

Space-enabled mobility ecosystem

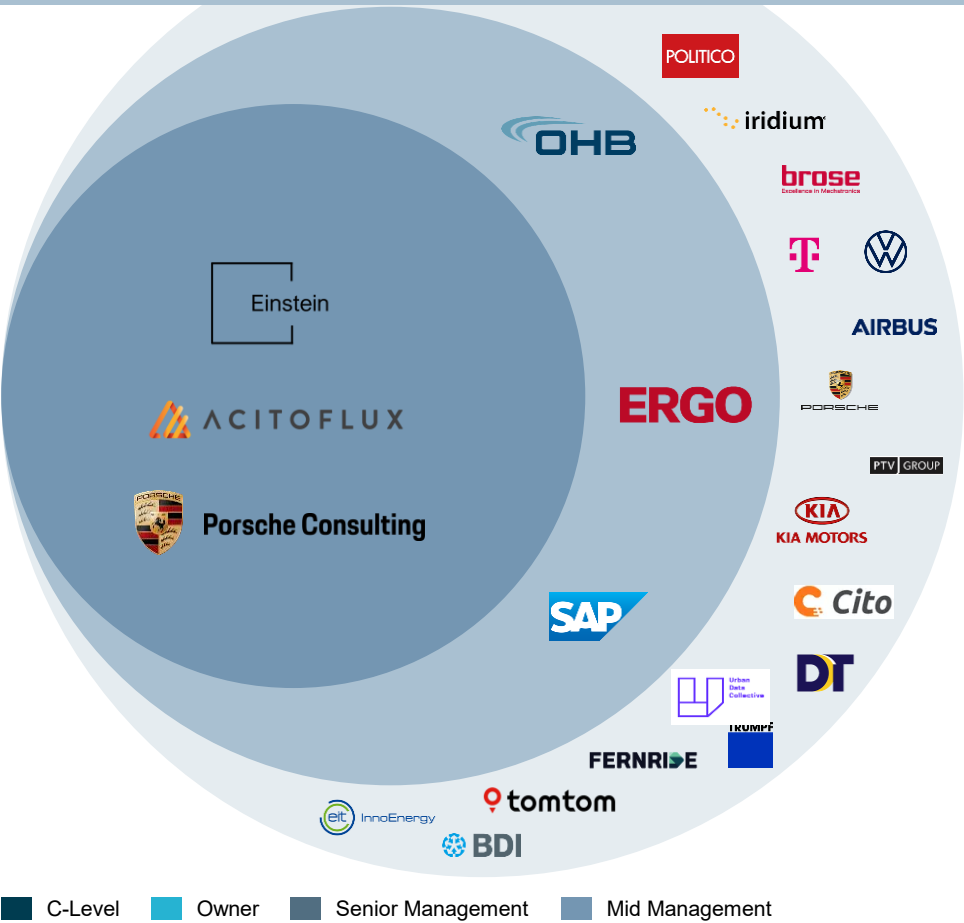
ESA Commercialization Days 27.11.2023

Prof. Dr. Ulrich Hermann

A call to action for Europe



Survey of decision makers across Europe and value chain underpins study regarding topic relevance, economic impact and technological maturity

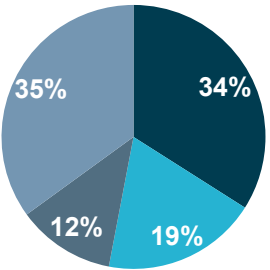


Survey Participants Profile

170 Mid and Senior Level Executives Survey done

Automotive & Automotive related Industries

52 Interview Leads addressed
21 Qualified Interviews performed



» Extended Team
Experts and Interviews

» Associated Team
Industry Consortium

» Core Team
Study design, concept, mgmt.

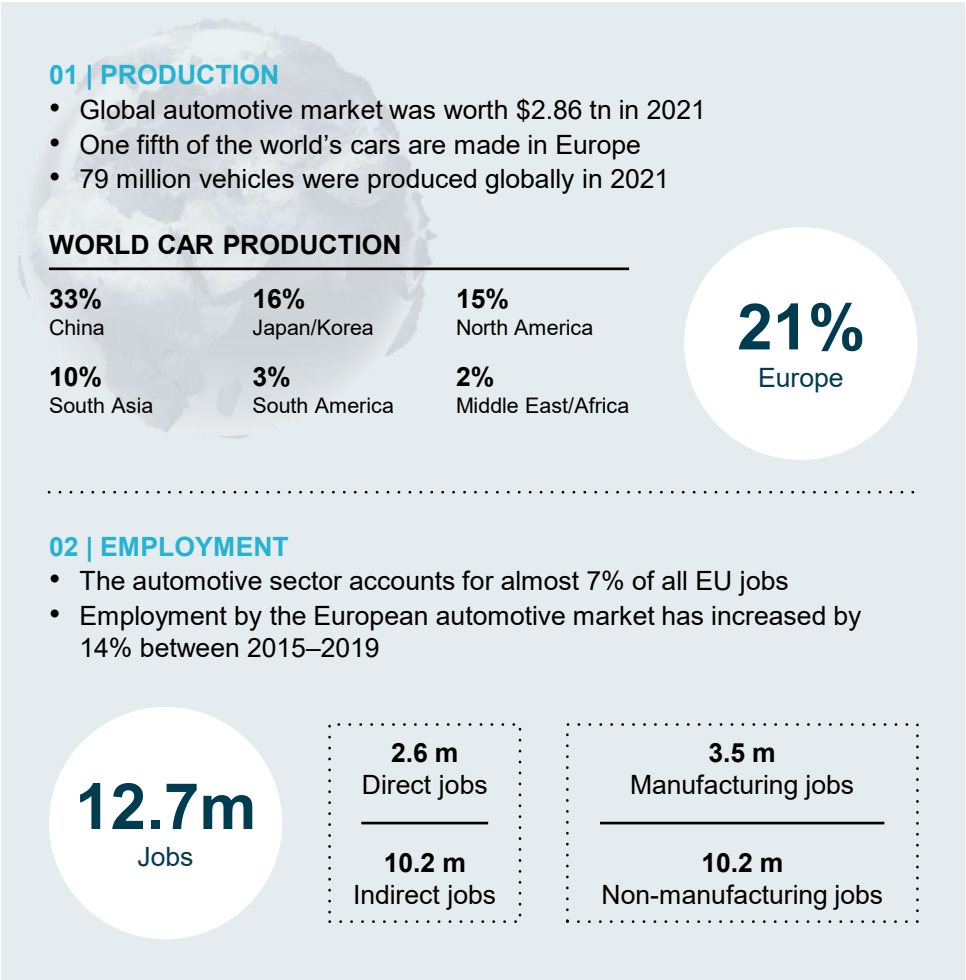
Summary Outcome

01
Use Case validation based on 1st and 2nd order **economic impact**

02
Identification of key **enablers and challenges** for the industry players

03
Validation of space **technologies readiness** and maturity for use

The \$3 tn risk – Automotive industry is a \$3 tn business that sustains 13 m jobs in the EU (7% of total)



