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AI-SECRET: AI Supported and Enhanced Creativity for the Triple Transition

The Triple Transition and AI-Enhanced Creativity in the EU Transport and Mobility Sector

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Abstract

Transport and mobility form the backbone of the European single market, and the sector is now being reshaped simultaneously by digitalisation, decarbonisation and mounting social pressure, a convergence increasingly described as a triple transition. Each of these shifts is well documented in isolation, but far less is known about how they interact within a single industrial ecosystem, or about the role artificial intelligence plays across all three at once. This paper asks how AI, understood not as a consumer tool but as critical, publicly accountable infrastructure, can enhance collective creative capacity in the European transport and mobility sector. Drawing on desk research across EU policy instruments, agency reports, statistics and sectoral literature at EU level, it maps the structure and dynamics of the sector, analyses each transition dimension in turn, and examines the governance architecture that frames them. The analysis finds that the three transitions are tightly coupled but governed in institutional silos; that the sector's most acute constraint is not technological but human, with severe workforce and skills shortages compounded by poor working conditions and low attractiveness; and that AI's contribution is greatest where it is treated as shared infrastructure rather than as an added technological layer. The paper contributes a benchmarking framework of four indicators linking sectoral transition challenges to measurable learning outcomes, intended to inform curriculum design for advanced digital skills in transport and mobility, and to support education and skills policy more broadly.

Keywords

triple transition; transport and mobility; AI as critical infrastructure; mobility-as-a-service; transport poverty; skills and just transition

1. Introduction

The transport and mobility sector supports the architecture of the European economy and of the single market, enabling the free movement of goods, services and people while actively supporting cohesion and competitiveness. It is also the sector in which the European Union's digital, green and social ambitions collide most visibly. Digitalisation is making transport systems smarter, more connected and data-driven, changing how Europeans move, commute and travel, and cities and rural areas alike are expected to be reshaped as these advances are fully implemented. At the same time, transport remains one of the most polluting parts of European industry, and efforts to cut emissions and promote clean mobility generate significant industrial and political tension. Both shifts carry social consequences: services risk becoming more costly and less accessible, while the sector must absorb the cost of heavy digital and green upgrades.

These pressures do not act in isolation. They converge on the same infrastructures, the same operators and the same workforce, and users experience them together. Yet they are typically analysed and governed separately, which obscures the trade-offs between them and the points at which an intervention in one dimension undermines or reinforces another. The stakes are considerable: over ten million jobs in the sector are exposed to automation and electrification, transport poverty already affects a measurable share of the European population, and the sector's emissions trajectory is the single largest outlier in the European decarbonisation record.

This paper takes a forward-looking perspective on the sector and asks a single guiding question: how can artificial intelligence, understood as critical infrastructure rather than as a consumer technology, enhance and complement human creativity across the digital, green and social transitions in European transport and mobility, so that the outcome is fair as well as efficient? The contribution is threefold. First, the paper treats the three transitions as one coupled system within a single sector rather than as three parallel literatures. Second, it applies to transport an infrastructural and sociotechnical reading of AI that has so far been developed mainly in general AI governance debates. The paper is therefore not merely a description of the sector and its transitions, but connective tissue between the realities of the triple transition and the potential of AI to enhance and complement human creativity.

The working paper is structured as follows. Section 2 sets out the conceptual framework, covering the triple transition, AI as critical infrastructure, and a situated understanding of creativity, and positions the paper within the AI-SECRET project. Section 3 describes the desk-research method and its limitations. Section 4 maps the structure and dynamics of the EU transport and mobility sector. Section 5 analyses the digital, green and social transitions in turn. Section 6 develops the argument for AI as critical infrastructure and as a multiplier of systemic creativity in the sector. Section 7

identifies gaps and opportunities, with particular attention to workforce and skills. Section 8 maps the EU policy and governance architecture and its shortcomings. Section 9 concludes with implications for policy, skills and further research.

2. Background and conceptual framework

2.1 The triple transition: digital, green, social

The notion of a “triple transition” extends the now-standard European pairing of the green and digital transitions with a third, social dimension. The twin-transition framing is embedded in EU policy through the European Green Deal and the Digital Decade Policy Programme, which set out climate neutrality by 2050 and a target of twenty million ICT specialists by 2030, respectively. The European Pillar of Social Rights and its Action Plan supply the normative basis for the third term, committing the Union and its Member States to fair wages, safe working conditions, social protection and lifelong learning, while the Just Transition Fund provides the principal financial instrument for absorbing the distributional costs of the other two transitions.

Read together, these instruments imply a claim that is analytically significant: that the digital and green transitions are not socially neutral, and that their governance requires an explicit account of who bears their costs. The triple transition framing therefore does more than add a third policy objective. It reframes the digital and the green as inherently distributive processes, whose success is measured not only by emissions curves and deployment rates but by whether access, affordability and job quality improve or deteriorate. In sectors such as transport, where the service in question is a precondition for participation in economic and social life, this distributive reading is not optional.

2.2 AI as critical infrastructure: a sociotechnical framing

This paper does not treat AI as a single technology, but it is still less as the family of consumer-facing open-access tools that dominate public debate. AI is understood instead as critical infrastructure, grounded in particular assumptions about representation, reasoning and control, and bound up with the question of technological sovereignty in Europe. On this reading AI is not a neutral, standalone technological tool but a sociotechnical system that shapes the production of knowledge and decision-making processes across all governance levels within the EU and its Member States. AI systems embed and frame normative assumptions, aesthetic and cultural relationships, and ownership-power structures that condition access to central decision-making.

The consequences of this framing are practical rather than merely definitional. If AI is infrastructure, then the relevant questions are infrastructural ones: who owns it, who can access it, on what terms, with what accountability, and what happens when it fails.

It follows that AI must be strategically autonomous at EU level, democratically governed and publicly accountable. Only under these conditions can AI produce positive, long-term outcomes for a fair social transition and for equitable green and digital transformation in the EU. The alternative — AI adopted sector by sector as a procurement decision — leaves the normative content of these systems unexamined and their governance to actors with no public mandate.

2.3 Creativity, situated and distributed

Creativity, in the sense used throughout this paper, is not a gifted talent that someone is born with but a situated and relational capacity, powered by human interaction, capable of incorporating technological tools, and grounded in aesthetic, cultural and institutional contexts. On this definition creativity is a distributed, dynamic process, shaped by the physical, technological and learning environments to which individuals and groups are exposed, and by the opportunities that public or private institutions cultivate through democratic and equal processes.

