2015-12-18

Dear Sir or Madam,

The epsilon consortium has finalised the concept development of a new category of an urban small electric passenger vehicle that is lighter, more energy efficient and requires less road space than today's sub-compact cars, still offering the same level of safety. The key features are:

- At least two seats, all weather comfort
- Maximum crash safety (legislation and NCAP)
- Weight < 600 kg
- Attractive driving performance
- Acceleration 0-100 km/h < 10 s
- Purely electric range > 150 km
- High energy efficiency (< 80 Wh/km)

As shown in Fig. 1, at first a package concept has been defined and thus the domains body, drivetrain and chassis have been developed according to the requirements.

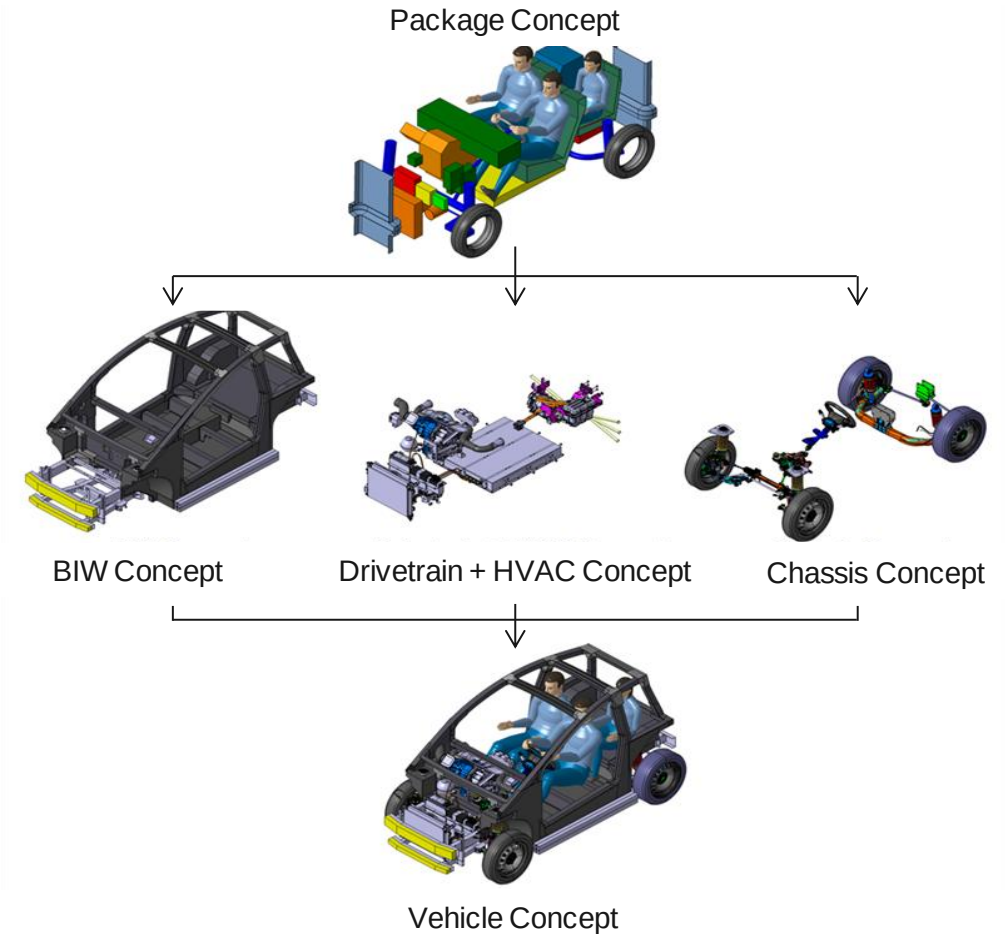


Fig. 1: Vehicle concept

As a baseline for any further design steps a package concept was defined. Taking into account the specific requirements and the proposed styling of the vehicle, the design space and position for all the subsection components has been defined as well as the ergonomic demands for two 95% males in the front and a 5% female in the back row have been considered (see Fig. 2).