03 | TRADE & TAXES

- EU vehicle exports brought in €140 bn in 2021
- The auto-sector generates €375 bn in taxation for governments in major EU markets

04 | R&D

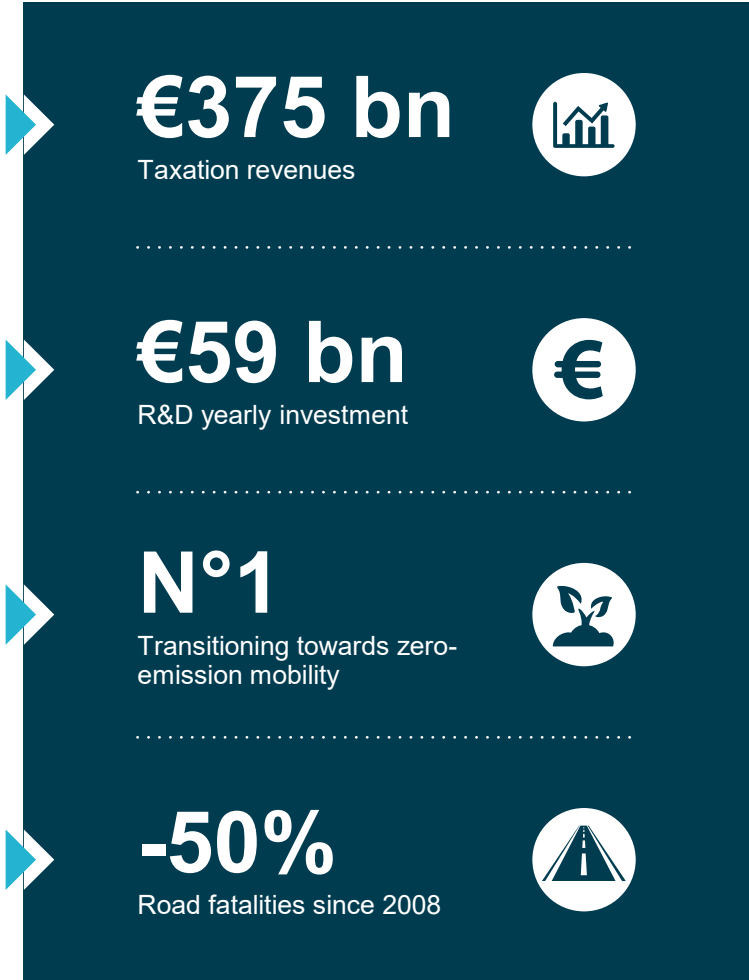
- The auto-sector is Europe's top investor in R&D
- €59 bn are invested yearly in R&D in Europe, accounting for one third of the region's total spending

05 | SUSTAINABILITY

- Europe is leading the transition towards zero-emission mobility
- Market share of battery electric cars almost doubled to around 10% in 2021

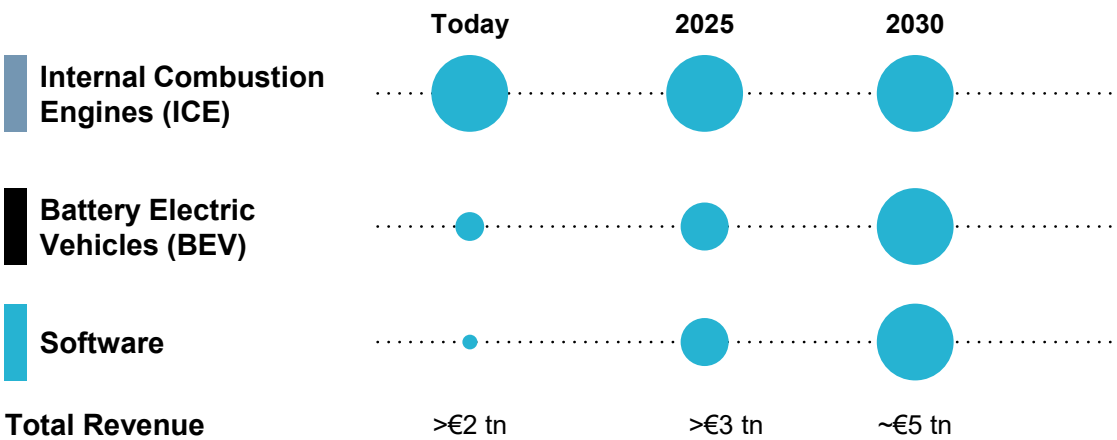
06 | SAFETY

- Europe is the world absolute leader in road safety with a year-on-year drop in road fatalities of >17%
- Data and AI initiatives will continue to positively contribute to lower accident rates



The next \$1 tn – Business models will change to services around individual mobility, autonomy and connectivity

Future Revenue Pools

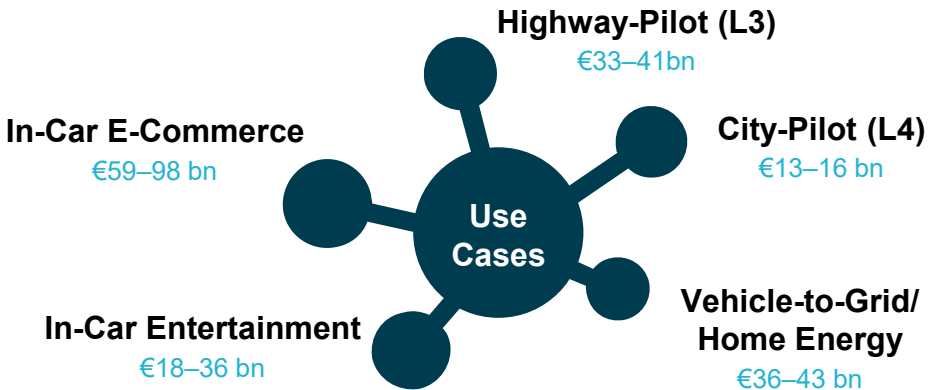


- Autonomous driving lay the ground for new business models
- Electric vehicles success depends on cost-efficient and sustainable production of battery systems and expansion of charging infrastructure
- Sources of revenue will gradually shift and excite customers with constantly improving digital functionality is the prerequisite for this

Shift to new revenue pools is a threat and an opportunity

Source: Volkswagen Group

» Software-based services



* Potential sales volume

- Potential annual sales volume could amount to 234bn € worldwide in 2030
- The highest customer benefits come from charging network providers and autonomous driving functions, however represent the highest costs to OEMs
- Vehicle-to-grid, predictive services and in-car payments are a few examples of quick wins for the sector with lower costs to OEMs

Software-based services will drive profitability in future

Source: Connected Car Innovation Service 2022

Mobility vision in the sat-com era: Services, autonomy, software-defined – all enabled by space

