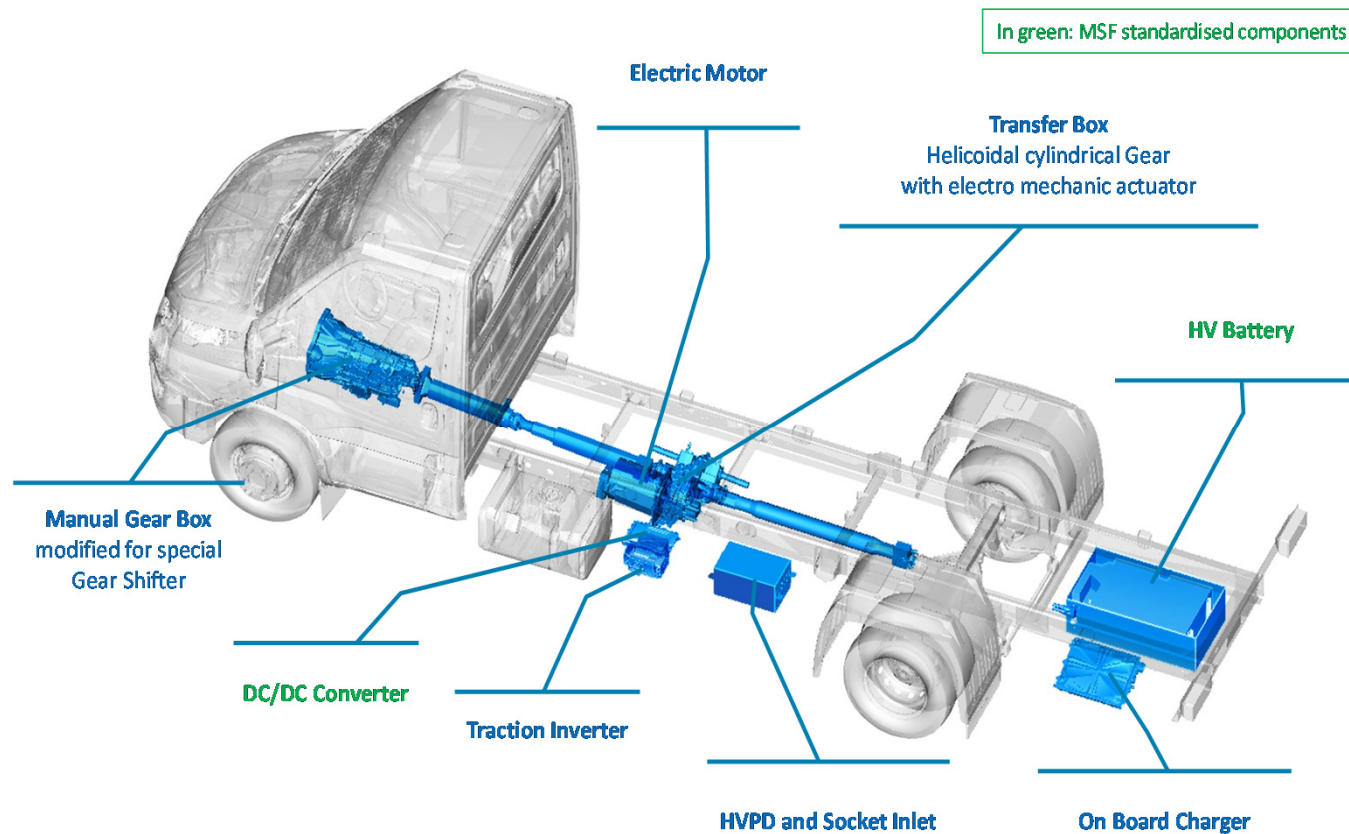
“Reach with a 48V hybrid, almost the same CO<sub>2</sub> savings as HV hybrids”



# Medium Duty Hybrid powertrain

## Achievement

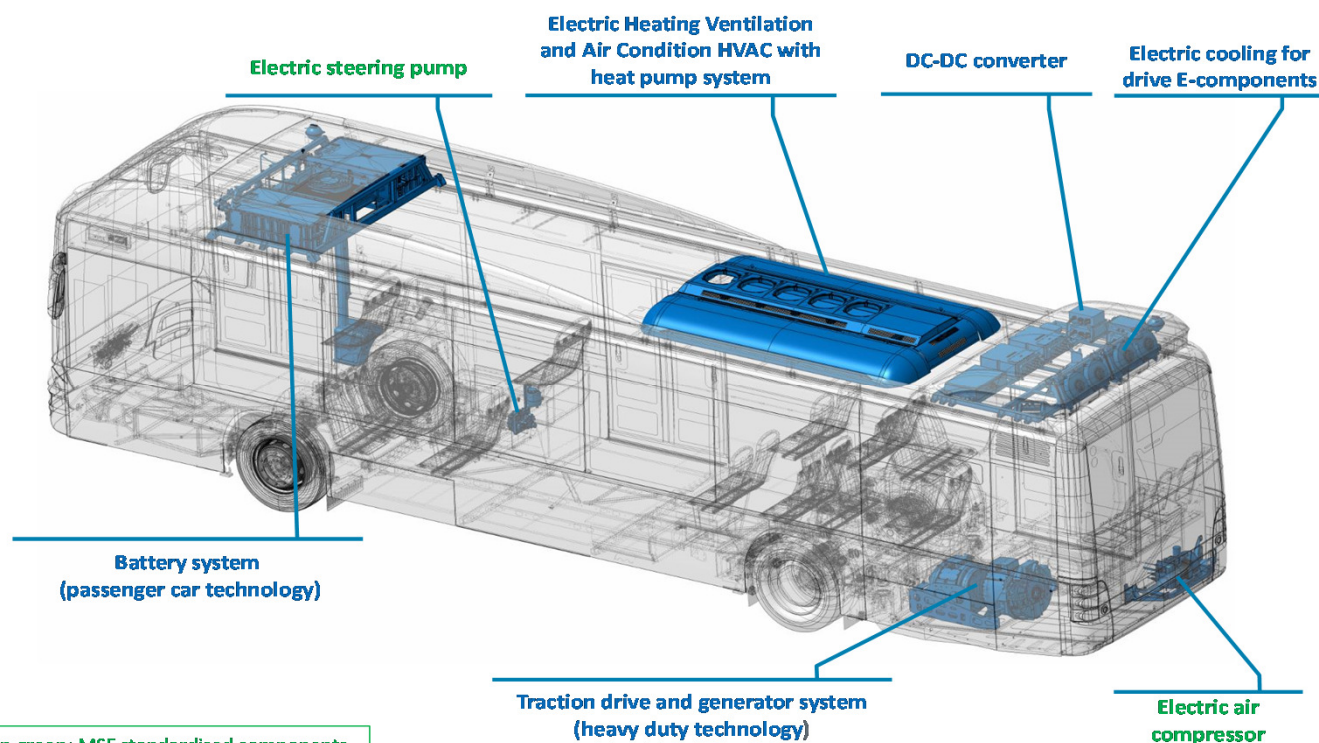
“Add-on e-drive system for full electric driving”



# City Bus Hybrid Powertrain

## Achievement

“Modular e-bus powertrain concept, compatible with multiple energy sources”



# Heavy Duty Hybrid Powertrain

## Achievement

“Improving cost effectiveness of the hybrid system combined with increased CO<sub>2</sub> reduction”

