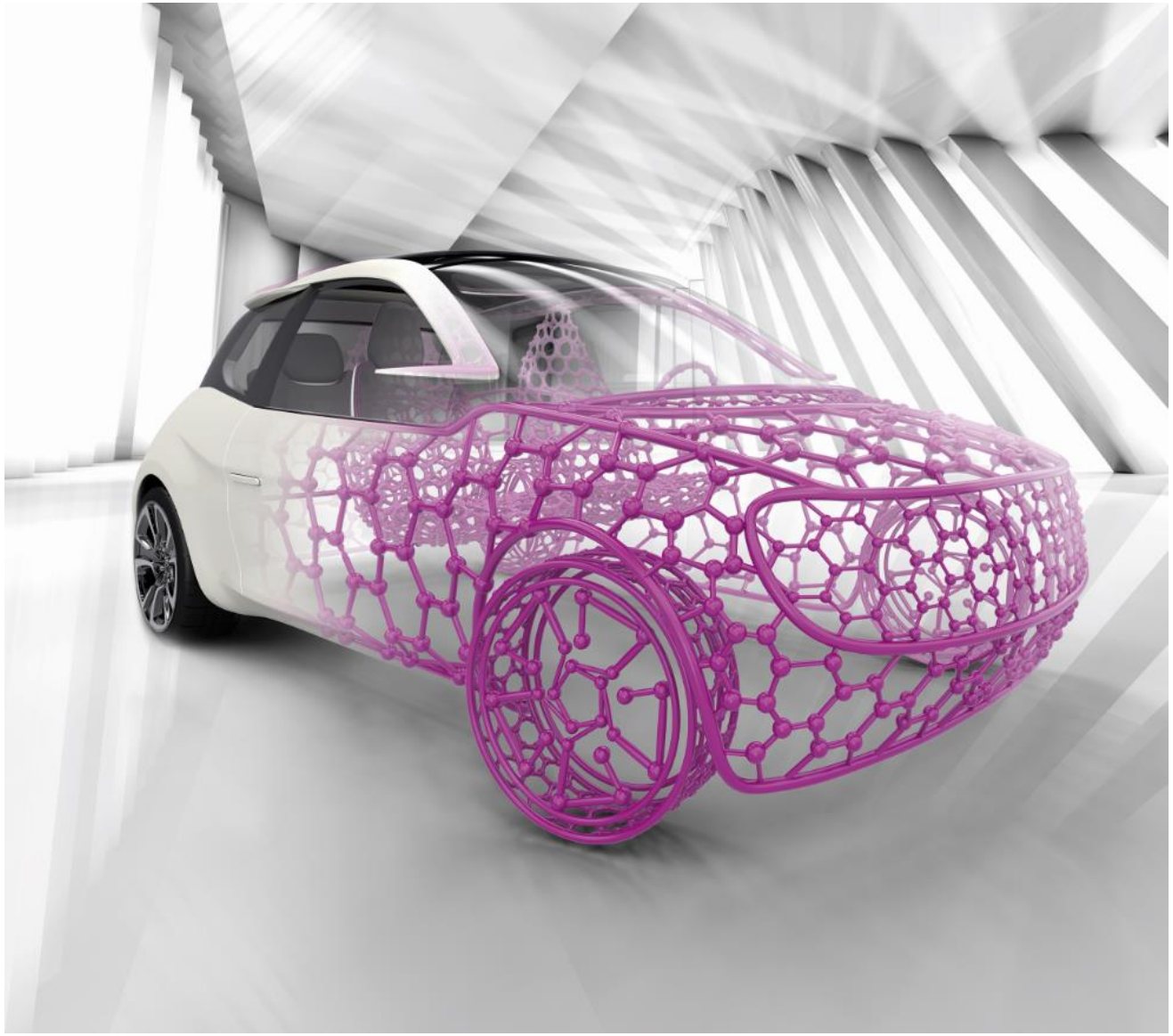

Specialty Chemicals for Green Automotive

Innovate mobility – we provide the chemistry.