Creativity so understood is a driver of social impact and public value, and its relationship with AI is best described as AI-empowered creativity: a process committed to open-access methods and practices. It includes the ability to interact with AI constructively and complementarily, whether individually or in groups, moderated by ethical rules. AI-enhanced creativity thus corresponds to a collective transformation and a linked capacity for cultural production, technological innovation and societal change that benefits cultural, societal and economic progress. This is deliberately systemic rather than individual conception, and it is what allows the analysis in Section 6 to speak of creativity at the level of a sector rather than of a person.

2.4 The AI-SECRET project: a brief positioning

AI-SECRET — AI-Supported and Enhanced Creativity for the Triple Transition in section 6 on — is a four-year, €7.2 million initiative co-funded under the Digital Europe Programme (DIGITAL-2024-ADVANCED-DIGITAL-07) and coordinated by the University of Valencia (Spain). It aims to foster a new generation of professionals equipped with advanced digital skills, particularly in artificial intelligence, capable of driving Europe's digital, green and social transitions. The project designs and implements an AI-enhanced educational ecosystem, including a joint online master's programme and short, practice-oriented training modules that bridge technology, creativity and ethical responsibility, and it promotes a human-centric approach to AI, positioning it as an empowering tool to augment — not replace — human creativity and innovation. Through an interdisciplinary consortium of universities, SMEs, research institutes, public bodies and cultural institutions, AI-SECRET connects education, innovation and policy in support of a sustainable European talent pipeline aligned with the Digital Decade goals of twenty million ICT specialists by 2030, with gender balance and inclusion. It contributes directly to the Digital Decade Policy Programme, the

European Green Deal, the New European Bauhaus, the AI Act and EU Data Strategy, and the Apply AI Strategy.

This working paper is one of a series of sectoral state-of-the-art analyses produced within the project, covering the verticals it addresses: transport and mobility, agri-food, cultural and creative sectors, energy and environment, housing, manufacturing, and non-touristic services. Its role within the project is twofold: to establish the evidence base on the triple transition in transport and mobility, and to derive from that base a benchmarking framework for the curriculum design of the project's joint education and training programme, which will be delivered through a micro-credential approach. The analysis is closely connected to the Vision, Mission and Values (VMV) document developed by the project coordinator, which supplies the conceptual definitions of AI and creativity set out in Sections 2.2 and 2.3 above.

3. Methodology

This paper is based primarily on desk research, with a focus on policy documents and reports that inform an understanding of transport and mobility policy at EU level. The source base comprises four types of material: (i) EU legislative and strategic instruments, including White Papers, regulations, directives and Commission strategies and packages; (ii) reports and statistics from EU institutions and agencies, principally Eurostat, the European Environment Agency and the Joint Research Centre; (iii) sectoral and social-partner sources, including the International Road Transport Union, the European Transport Workers' Federation and the European Trade Union Institute; and (iv) academic and think-tank literature, used to complement the policy material where conceptual or analytical framing is required. Sources were selected on three criteria: relevance to transport and mobility vertical, EU-level scope, and currency. The time window is concentrated on the period from the 2020 Sustainable and Smart Mobility Strategy to early 2026, with earlier foundational instruments – notably the 2011 White Paper on a Single European Transport Area and the NACE Rev. 2 classification – retained where they remain the operative reference. The level of analysis is the EU, with references to national and regional levels where these illustrate divergence or implementation gaps.

The desk research is complemented by a literature review where needed and by secondary data analysis intended to achieve a broader understanding of the subject. A substantial part of the analysis rests on the expertise of the research team in the transport and mobility sector, through evidence-based knowledge of the field; the interpretive weight this carries is acknowledged explicitly rather than presented as an emergent property of the sources.

Several limitations follow from this design and should be borne in mind when reading the findings. No primary data were collected, whether quantitative or qualitative, so the

paper cannot speak directly to the experience of workers, operators or users beyond what the secondary sources report. The policy landscape is evolving rapidly, and several instruments discussed here, particularly those concerning automotive decarbonisation and AI governance, were under active political contestation at the time of writing; positions may have shifted since. Coverage across sub-sectors is uneven, reflecting the underlying availability of EU-level evidence: road transport and the automotive value chain are documented far more thoroughly than inland waterways, postal and courier activities, or warehousing. Statistical series are also lagged, with the most recent complete structural business statistics referring to 2022. Finally, the forward-looking elements of the analysis are analytical projections from current policy and sectoral trajectories, not forecasts.

No primary data collection from individuals or minors took place, and no sensitive or personal information was used that would require the intervention of a data steward or an ethics committee or body. The authors did not process sensitive data or store personal or sensitive data in any external repository outside the services and security procedures of INESC TEC. The process and the views expressed are solely the responsibility of the author and do not represent the views of INESC TEC.

4. The EU transport and mobility sector: structure and dynamics

4.1 Defining the sector

The transport and mobility sector in the EU is the backbone of the EU economy and the EU single market, enabling the free movement of goods, services and people while actively supporting cohesion and competitiveness, all crucial components of the EU's triple transition. The Single European Transport Area (White Paper for a Roadmap to a Single European Transport Area, 2011) is the vision of EU transport policy, but since the sector faces important global challenges and disruptions, the Sustainable and Smart Mobility Strategy (with no fewer than 82 initiatives) is intended to address them and lay the foundations of a coherent EU transport system (European Commission, 2024a).

When we refer, in EU terms, to the transport sector, we mean the industries and infrastructure that provide services for moving people and goods. The transport sector centres on infrastructure, vehicles, logistics and the entire regulatory system that governs the movement of people and goods from one place to another. The transport sector can include:

- infrastructure, planning and operations (roads, rail, airports, ports and similar);
- vehicles that enable transportation and mobility (automotive, aviation, shipping and similar);
- transport operators, courier and postal firms (public transport systems, courier services, freight and similar);

- storage and logistics companies.

The mobility sector centres on the potential for movement and transportation of people and goods from one place to another in a worldwide landscape. Mobility is also defined by the ease of moving people and goods and by providing transport services. This can determine the accessibility of a place or region and indicate the level of its development, employment and economic activity. Mobility, as an enabler that connects people and places, and as a vital component of local economic development, must take an accessible and equal form. Affordability and safety of transport options must be a given if transport systems in the EU are to be described as a public and accessible good for all. The mobility sector in the EU can include:

- shared mobility options (carpooling, ride-hailing and similar);
- Mobility as a Service (MaaS), with integrated digital functionalities in advanced mobility options;
- new services and digitalised internet technologies around mobility and access (micromobility, digital platforms connecting demand and supply of mobility services, on-demand mobility and similar).

