
EARPA Position Paper

Mobility for People and Goods

September 2026

About EARPA

Founded in 2002, EARPA is the association of automotive R&D organisations. It brings together the most prominent independent R&D providers in the European automotive sector. At present its membership numbers 60, ranging from large and small commercial organisations to national institutes and universities.

Introduction

The EARPA Foresight Group Mobility for People and Goods addresses the systemic dimensions of future mobility: how people and goods move, how business and governance models evolve, and how technological developments from other EARPA groups can be deployed at scale. This group anticipates research needs that cannot be met by industry or academia alone and therefore require coordinated support from European and national research and innovation programmes.

Europe's mobility of people and goods is central to competitiveness, resilience, and social cohesion. It enables economic activity, secures supply chains, and is embedded in the daily life of citizens. At the same time, it faces profound transformations driven by technological changes, shifting societal demands, climate challenges, and geopolitical disruptions.

The EU's broader ambition of Open Strategic Autonomy (OSA) has framed the policy debate ever since 2020, encapsulated in the principle "as open as possible, as closed as necessary." Formalised in the European Economic Security Strategy (1), OSA rests on three pillars: promoting competitiveness, protecting against strategic risks, and enabling structured international collaboration. To advance this agenda, the European Council and Commission tasked two high-level reviews: the Draghi Report on Europe's competitiveness strategy (2) and the Niinistö Report (3) on resilience and preparedness. In parallel, the Clean Industrial Deal and associated sectoral initiatives, such as the strategic dialogue on the future of the European automotive industry, the Sustainable Transport Investment Plan and emerging EU port and rail strategies, translate these principles into concrete industrial and infrastructure action.

Building on these foundations, the European Commission presented the *Competitiveness Compass*⁴ as an operational framework for EU action in the years ahead. It defines three cardinal targets: closing the innovation gap, aligning decarbonisation with competitiveness, and reducing

¹European Commission & High Representative. (2023). European Economic Security Strategy (JOIN(2023) 20 final). <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX%3A52023JC0020>

² Draghi, M. (2024, September). The future of European competitiveness – In-depth analysis and recommendations. Report prepared for the President of the European Commission. European Commission. https://commission.europa.eu/topics/eu-competitiveness/draghi-report_en

³ Niinistö, S. (2024, October). Safer together – Strengthening Europe's civilian and military preparedness and readiness. Report prepared for the President of the European Commission. European Commission. https://commission.europa.eu/document/download/5bb2881f-9e29-42f2-8b77-8739b19d047c_en

⁴ European Commission. (2025, January 29). A Competitiveness Compass for the EU (COM(2025) 30 final). Publications Office of the European Union. https://commission.europa.eu/document/download/10017eb1-4722-4333-add2-e0ed18105a34_en

dependencies while strengthening security. The Competitiveness Compass, together with the Clean Industrial Deal, forms the operational backbone for EU action in the coming decade.

For the mobility of people and goods, this combined agenda translates into a triple challenge:

1. to accelerate green and digital transitions in mobility,
2. to strengthen Europe's strategic autonomy and competitiveness in key mobility value chains,
3. and to ensure resilience and preparedness in the face of shocks and systemic risks.

These challenges apply across the full mobility system: from the design of vehicles and infrastructures to digitalisation and automation, from energy supply chains to business and market models, and from road safety to societal inclusion. Meeting them requires not only technological advances but also systemic approaches that connect innovation with regulation, investment, and user needs.

The EARPA Foresight Group on Mobility of People and Goods identifies three mutually reinforcing priorities for European R&I. The following sections develop these in more detail:

- European strategic autonomy, competitiveness and resilience in mobility;
- Human-centric and inclusive mobility;
- Business and investment models for sustainable mobility;

Europe's ability to maintain freedom of movement, secure supply chains, and sustain prosperity will increasingly depend on the adaptability of its mobility systems to both long-term transformations and disruptive shocks.