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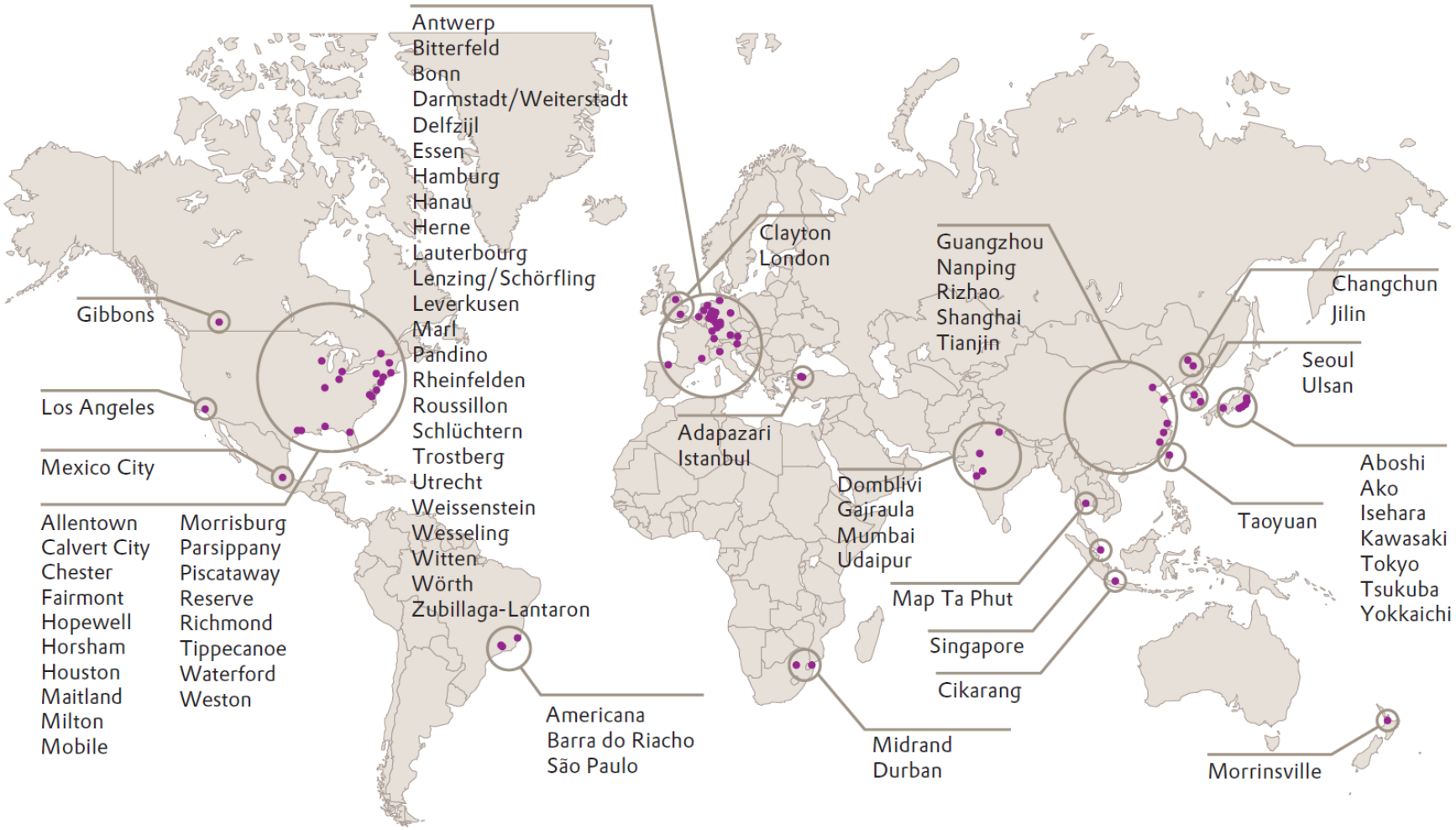
Global operations of Resource Efficiency



- About **60** sites **20** of in Asia
- **€4.5 billion** in sales
- ~ **9000** total employees
- **€300m** for investments
- R&D spent €180m
- An **experienced** management team

The Resource Efficiency markets

Automotive, Transport, Machinery

Share of the automotive, trans-portation and machinery industry at the Resource Efficiency segment‘s sales:

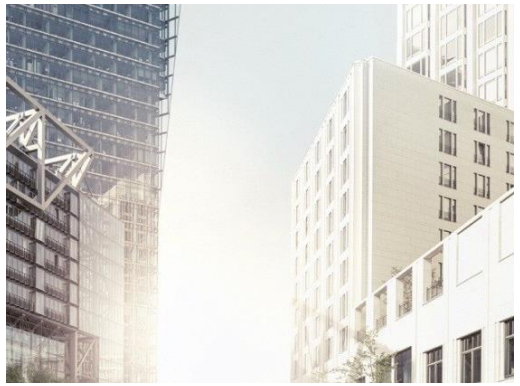
~35 %

Paints & Coatings

Share of the paints and coatings industry at the Resource Efficiency segment‘s sales:

~20 %

Construction



Share of the construction industry at the Resource Efficiency segment‘s sales:

~10 %

Others

Share of other industries (such as composites, catalysts, batteries, …) at the Resource Efficiency segment‘s sales:

~35 %

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Automotive Megatrends : CASE

Connected

Automated, Digitalized

Shared

Electrified

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Automotive trends are a key driver for our material innovations

Automated/piloted driving, Connected Car

E-Mobility, BEV

Assistance systems / sensors, actuators

Emission Regulations, charging infrastructure

Li-Ion / Engergy storage

Hybrid, Plugin, CNG, Fuel Cell

Fuel-/Energy Efficiency

Friction Reduction

Safety, Comfort, Thermal Management

3D printing

Lightweight

Tire efficiency

TCO, LCM, …

LED, Intelligent Lighting, Laser

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Global CO_2 emission and fuel ecomony legislations require material innovations

source: ICCT, IEA, OICA, ACEA, EPA, CAAM, JAMA, JP Gov.