According to the NACE classification (Nomenclature statistique des activités économiques dans la Communauté européenne, NACE Rev. 2, 2008, Section H) and the latest sectoral analysis of transportation and storage, which can clearly be broken down into sub-sectors, whereas mobility as a concept cannot — the main sector divisions are:

- land transport by rail, road and pipeline (Division 49);
- sea and coastal water transport and inland water transport of freight and passengers (Division 50);
- passenger air transport, as well as freight air transport and space transport (Division 51);
- warehousing and support activities for transportation (Division 52);
- postal and courier activities (Division 53).

4.2 Trends and current dynamics

Eurostat, through the latest Structural Business Statistics (2025) on businesses in the EU transport and storage sector, identifies that enterprises in the transportation and storage sector employed 10.4 million persons in the EU, accounting for 5% of total EU employment and almost 5% of gross value added, and generated a net turnover of €1.9 trillion in 2022. According to the same source, there were 1.4 million enterprises in the EU's transportation and storage services sector that year, representing 6.4% of wealth generated in the EU business economy. The sector has seen a sharp increase in turnover in the context of post-COVID recovery, as demand for its services has risen and mass tourism and mass transport services have sparked increased demand. On

one side stand logistics and postal services; on the other, the restart of long- and short-haul journeys as a comeback from the COVID-19 pause, a restart that mainly involves the use of all transport services so that people can meet, work, enjoy and exchange in person again.

The latest analysis extracted from Eurostat statistics (ibid.) showed that the largest sub-sector was land transport and transport via pipelines, which accounted for two-fifths of the sectoral added value in 2022. The latest ranking of the sub-sectors' activities is shown in Figure 1.

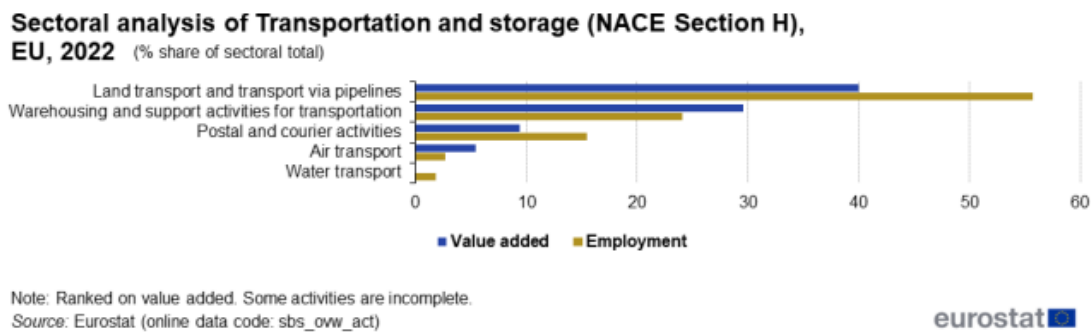


Figure 1. Sectoral analysis of transportation and storage (NACE Section H), EU, 2022. Source: Eurostat, https://ec.europa.eu/eurostat/databrowser/view/sbs_oww_act/default/table?lang=en

In the road sector, one distinction that exists between passenger and freight transport is between buses and taxis carrying persons on the one hand, and trucks carrying freight on the other (European Commission, 2009). In the rail sector, the major distinction is between domestic/regional train transport, international trains, high-speed trains, and trams, metros and subways. In sea transport, the main distinction is between international operation on the high seas and oceans, and inland waterway transport on rivers, canals and lakes (ibid.). The transportation and storage sector in the EU does not include major repair or alteration of transport equipment, which forms part of repair activities in the manufacturing sector.

In terms of geographical concentration and the importance of transportation and storage services in the EU, the EU-14 hold the majority of companies (57%) and employment (63.3%), with significant concentrations in Central Europe as well as in Poland, Germany, France, Italy and Spain. While road freight transport appears heavily fragmented and dominated by SMEs, sub-sectors such as rail, air, sea and postal services are dominated by large players and enterprises, which sometimes create monopoly dynamics and directly affect the character and operations of the sub-sector. Those sub-sectors are therefore heavily dependent on large industrial actors that determine research and innovation investment, employment levels, and the ways in which the triple transition is handled. According to Zawieska et al. (2024), innovation engagement remains high among transport companies, and according to the

Community Innovation Survey (2020), a high level of innovation activity is evident, particularly among enterprises in the automotive industry and transport equipment manufacturing.

5. The triple transition in the sector

The mobility and transport sector in the EU has been undergoing three major transitions. The sector is highly active industrially, with rapid technological advances that improve efficiency and influence every sub-sector and stage of operations. As economic activity increases, as discussed above, environmental concerns also grow. The demand for sustainable and clean mobility in Europe continuously rises, and the need to secure future mobility options remains essential. Mobility in Europe should not only be technologically advanced and environmentally friendly but also socially just, fair and inclusive for all Europeans, regardless of economic background or region. The following sub-sections analyse the three transition dimensions in turn, taking a forward-looking approach in order to identify potential points at which AI can intervene to boost creativity and innovation in the sector.

5.1 The digital transition

Digitalisation is reshaping transport and mobility in Europe, driven by digital technologies such as artificial intelligence, the Internet of Things, cloud and edge computing, and 5G networks. Some of these technologies are disruptive upon full deployment, transforming the world and its existing image. The sector's accelerated digitalisation is supported by major actions and funding instruments at EU level, including Horizon Europe, the Digital Europe Programme and the Connecting Europe Facility, as well as at Member State level through the Recovery and Resilience Facility. These EU-funded digital transition developments add a layer of advanced technology to address new challenges in an industry where technology was already integral to operations.

At this stage, advances in digital transition within the transport and mobility sector are making transport systems smarter, more connected and data-driven, while working constantly towards making transportation independent of the human factor. This development has been controversial in policy and scientific discussion so far, mainly because of concerns related to safety and to ethical and social dimensions.