“

Car software is the backbone of our vehicles today



Ola Källenius
CEO Mercedes-Benz

“

The value of the company is primarily on the basis of autonomy



Elon Musk
CEO Tesla

“

Cars will turn into digital marketplaces on wheels with in-vehicle payment as a driver



Jorge Bento
CEO Vodafone DAB

“

The car of the future will not just make users mobile, but will also be digital and smart



Oliver Blume
CEO Volkswagen Group

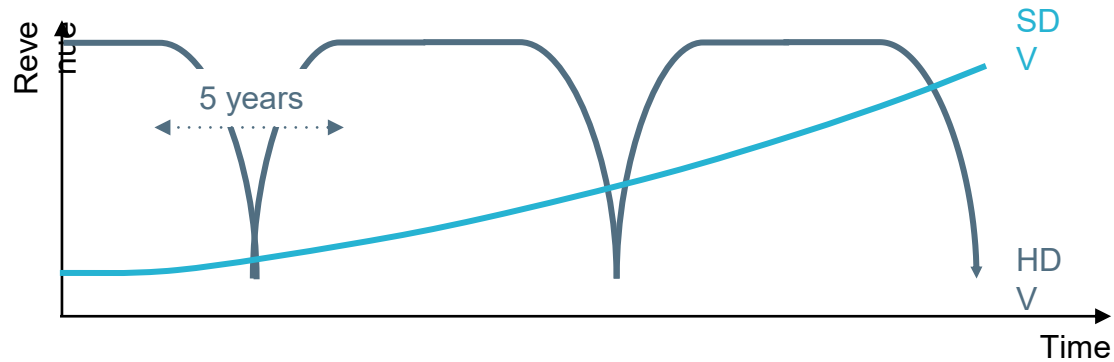
CONNECTIVITY

POSITIONING

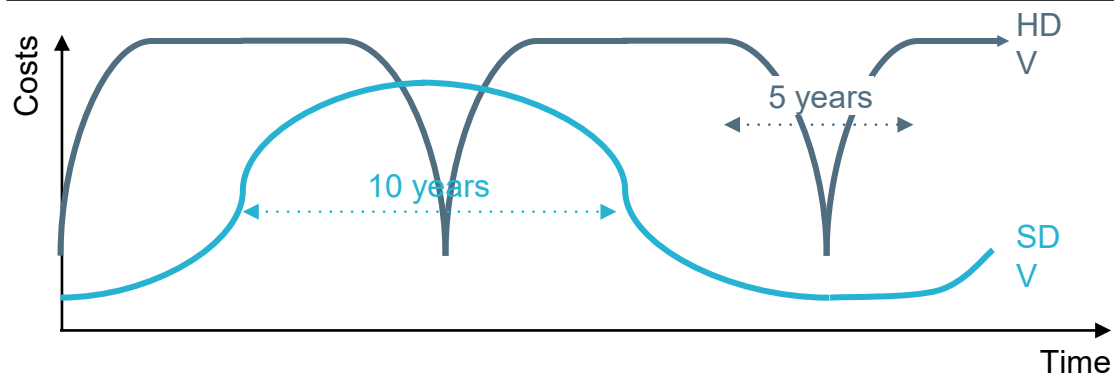
OBSERVATION

Electrification and software transform a 100+ year old business model

Product life cycle



Investment life cycle



HARDWARE DEFINED VEHICLE

Revenue

- New product sales
- Service/spare parts
- OTA

Cost

- 5–7 years Investment cycles
- Product development

Limitations

- Factory OEE
- Decarbonization

SOFTWARE DEFINED VEHICLE

Revenue

- Subscription/pay for access
- Entertainment
- Data services

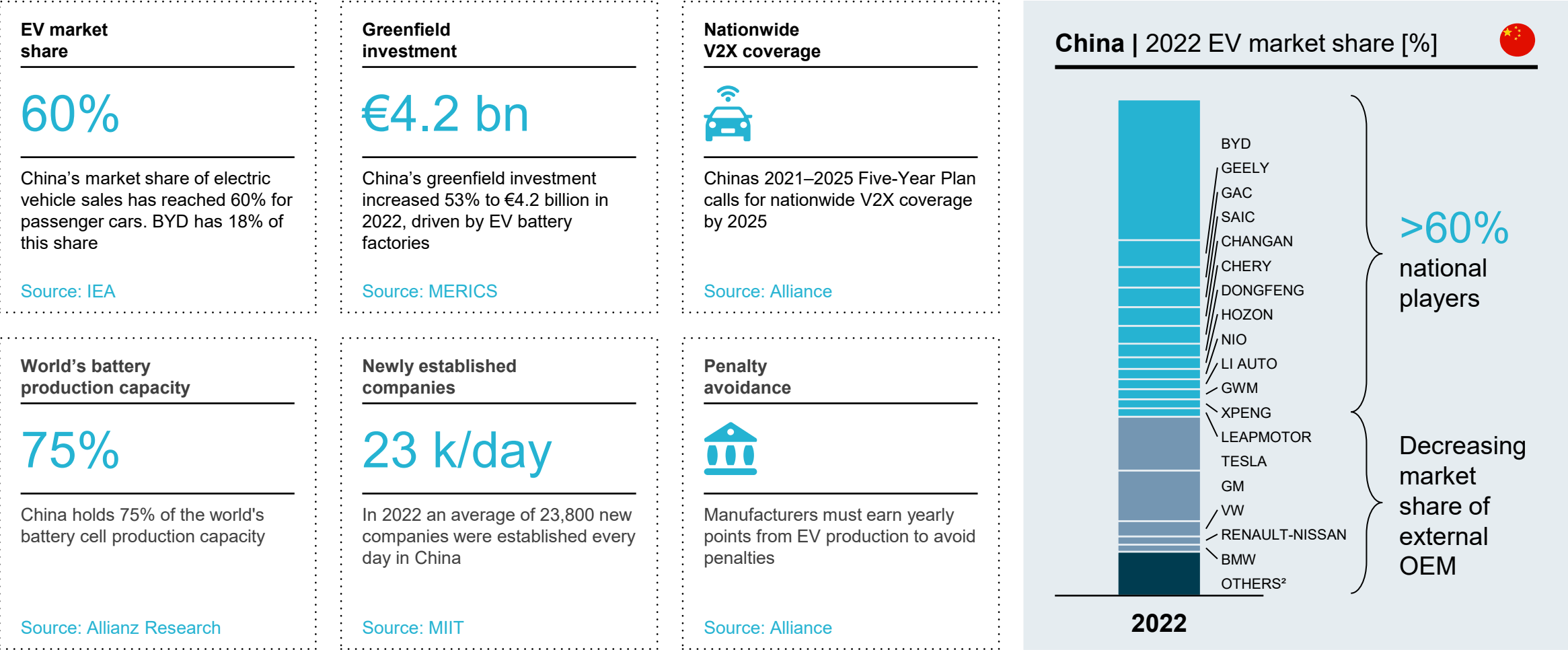
Cost

- 10–15 years Investment cycles
- Software upgrades (sprints)

