A3PS

Rethinking Propulsion.

Approaches for the increasing energy diversity

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Alternative Propulsion Systems and Energy Carriers - Vehicle Integration and System Optimization

National and international R&D-projects, research institutions and funding programs

Vienna, November 18st 2010

in cooperation with bmvit and arsenal research
Ein Unternehmen der Austrian Research Centers

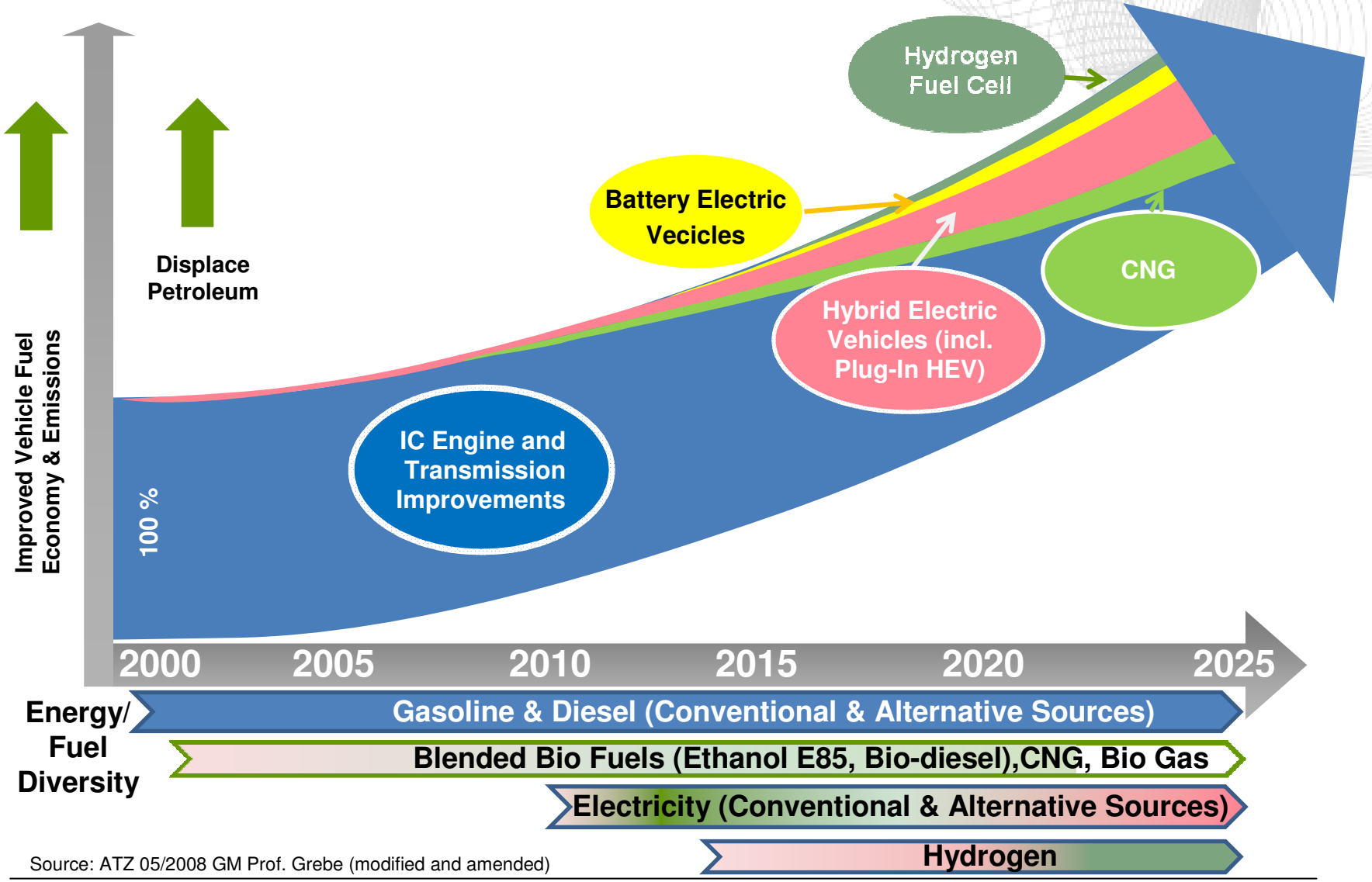
Presentation Overview

- Future diversity of fuels and power trains
- Future competing vehicle concepts
- Addressing complexity & mass penalty
- Magna Steyr‘s R&D activities
- Introduction ongoing R&D program “CULT”
- Summary & conclusion

Why do we need alternative fuels?

