

## PS4: MATERIALS EFFICIENCY THANKS TO AUTONOMOUS VEHICLES

### KEY SECTOR TRENDS

1. Automated vehicle with an electric powertrain is going to answer several mega trends, societal trends, automotive trends and consumer expectations.
2. Making autonomous vehicles happen in mass production on the market is going to be a 2 phases process
  - First, a maturation learning phase. It started from 2010/2015 and should go on until 2025/2030. The main stakes and challenges for a non-predictable market are
    - Define and converge regarding regulations :driverless, road infrastructures, city policies and need for vehicle supervision.
    - Technical definition (mainly set of sensors for the different autonomy levels and electronic architecture) and economics to make it affordable. The high projected costs of level 4 and 5 should only lead to professional applications.
    - Large scale tests led currently by Waymo with 10 million miles.
    - Investments : more than 800GWh battery production capacity needs representing around €100bn investments by 2030 and €40bn for charging points.
  - Then an efficiency phase, starting in 2025/2030, producing its full effects from 2040-2045 and going on after that. Combining autonomous vehicles and electrification will lead to
    - Improve the environment and mobility conditions: declining in CO2 and pollution emissions, better health, 5 to 10 times less fatalities, robocab travel cost decrease by 70%, better access to mobility for disabled or elder people
    - Optimize material usage: 15% less energy consumption thanks to road traffic management, car manufacturing drop by 2040 due to higher mobility sharing, 200kg average weight saving thanks to accident avoidance, life time increase and less maintenance costs thanks to electric motors.

### MATERIALS EFFICIENCY SOLUTIONS AND GOALS

1. Smarter: Huge potential material saving due to a higher utilization rate of the vehicle and mobility sharing, better traffic management and collision avoidances.
2. Longer: better traffic management and collision avoidances as well as new vehicle concepts and business models allowing reshuffling, functional design, predictive maintenance, Over The Air and hardware upgrades will all contribute to extend the vehicle life cycle. Shared mobility will also put the emphasis on the need of self healing, self cleaning materials such as graphene technology (x16 life time vs epoxy/glass)
3. Less: Reduce the weight of vehicles thanks to materials like composites : carbon fiber structures reducing weight by 35% versus aluminum or new designs like structural batteries could lead to 50% weight saving versus current design or additive manufacturing. 4D printing, changing the shape of the part from a material stimuli could open. Without forgetting Additive manufacturing as a potential game changer. And reduce the quantity of materials used altogether thanks to simulation: Numerical models used to simulate autonomous driving have a huge impact (1 month simulation is equivalent to 236 years of road test) and automatic topology design incorporating new materials can lead to 20% weight saving

But caution:

- Such a transformation will require a massive increase of computing power for autonomous vehicles; 100 million lines of code will be necessary (x15 versus a Boeing 737).
- A key factor will be the affordability of new materials, particularly to get to level 3 autonomous driving (eyes off/hands off) high speed from level 2 will require to multiply by 25 the material costs.
- Another one will be Recyclability as current consumer vehicles may be 90% recycled. Driverless electric vehicle are mainly made of composites which allows a 55% recyclability average rate. The goal will be to reach 90% recyclability and more thanks to the use of new technologies such as vitrimer composites (Malinda)
- The priority - and difficulty - will be to work as an ecosystem across industries and all along the entire life cycle from creation, through design, use, reuse, in-cycle improvement and finally repurposing or return to the original material will be planned and monetized and monitored.

### SPEAKERS

Patrick Koller - CEO Faurecia (France) - Chair  
 Maxime Picat - Executive VP Europe PSA (France)  
 Philip Taynton - Co founder and CTO Mallinda (USA)  
 Tim Swords - President Industrial Business Hexcel (USA)  
 Simon Verghese - Lidar Systems Manager Waymo (USA)

**Moderator:** Arnaud Le Gal, Deputy Editor in Chief Les Echos