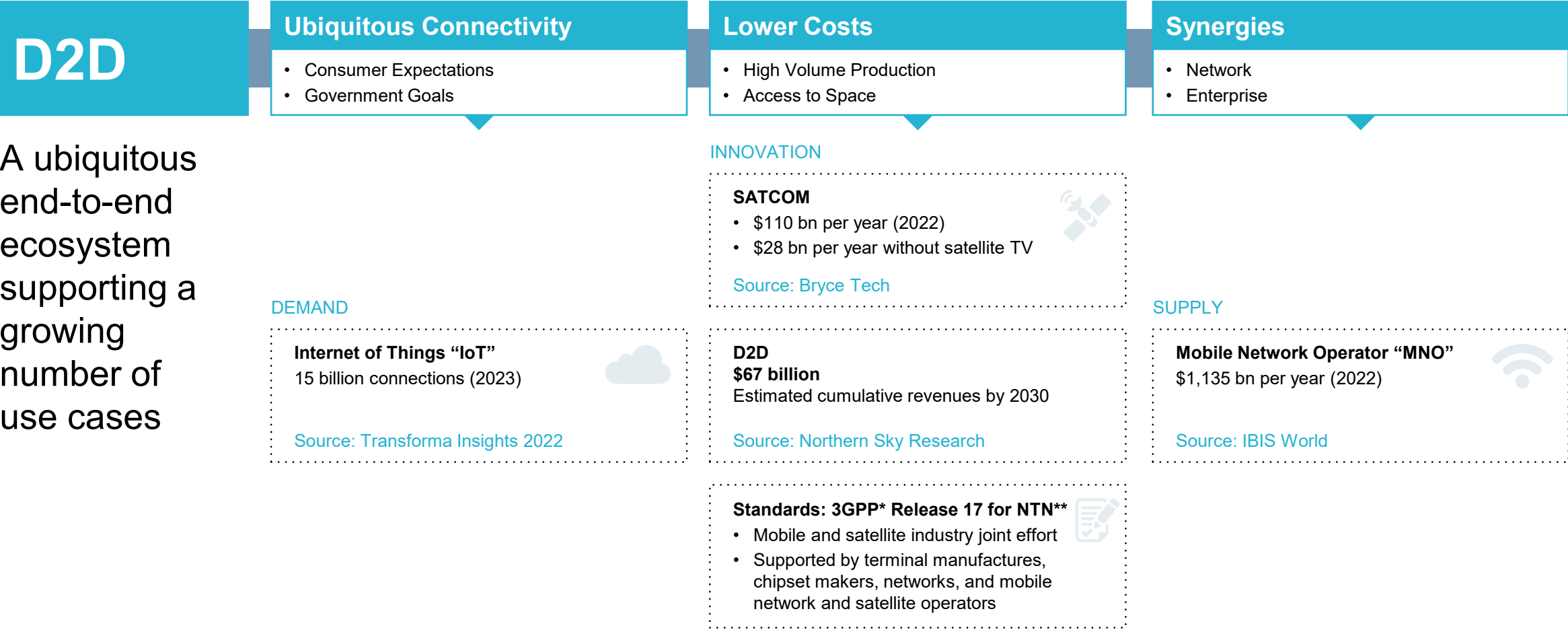
Limitations

- Satellite connectivity/data
- Electrification

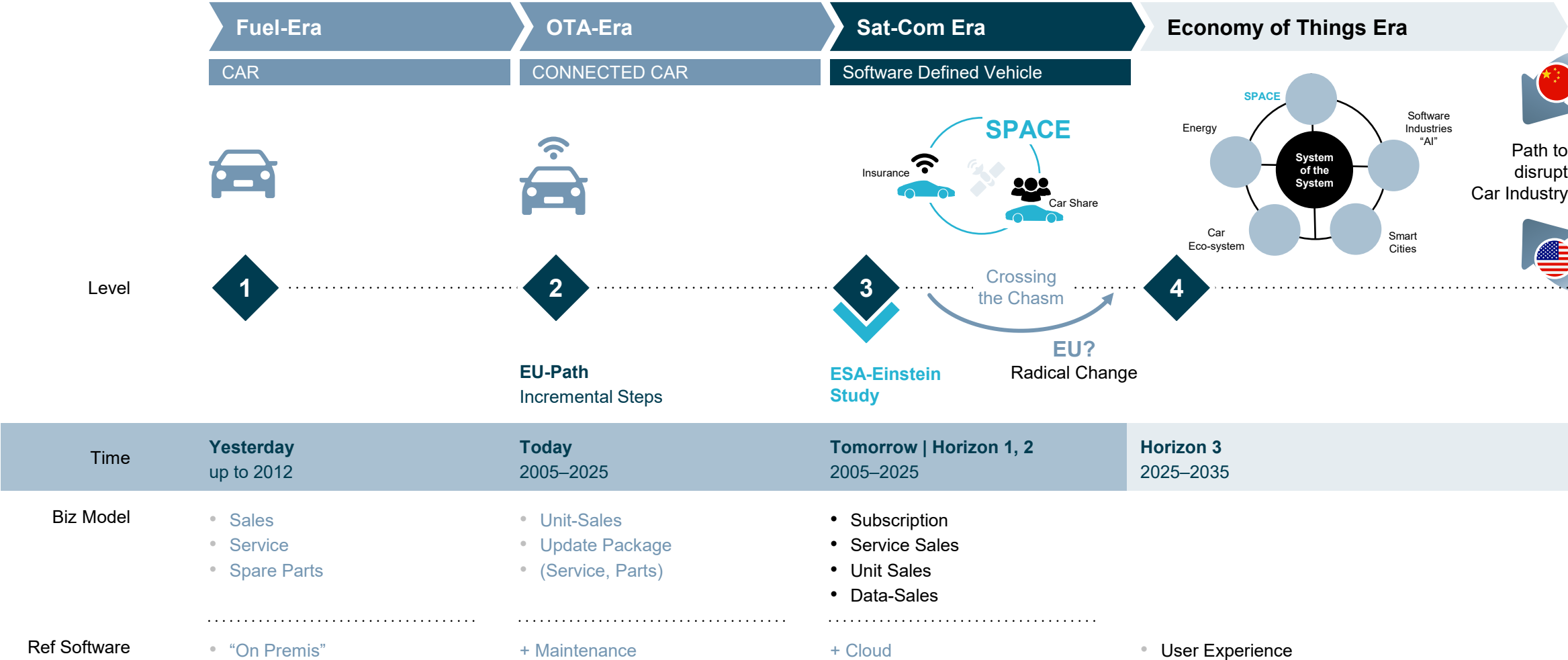
Chinese national champions, industrial policy and digitally native customers created a new Automotive paradigm ready for export