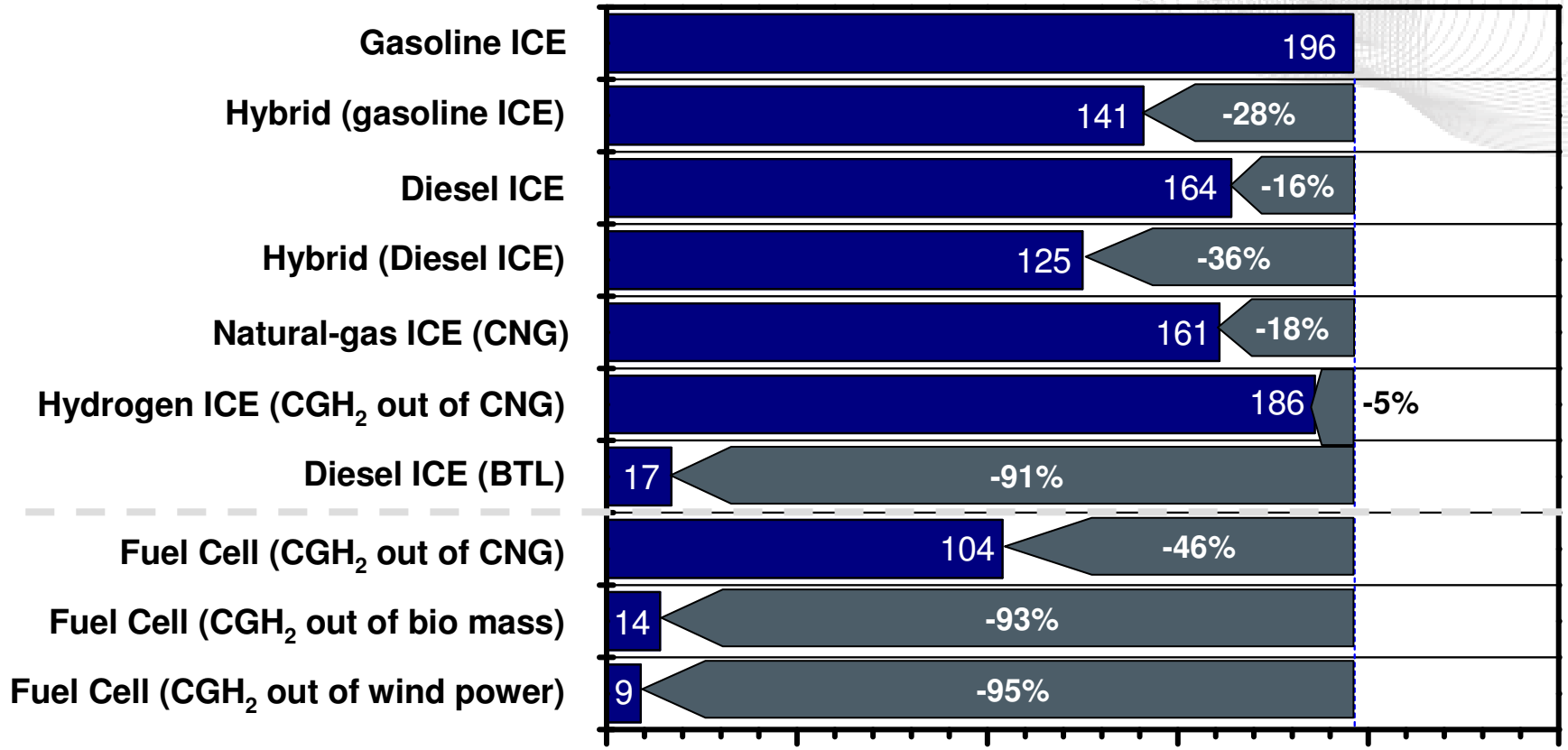
- **Limited reserves of fossil fuels**
- **Reduction of greenhouse gas emissions**
- **Reduce dependency on petroleum exporting countries**

Future energy diversity



Source: ATZ 05/2008 GM Prof. Grebe (modified and amended)

CO_2 Reduction potential for various powertrains & fuels



Reference: Compact sedan, NEDC

Source: EUCAR/CONCAWE/JRC

Pure EVs „emit“ approx. 80 g/km CO_2 according the energy mix in the EU!