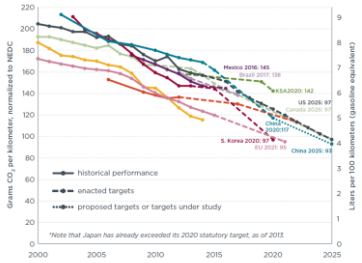
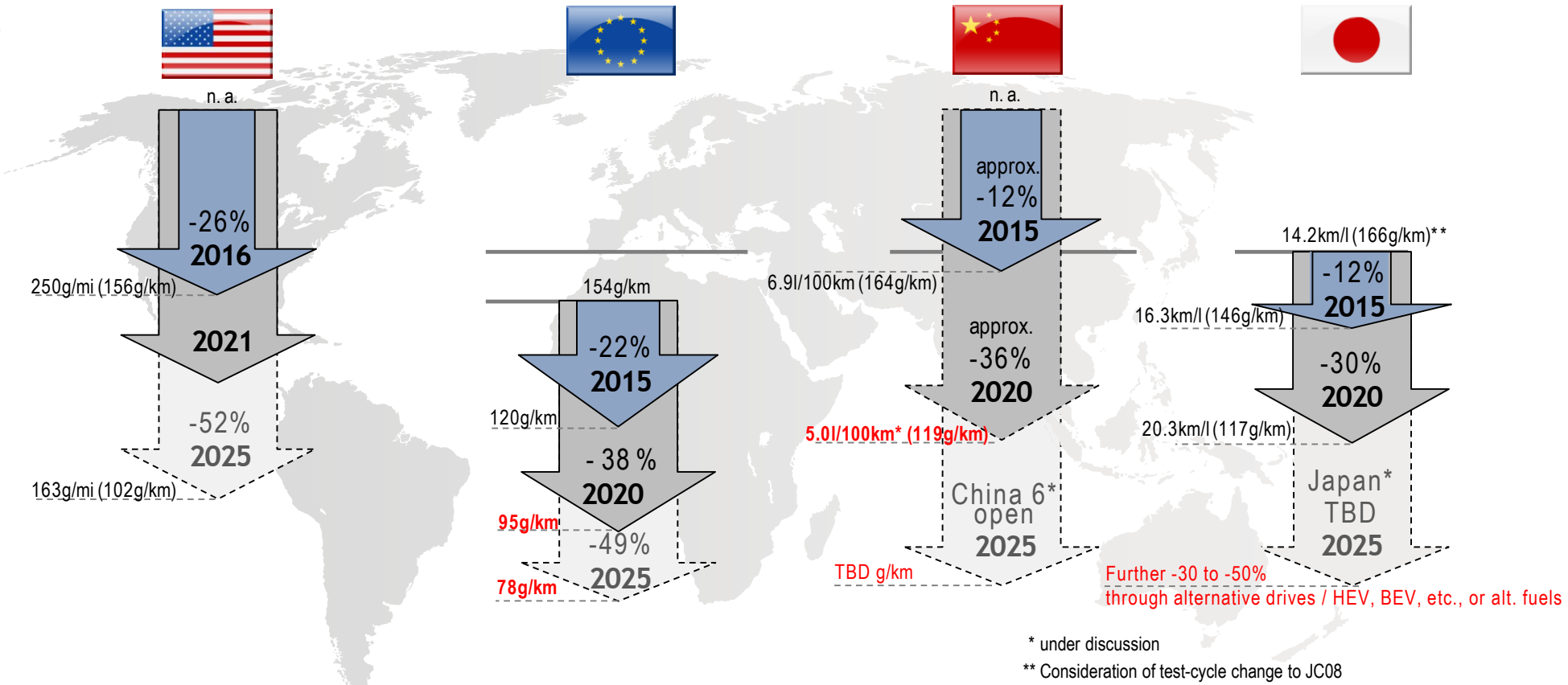


Figure 5: Comparison of global CO_2 regulations for new passenger cars.[5]



Note:

- **Fleet objectives require a global reduction in CO_2 emissions.**
- Regional objectives are not directly comparable due to differences in vehicle portfolio (market demand) and test-cycles/procedures.