The sector is going through changes related to data and connectivity. There is a move towards integrated mobility data and Mobility as a Service (MaaS) platforms that combine connectivity options for passengers. This digitalised, integrated approach builds a direct and dynamic relationship with the end user and offers transport options through on-demand service platforms. Transport and mobility platforms bring together several transport services, whether public or private, into a single on-demand service, allowing users to access, book and pay directly without intermediaries or extra

fees. The focus of this service is the technological integration of the various options a passenger might have, such as bike-sharing, trains or even aircraft. In addition to transport options, the service provides payment and ticketing features, and raises concerns about data-sharing obligations, passenger rights and fair access for operators. This all-in-one mobility application is coordinated through the MaaS Alliance, a public-private partnership dedicated to creating and advancing a common MaaS framework in Europe and beyond.

In terms of data and connectivity, the rollout of 5G-enabled C-ITS (Cooperative Intelligent Transport Systems) to support real-time traffic information and vehicle-to-vehicle communication is expected to improve urban and suburban vehicle safety through emergency braking and collision avoidance. The Connected, Cooperative and Automated Mobility partnership supports this technology, which is currently in the laboratory stage and is expected to transition from pilot projects to full deployment. This will actively enhance traffic efficiency and management as well as driver and passenger comfort. As of 2026, the initiative is being actively rolled out and relies on an uninterrupted high-speed 5G network to enable communication among cars, trucks, infrastructure, pedestrians and cloud services.

Digital transition in the transport and mobility sector also encompasses intelligent and automated transport solutions. The rise of automated driving and autonomous vehicles allows for fully or partially autonomous transport options, such as robotic taxis, connected trucks and driverless delivery systems. To support these innovations, the deployment of 5G corridors across Europe is essential, with a focus on cross-border routes and national sections. In terms of intelligent transportation, AI-driven traffic management is intended to assist with adaptive signal control, predictive flow management and incident detection, helping both public and private entities to estimate travel times, optimise signals and prevent street incidents. The goal is to reduce congestion and forecast traffic jams while enhancing passenger safety and lowering emissions through route optimisation and fewer stops. When scaled, intelligent AI transport systems are expected to deliver measurable improvements in operational efficiency, regional development and economic returns.

Closely linked to the development of intelligent and autonomous transportation is investment in digital infrastructure for corridor-oriented digitalisation and the creation of single market platforms such as EU ITS and the Connected Automated Driving Highway Corridors Network, to ensure interoperability of systems and infrastructure across Member States.

AI has numerous, if not countless, applications in the transportation and mobility sector, including optimised charging and battery management for electric vehicles, improved routing, and AI-supported decision-making during route planning for passengers and drivers. Notably, generative AI can develop predictive models and

simulations for transport scenarios and can also make autonomous driving decisions. Under the AI Act, which classifies AI systems into different risk levels, AI systems in the mobility sector are considered high-risk, critical systems, as they directly affect human safety.

5.2 The green transition

The digital transition in the sector is directly linked to the green transition and to the overarching goal of enabling sustainable, accessible transformation. The green transition in transport and mobility can also be viewed as a consequence of digitalisation and advanced automation processes. At EU level, the green transition is driven by the overarching European Green Deal strategy to cut greenhouse gas emissions by 90% by 2050, supported by its key pillars, initiatives, funding instruments and support measures. At sector level, the comprehensive strategy to meet this target and ensure a sustainable transport sector is set out in the Sustainable and Smart Mobility Strategy and its 82 initiatives. The strategy, adopted in 2020, aims to increase the adoption of zero-emission vehicles, make sustainable alternatives accessible to the public and to businesses, support the digitalisation and automation of the sector, and enhance connectivity and access. Transport modes must become sustainable, efficient and multimodal, promoting the use of alternative transport solutions.

The primary aim of the green transition in transport and mobility is to cut pollution and replace fossil-fuel-based systems with low-carbon options. Decarbonising this sector is a complex challenge involving political and technical factors, requiring new technologies, new skills and higher industrial investment. Despite the EU's environmental policies introduced over a decade ago, transport carbon emissions are still projected to account for 44% of Europe's total by 2030 (Heinrich Böll Stiftung, 2024). As shown in Figure 2, greenhouse gas emissions from transport increased drastically between 1991 and 2025, while other major sectors improved. According to the European Environment Agency (2023), the transport sector consumes one-third of all final energy in the EU and accounts for over a quarter of the EU's total greenhouse gas emissions. This regression is alarming and calls on policymakers and stakeholders to develop affordable, practical solutions to address a persistent environmental problem.

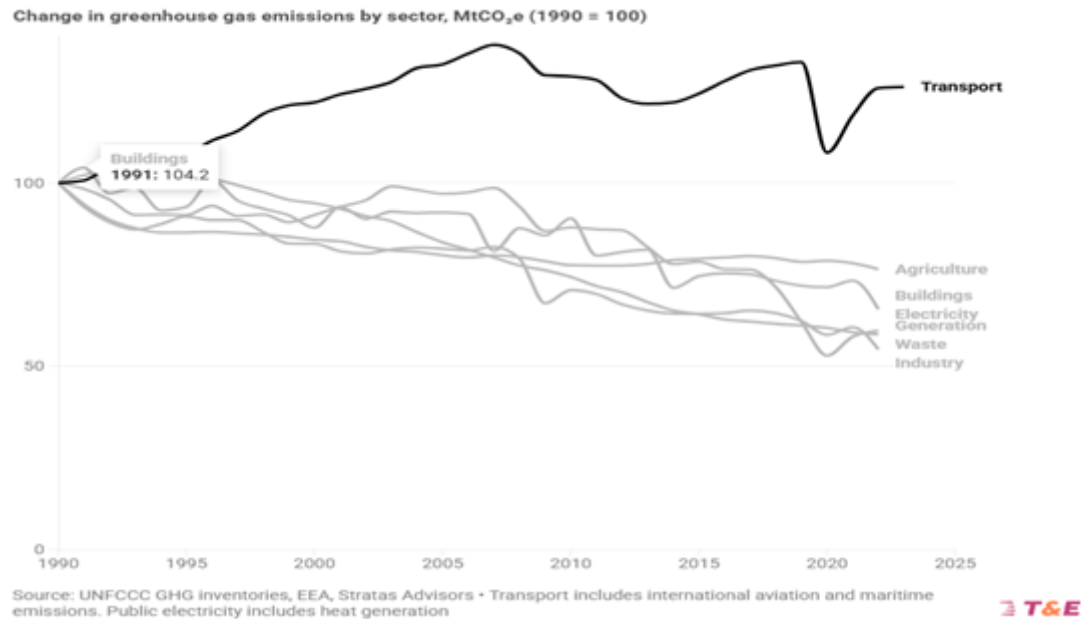


Figure 2. Change in greenhouse gas emissions by sector, 1991–2025. Source: Transport & Environment, State of European Transport (2024).