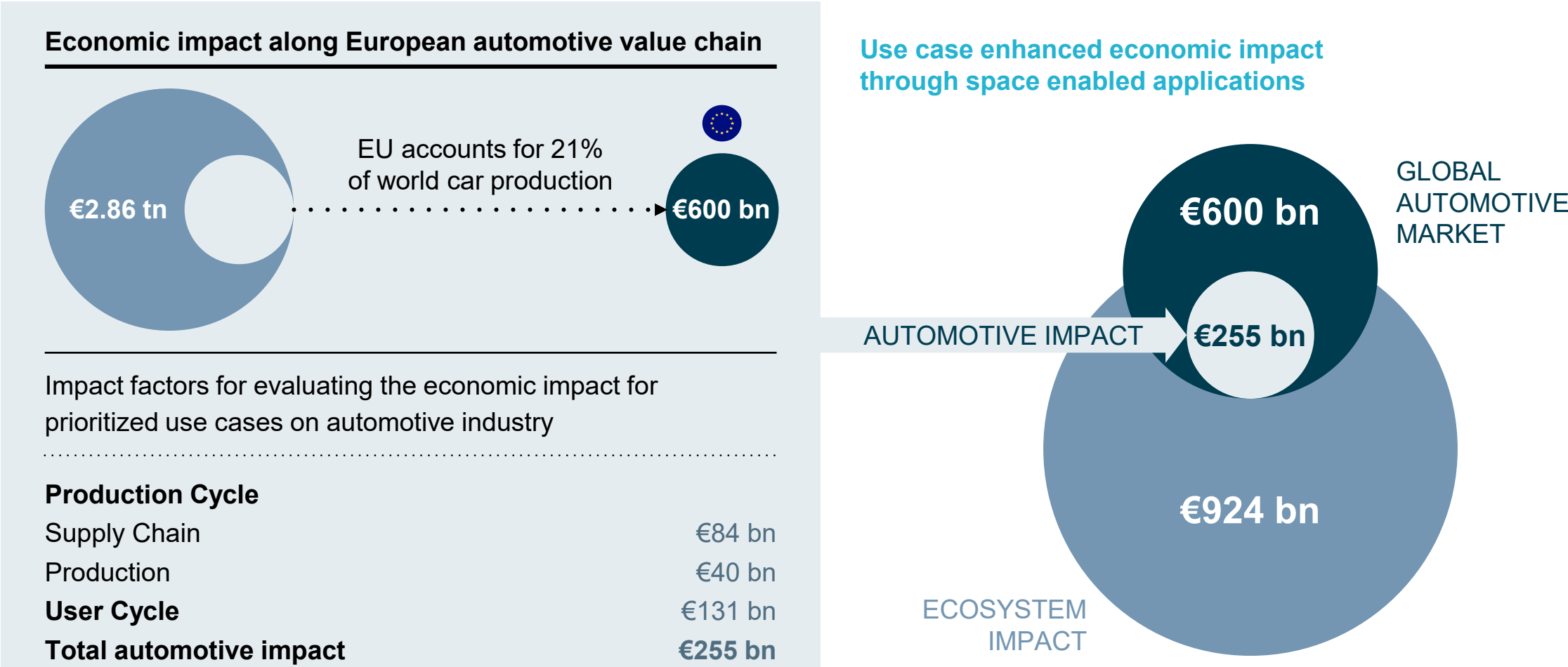
Connectivity is now a must-have feature for customers as shown by the trend of Direct-to-Device (D2D)



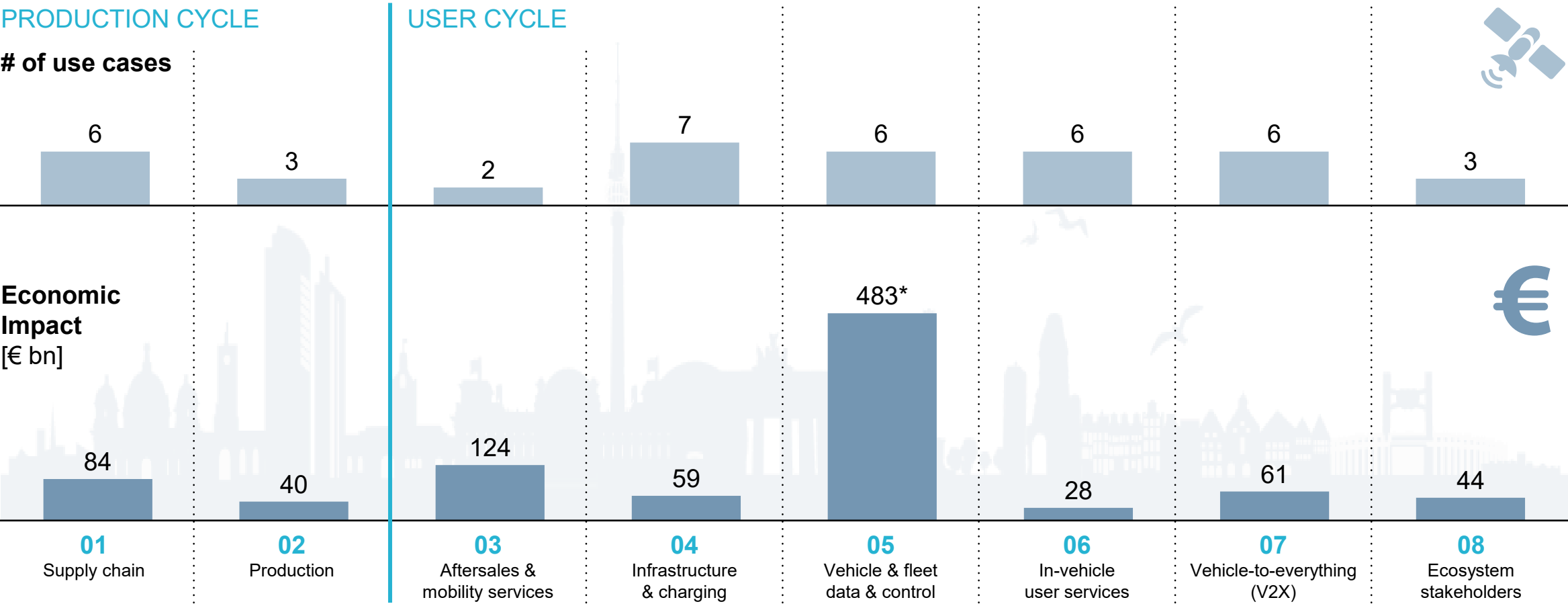
Automotive industry moves into a new era where space plays a critical role



Unlocking a €255 bn economic potential in the automotive value chain through a priority selection of space-enhanced use cases until 2030



Study identified 39 space-related use cases along mobility value chain with an estimated economic impact of ~€1 tn



*Majority of economic impact is linked to time gains by surrendering driving control to (part-) autonomous vehicles, which can be used productively

