

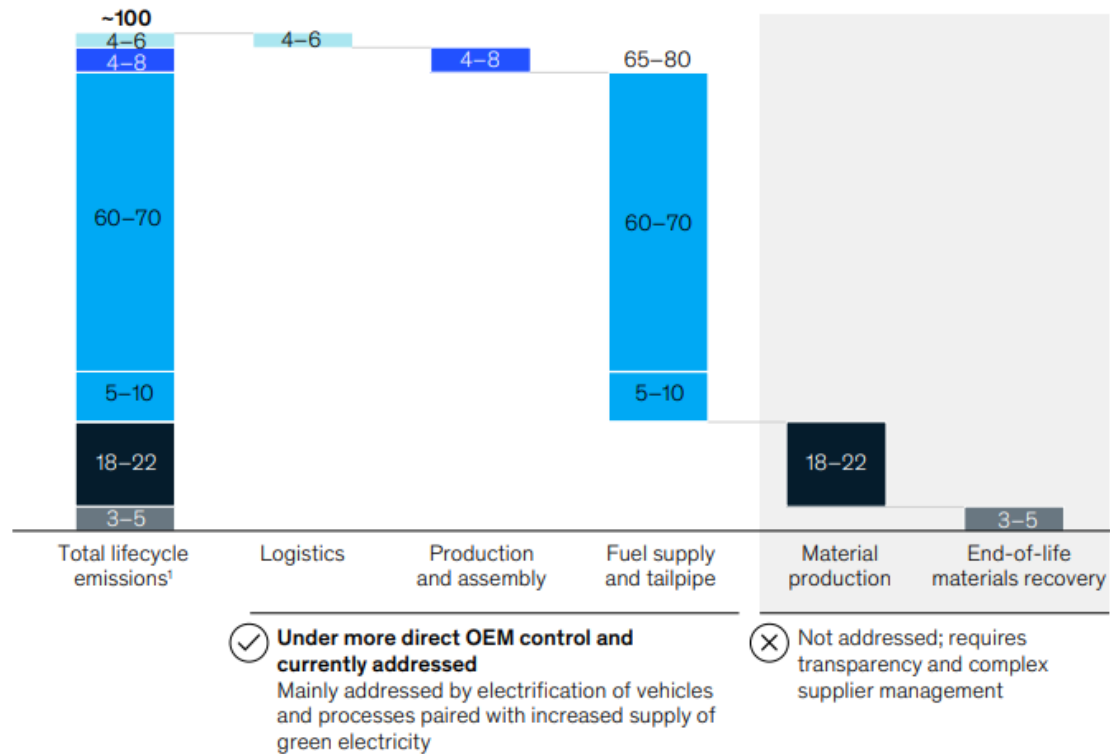
The future of the automotive industry: decarbonization & automation



Automotive Industry | Emissions Life-Cycle Analysis

The automotive industry has largely focused on the reduction of tailpipe emissions, but reducing material production emissions is also a priority.

