

# LCA of vehicle components: how weight reduction could influence the environmental impact

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**Introduction:** The objective of this study is to determine how changes in materials and design could influence the weight and the environmental performances of some vehicle components. Four case studies are investigated. These have been developed during the Light Vehicle 2025 Interreg project (Euregio Meuse-Rhine). The objective of this project is to develop safer, lighter and more fun to drive vehicles thanks to lightweight materials and optimized designs.

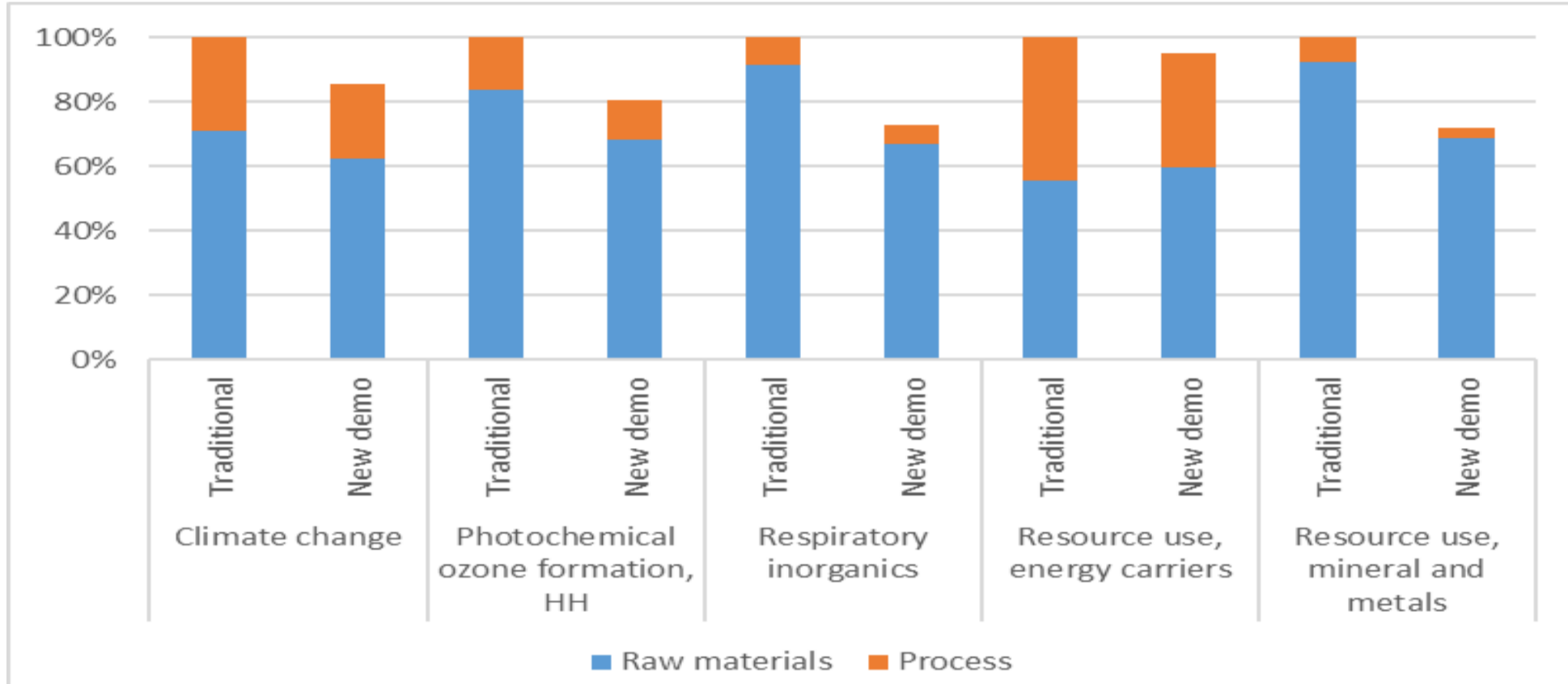
**LCA: Cradle-to-gate:** functional unit = **1 piece**. Only production (raw materials extraction and production). Raw materials transport not included (sensitivity analysis shows only a small influence). Use and end-of-life not included.  
**Or Cradle-to-wheel:** the functional unit: the life of one car, i.e. 12 years with a driving distance of 150 000 km.