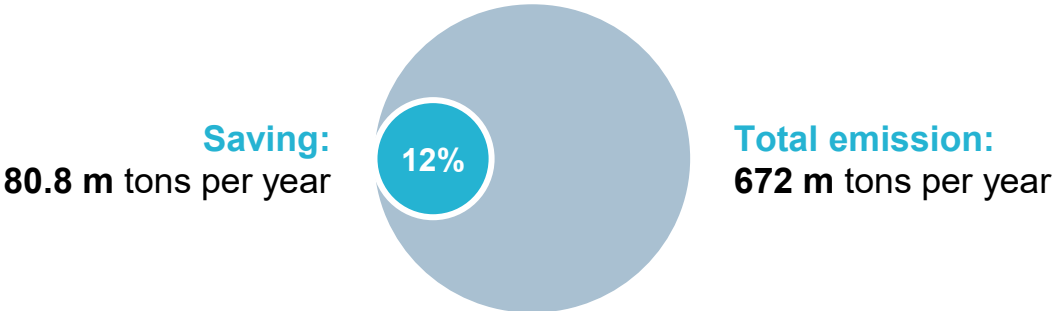
Priority use cases show a 10%-12% CO2 reduction potential of European car operations and production

User cycle

Decarbonization impact factors

- Driving efficiency (e.g., Auto pilot)
 - Less driving (Car-sharing)
 - Efficient route planning (Platooning)
- 
Use cases with **high** impact
 - Autopilot
 - Condition-based Maintenance
- 
Use cases with **low** impact:
 - Connectivity
 - Entertainment

Europe's car/driving CO₂ emission can be reduced by 12%



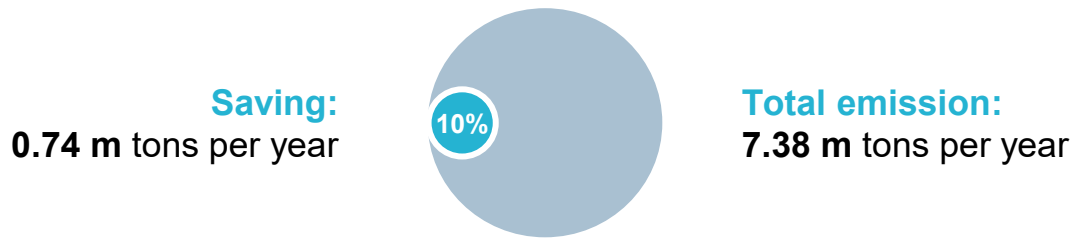
Source: European Environment Agency

Production cycle

Decarbonization impact factors

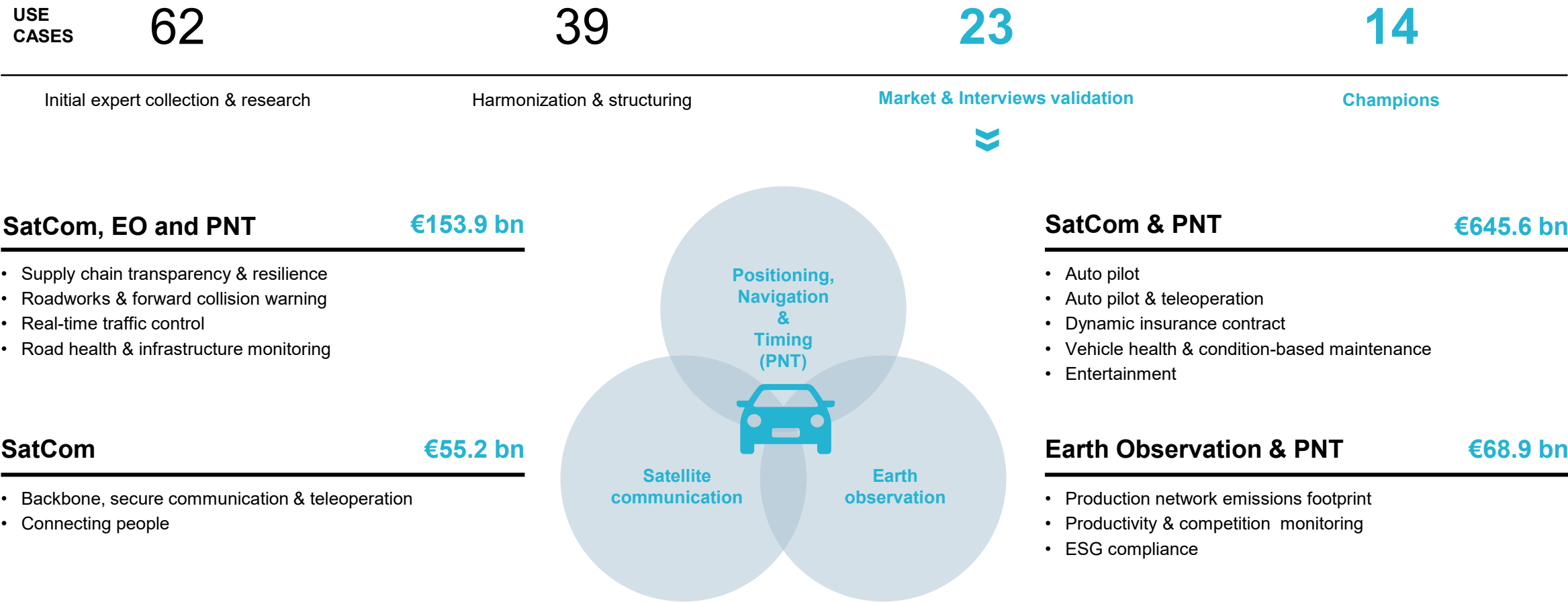
- Reduced energy consumption
 - Optimized production
- 
Use cases with **high** impact
 - ESG compliance
 - Production network emissions
- 
Use cases with **low** impact:
 - Competition monitoring