% of total current life-cycle emissions of internal combustion engine vehicles



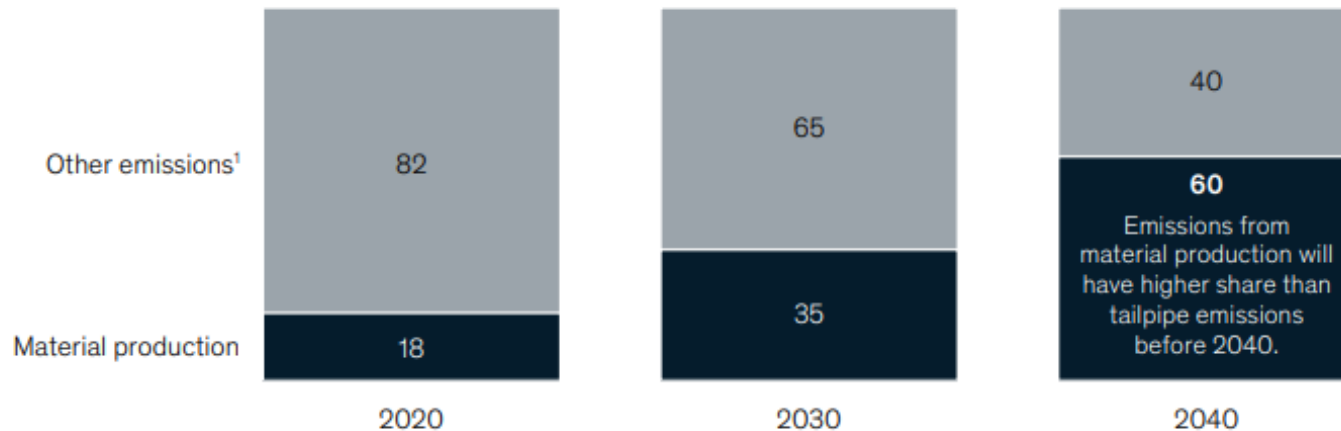
¹For C-segment vehicle.
Source: Natural and bio Gas Vehicle Association; expert interviews; McKinsey analysis

Fuel Supply & Tailpipe represent only 70% of the total emissions.

Zero-carbon drivers | Materials emissions

Emissions from material production may reach 60 percent of life-cycle emissions by 2040.

% of life-cycle emissions, (based on required sales data)



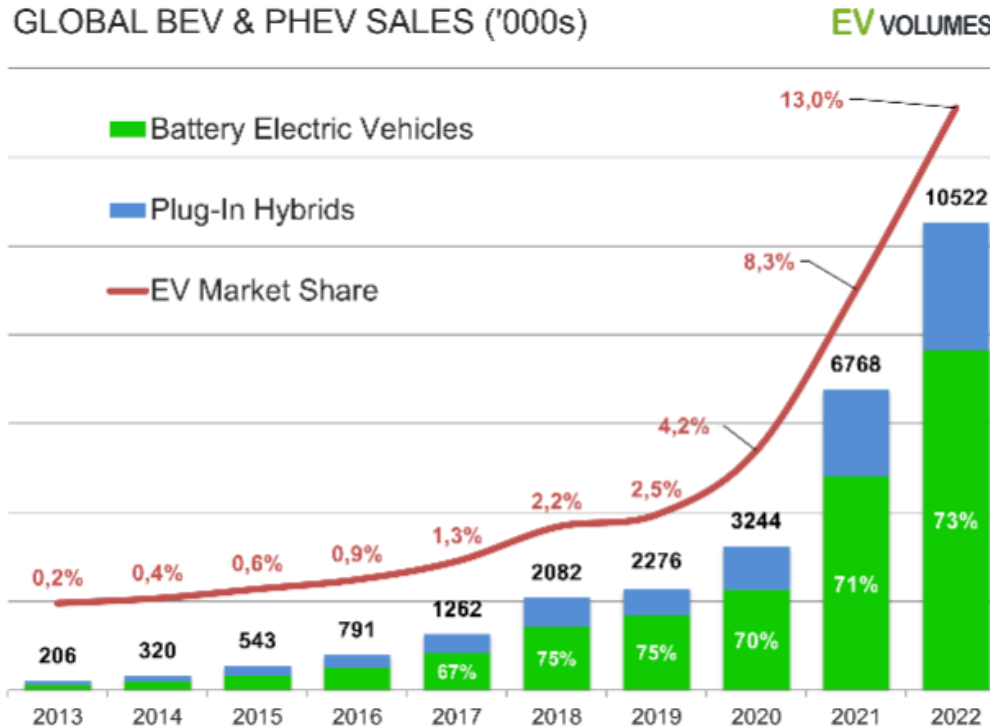
¹Assumed constant range of 150,000 km/vehicle as baseline – End-of-life emissions not considered here.