**SimaPro**

**econvent**

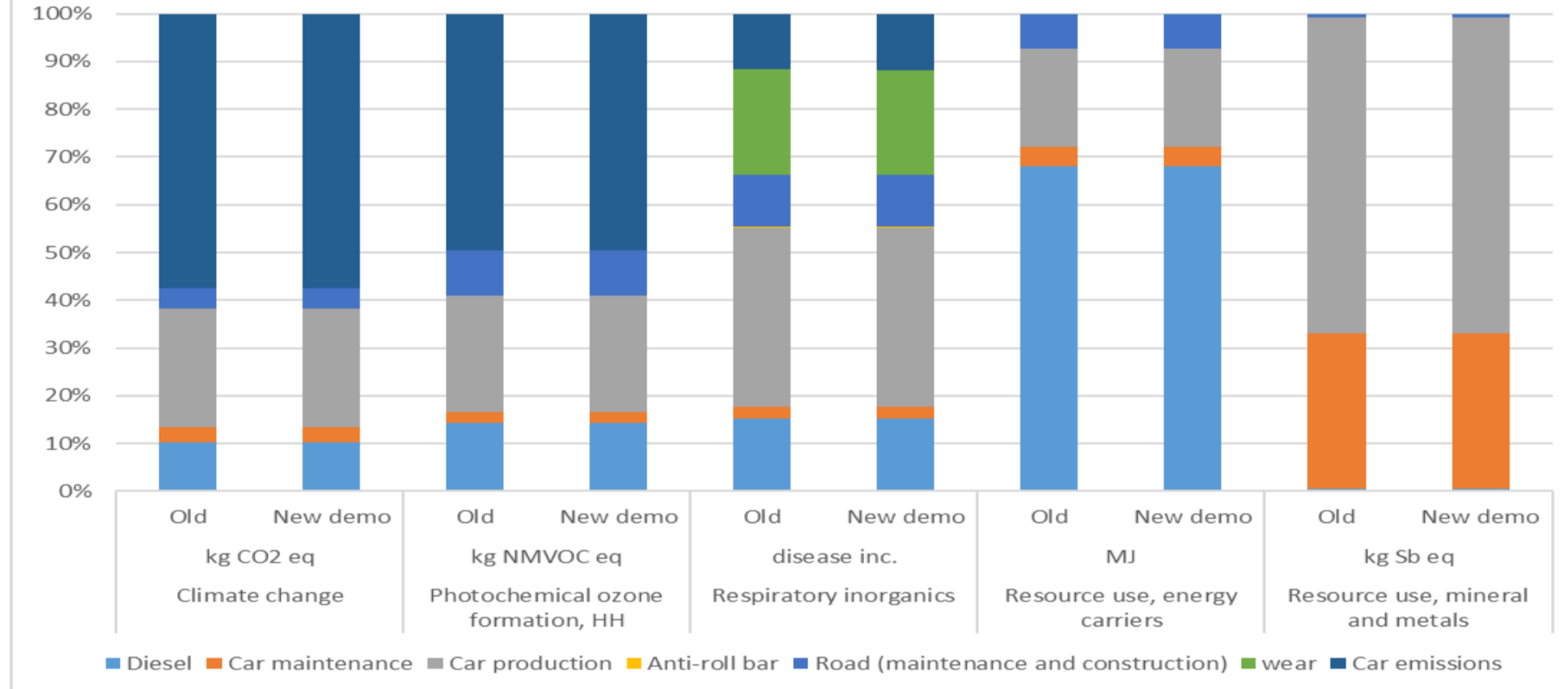
## Case 1: Anti roll bar

Substitution of steel by epoxy resin and glass fibers  
**Cradle-to-gate**



Reduction of greenhouse gas emissions of 18 % thanks to change in materials and production process.  
No impact transfer