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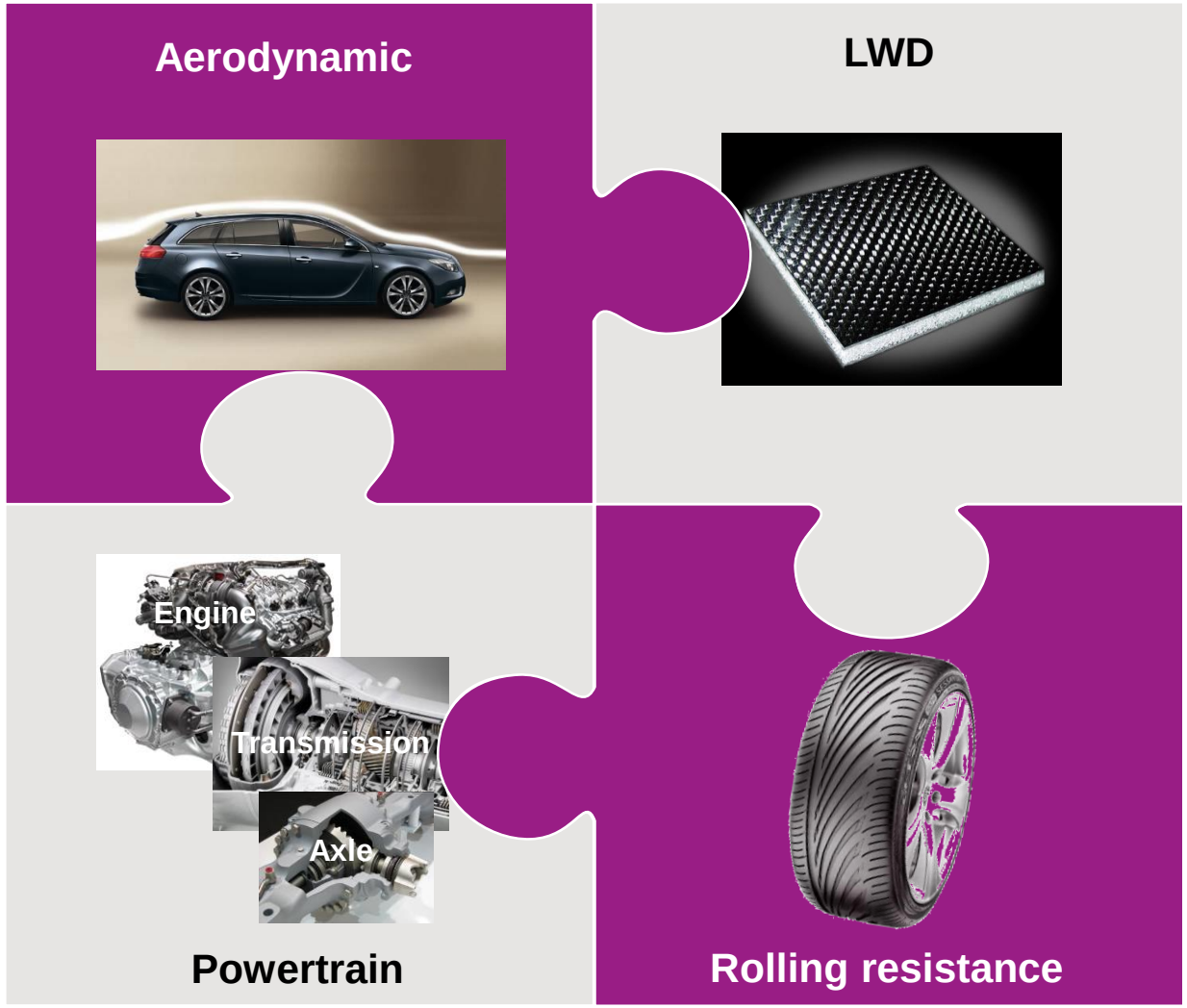
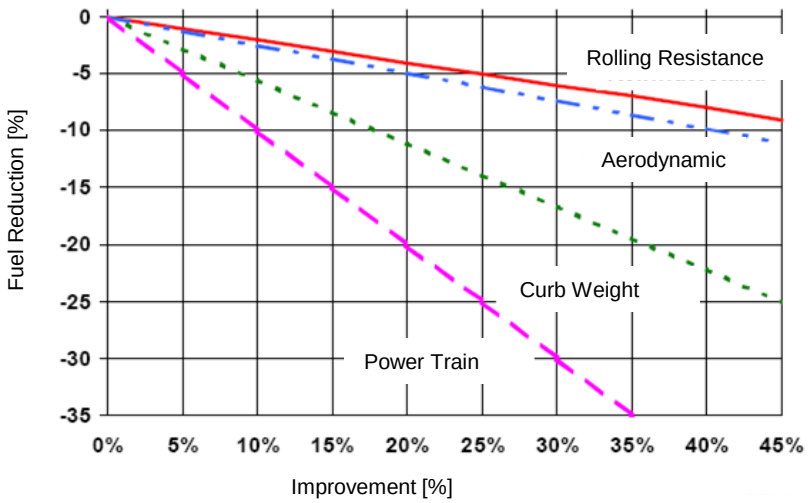
Different technical roadmaps to improve automotive fuel economy