The European Green Deal no longer holds an uncontested position as the main driver of EU environmental policy in the sector, facing substantial opposition from industrial and political lobbies, especially as it raises costs for production and services. In the current climate of high inflation, intense geopolitical tension, war within and at EU borders, and a global shift towards right- and far-right politics, the pursuit of climate goals remains an ongoing challenge that has not yet been secured.

These developments significantly affect the sector's green transition plans as it undergoes many shifts to address the environmental effects of mass tourism, mass transportation and major mobility challenges in cities. While cars and vans account for the largest share of transport carbon emissions (70%), investment in electric vehicles and mass production are driving the European automotive sector towards clean mobility, but only with coordinated support from the EU. The Automotive Package introduced by the Commission (2025) sets ambitious goals for the sector, sends a strong message in favour of zero-emission vehicles, and promotes EU-made vehicles and batteries to become globally competitive. Decarbonisation in the sector must ensure industrial competitiveness while supporting a fair transition, economic growth and employment. In addition to cars and vans, light- and heavy-duty vehicles must also become nearly zero-emission by 2040. Similarly, transitioning to green fuels for the aviation and shipping sectors, which involves the effective use of hydrogen and its derived fuels, is essential.

The green transition in the transport and mobility sector is a transformative force, driven by the deployment of industrial strategies to secure green manufacturing in

Europe at local and regional levels. This will enable cross-cutting green improvements within the sector and enhance the potential of its green transition as a whole. The challenge remains to make Europe attractive to green manufacturing for the transport supply sector, which requires economic incentives and effective regulation. Competition for green manufacturing between the EU and other global players requires a European investment agenda for green funding for manufacturers, not only to support existing large European manufacturing players but also to empower local manufacturers to supply affordable and clean solutions made in the EU.

Green transportation and mobility in Europe pose significant challenges for environmental policy because of their high private costs, limited direct economic benefits, and the substantial public funding and administrative support they require. Encouraging public support involves promoting greener options for everyday travel and advocating the purchase of affordable, reliable and accessible green transport products. Transforming the industry is essential to facilitate the adoption of green solutions that enhance mobility within the sector. Most importantly, shifting mindsets is crucial, not only in choosing eco-friendly transport methods but also in selecting sustainable products to meet mobility needs. The success of these efforts depends heavily on ensuring that green options are affordable, meet user needs and are accessible to the wider public.

5.3 The social transition

The digital and green transformations in the transport and mobility sector are driving significant change, especially as they are fully implemented in the coming years. These transitions cannot happen in isolation without affecting society and causing unintended consequences. At the core of the social shift in this sector is the need to mitigate the negative societal impacts of digital and green change, ensuring society remains closely connected to these developments. This involves processes and actions that prevent society from being left behind in terms of inclusivity, economic participation, accessibility and affordability of transport and mobility options. Society needs to be able to depend on trustworthy public transport that serves the public interest and operates accordingly, providing services in remote regions, at late hours, and with sufficient frequency to place public transport at the heart of urban and suburban mobility and at the forefront of the ecological mobility transition.

One of the core issues of the social transition is the need to make all green and digital transport and mobility options accessible and affordable, both those currently available and those that will become available in the future. Technological and environmental advances in the sector are securing safety, connectivity, smart inputs and low emissions, but they also need to correspond to the needs, economic capacity and of regional disparities of the population. Between 2015 and 2025, the most researched topic in Horizon Europe projects, according to TRIMIS database, around transport and

mobility was centered around transport poverty, revealing the importance of the social factor in the sector (Grosso et al, 2026).

Even with the same transport and mobility systems and infrastructure, rural and suburban areas lack connectivity, with 5.8% of the population unable to afford regular public transport and at risk of poverty, experiencing transport poverty (European Commission, 2024b). Besides cost, which can be a major factor, there are also issues with the quality and frequency of services, the condition of existing infrastructure, and its accessibility to the public. Transport is part of essential services in the EU, alongside water, sanitation, energy, financial services and digital communications, which are necessary prerequisites for a fair and inclusive green and digital transition.

In the transport and mobility sector there is a clear paradigm of a strong social transition process, which concerns jobs. Over ten million jobs in the sector are at risk in the long run owing to automation and electrification (European Commission, 2024), while the existing workforce is ageing and fewer young newcomers choose this career path. According to the European Commission's Expert Group on Urban Mobility, there has been a 40% rise in driver shortages across Europe since 2020, leaving the continent with a gap of 105,000 drivers (ibid.). This negative outlook is counterbalanced by the public sector's potential for job creation, with 2.5 million additional jobs created, rising to 5 million if broader economic impacts are considered, according to the European Transport Workers' Federation (2024).

Worker shortages in the sector result from demographic shifts in Europe, where the population is continually ageing and the active workforce is shrinking. In transport and mobility the problem is especially severe, with significant labour shortages remaining the top issue. The human geography of the sector consists mainly of working men over 50, with women, minorities and people with disabilities under-represented. The sector is not seen as an inclusive workplace, and discriminatory practices occur frequently. The challenging working conditions often found in the sector, whether on streets, rails or in the air, create fertile ground for excluding opportunities for women, increasing psychosocial risks at work and raising work-related stress, which can cost lives.

To tackle staff shortages and facilitate a real social transition in the sector that stands with workers and users, working conditions and wages need to be fair and attractive to the new generations entering the labour market. The skills shortage in the sector is becoming an increasingly acute problem that hinders the social transition during an era of green and digital transformation. In most Member States there is a deterioration in working conditions owing to existing competition. Workers face long hours in an understaffed sector and the inherently harsh nature of the profession. This makes transport and mobility one of the sectors offering some of the worst types of work in terms of low wages and poor working conditions, including violence, shift and weekend

work, poor health and safety conditions, work-related hazards and lack of sanitary facilities (IRU, 2024).

The rise of Mobility as a Service solutions and of transport and mobility platforms also generates various social challenges related to working conditions, inclusion, rights and governance. Platform work can in many cases be a precarious form of employment, with algorithmic management risks and opaque working conditions. Many drivers are classified as bogus self-employed, weakening their employment conditions and job-related rights. Trade unions in Europe (ETUI, 2021) have argued that this model of work undermines long-term job quality and social rights in land transport and weakens the effectiveness of social protection systems through constant underfunding and minimised contributions.