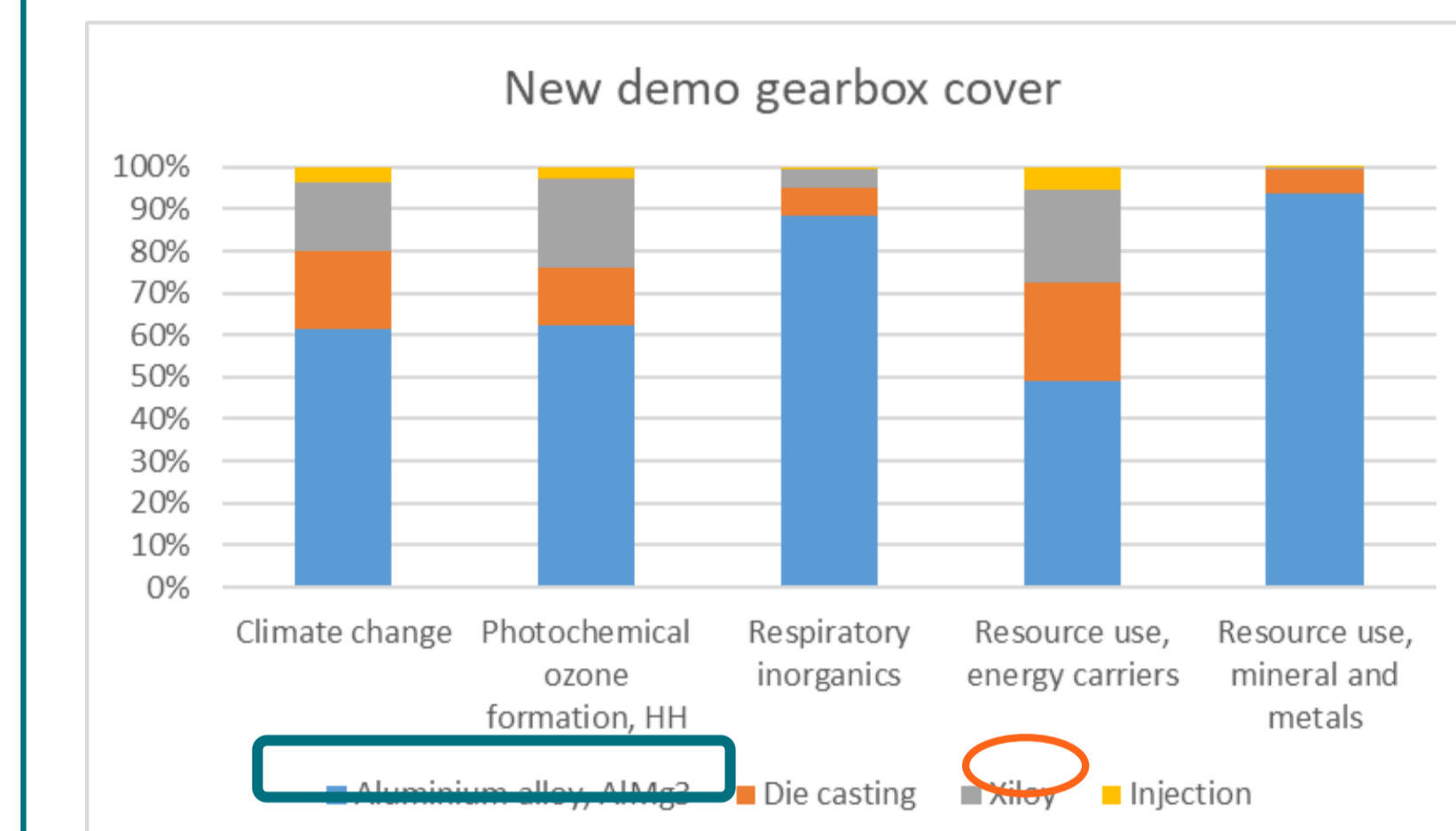
**Cradle-to-wheel**



The weight of the conventional vehicle is 1697.2 kg. The new suspension bar is 2.35 kg whereas the old is 2.85 kg, therefore, the weight of the new vehicle is 0.5 kg lighter. Fuel consumption and proportional emissions have been reduced accordingly.  
**The contribution of the anti-roll bar in itself are so small that they are invisible: small mass → no difference between the two cases**