Conclusion on fuels

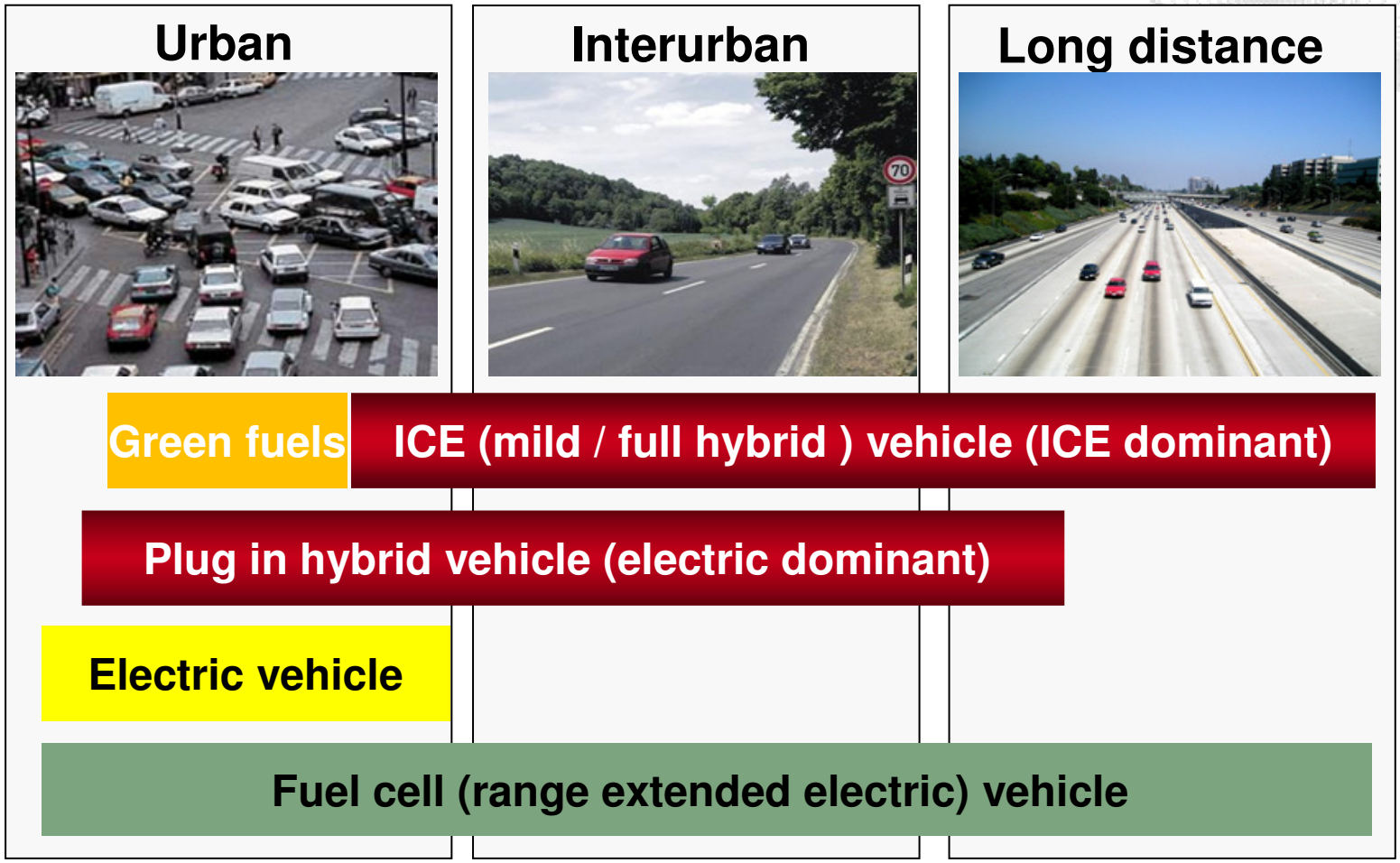
- **Conventional Fuels:**
  - **will have the dominant market share, also in the year 2025**
  - **will be increasingly „diluted“ by bio fuels**
  - **will be also produced in synthetic processes**

- **CNG & Biogas**
  - **CO_2 advantage, relatively easy to be applied**
  - **usage will steadily increase, initiated also by cities**
  - **enough resources available, also long term**

- **Electric Energy**
  - **need to be produced by renewable sources (solar, wind, water)**

- **Hydrogen**
  - **optimal energy carrier and “best fuel” regarding CO_2 and pollutants**
  - **problematic production, storage and infrastructure**
  - **mid term cost penalty (expensive, complex FC vehicles)**

Which powertrain for which mission (use/range)?

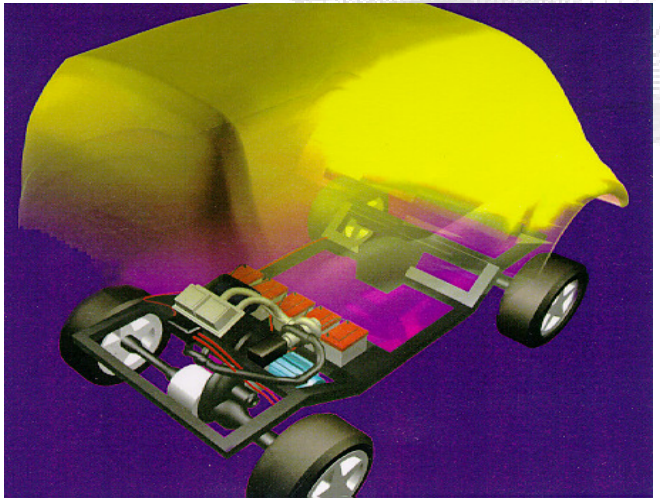


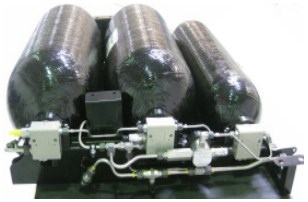
Future individual mobility - a competition of ...

Convent. vehicles ICE dom. Hybrids **Green fuels**	Plug-In Hybrids Electric dominant	Fuel Cell (range extended) vehicles	Electric Cars
			 