6. AI as enabler of creativity in the triple transition

6.1 AI as critical technological infrastructure

Section 2.2 set out the conceptual claim that AI in this paper is treated as critical infrastructure rather than as a tool. This section applies that claim to the transport and mobility sector, where the digital, green and social transformations take the form of groundbreaking change that requires an adapted governance and institutional approach embedding AI as a transversal enabler. AI, as a sovereign technological infrastructure, catalyses the triple transformation of the sector. It serves not only as a foundational digital infrastructure but also empowers the triple transition in an interconnected and powerful way.

Supporting smart and sustainable mobility in Europe, AI can serve as a vital infrastructure within the fundamental ‘stack’ for sovereign, self-reliant technological governance. All developments related to a fully automated, digital mobility system in Europe — 5G corridors, autonomous driving, interconnected and interoperable transport systems — depend on AI as a core layer, alongside data spaces and cloud-to-edge systems. As shared infrastructure in the digital transformation, AI enables the scalable deployment of real-time analytics and decision-making tools, automated mobility and smart specialisation applications. AI stands in the digital transformation of the sector not as an added layer but as a key tool and strategic enabler. Within Europe’s Digital Decade programme, the role of AI in critical transport and mobility infrastructure is a pan-European challenge and a collective economic and social effort to acquire and maintain the critical mass needed to realise digital transformation plans that enhance urban mobility and international and intra-national transport capabilities across Europe.

As developed earlier, the green transition in the sector is the most prominent part of its triple transformation and a pan-European bet. As the sector emerges as the most

polluting of all industrial sectors in Europe, with mass transport and tourism on the rise, deep dependence on fossil fuels and geopolitical instability, the green transition presents a matrix of political, economic and societal equations that need realistic solutions now. AI can facilitate this demanding process by providing shared infrastructure that optimises energy-mobility integration, enhances energy-efficient power distribution, supports real-time coordination of electric vehicle charging, and supports renewable grid balancing. AI enables predictive maintenance and digital twins for resilient transport networks that can operate under extreme or critical conditions, such as extreme temperatures and climate stress, extending infrastructure life while cutting emissions.

AI as infrastructure supports and integrates directly into the sector's green transition towards climate neutrality. It is not only a cross-cutting enabler but also an essential requirement for reaching climate neutrality and promoting clean transport and mobility in the EU. It is no exaggeration to say that if Europe fails to deliver its green transition in the transport and mobility sector coherently and effectively, the European Green Deal's targets could become mere declarations, and the negative externalities of increased pollution could threaten the EU's political stability and common future.

In the transport and mobility sector, the social transition is omnipresent, adding a necessary layer of social transformation amid profound digital and green change. As analysed above, the social transition in the sector is interlinked with affordable and accessible transport systems, inclusive mobility options, and fair working conditions and remuneration for workers. In other words, societal benefits should be placed at the heart of the triple transition, and technological and sustainable development should not occur to the detriment of inclusive societal progress. AI can be a critical infrastructure that turns the benefits of digital and green transformation into tangible positive social outcomes for societies and local communities, especially for under-represented groups.

AI can help authorities design inclusive and zero-emission systems that are ready to address urban challenges, serve as a buffer against the rising cost of living, and support social cohesion. Investment in AI for all public transport systems in the EU, and not only through industrial investment in the private sector, can make public transport a reliable choice for passengers regardless of socio-economic background, gender or disability. AI can guide solutions to make systems more affordable, information more accessible, and fleets more inclusive for passengers facing different vulnerabilities.

AI has the full potential to optimise systems, simplify work routines and improve safety procedures, also making careers in the sector more attractive. The transport and mobility industry should become an appealing career choice, with AI as a key driver of that change. Platform mobility in the industry is being transformed by AI as systems

become more predictive, but managing AI compliance is crucial for a fair social transition.

6.2 Creativity and AI in the sector

A question that recurs as the content of the AI-SECRET master's programme is developed is what AI can do to enhance creativity and train creative professionals for the benefit of the transport and mobility sector. Creativity in the sense of collective creative capacity can be developed and structured through AI and its potential to offer new patterns of development, using AI solutions to accelerate the triple transition.

AI opens a new frontier for the transport and mobility sector and introduces a new theoretical framework for how mobility is conceived, operated and delivered to passengers. As a critical infrastructure for the sector's transitions, AI can offer a central organisational perspective on transnational efforts across the triple transition and new pan-European ways to develop through cultural and aesthetic channels. Creative development in the triple transition can be facilitated through AI, which can act as a multiplier of systemic potential.

AI can expand the horizon of mobility innovation and allow planners and system designers to explore new forms of traffic flow, service patterns, logistics solutions and user interactions. AI models can help prototype multimodal networks and enhance interoperable connections. Dynamic route variations, new conceptual urban layouts and speculative scenarios can change the landscape of mobility through the use of advanced AI options.

The rediscovery and optimisation of transport infrastructure can be an opportunity for the sector, supported by AI. AI predictive maintenance of digital twins of corridors and networks, and large-scale traffic analysis, can allow operators, authorities and relevant stakeholders to recover underused capacity and lost lines, contextualise overlooked routes and connect previously fragmented systems. Cities can be reinvented and find new, unexplored connections, and their residents can benefit from more immersive planning environments and infrastructures that are more resilient and adaptive.

AI can create an important opportunity in the co-design of hybrid mobility formats that integrate real-time flows and information to respond to pedestrian flows, traffic conditions, and social events or demonstrations in large cities and metropolitan areas. These hybrid ecosystems link mobility with human choices and advance responsive mobility options in European cities, fostering interdisciplinarity between mobility, transport AI and urban planning, with clear connections to the architectural and construction development of cities.

During the social transition in the transport and mobility sector, AI can create new opportunities for designers and technical managers to develop more adaptive and socially inclusive transport and mobility systems, while increasing participation from

underserved groups. AI can act as a catalyst for tailoring interventions to promote social cohesion and safety during commuting, travel and movement within the city. Transport can serve as a foundation for the responsible use of AI, helping to establish a European model that prioritises rights in the context of fair and accessible transport and mobility for everyone. In this context, AI can boost the sector's ability to incorporate public values and resilient strategies to combat transport poverty and the exclusion of remote regions. AI is not just a technological development that offers digital services with green benefits, but also a trusted option for fair development, providing designers with measurable insights, dynamic quantitative analytical tools, and smart, adaptive solutions to reinvent transport and mobility options for society's benefit.