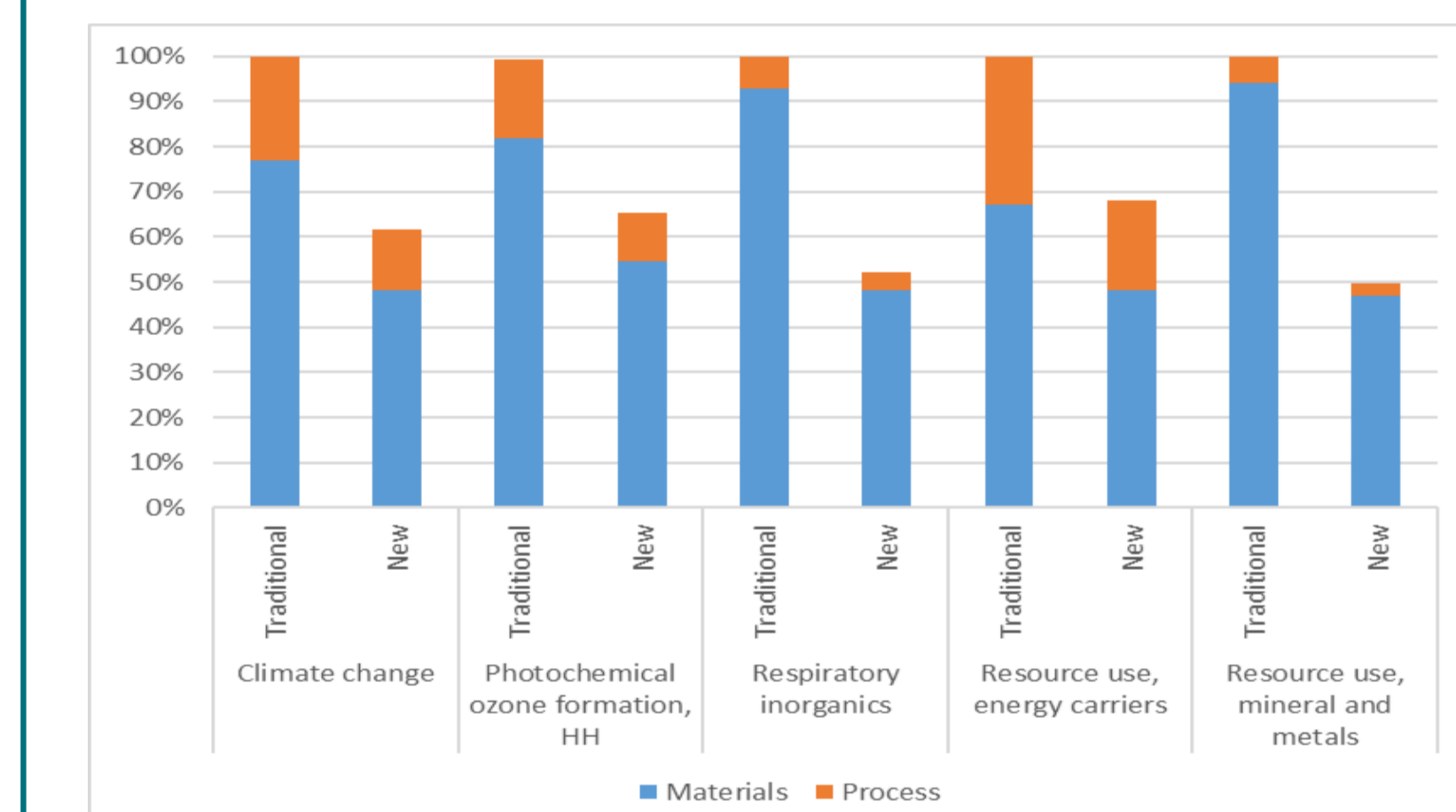
## Case 2: Gearbox cover

Substitution of steel by epoxy resin and glass fibers



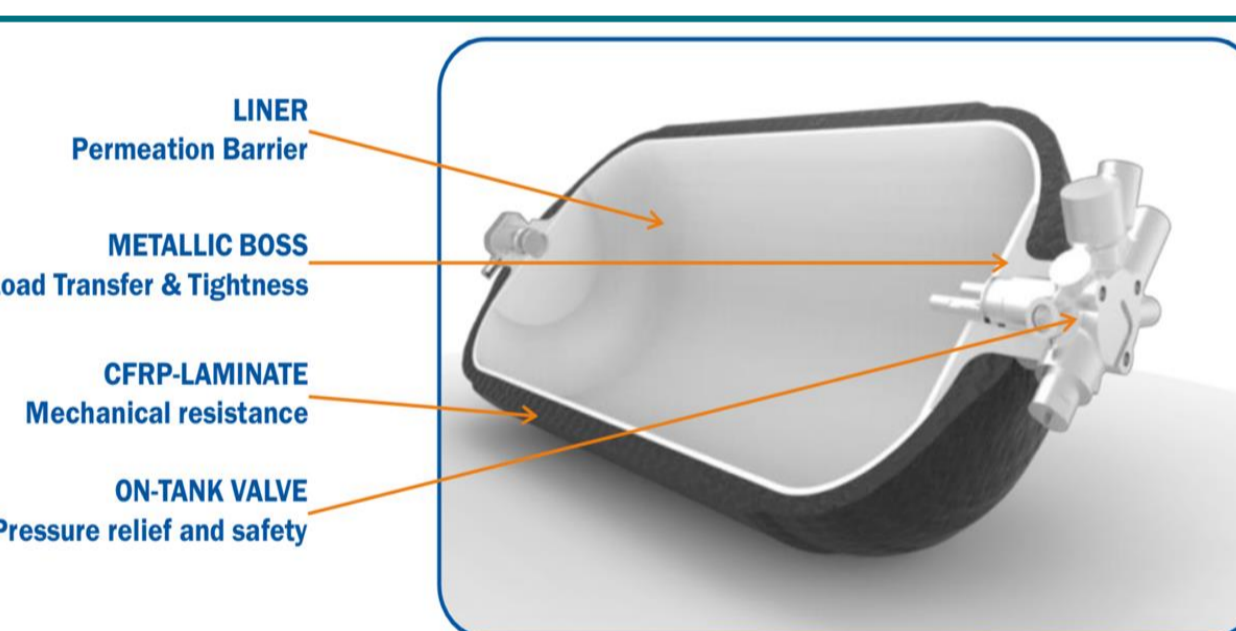