New specific components: e-motors & new energy storage systems			
			
In common: complexity and mass penalty			

Example for complexity: Fuel Cell Powertrain

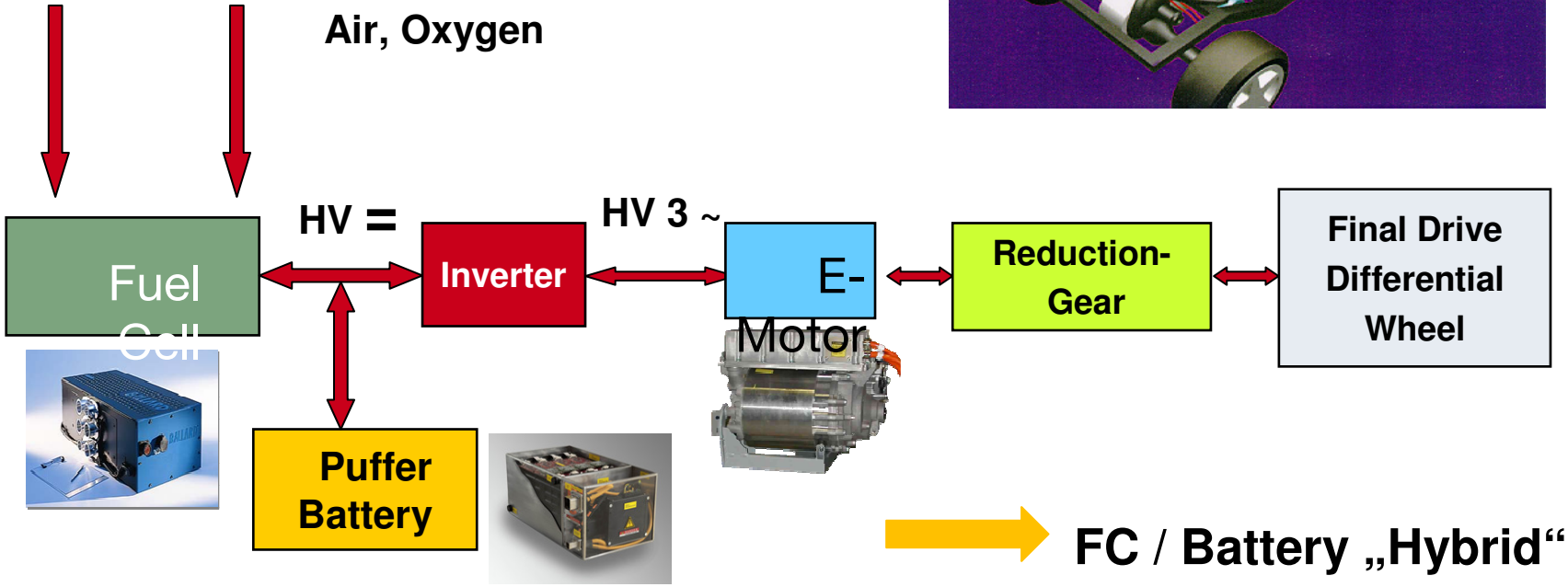
Principal Layout / Components:





H_2 Tank system

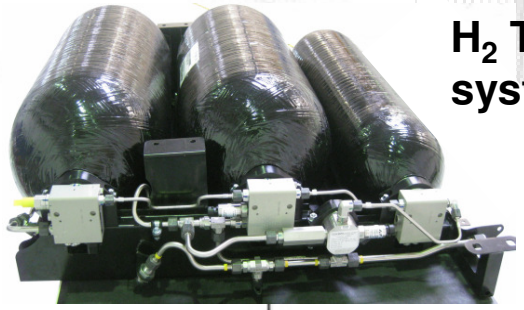
Air, Oxygen



FC / Battery „Hybrid“!

Fuel cell-system - H_2 / Air

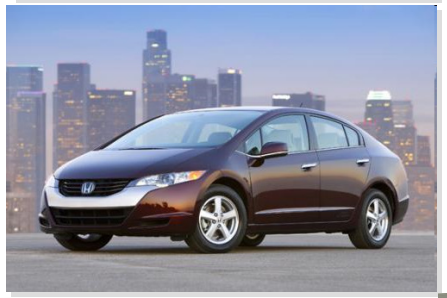
Major components/auxiliaries



H_2 Tank system

<u>Auxiliaries:</u> air filter, compressor, cooling pump, condensator, cooler, humidifier

Overview Fuel Cell Vehicles



Typical todays Fuel Cell Vehicle Specs:

- **PEM fuel cell**
- **Appr. 4.5 kg H2 in gas tanks @700 resp. @350bar**
- **SUV, mid & compact class configured as FC-Battery Hybrid, no transmission**
- **„all performance vehicle“: range >500km, typ. power 100kW , full transport capability**

Almost all OEMs are developing FCVs!