Key findings

Strategic Area	Key Needs (clustered)	Gaps/Challenges	Proposed EU R&I Response
Strategic autonomy, competitiveness & resilience	Key technologies, risk assessment, EU coordination	• Dependence on non-EU suppliers; fragmented national approaches; limited understanding of risks across transport, energy and digital systems	Develop and scale European mobility solutions that reduce dependencies and improve resilience
Human-centric & inclusive mobility	Automation, trust, inclusion, safety, UX, AI governance	• Limited trust, cultural fit and impact assessment mechanisms • Accessibility and affordability barriers for vulnerable groups • Risks in human-machine interaction, control transitions and system resilience • Insufficient transparency, user control and digital literacy	Human-in-the-loop mobility systems with adaptive interfaces and participatory governance
Business & investment models for sustainable mobility	Financing, interoperability, data, regulation, skills, infrastructure	• Pilot-to-scale financing gap; fragmented markets, standards and data ecosystems; • Weak cross-sector coordination; charging and grid constraints; • Skills shortages and regulatory fragmentation	Orchestrated mobility ecosystems integrating transport, energy and digital services

European strategic autonomy, competitiveness and resilience in mobility

In the mobility of people and goods, open strategic autonomy and competitiveness are not just abstract policy goals, but practical requirements for securing EU's future. Automotive and transport systems depend on complex supply chains, vehicle electronics, digital infrastructures, and critical raw materials. Vulnerabilities in these areas directly affect EU's ability to innovate, scale zero-emission mobility solutions, and ensure continuity of transport services. Strengthening autonomy reduces exposure to external shocks and dependencies, while competitiveness ensures that EU's automotive and mobility industries can lead in global markets. Resilience ties these objectives together by safeguarding mobility services even under disruption, from semiconductor shortages to grid instabilities. These challenges, and the opportunities they create, are at the heart of the EU's Clean Industrial Deal, the strategic dialogue on the future of the European automotive industry and the Sustainable Transport Investment Plan.

Vision 2050

By 2050, the EU aims to be both open and strategically autonomous, and to remain globally competitive. In the mobility domain, this vision translates into:

- secure and diversified supply chains for automotive-grade semiconductors, batteries, and raw materials,
- leadership in enabling technologies such as connected, cooperative and automated mobility (CCAM), digital twins of road and logistics networks, and secure vehicle-to-infrastructure data platforms,
- transport, energy, and digital infrastructures (e.g. resilient road corridors, charging and refuelling networks, and secure data backbones) designed with redundancy and preparedness against systemic shocks,
- circular and resource-efficient value chains for vehicles, components (like batteries) and infrastructure materials, reducing dependency on critical raw materials and strengthening Europe's economic security,
- the ability to respond to the rapidly changing market requirements in particular related to the digital stack,
- the ability to shape global standards for sustainable, safe, and automated mobility, cooperating internationally where possible while retaining the capacity to act independently where necessary.

Existing Technologies, Methodologies, Policies

Europe has built foundations to advance this vision:

- **Technologies:** Progress in automotive semiconductors and chips for CCAM systems, secure mobility data infrastructures, high-performance computing for AI and data-driven vehicle simulation and traffic and logistics optimisation, and automation technologies strengthen EU's technological base for autonomy, which is urgently needed taking into account the current dependencies on non-EU technologies.
- **Methodologies:** Strategic foresight, resilience stress-tests, and industrial policy scoreboards provide initial tools to assess vulnerabilities in transport and automotive supply chains and to benchmark competitiveness in mobility innovation.
- **Policies and Partnerships:** The Competitiveness Deal for Europe (European Commission, 2024a), the Net-Zero Industry Act, and the Critical Raw Materials Act anchor EU-level action. European Partnerships such as 2ZERO (zero-emission mobility) and CCAM operationalise autonomy and competitiveness in mobility research and innovation.

Gaps and Research Needs

Despite significant progress, several challenges remain:

- *Technological*: Persistent dependencies on non-EU suppliers for automotive semiconductors, advanced digital components, and raw materials essential for EV batteries and vehicle electronics. Harmonised and federated digital resources to facilitate international CCAM functionality among the EU member states.
- *Methodological*: Lack of integrated indicators linking competitiveness, autonomy, and resilience in the mobility field; foresight tools insufficiently capture cascading risks across automotive supply chains, energy grids, and transport-digital infrastructures.
- *Policy*: Fragmented implementation across Member States, with resilience planning insufficiently embedded in automotive and transport industrial strategies. Research, Innovation and Deployment funding schemes have a long term (pre-competitiveness) focus and do not sufficiently match with the competitiveness target needs (including knowledge security) and speed of technological developments in order to be of support of the competitiveness of the EU industry. EU directives for digital services supporting CCAM are missing.
- *Conceptual*: The notion of OSA still lacks operational clarity.⁵ In the automotive sector, this translates into uncertainty about how sovereignty and competitiveness objectives should be applied to vehicle supply chains, charging and refuelling infrastructures, standards for automation, and R&I investment priorities.