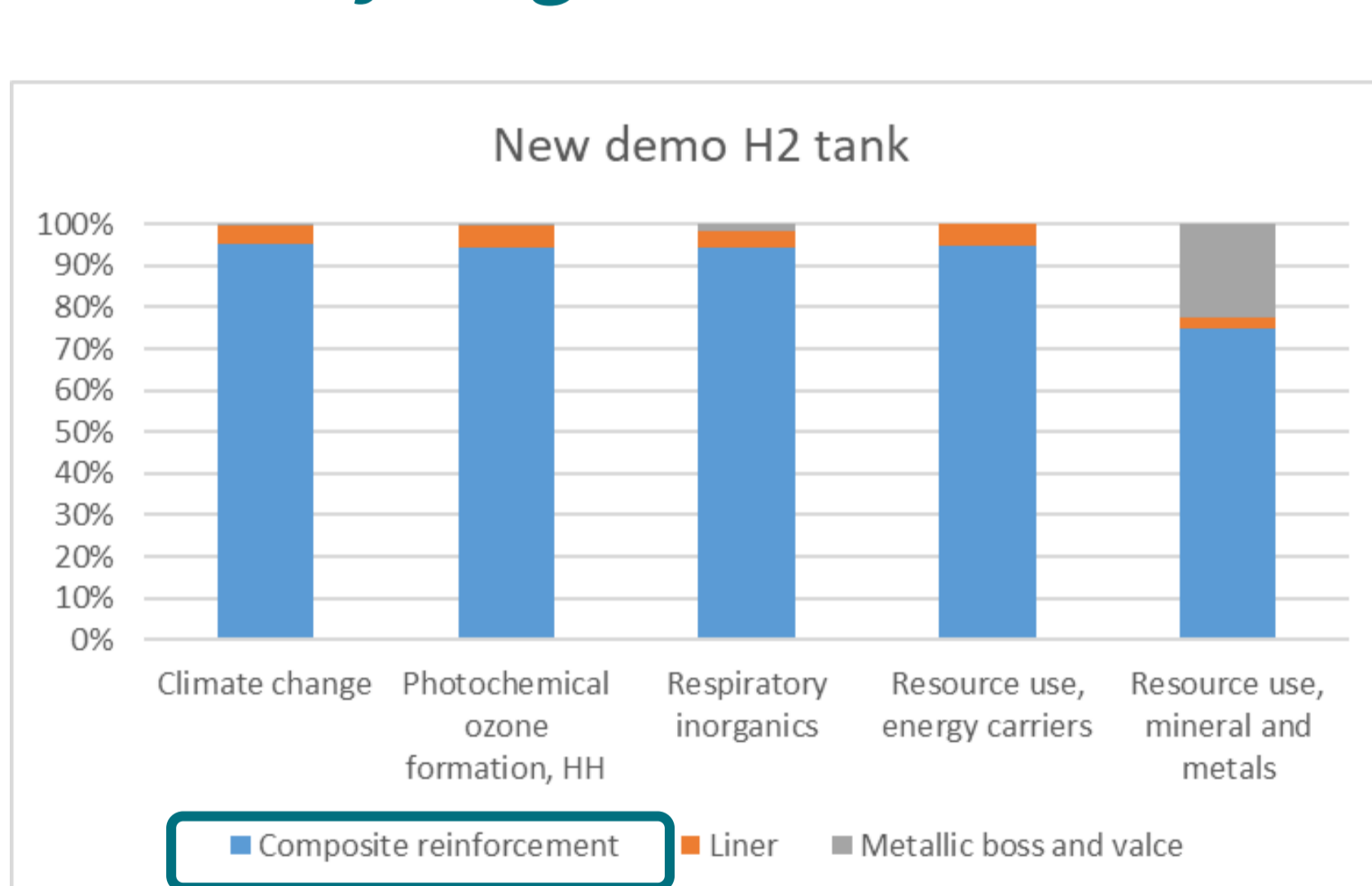
Large contribution of steel  
High sensitivity to the hypothesis made during the AI alloy modeling.

