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Why automotive lightweighting?

Lightweight materials can reduce the mass of a vehicle. Reducing a vehicle’s mass reduces its energy consumption.

Reducing the energy consumption enables a lower fuel bill for the driver, as well as reduced emissions.

Additionally, lightweight materials allow the possibility to achieve a better vehicle mass distribution, which enables better driving behaviour.
Lightweighting initiatives in Europe go way back...

SuperLightCar
2005-09, FP6
19 M€, 37 partners
WV Golf Mk 5
-39% BIW Weight using Al (53%), Steel (36%), Mg (7%) and Plastics (4%)”

elva
2010-13, FP7
5 M€, 7 partners
Expand potential of vehicle architecture

ALIVE
2012-16, FP7
13M €, 23 partners
4y, mass production
-45/50% Weight (BiW)

ENLIGHT
2012-16, FP7v
11M €, 21 partners
8-12y horizon
-35% WR

urban
2013-16, FP7
3,6 M€, 10 partners
Hybrid material architectures
Off the shelf technology

FG
2014-17, FP7
www.fibrospec.net
New carbon fibres precursors
Modelling and testing in LC
Industrialization of final CF composite.

epsilon
2013-16, FP7
2,5 M€, 9 partners
Novel body architecture – comfort, safety, efficiency
5-10y horizon

alliance
Affordable Lightweight Automobiles Alliance

HIVO
2010-14, FP6
Cost effective of PU and PP matrixes CFRP
High volume production
Tech-demonstration

NewsPEC
2014, FP7
Carboprec
2014-17, FP7
Low cost precursors of CF from lignin and cellulose
Medium mechanical performance
New tech development

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 723839
Funded Past Lightweighting Initiatives

Although they have resulted in several innovative solutions, the majority of these efforts have failed to reach widespread adoption.

This is due to the high costs, which is a result of several factors, including:

- the cost of materials (e.g. carbon fibre reinforced plastics),
- long cycle times and
- investments in new machinery.
An ALLIANCE of automobile leaders within EUCAR - European Car Automotive R&D

6 European carmakers
Daimler, Volkswagen, Fiat-Chrysler Research Centre, Volvo, Opel, Toyota

4 Suppliers
Thyssenkrupp, Novelis, Batz, Benteler

8 Knowledge partners
Swerea, Inspire, Fraunhofer LBF, RWTH-IKA, KIT-IPEK, University of Florence, Bax & Company, Ricardo

Duration 10/2016 - 09/2019

9,019,277 € Funding

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Objectives of ALLIANCE

- 21-33% Weight
- 6% GWP
- <3€/Kg Saved

both for internal combustion engine vehicle (ICEV) and battery electric vehicle (BEV)
Addressing the concrete need for more efficient vehicles

Novel advanced materials
- High strength steel alloys
- New aluminium grades
- Fibre reinforced polymers
- Innovative hybrid materials

Focusing on:
- superior performance
- lower cost
- low embedded footprint

Manufacturing and joining technologies, aiming at:
- reducing energy consumption
- increasing automation
- decreasing cycle times

Support tools
- life-cycle assessment
- mass optimisation software
- multi-parameter design optimisation methodology

Aiming at pre-assessment of technologies

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Making sure technologies find their way to the market

Implementing the new technologies on

- **eight different demonstrators of real vehicle models**, aiming at market application by OEMs
- **within six years** from project end (in 2025).

During the project, the optimised modules are being **implemented into a virtual full-vehicle model.**
Holistic Development

Vehicle Assessment Model
Costs, Energy Demand, CO₂

Reference Vehicle Concept
Assembly
Component
Drive train configuration

Open Lightweight Challenge

Production
Use-phase
EoL

Pre-assessment of technologies

De-subjectification
• Transferability
• Scalability

Technology Database

ALLIANCE Technology Demonstrators

Expected impact
• Mass reduction of 25%
• Energy demand -10%
• 3 €/kg @100,000 u.p.a.
• LCA impact -6% (GWP)

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New methodologies for scalability and transferability
Approach – Material development

- Plastics, composites, steel & iron and light metals contributed to about 91% of the materials used → focus on **aluminium and steel**
- Advanced steel alloys development and characterisation
  - Optimize the manufacturing process to produce the best combination of properties
  - Weldability of the steel material: resistance spot, laser, MIG/MAG welding
- Advanced aluminium alloys development and characterisation
  - Development of high-strength 6xxx and 7xxx grade alloys
  - Mechanical characterisation of the alloys with process induced tailored properties, assessment of the manufacturing influences and measurement of forming properties for process simulation
**Approach - Efficient manufacturing**

- Development of advanced metal forming technologies
- Development of manufacturing strategy for hybrid metal-FRP components
- Development of improved thermoplastic composite manufacturing process
- Joining technologies development (multi-material)
- Process compatibility assessment
Approach - Design & Optimisation

- Multi-material and function integrated design concepts are required taking into account the full vehicle in a holistic way
- Lightweight orientated functional design concepts need to be introduced in very early stages of product development
- Preparation of generic methodology and training for holistic multi-material design and optimisation for light weighting
- Development and refining of the methodology, applied to a specific use case
- Analysis of benchmark and Functional concepts generation
- Multidisciplinary and multi-parametric Optimisation
- Validation of the methodology
Expect Outcome

- **Advanced lightweight materials and related manufacturing technologies**
  - Advanced steel alloys and forming technologies
  - Advanced aluminium alloys and manufacturing process
  - Advanced plastics and manufacturing process
  - Novel developments in joining technologies

- **Advanced simulation tools and methodologies**
- **Multi-parameter design optimization methodology and process**
- **Mass optimizer software tool and LCC tools and database**
- **Environmental assessment (LCA) tools and database**
- **Design concepts of demonstrator components and subassemblies**
- **Test strategies for the novel design**
- **Economic business cases for specific technologies**
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**Coffee break – Demonstrator guided tour I**

**Project outcomes**

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<td>Mass manager</td>
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<td>Full vehicle model</td>
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**Lunch**

**Demonstrator guided tour II**

**Impact**

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<td>on Costs</td>
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**Discussion**

**Suggestions for next steps**

Presentation of roadmap main outcomes

**Networking & End of Day Coffee**