Source: Prof. Dr.-Ing Haldenwanger, Audi AG 1997

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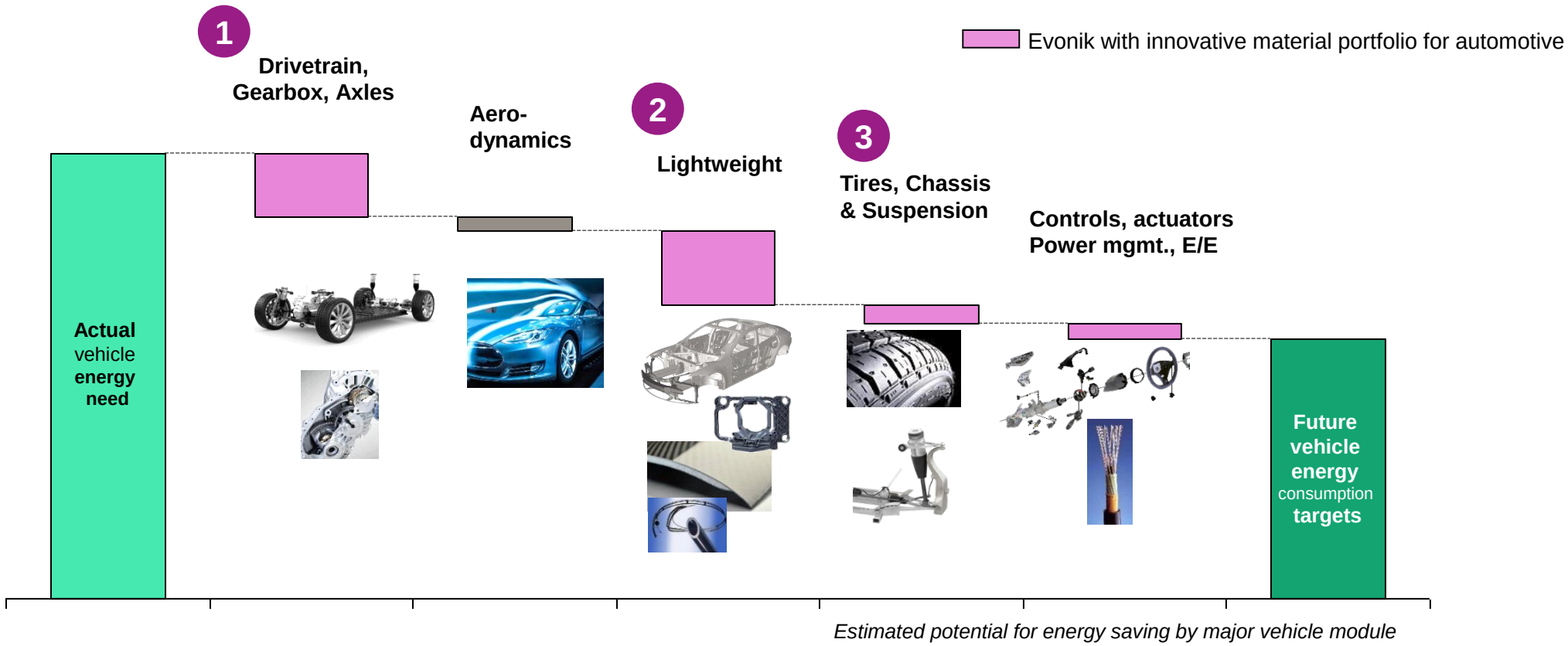
EVONIK offerings help to reach automotive fuel economy targets



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Example 1 - DRIVON™ technology to reduce friction of engine and transmission

Fuel economy & CO_2 emission reduction

Combs VIIs in **Engine Oils application** help reduce fuel consumption

by up to **2%**

PAMA and Combs VIIs in **Automatic Transmission Fluids application** enable fuel consumption reduction