New materials (styrene maleic anhydride (SMA) copolymer)

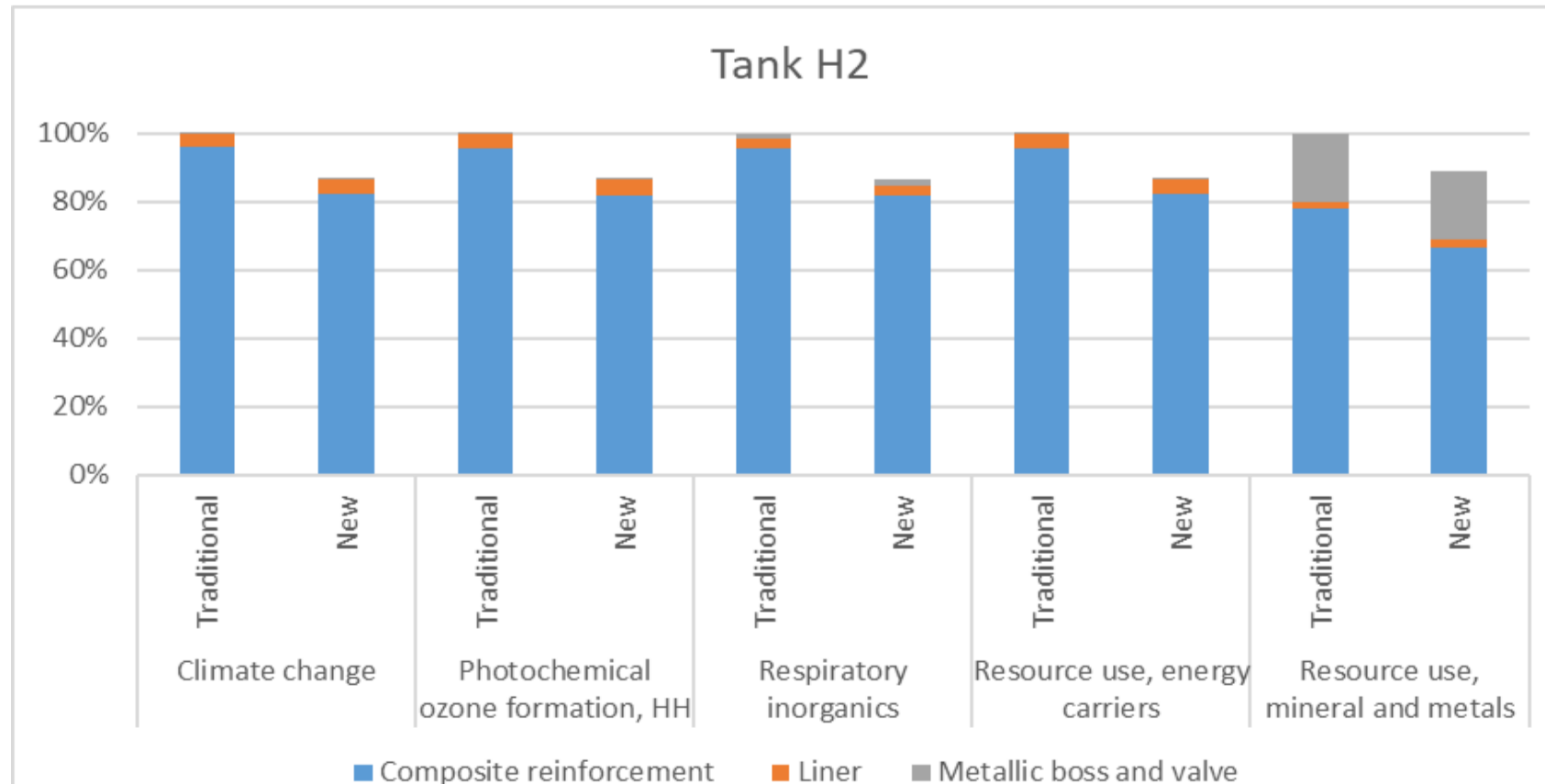


Reduction of greenhouse gas emissions of 40 % thanks to change in materials and production process  
No impact transfer.  
In photochemical ozone formation, respiratory inorganics and resource use: smaller impact of the new gearbox cover due to the smaller impact of the materials (weight reduction and change from aluminium alloy to plastic materials)