²2018 average ~120gCO₂/km, target today 95 gCO₂/km. Future assumptions: 2030 75 gCO₂/km; 2040 50 gCO₂/km.

Source: High level estimation of Circular Cars Initiative (2020) for ambitious EV adoption scenario

Eco-Design is the next big opportunity for the automotive industry

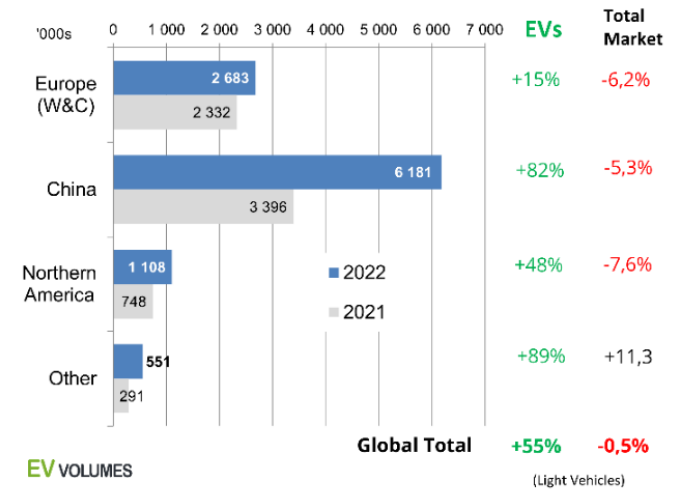
Electrification Trends and Threats



Growth +55% +70% +46% +59% +65% +9% +43% +109% +55%

Source: EVvolumes.com worldsalesdatabase

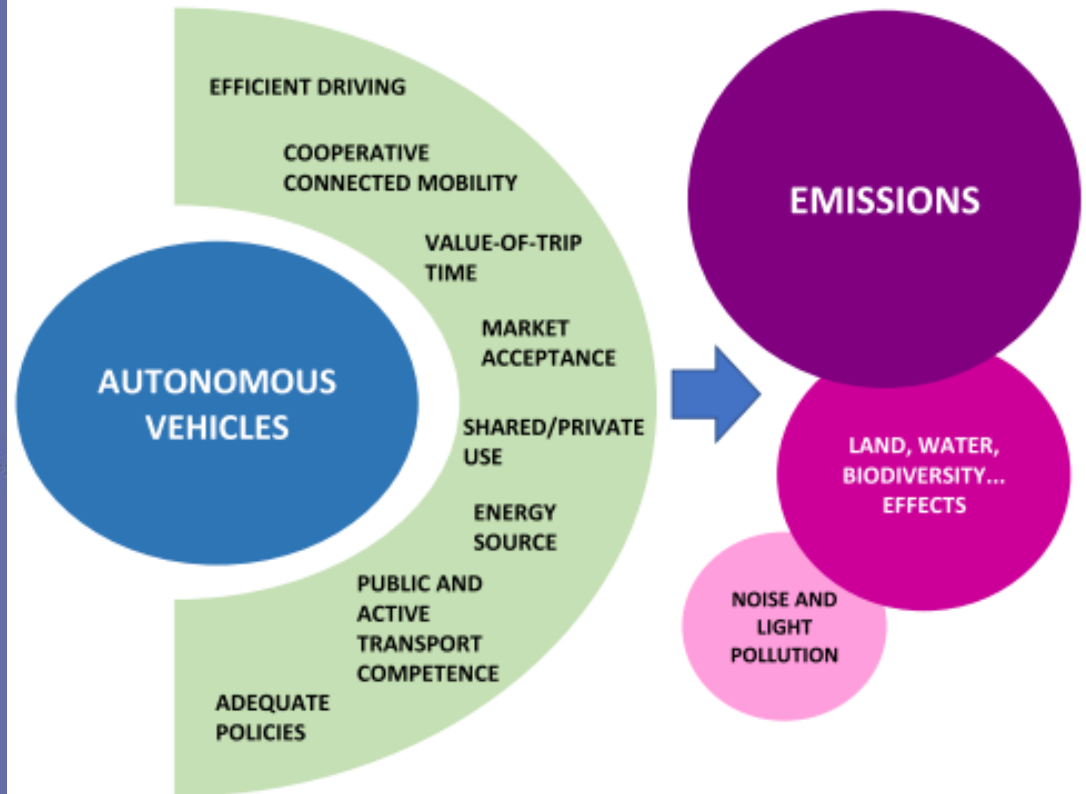
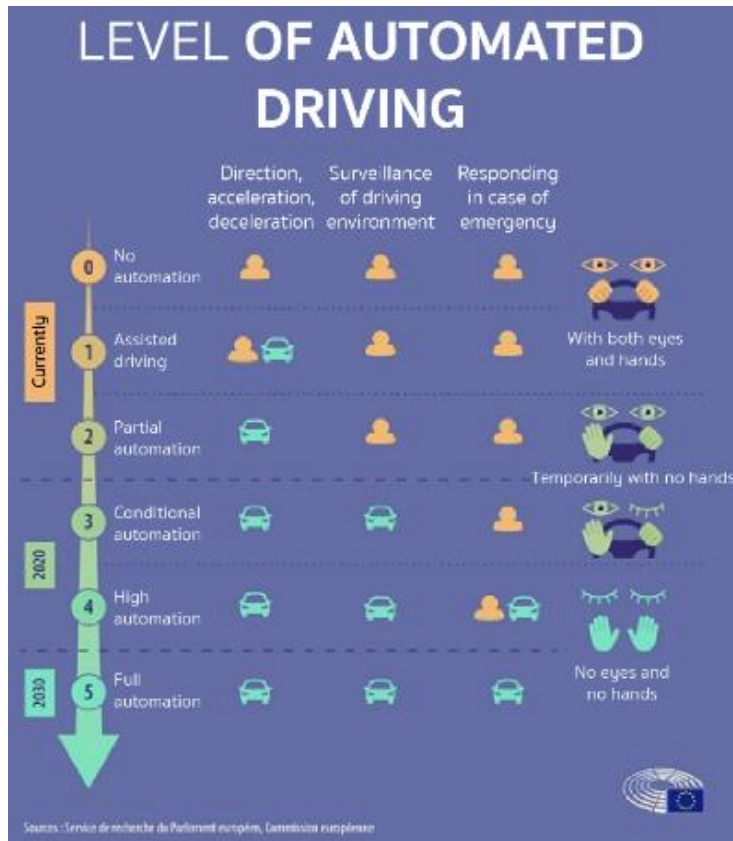
BEV+PHEV SALES AND % GROWTH FOR 2022 vs 2021



Hybrids & Full electric vehicles reached 13% of the 2022 market share

Subsidies, Battery technology, Charging points, and Green Grids are critical for growth

Autonomous Vehicles (AVs) Mobility, emissions impact



Reference: Environmental impacts of autonomous vehicles: University of Cantabria, Spain, 2022

Eco-driving & miles traveled benefits offset by higher technology content

Emissions breakthrough achievable with full autonomous vehicles (L5), shared mobility

Conclusions

- Zero-Carbon vehicle targets can only be achieved with clear and aggressive Material Usage and Circularity Objectives and Policies.
- Electrification Policies to enable technology competition and drive to the best cost and environmentally efficient solution.
- Autonomous driving enables Shared Mobility and contributes to transportation decarbonization. Regulations lacking behind.

Bibliography

- The zero-carbon car: Abating material emissions is next on the agenda, McKinsey 2020.
- Why the automotive future is electric, McKinsey 2021.
- EVvolumes.com world sales database, 2022.
- Environmental impacts of autonomous vehicles: A review of the scientific literature, University of Cantabria, Spain, 2022.

Appendix

Vehicle Life Cycle Assessment