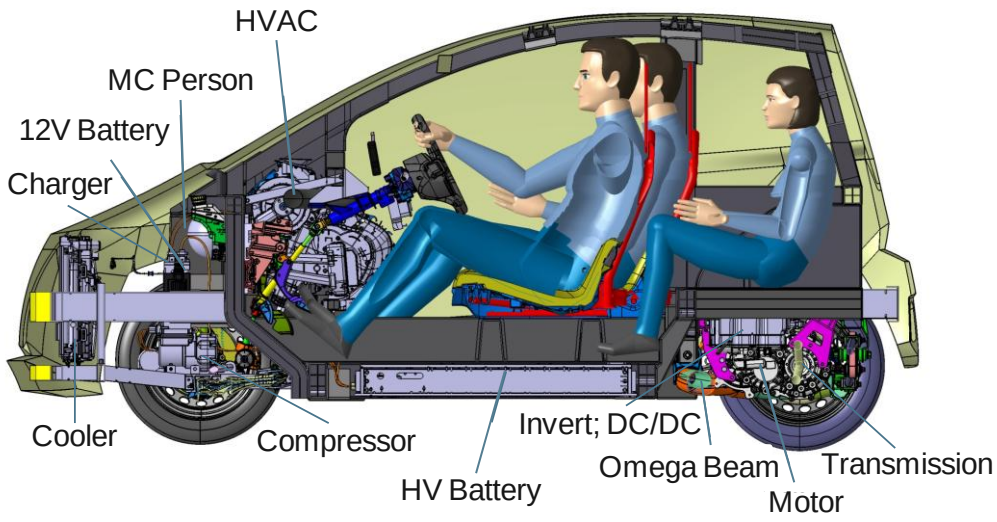


Fig. 2: Package concept

Within the given design space a multi-material body concept has been developed. The core of the body in white (BIW) architecture is a space frame structure with a cell made out of carbon fibre reinforced polymer (CFRP) beams enclosing the passenger compartment and modules made out of aluminium extrusion tubes as crash absorbing structures for the front as well as for the vehicle rear. This space frame is provided with a number of sheet panels, closing the frame to a robust structure, suitable to withstand the requirements concerning stiffness and crash safety. Furthermore, GFRP exterior panels have been designed, reflecting the proposed styling but not adding to the structural performance of the body structure.