## Case 3: Hydrogen tank

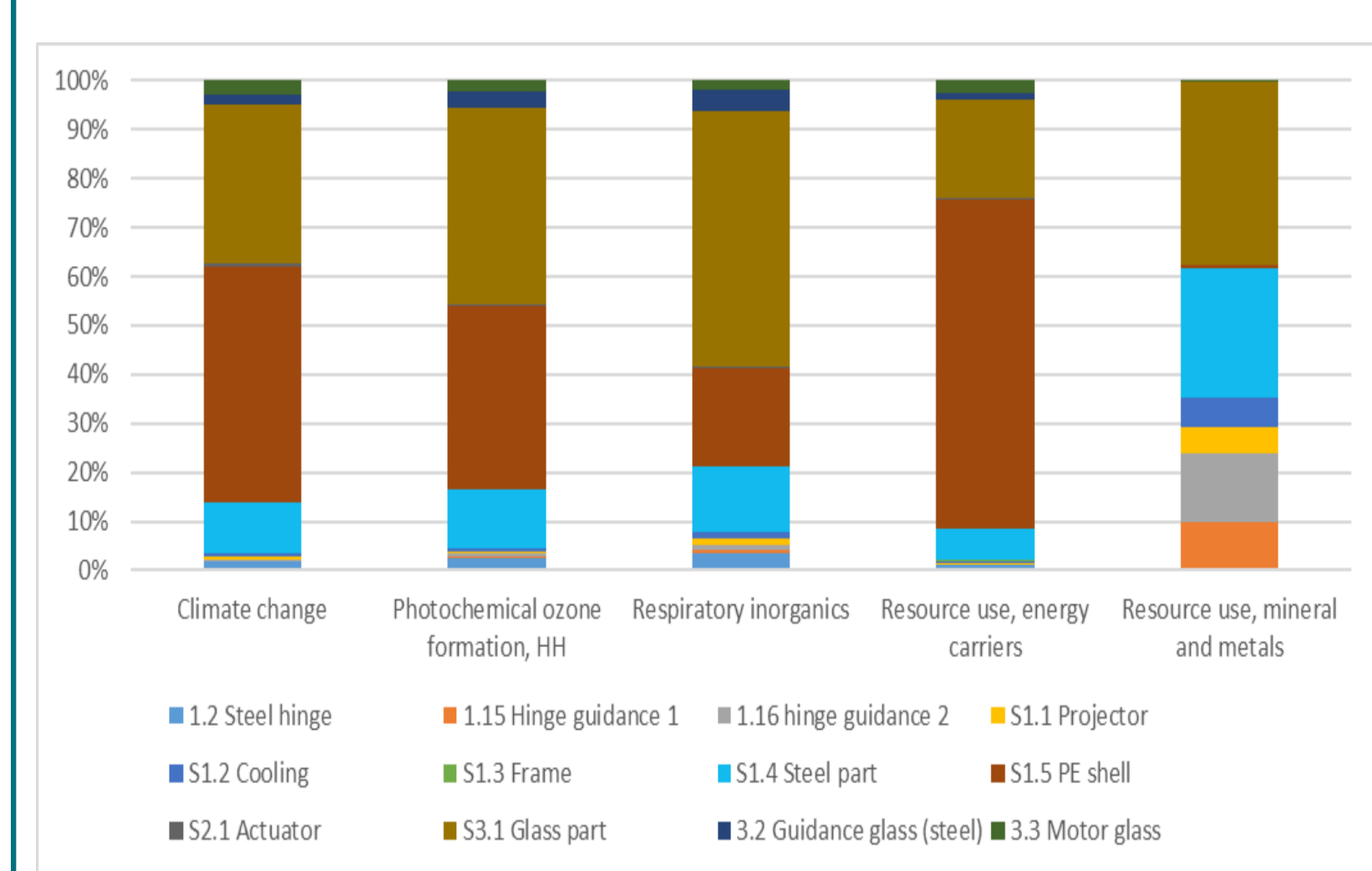


Reduction of weight of reinforcement and liner with change in production process for the liner  
No change in metallic boss and valve