Research needs:

- Map and model vulnerabilities in EU transport and automotive supply chains, including battery value chains, semiconductor and software dependence, and explore risk-reducing configurations (e.g. diversification, reshoring, circularity),
- Develop methodologies and tools to assess and reduce systemic risks and cascading failures across interconnected transport, energy, and digital infrastructures, including cyber-physical threats,
- Design of frameworks to operationalise OSA in EU mobility R&I, linking high-level principles to concrete portfolio choices, investment priorities and standards.
- Develop circular and resource-efficient value chains for vehicles, components and infrastructure
- Design frameworks addressing the accountability aspects and anticipatory governance for OSA and resilience.

Innovation Policy enablers:

- Enabling impact of the competitiveness Research, Innovation and Deployment topics (i.e. requiring short term results), with matching funding instruments (i.e. fast, responsive and EU industry driven).
- Stimulate prioritisation of financial investment in EU technology and reduction of financing of non-EU competing technologies with EU investments, in particular digital infrastructure.
- Ensure that resulting scale-ups remain EU entities.

⁵ Mariotti, S. (2025). “Open strategic autonomy” as an industrial policy compass for the EU competitiveness and growth: The good, the bad, or the ugly? *Journal of Industrial and Business Economics*, 52.

Expected Impact

Advancing open strategic autonomy and competitiveness in mobility will deliver:

- Policy impact: Stronger EU-national alignment, integration of resilience into competitiveness monitoring, and enhanced global influence in automotive and mobility standard-setting.
- Technological impact: Leadership in vehicle semiconductors, secure CCAM infrastructures, and mobility data platforms, reducing dependencies and safeguarding sovereignty, less fragmentation in CCAM functionality development.
- Societal impact: Reliable and resilient mobility systems, ensuring continuity of passenger and freight transport during crises and sustaining citizen trust, consistent education and promotion of CCAM services throughout the member states.
- Economic impact: Enhanced productivity, industrial renewal, and sustainable competitiveness of EU's automotive and mobility sectors, anchored in resilient supply chains, common digital resources to reduce parallel development and investments for the same service.

Human-centric and inclusive mobility

Vision 2050

By 2050, European mobility systems will be designed with and for people, ensuring inclusivity, safety, trust, and adaptability across all modes of transport of people and goods. Technology will enhance—not replace—human decision-making, integrating stepwise automation into public transport and shared mobility services while respecting diverse cultural, social, and individual needs. A human-centric approach will balance competitiveness with inclusivity, ensuring all societal groups, including minorities and vulnerable users, benefit equally from technological advances.

Existing technologies, methodologies, policies

- *Human-Centred Design frameworks* already inform Connected, Cooperative, and Automated Mobility (CCAM) projects.
- Ongoing *large-scale pilots* explore user acceptance, safety assurance, and inclusivity in road transport.
- *Digital and AI-based tools* (e.g., adaptive interfaces, health monitoring, immersive experiences) are being trialled to improve user comfort and trust.
- Policy context includes the *EU Sustainable and Smart Mobility Strategy*, *European Accessibility Act*, and *GDPR* for data protection in personalised mobility services.

Gaps and research needs

- *Integrated Automation Roadmaps*: Define, test, and validate strategies for the gradual introduction of automation in public transport, from pilot feasibility to fully automated fleets.
- *Adaptive Trust, Cultural Alignment and Impact Evaluation*: Develop metrics and dynamic systems to measure and enhance user trust and cultural fit, embedding continuous, people-centred impact assessment to track societal and individual outcomes.
- *Inclusive and Equitable Access with Measured Outcomes*: Design economically viable solutions that guarantee mobility for vulnerable populations and bridge geographic, rural–urban, and socioeconomic divides, supported by iterative evaluation and user-engagement frameworks.

- *Safe Human–Technology Interaction:* Investigate seamless transitions between human control and autonomous operation, particularly during rare or emergency situations.
- *Resilient and Secure Design:* Ensure mobility systems remain robust against disruptions, cyber threats, and technical failures while maintaining continuous service.
- *Adaptive User Experience and Digital Literacy:* Create information interfaces and support programmes that manage cognitive load, prevent user overwhelm, and enable adoption across all age groups and levels of digital literacy.
- *Transparent AI and Data Governance:* Develop explainable AI for mobility decisions with fine-grained consent, data portability, and clear user control of personal information.
- *Human Agency and Social Well-Being:* Safeguard meaningful human control, essential mobility skills, and social connectedness in increasingly automated environments, including crisis response protocols and democratic participation.