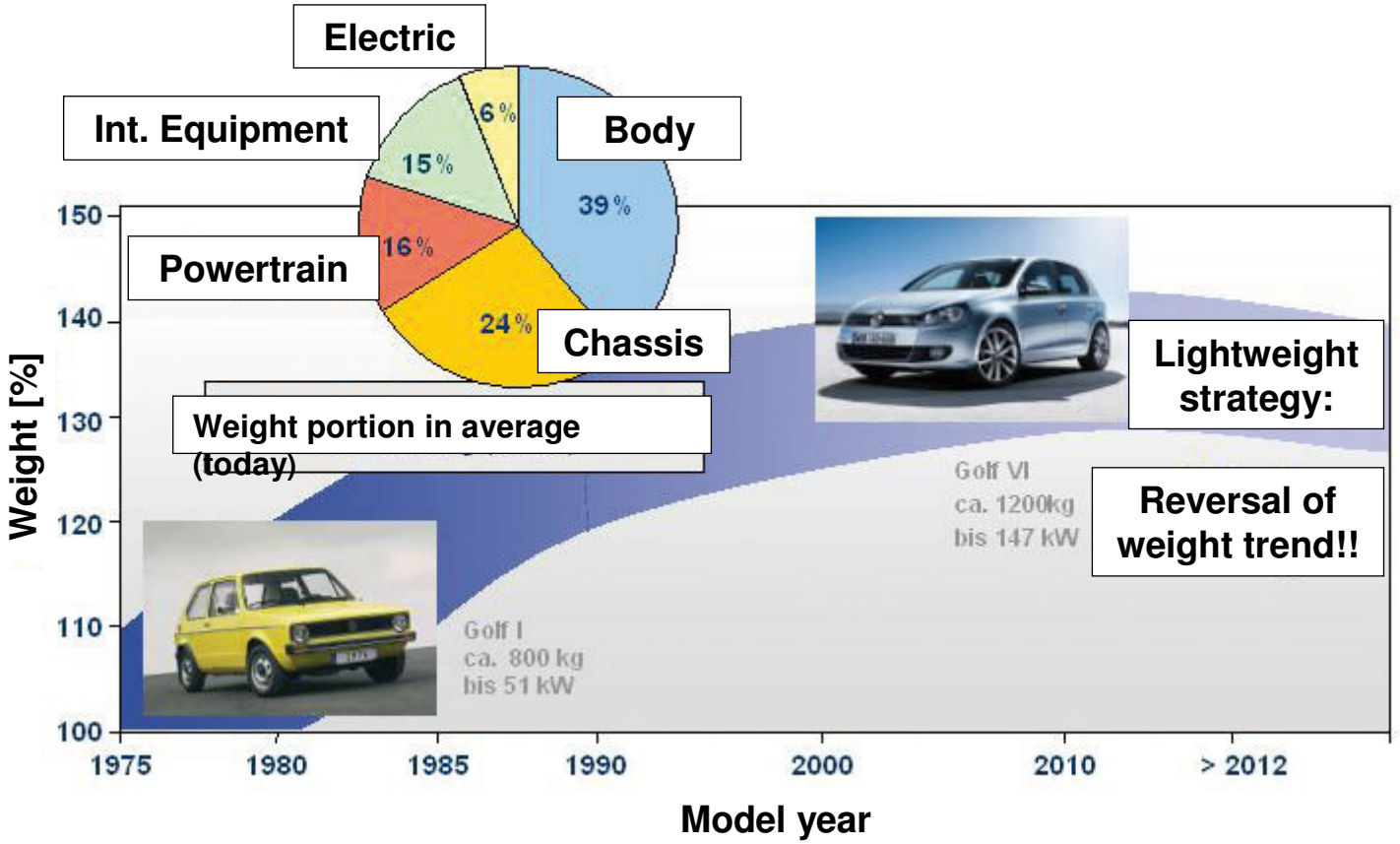
Comittment for development and market introduction of FCVs in 2015 by:

Daimler AG, Ford Motor Company, General Motors Corporation/Opel, Honda Motor Co., Ltd., Hyundai Motor Company, Kia Motors Corporation, Alliance Renault SA und Nissan Motor Co., Ltd. and Toyota Motor Corporation

Source : AVL/Ramschak/ 2010

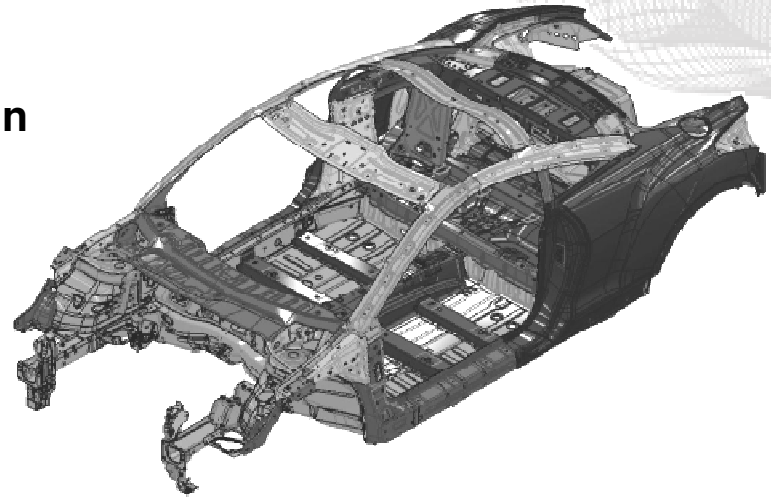
Addressing vehicle weight

Example: standard Golf

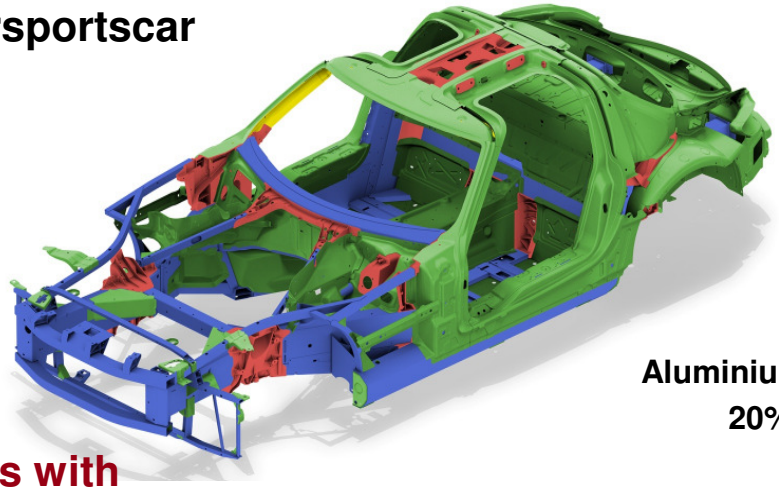


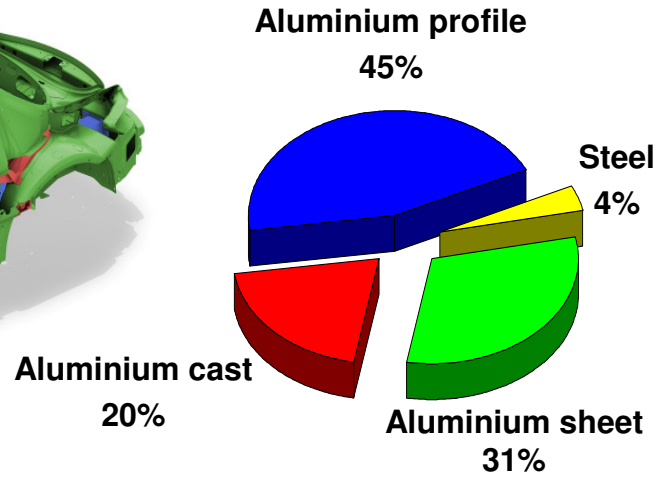
Body in White (39% Weight) : state of the art