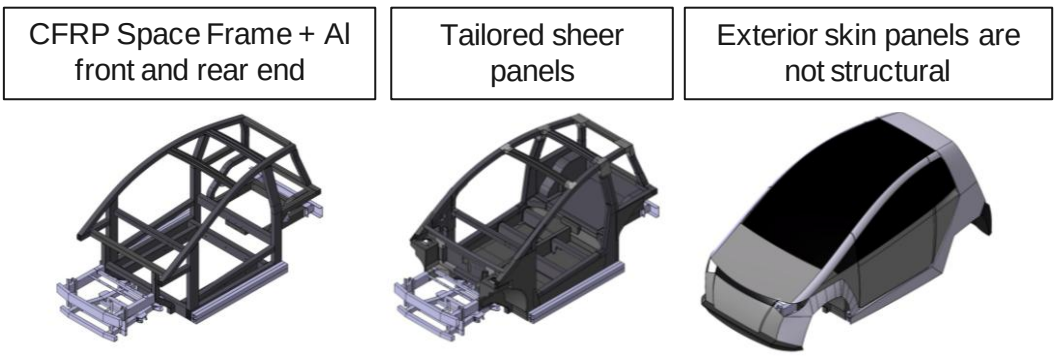
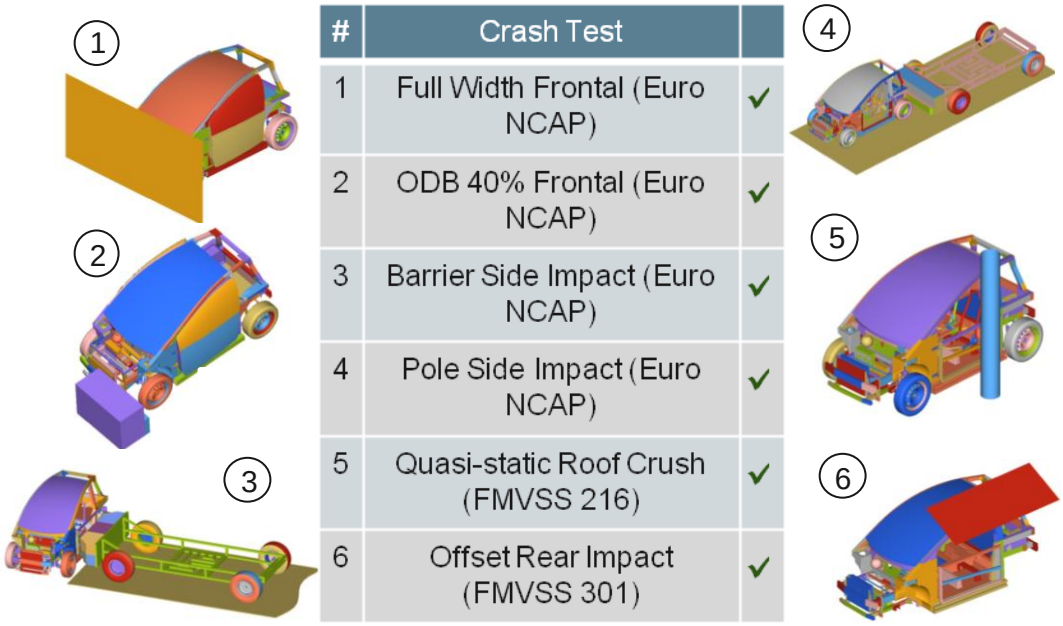


Fig. 3: Body design

To secure the safety concept of the vehicle an FEM model of the full structure has been built up, taking into account the properties of the applied materials and the corresponding thicknesses of the body and other crash related components as well as making suitable assumptions for the other package components. Thus, the simulation programme presented in Fig. 4 has been set up for explicit FEM simulations. Based on the evaluation of these load cases the vehicle design has been optimised to fulfil all defined safety requirements. Furthermore, load cases concerning the bending and torsional stiffness have been simulated using an implicit FEM model of the BIW. Here, again optimisation has been carried out in order to achieve the requirements.



#	Crash Test	
1	Full Width Frontal (Euro NCAP)	✓
2	ODB 40% Frontal (Euro NCAP)	✓
3	Barrier Side Impact (Euro NCAP)	✓
4	Pole Side Impact (Euro NCAP)	✓
5	Quasi-static Roof Crush (FMVSS 216)	✓
6	Offset Rear Impact (FMVSS 301)	✓

Fig. 4: Load cases considered for FEM simulation

A drivetrain concept including the electric engine, battery, energy management system, power electronics, mechanical transmission and cooling system has been developed in order to fulfil the vehicle requirements in terms of performance and range as well as to fit into the given package concept. This incorporated not only the design of the components but also driving simulations analysing the energy demand and the range for the new European driving cycle (NEDC), in order to prove the suitability of the concept.