Expected Impact

- Increased public trust and adoption of automated mobility services, as well as broader social inclusion and accessibility, reducing mobility inequalities.
- Enhanced safety through collaborative human-technology decision-making.
- Improved competitiveness of European mobility solutions by aligning innovation with human values and needs.
- Contribution to EU strategic autonomy through user-driven, resilient mobility ecosystems.
- Reduced digital divide and enhanced intergenerational equity in mobility access through targeted literacy programs and adaptive interfaces.
- Strengthened economic sustainability of mobility services across diverse geographic regions, from urban centres to rural communities.
- Improved cross-border mobility fluidity, supporting European integration and reducing barriers to free movement of people.
- Enhanced user empowerment and data sovereignty, building citizen confidence in digital mobility services while ensuring GDPR compliance.
- Preserved human capabilities and social cohesion, preventing skill atrophy and maintaining community connections in an automated mobility future.
- Increased system resilience and crisis preparedness, ensuring mobility continuity for all population groups during emergencies and disruptions.
- Strengthened democratic governance of mobility systems, maintaining public participation and accountability in increasingly complex technological infrastructures.
- Improved mental health and wellbeing outcomes through mobility systems designed to actively contribute to citizen quality of life.

Business and investment models for sustainable mobility

Europe's ability to lead in sustainable mobility is challenged by a growing innovation gap, as highlighted in the Draghi report. Despite the sector's reliance on digital infrastructure and advanced technologies, Europe attracts only 5% of global venture capital, compared to 52% in the US. This severely limits the growth of mobility start-ups and slows the adoption of clean, scalable transport solutions. At the same time, the European Parliamentary Research Service reports that nearly €83 billion is being invested in smart and sustainable transport through national recovery and resilience plans—12.8% of the total Recovery and Resilience Facility (RRF). The largest shares come from Italy, Spain, and Germany, with rail transport receiving most of the funding (€48.9 billion), followed by investments in urban mobility, alternative fuels infrastructure, zero- and low-emission vehicles, and cycling networks.

To fully unlock the business potential of sustainable mobility, Europe must:

- Significantly increase venture capital for high-growth areas such as electric and hydrogen-powered transport, digitalisation and automation, smart logistics, and integrated public transport systems.
- Simplify access to funding, especially for SMEs and start-ups working on urban mobility, last-mile delivery, and multimodal freight.
- Prioritize investment in scalable, low-emission, and digitally enabled transport solutions that improve the movement of both people and goods.

Vision 2050

By 2050, Europe aims to be a global leader in sustainable mobility, not only in environmental terms but also as a hub for innovation, investment, and industrial competitiveness, through clean, digitally enabled, and resilient mobility systems.

- *Mature clean mobility market:* Mass adoption of electric, hydrogen, and other alternative-fuel solutions, supported by interoperable charging/refuelling infrastructure and strong service ecosystems.
- *Smart and efficient logistics:* Rapid growth in last-mile delivery and a major expansion of multimodal logistics enabled by end-to-end digital planning and orchestration.
- *Innovative ecosystems:* Stronger venture capital, effective public–private partnerships, and scaling mechanisms (testbeds, procurement, cross-border rollout) that help start-ups and SMEs grow across Europe.
- *Global competitiveness:* Greater strategic autonomy in key enablers such as digital technologies, batteries, semiconductors, and green fuels, strengthening supply security and European industrial leadership.
- *Business solutions for both rural and urban areas:* Inclusive mobility models that work in cities and in lower-density regions, improving accessibility while reducing emissions and congestion.

Existing technologies, methodologies, policies

Businesses are already leveraging a wide range of technologies to support the transition to sustainable mobility, supported by growing policy frameworks at EU and national levels.