Ecosystem efficiencies reduces CO₂ emissions by 10%

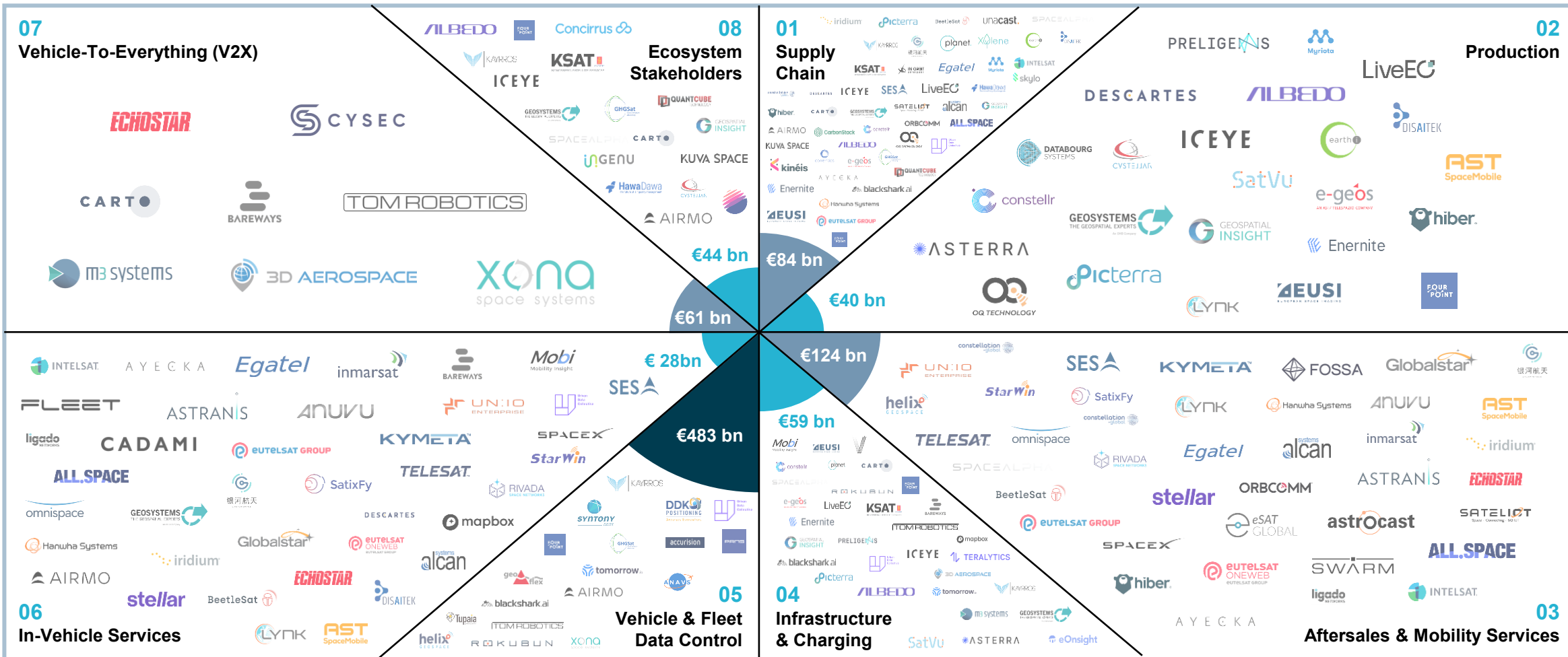


Source: ACEA.auto

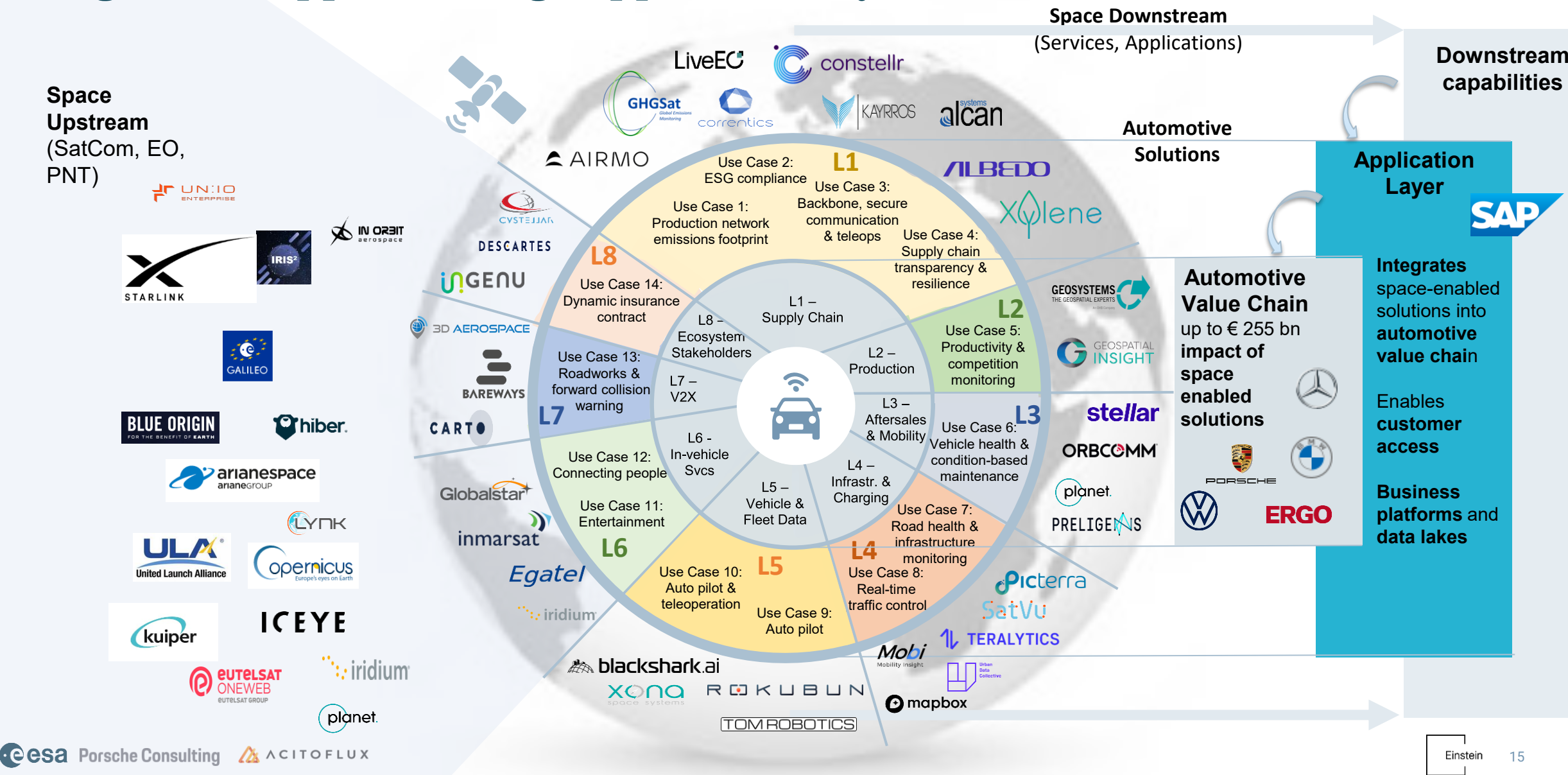
use cases rely significantly on the interplay between the 3 pillars of space infrastructure



Study mapped 137 space companies of which ~50% are European showing that a tentative service ecosystem is forming along mobility layers