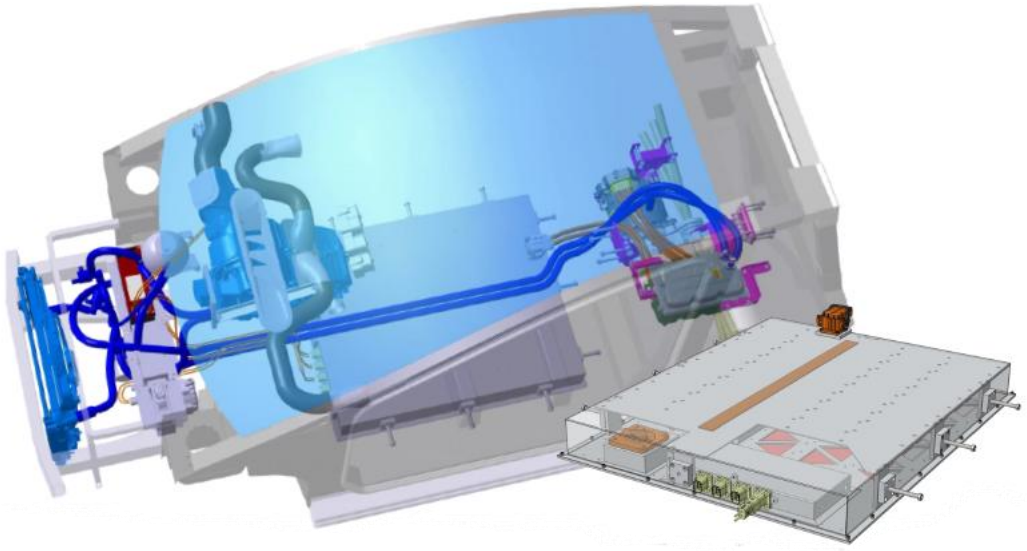
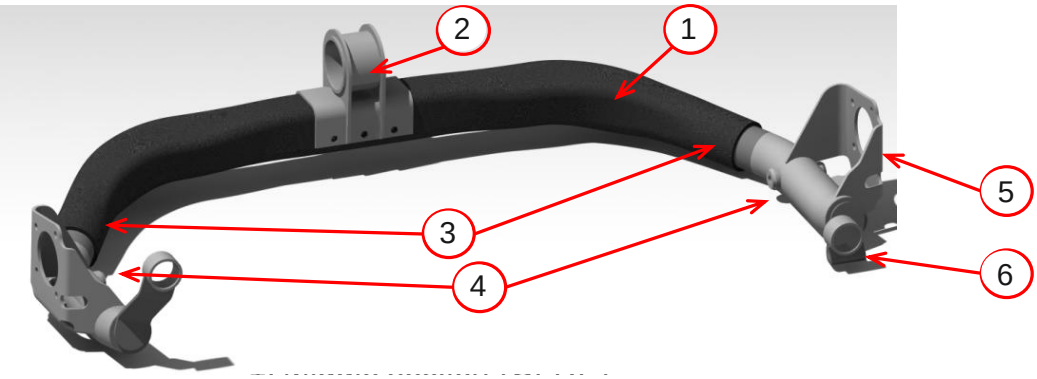


Fig. 5: Drivetrain and battery concept

Concerning the chassis a novel multi-material concept for a rear axle has been designed as presented in Fig. 6. Here, the usage of a braided tube in the middle section as well as function integration allowed a weight reduction of 45%.



1: Middle section (CFRP)
2: Connection of central joint (metal)
3: Connection between middle section and side section
4: Side section (metal)
5: Wheel trunk (metal)
6: Connection of watt-linkage (metal)

Fig. 6: CFRP rear axle concept

In the following month the consortium will build up three prototypes, a full running vehicle as well as two reduced structures for crash test purposes.

This will be followed by an extensive testing programme to prove the key features vehicle safety, energy efficiency and vehicle dynamics.

For more information please refer to our website www.epsilon-project.eu

On behalf of the epsilon consortium, best regards
Ralf Matheis

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epsilon aims to conceptualise and prototype the electric urban small vehicle of 2020-2025. It will focus on the development of an innovative electric vehicle concept specifically designed for the typical transport tasks in urban areas. The project is coordinated by fka Forschungsgesellschaft Kraftfahrwesen mbH Aachen. Furthermore, the consortium consists of Kompetenzzentrum - Das Virtuelle Fahrzeug, Centro Ricerche Fiat SCPA, Autoliv Development AB, HPL Prototypes LTD, Vehicle Safety Insitute of Technical University Graz, Fraunhofer Institute LBF, LEC 2 Limited and Institut für Kraftfahrzeuge (ika) of RWTH Aachen University.

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