Classic steel - shell design
Product: Peugeot RCZ



Classic ALU-spaceframe body for Supersportscar
Product: AMG





In future:
multi material bodies with fibre composites

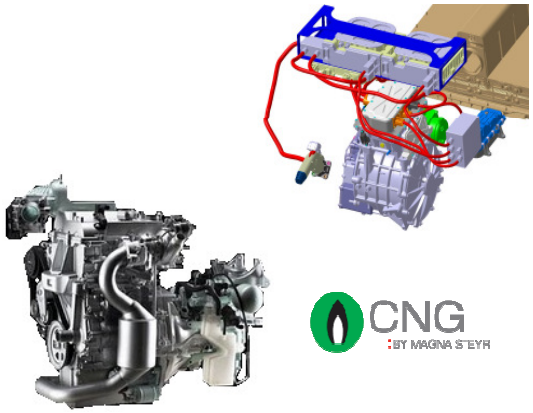
Our task: Overcome complexity and mass penalty

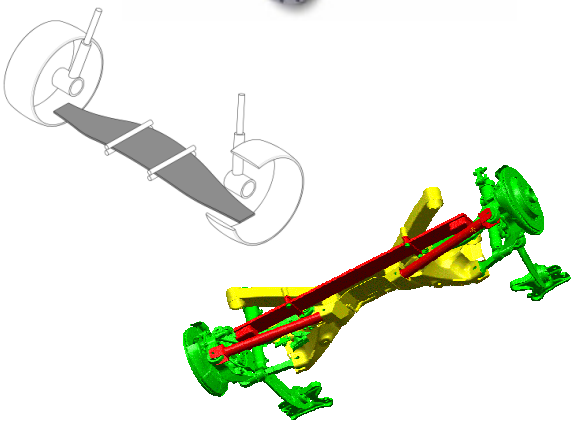
- Downsizing powertrain components (i.e. ICE)
- PT adaptations and conversions (i.e. to CNG, H_2)
- Intelligent system integration
- New light vehicle concepts & architectures
- Light weight components such as storage systems and body components

New specific components: e-motors & new energy storage systems

In common: complexity and mass penalty

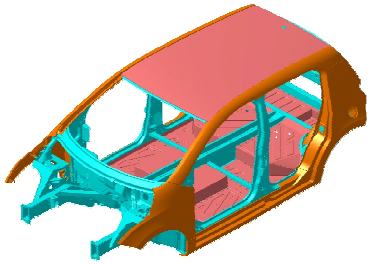
Magna Steyr‘s research and development activities

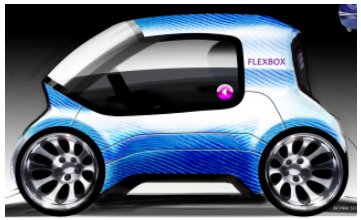


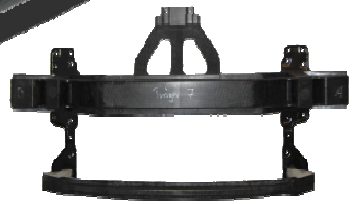


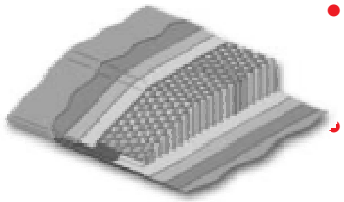
- System integration (geometric, electric, functional) for alternative powertrain systems (gas systems, battery hybrids etc.)
- Powertrain conversions to CNG or H_2
- Development of composite powertrain components (i.e. shafts)
- Composite spring, stabilization (“COAM”/ cost optimized axle module)