7. Gaps and opportunities

The transport and mobility sector in the EU faces significant challenges that can be turned into opportunities through AI. The sector's most urgent problem is workforce shortages, as explained in the analysis of the social transition, mainly owing to specific working conditions and the low career prospects and wages offered in most parts of the sector. In road transport in particular, according to IRU (2024), 500,000 bus, coach and truck driver positions are unfilled in the EU, and this number is expected to grow if no action is taken. There is also an age gap that raises further concern, with only 3% of professional drivers under 25 and 41% over 55. This threatens the EU single market and intra-EU trade, creating serious economic bottlenecks. To address it, the EU has been discussing over the past two years whether to lower the minimum age for truck driving to 17 so that young drivers can start with accompanied driving (European Transport Workers' Federation, 2024). The current recommended minimum age in the EU is 21. This is a contested topic, as the scientific community and trade unions disagree on whether younger ages are appropriate for accompanied driving, since driving is a demanding profession requiring skills and experience that are difficult to acquire at a young age.

At the same time, increased skill shortages in the sector cannot be filled immediately, even with typical active labour market policies, targeted sectoral programmes of public aid, or third-country-national programmes discussed at EU level. The new jobs the sector is generating require distinct digital and green skills that correspond to its digital and green transition, with deep expertise and smart specialisation in the new technologies of each solution.

The green transition in particular risks causing job losses in current positions without adequate reskilling and upskilling to adapt to new sectoral realities. According to the European Commission (2024), around 40% of employers cannot find skilled workers to fill their vacancies, while the green and digital transitions are reshaping how Europeans

commute, consume and live in cities. These changes are reflected in the way we work, shop and move after COVID-19, when teleworking patterns became permanent, e-shopping expanded rapidly, and short- and long-haul travel recovered. All these shifts have led to a sharp increase in logistics and courier services, and the tourism sector has flourished. The supply chain sector was disrupted by these shifts and could not fully recover immediately. People rarely returned to low-paid, fragmented jobs, resulting in a serious talent-attraction problem in the sector.

AI skills training programmes can enhance opportunities in the sector, but only when they are developed with a long-term perspective from employers and coupled with full-time, decent employment from the start. Reskilling and upskilling opportunities for existing workers to meet the needs of the triple transition should be fair and accessible to everyone; at present, not all workers in the sector appear to have adequate access to them. For newcomers, education, learning and training can be guaranteed by the education system, by vocational training providers offering on-the-job training, and by employers who can allocate resources to targeted programmes based on their specific needs.

AI can effectively enhance human creativity by expanding the capabilities of individuals, employees and teams in the transport and mobility sector. It can promote resilience within the industry, resulting in efficiency improvements and supporting long-term recovery and sustainability. AI also facilitates reskilling and adaptation through AI-powered platforms that provide personalised, tailored training, thereby aiding talent retention. It can address the skills mismatch by providing personalised reskilling solutions suited to individual needs and can maximise the potential of reskilling in the sector by creating inclusive conditions that meet the needs of under-represented groups in training activities. This can be achieved through impact simulation and adaptive tools that reconfigure roles and their requirements during digital and green transitions. AI can itself forecast skill needs in the sector via specialised analytical tools that leverage predictive optimisation to anticipate market demand and turn shortages into innovation edges.

AI should be viewed in the transport and mobility sector not as an abstract, neutral force but as a holistic, transformative enabler that can provide competitive advantages through targeted positive interventions in the three transitions. AI can give workers and teams an enhanced creative boost when addressing workforce shortages by pairing humans with AI-assisted tasks. It should not be seen as a means to replace the human mind, but rather as an additional technological tool when human capacity is reaching its limit. AI is also a planner, a designer and an optimisation force that reconfigures transport options and regional capacities and contributes to suburban, rural and intra-national connectivity. The focus of technological development in the transport and mobility sector is making AI a central tool to reshape industrial capacity, redistribute human resources, attract new talent and reskill existing workers. This transformation is

a necessary step towards clean, digital and equitable progress in a sector that is a driving force for the rest of Europe's industrial sectors and the foundation of its industrial ecosystem.

8. EU policy and governance context

8.1 The EU policy architecture for transport and mobility

The EU's governance of the transport and mobility sector is built upon a multilayered policy architecture that spans foundational single market principles, strategic transition agendas and sector-specific regulatory instruments. At its core, the Single European Transport Area, established through the 2011 White Paper, remains the foundational vision for EU transport policy. It envisages a common regulatory space enabling the free movement of goods, services and people through open markets, interoperable systems and a harmonised legal framework. While this framework has delivered significant progress in liberalising transport markets and standardising operations, it was designed before the urgency of the green and digital transitions became paramount on the EU's policy agenda.

The current operational architecture is shaped by the Sustainable and Smart Mobility Strategy (2020), which sets out 82 initiatives to make EU transport smarter, greener and more connected by 2030 and 2050. This strategy is the sector-specific translation of the European Green Deal and the Digital Decade Policy Programme, offering a coherent policy roadmap across all transport modes. It introduces flagship milestones such as 30 million zero-emission vehicles on the roads by 2030, doubling high-speed rail traffic by 2030, and making multimodal transport the default option for medium-distance travel. Underpinning the physical infrastructure of these ambitions is the revised Trans-European Transport Network (TEN-T) Regulation (2024), which sets binding deadlines for the completion of core and comprehensive transport corridors by 2030 and 2050 respectively, mandates the deployment of multimodal freight terminals, and introduces digital and sustainable requirements for new infrastructure investments. The TEN-T framework also establishes "European Transport Corridors" as the backbone of a connected, resilient and sustainable European transport system.

8.2 Green policy instruments

The green transition in transport is driven by a dense ecosystem of EU legislative instruments, each targeting a specific mode or dimension of the decarbonisation challenge. The Fit for 55 package constitutes the legislative backbone of transport decarbonisation, including mandatory CO₂ emission standards for cars and vans (with a de facto phase-out of new internal combustion engine vehicles by 2035), revised standards for heavy-duty vehicles targeting near-zero emissions by 2040, and the extension of the EU Emissions Trading System (ETS) to cover maritime shipping and

aviation. These measures collectively target a 90% reduction in transport greenhouse gas emissions by 2050 compared with 1990 levels.