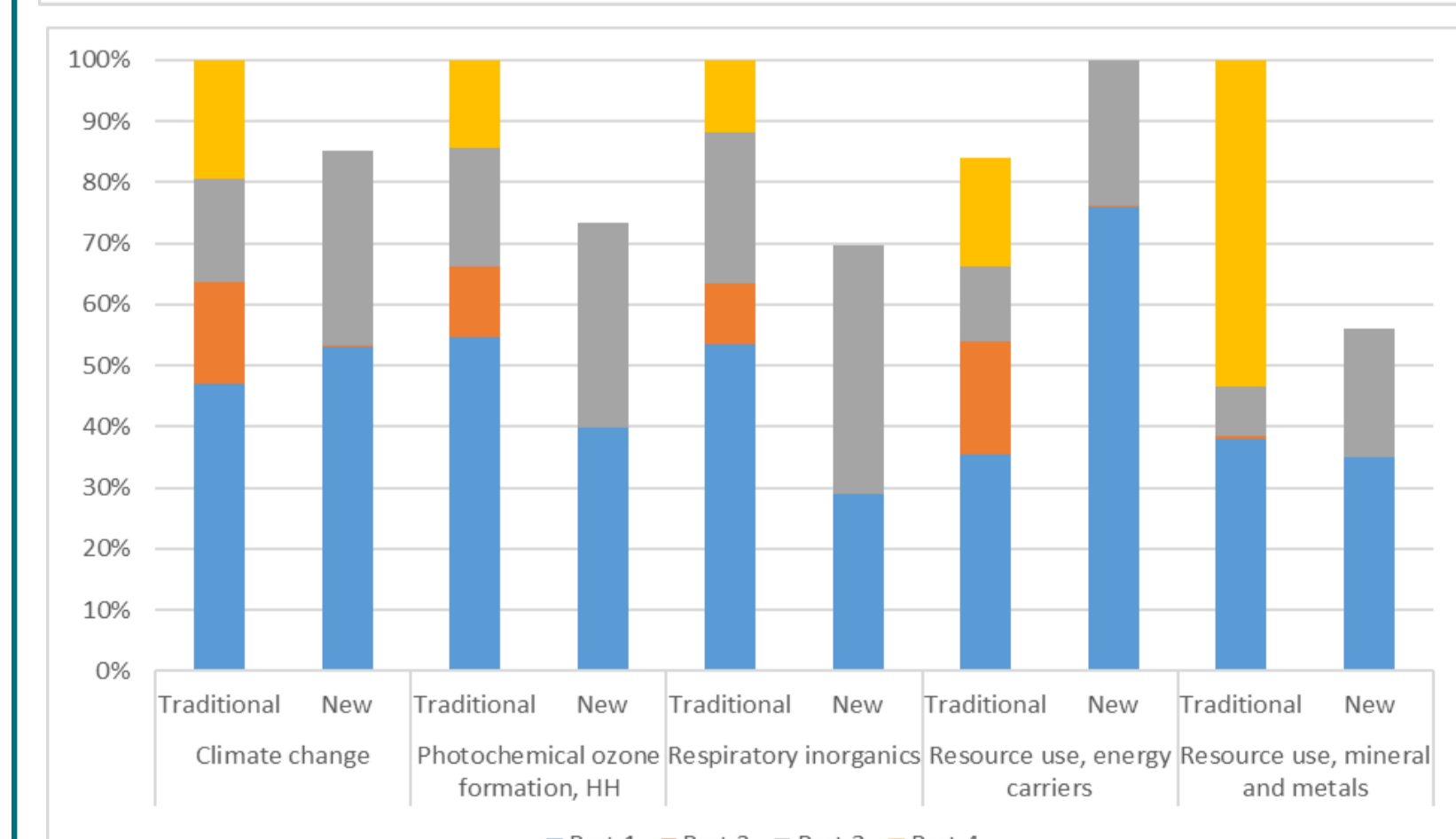
Large contribution of carbon fiber  
High sensitivity to the hypothesis made during the AI alloy modeling.  
Reduction of greenhouse gas emissions of 15 % thanks to change in composite reinforcement (reduction of the materials consumption, no change in the production process).  
No impact transfer.

## Case 4: Truck door



Reduction of weight: by moving from steel to plastic and glass materials

New demo door: PE sheet and glass parts = largest contribution. The steel part (door frame) have also non-negligible contribution. These parts = the heaviest part.



Part 1: door frame – part 2 : main panel – part 3: window – part 4: spoiler  
The new door allows a reduction of the environmental impact in all the categories, thanks to the weight reduction, except in resource uses, energy carrier. This is due to the large energy consumption need to process the PE materials.

## Conclusions

- Data quality: a challenge!
- Large contribution of the materials
- Weight reduction: allows an impact reduction in the production process for the for case studies.
- When the complete life cycle of the car is considered (from car production to its use), the contribution of the anti-roll bar is too small to observe any differences between the new system and the conventional system. Nevertheless, as the analyses of the bar has demonstrated, if this kind of improvement were performed for more parts of the car, it could lead to a significant impact reduction.