Magna Steyr‘s research & development activities





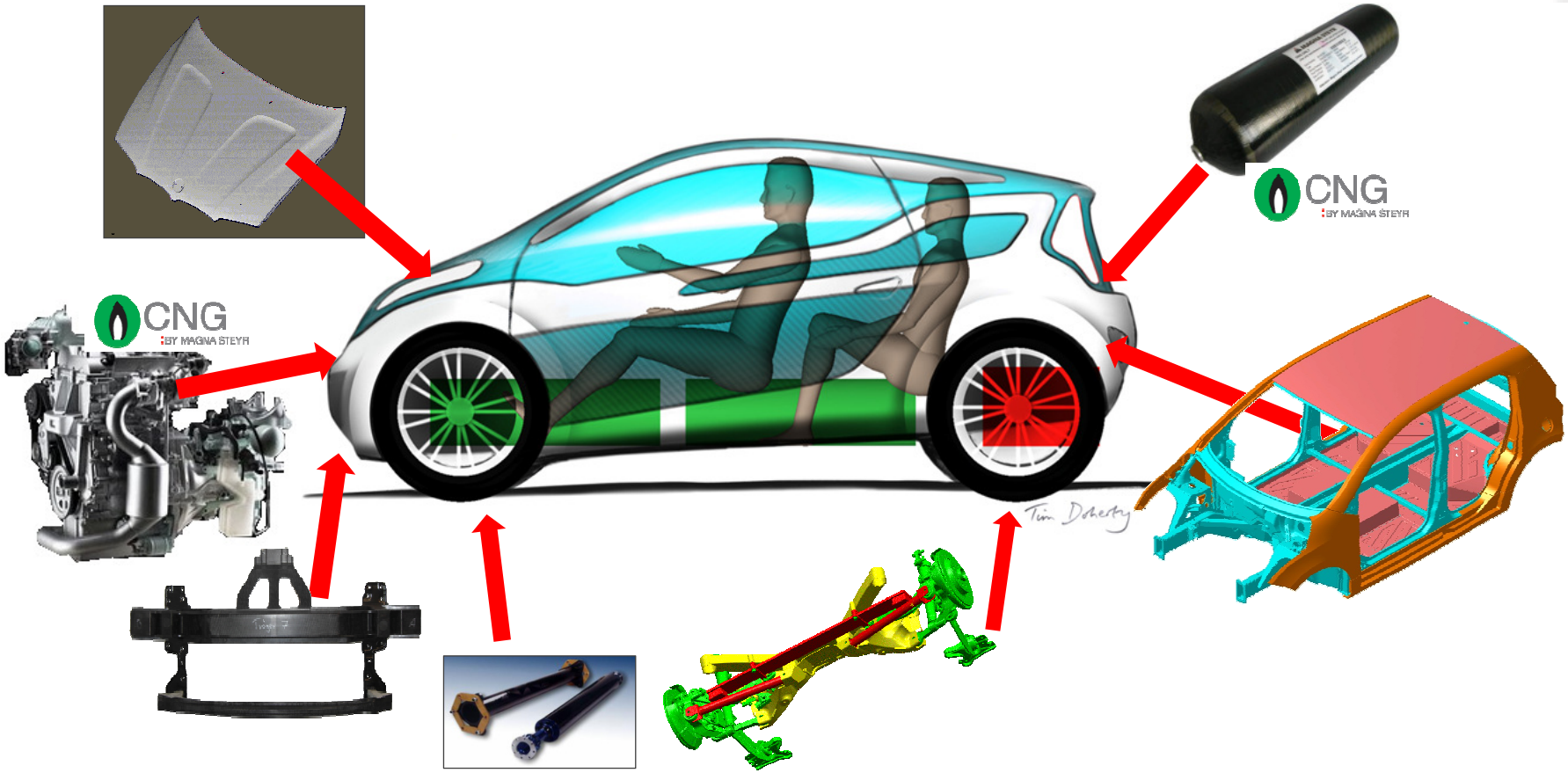




- **Light weight fibre composite / low invest vehicle concepts**
- **Composite high pressure gas vessels for CNG (200 bar) & hydrogen (700 bar)**
- **Cryogenic fuel storage for LNG and LH2**
- **Complete tank systems for CNG and Hydrogen**
- **Development of light weight structural components i.e fibre comp. crash systems**
- **Light weight chassis components such as front/rear closures, roofs, panels**
  i.e. fibre reinforced sandwich design with honeycomb core

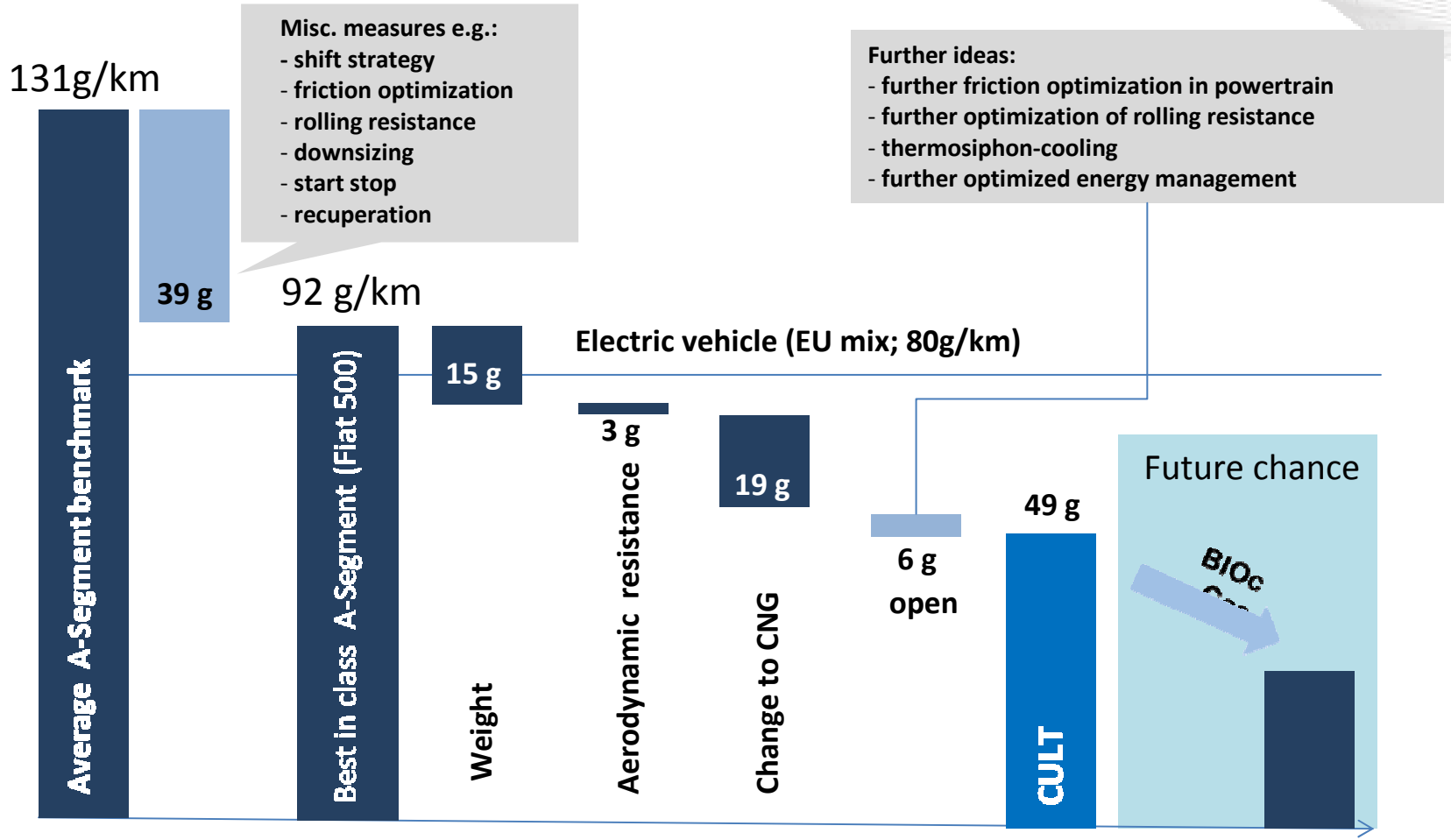
Bringing all this together in a vehicle !