- Electric vehicles: Rapid deployment of battery-electric mobility across passenger and light commercial segments, alongside expansion of charging networks, megawatt charging and related energy and grid services.
- Hydrogen vehicles: Targeted adoption in segments where batteries are less suitable (e.g., heavy-duty transport and specific long-range use cases), enabled by emerging hydrogen supply and refuelling infrastructure.
- CCAM: Integration of connectivity, automation, and cooperative systems to improve safety, efficiency, and network capacity, with increasing emphasis on real-world pilots and scalable deployment.
- Smart mobility platforms: Platform-based integration of services (e.g., planning, ticketing, payment, and customer engagement) to enable multimodal travel and new business models such as Mobility-as-a-Service (MaaS).
- Digital freight logistics: Use of data-driven planning, track-and-trace, and orchestration solutions to increase load factors, reduce empty miles, and enable multimodal freight and low-emission last-mile operations.

Relevant policy frameworks already shaping investment and adoption include:

- European Green Deal / European Climate Law ((EU) 2021/1119): Overarching EU framework steering decarbonization and investment priorities across sectors, including transport.

- Sustainable and Smart Mobility Strategy (SSMS): EU strategy setting a pathway for greener, smarter, and more resilient transport, including targets and enabling measures.
- National Recovery and Resilience Plan (NRRPs): National investment programs under the Recovery and Resilience Facility that finance smart and sustainable transport measures at scale.
- AFIR - Alternative Fuels Infrastructure Regulation - (EU) 2023/1804
- New EU Urban Mobility Framework (COM/2021/811): policy direction for cities (SUMP focus, public transport and active mobility).

Gaps and Research Needs

Europe's sustainable mobility ambitions are constrained by several scale-up gaps that require targeted research and coordinated action:

- Innovation financing gap: What instruments are needed to bridge the pilot-to-scale gap for high-growth mobility ventures? How to support decisions on where and how much to invest (as needs differ between large metros vs. small/medium cities and peri-urban zones)?
- Interoperability: How to reduce fragmentation in access, roaming, payments, ticketing, and standards through scalable architectures and governance?
- Fragmented data ecosystem: How to enable trusted, interoperable data-sharing (including open platforms where appropriate) to support multimodal optimization and innovations?
- Regulatory complexity: How to harmonize and simplify cross-border rules, permitting, and certification while maintaining safety and public value safeguards?
- Viable business models: How to design sustainable business models for new mobility services (e.g., shared mobility, MaaS) under evolving local rules and regulations? How to balance economic viability and societal and environmental outcomes, given the lack of robust methods and consistent KPIs?
- Partnerships and governance models: What governance models best integrate public transport, shared mobility, and energy/charging providers for allocating risk and returns fairly?
- Charging infrastructure readiness: How to roll out charging/refuelling—and research on grid integration, high-power charging, pricing, and uptime?
- Grid capacity and connection delays: How to address electricity network constraints, improve pricing mechanisms to attract grid-friendly charging behaviour, long connection lead times, and local bottlenecks that slow charging deployment and fleet electrification?
- Skill shortages: How to expand reskilling and talent pipelines in batteries, hydrogen, software/AI, cybersecurity, and operations?
- Affordability and inclusion: How to ensure the transition remains accessible across regions and income groups through viable pricing models, targeted support, and service design for diverse user needs?

Expected Impact

If Europe closes the identified scale-up gaps and accelerates deployment, the expected impact is multi-dimensional:

- Reduce emissions: Faster decarbonisation of passenger and freight transport through cleaner fleets, fuels, and better system optimization.
- Expansion of green industries: Growth in European value chains for batteries, charging, hydrogen, software, and circular mobility services, supporting jobs and investment.
- Increased competitiveness: Stronger European firms and start-ups that can scale across the Single Market and compete globally in vehicles, platforms, and logistics solutions.

- Increased efficiency: Better utilization of infrastructure and assets (vehicles, fleets, networks) via digitalization, interoperability, and data-driven operations.
 - Improved accessibility and inclusivity: More affordable, reliable mobility options across urban and rural areas and for diverse user groups, reducing transport disadvantage.
 - Stronger European leadership: Clearer global positioning as the reference region for sustainable, safe, and digitally enabled mobility—combining regulation, innovation, and industrial capacity.
-

For further information, please contact our contact persons of the Foresight Group Mobility for People and Goods:

Contacts:

FG MPG Speaker

Magnus Granström

E: magnus.granstrom@chalmers.se

T: +46 73 4060424

FG MPG Secretary

Fanny Breuil Aymami

E: fanny.breuil@eurecat.org

T: +34 649552871

More information at our website: www.earpa.eu