by up to **2 %**

Axle Oil application enable Fuel consumption reduction about

0.5 %

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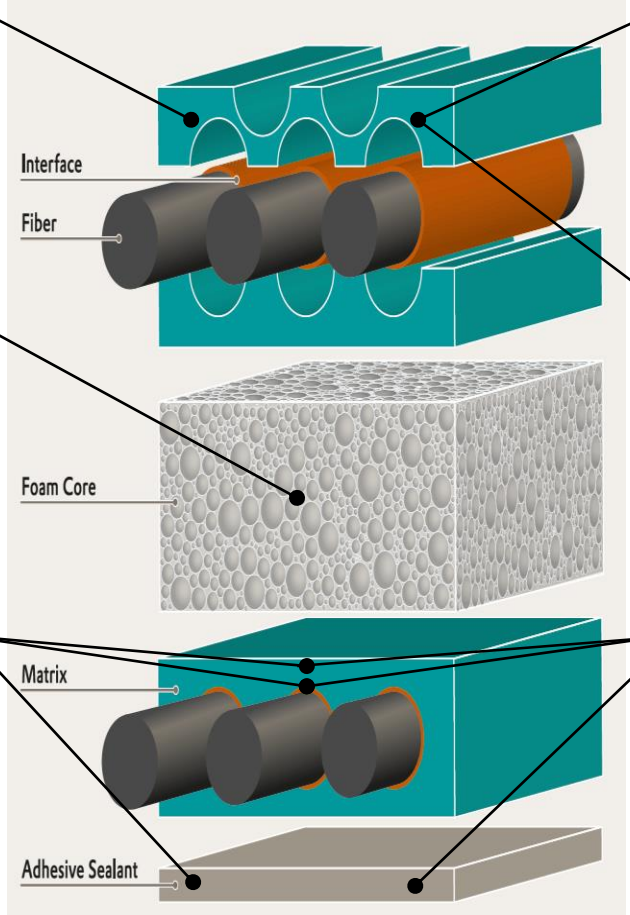
Example 2 – Evonik's backbone of LWD composite products

Composite sandwich system – cross sectional view

Thermoplastics
VESTAKEEP®
VESTAMID® HT*plus*
VESTAMID® L
TROGAMID®

Foam cores
ROHACELL®

Additives/rheological modifier
AEROSIL®
Dynasylan®
TEGOMER ®



Thermosets
COMPIMIDE®
CALIDUR®

Crosslinker
VESTAMIN®
VESTANAT®
JAYHAWK™ Dianhydrides
VISIOMER®

Thermoset modifier
NANOPOX®
ALBIPOX®
ALBIDUR®
P84®

Understanding all aspects of a complex system is the key

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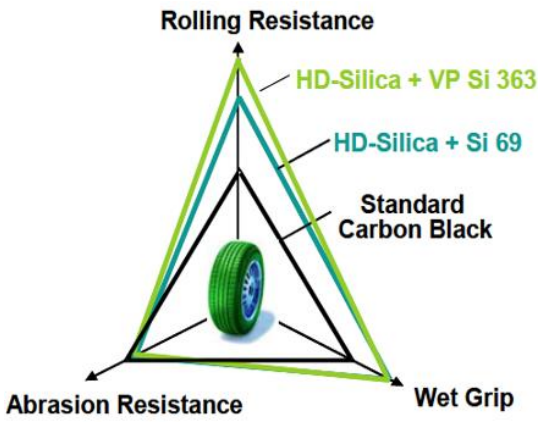
Example 3 - Through mechanical reinforcing in tire tread to improve Fuel-efficient

3

Target

- Request of the automotive industry to improve fuel efficiency and reduce the CO2 emission (tires account for 20-30% of total fuel consumption)
- Tire labeling is being implemented in most regions
- Increasing awareness of the consumers regarding performance and fuel consumption

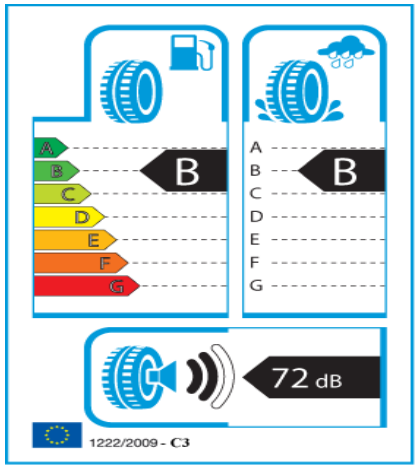


Solution

- By proper selection of new Silica-Silane reinforcing system and silane modified liquid rubber, rolling resistance of tire can be reduced by 30%, which will result up to 8% less fuel consumption
- Applying High Performance Additive in optimizing Silica dispersion in the reinforcing system

Benefits

- **Reduced Rolling Resistance, thus reduced Fuel Consumption**
- **Enhance Abrasion Resistance**
- **Improved Wet-Grip, thus improved safety**
- Reaching excellent rating in tire-labeling
- Brand building and differentiation



Evonik is the only supplier offering to the tire industry silica-organosilane reinforcing system