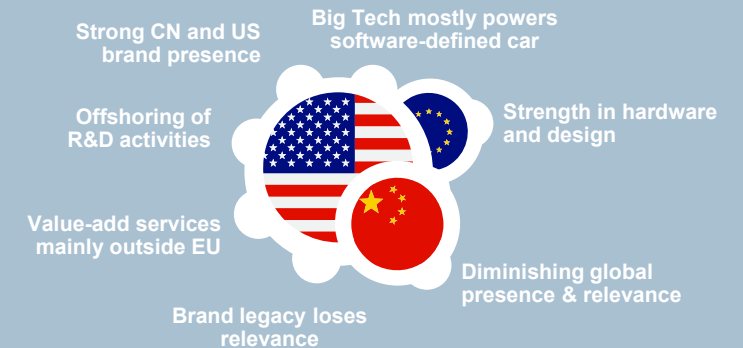
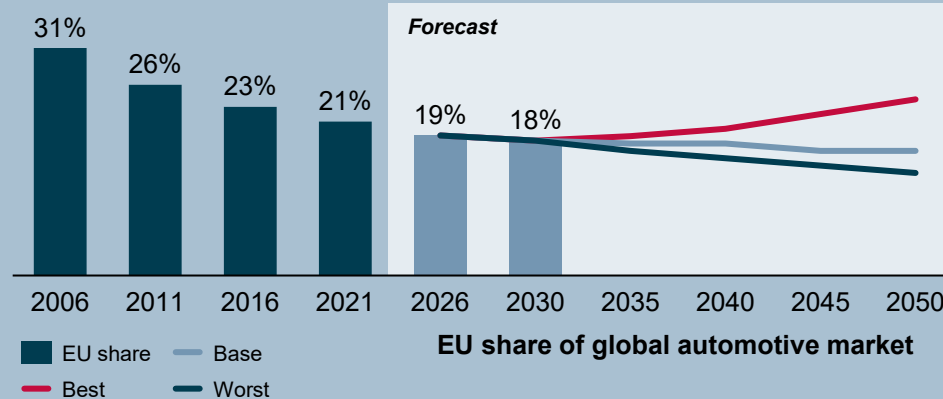
Space companies with strong growth potential in automotive, require integration support through application layer



The fragmented union – National interests and risk-awareness delay actions and endanger competitiveness of automotive and space industry

Automotive market

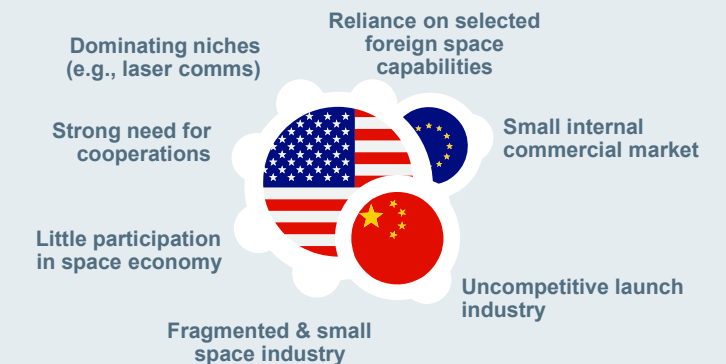
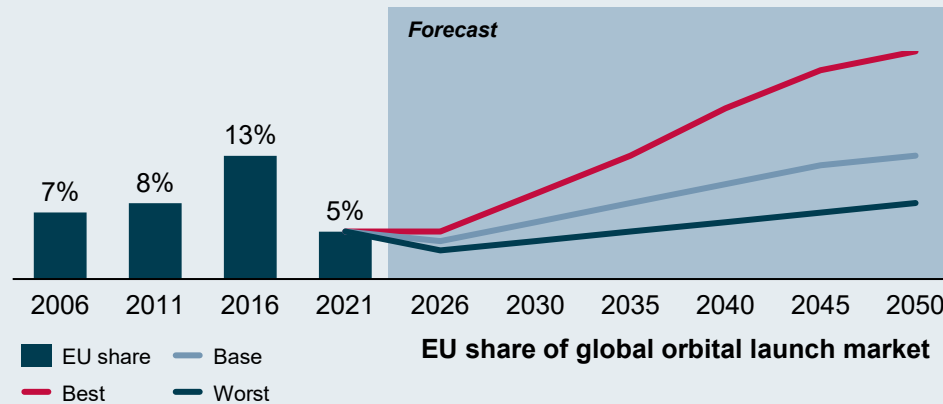
- New players on the market with strong digital capabilities gain market share and the EU efforts only guarantee a steady rate through 2050
- Supply chain ownership is fragmented, and the EU market is partially exposed to geo-political risks



Own the value chain

Space market

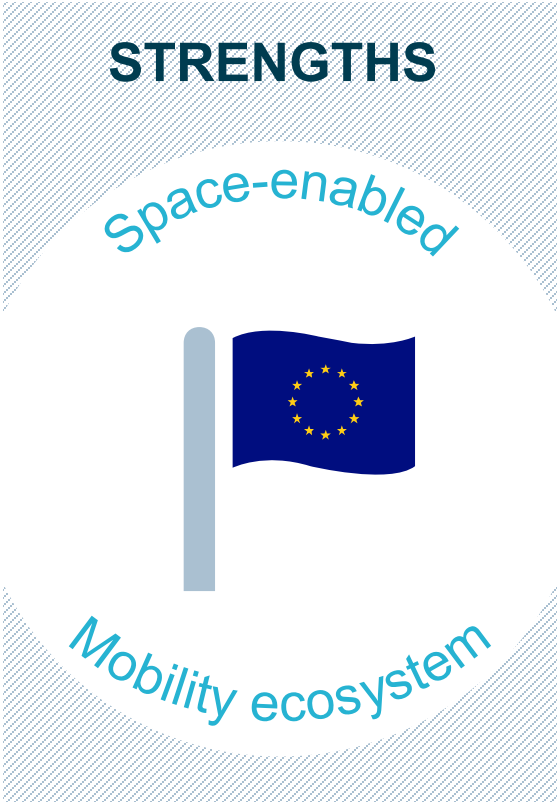
- Space industry remains niche and uncompetitive regarding price (esp. for launchers)
- Funding remains public focused and potential opportunities for the EU ecosystem have migrated to the US



European automotive and space industries have the right strengths to compete but must work together to build a European mobility ecosystem



- Technology leadership and high-quality products ✓
- Strong drive to develop own OS (e.g., Volkswagen) ✓
- First cross industry initiatives (5GAA, Einstein Study) ✓
- Strong industrial base (supplier, OEM) ✓
- Large market with strong export orientation ✓
- Diverse combination of nations with unique mobility opportunities ✓



- Vibrant start-up scene ✓
- Deep tech. know how (incl. hidden champions) ✓
- Growing venture capital industry ✓
- Solid industrial base ✓
- Strong higher education and research capabilities ✓
- Political stability and diplomatic relationships ✓

▶ Traditional automotive and space industries are both disrupted from new business models and ways of working outside of the EU. They must build a consortium that brings all capabilities to the table to build an end-to-end space-enabled mobility ecosystem.

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An ESA and Einstein Industries Project – Reference: ESA RFP/3-18222/23/NL/GLC