R&D Project "CULT" – Car's Ultra-Light Technologies



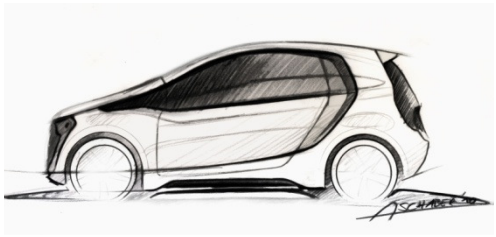
Magna Steyr's research & development activities

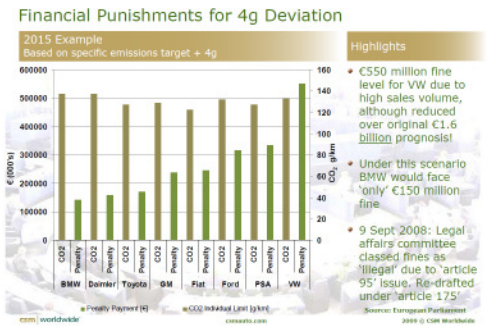
CO_2 Transition



Magna Steyr‘s research & development activities

CULT rough description





- **Project target:**

USPs, IPs lightweight technologies and production processes shown in a technological mule vehicle with CO_2-emission of 49 g/km

- **Approach:**
  300 kg weight reduction in comparison to the basic vehicle; 2 cylinder CNG engine; optimized powertrain
- **Vehicle segment/size:**
  A-Segment, ca. 3,40 m long; 4 seats; like Fiat 500, Toyota Aygo, Peugeot 107, Citroën C1
- **Cost target:**
  max. 3.500 EUR additional cost to the basic vehicle
- **Project timing:**
  3 years
- **Impact for MSF- customers (OEMs):**
  Avoiding of massive fines (e.g. VW 550 Mio. € in 2015)
- **Impact (possible OEM-follow up orders) for MSF:**
  - Production of 20.000-30.000 units/year, beginning 2016
  - 1 to 3 complete vehicle engineering orders
  - 1 to 3 orders for component development and production

Magna Steyr‘s research & development activities

CULT - The cooperative project for efficient CO_2 Reduction

MONTAN UNIVERSITÄT WWW.UNILEOBEN.AC.AT

Production processes for light-weight materials

ÖGI Österreichisches Gießerei-Institut

Metallic lightweight cast materials

PCCL Polymer Competence Center Leoben

Fibre-reinforced plastics

CULT (Cars´ UltraLight Technologies)

FACC

Aeronautic component development and production

TU WIEN IFA

Engine/transmission

4a MANUFACTURING GmbH

Sandwich parts (CIMERA material)

MAGNA STEYR

Complete vehicle development and production

Summary & Conclusion

- In the mid to long term future, a higher diversity of powertrains can be expected. ICE and conventional fuels will still be the backbone of individual transport, hybridization will be standard.
- Gaseous fuels will gain increased importance, especially CNG and to a smaller extent also hydrogen.
- Pure electric vehicles will have their place in urban transport, especially for commuting.
- Increased complexity and mass penalty of the alternative propulsion systems need to be addressed and programs to overcome these shortcomings are necessary.
- A beneficial approach to all kinds of vehicle is reducing vehicle weight without compromising essential vehicle properties such as safety and comfort.
- MS has set up dedicated programs such as the research project “CULT” to develop new lightweight materials and technologies and bring them into industrialization.

Our vision for a clean future

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thank you for your attention !!!!!