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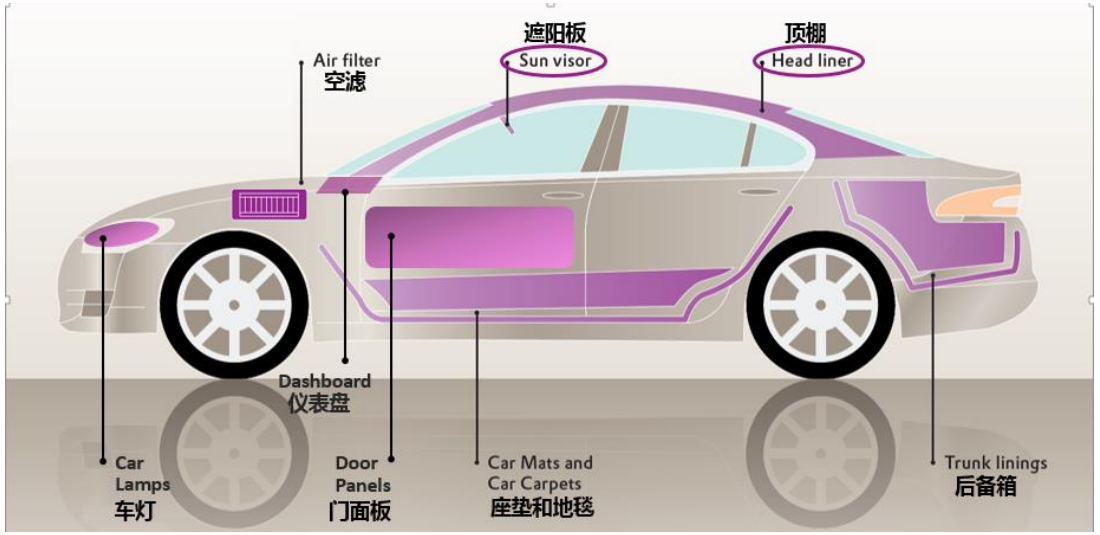
Low VOC automotive adhesives solutions for green and safe interior environment



Applications of low VOC hot melt adhesives & PUR:

- Air filter
- Sun visor
- Dashboard and door panels
- Car mats and carpets
- Head liner- Apply to bond window frame and fabric
- Car lamps- Apply to bond headlamp of automobile parts company
- Trunk linings- Apply to bond fabric and backplane

Benefits:

- Low odor, low VOC emission
- Solvent free
- High green strength and hot tack
- Adhesion to variety of substrates
- Water impermeability
- Fast setting
- Resistance to heat or low temperature
- cross linked and resistance to chemical

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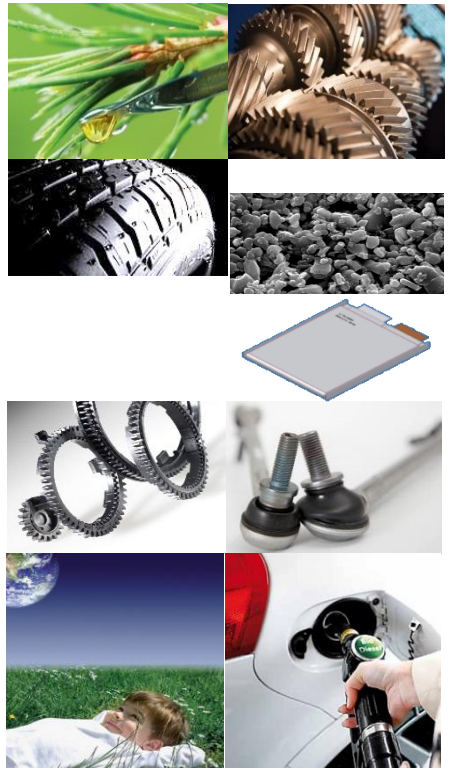
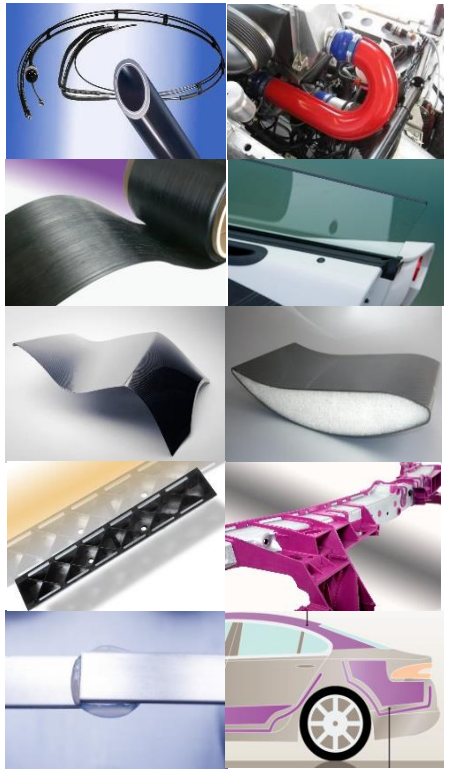
Evonik is supplying material solutions and innovations for the complete vehicle

Emission Reduction & Energy Saving



Lightweight Design



Surface Technologies

Lighting Technologies

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We’re developing material solutions for future mobility & transportation

EXAMPLES:

Evonik Lotus Elise 2012 -> LiIon battery/HV bordnet, lightweight, tires, friction

base vehicle for concept car:
TESLA S

2014 Xchange EV concept car -> autonomous driving, new interior , …

2013 Micromax EV minibus concept car
-> EV, functions, urban transportation

2015 Evonik Roding roadster GT3 racecar
-> super lightweight, friction

NEW: 2016 Evonik virtual concept car
-> Material Innovations Demonstrator

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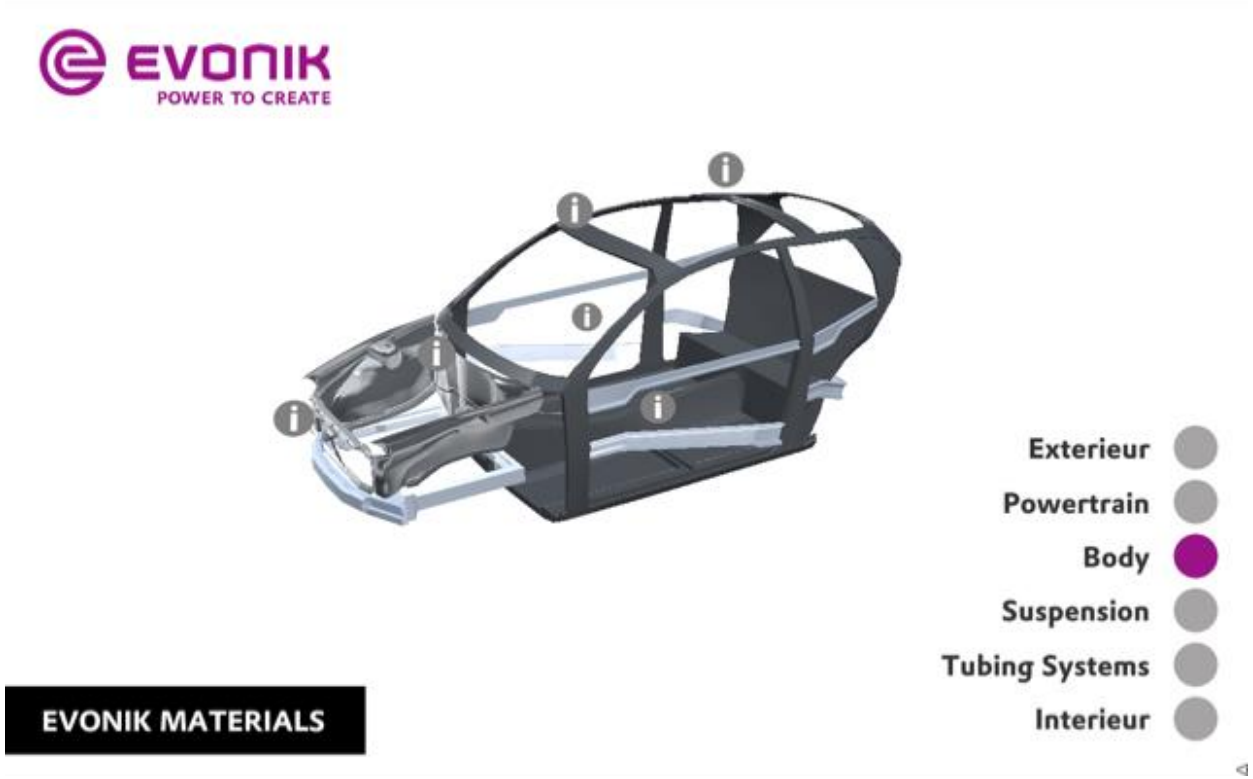
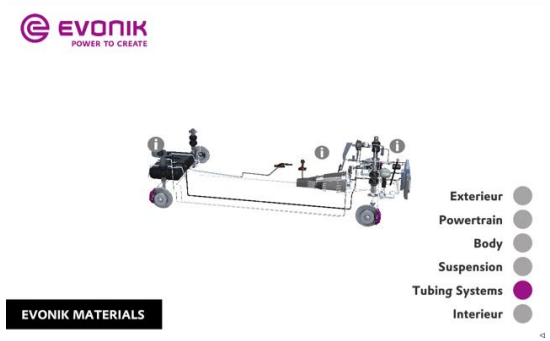
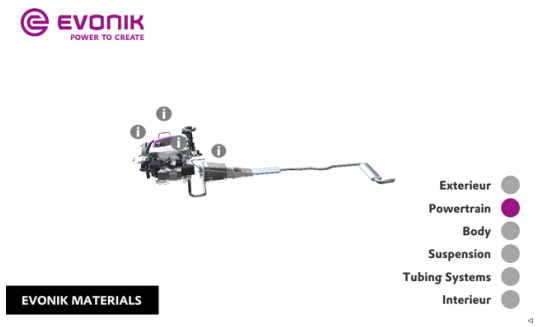
Visit the Evonik Virtual Car at automotive.evonik.com







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