For the aviation and maritime sectors, the ReFuelEU Aviation and FuelEU Maritime regulations mandate increasing blending of sustainable aviation fuels and green maritime fuels respectively, pushing hydrogen and its derivatives as credible long-term alternatives to fossil fuels. These sector-specific instruments complement the broader carbon pricing mechanisms and represent the EU's commitment to decarbonise all transport modes, not only road transport. The Alternative Fuels Infrastructure Regulation (AFIR) mandates the deployment of electric vehicle charging points and hydrogen refuelling stations at regular intervals along TEN-T core network corridors, addressing one of the key barriers to the adoption of zero-emission vehicles: infrastructure availability. Together with the Automotive Package (2025), the industrial action plan for the European automotive sector, which supports EU-manufactured zero-emission vehicles and batteries to be globally competitive, these instruments constitute a comprehensive and coordinated green industrial policy for the transport and mobility sector. It should be noted, however, that these ambitions are being tested by rising political pressure: right-wing electoral shifts, cost-of-living pressures and intense industry lobbying are creating significant tension around the pace and ambition of the green transition in transport.

8.3 Digital governance and data policy

The digital governance of the transport sector is being redefined by a series of interlinked EU legislative and policy instruments. The revision of the Intelligent Transport Systems (ITS) Directive extends its scope to mandate real-time traffic data sharing, multimodal travel information services, and digital infrastructure for connected and automated mobility. These provisions aim to ensure that the sector's digital transformation is interoperable across Member States and transport modes, creating a coherent digital backbone for European mobility. Closely connected to this is the EU Mobility Data Space initiative, which seeks to make transport data interoperable and accessible across operators, public authorities and transport modes, enabling a new generation of data-driven mobility services. This initiative is embedded within the broader EU data governance ecosystem, including the Data Act and the European Strategy for Data, and positions transport as one of the priority data spaces for European digital sovereignty.

The EU AI Act has significant implications for the transport sector, as autonomous vehicles, AI-assisted traffic management systems and AI-based infrastructure monitoring are classified as high-risk AI systems under its framework. This classification imposes strict requirements on transparency, human oversight, data governance and conformity assessment before deployment. While these requirements strengthen safety and public trust, they also impose significant

compliance burdens on transport operators and technology developers, particularly SMEs. The deployment of 5G corridors across Europe is also a critical governance challenge: ensuring continuous, interoperable 5G coverage along key transport corridors is a prerequisite for connected and automated driving, yet progress remains uneven across Member States. The Connected, Cooperative and Automated Mobility (CCAM) Partnership, co-funded through Horizon Europe, is working to accelerate the transition from pilot projects to full-scale deployment of these technologies, but sector-wide governance coherence remains a work in progress.

8.4 Social and labour governance

The social dimension of EU transport governance is increasingly recognised as inseparable from the green and digital transitions. The European Pillar of Social Rights and its Action Plan provide the overarching normative framework, committing EU institutions and Member States to fair wages, safe working conditions, social protection and lifelong learning. In the transport sector these principles are particularly relevant given the documented challenges of workforce shortages, poor working conditions and the under-representation of women and minorities analysed in Section 5.3. The Platform Work Directive (adopted 2024) is a landmark instrument with direct relevance to the transport sector, particularly for ride-hailing, delivery and courier services. It establishes a legal presumption of employment for platform workers, introduces binding rules on algorithmic management and transparency, and strengthens the rights of workers currently classified as bogus self-employed. The directive responds directly to one of the sector's most pressing social challenges: the erosion of employment rights and social protection for a growing segment of its workforce.

Skills governance is another critical pillar. The European Skills Agenda and the Pact for Skills identify transport as one of the key industrial ecosystems requiring targeted skills partnerships, bringing together employers, training providers and public authorities to address acute skills mismatches. These instruments provide the governance framework within which education and training programmes such as AI-SECRET can be positioned and evaluated. The Just Transition Fund and the broader Cohesion Policy provide financial instruments to support reskilling and regional development in the areas most affected by the green and digital transitions, including carbon-intensive transport regions and communities dependent on traditional automotive manufacturing.

8.5 Governance gaps and challenges

Despite the ambition of the multiple instruments in the EU's transport governance framework, significant gaps remain that limit its coherence and effectiveness. First, there is marked fragmentation in the implementation of EU directives across Member States: EV charging infrastructure rollout, ITS adoption rates and the integration of

digital mobility services remain highly uneven, creating a two-speed European transport system. Second, green and digital policy streams largely operate in institutional silos, with limited coordination mechanisms between, for example, the ETS and the AI Act in their joint application to autonomous transport systems. Third, the social and labour dimensions of transport governance remain under-represented in innovation governance structures: most EU funding instruments prioritise technological development over workforce transition and labour rights, leaving a structural gap between industrial transformation and social inclusion. Fourth, the AI governance framework for transport is still nascent: while the AI Act establishes risk categories, it does not yet provide sector-specific operational guidance for transport deployments, leaving operators and regulators without clear implementation pathways. These governance gaps represent not only policy challenges but also concrete learning opportunities for the next generation of transport professionals, who will be expected to navigate and help resolve them in their careers.

9 . Conclusions and policy implications

This paper set out to ask how artificial intelligence, understood as critical infrastructure rather than as a consumer technology, can enhance and complement human creativity across the digital, green and social transitions in European transport and mobility. Four findings emerge from the analysis.

First, the three transitions are tightly coupled in practice but governed in institutional silos. They converge on the same corridors, operators and workforce, yet EU instruments address them through largely separate streams, with limited coordination between, for instance, emissions trading and AI regulation in their joint application to autonomous transport. Second, the sector's binding constraint is human rather than technological: severe and worsening workforce shortages, an ageing and narrow demographic base, poor working conditions and low attractiveness limit the pace at which any technological transition can proceed. Third, the social dimension remains structurally under-resourced in innovation governance, with most funding instruments prioritising technological development over workforce transition and labour rights. Fourth, AI's contribution is greatest where it is treated as shared, publicly accountable infrastructure, a core layer alongside data spaces and cloud-to-edge systems, rather than as an added technological layer procured application by application.

The implications for EU policy follow from the first and third findings. Coherence mechanisms between green, digital and social instruments matter more than additional ambition in any one of them, and sector-specific operational guidance for AI deployment in transport remains a visible gap in the AI Act's implementation. Investment in AI as public infrastructure for public transport, not only as industrial

investment in the private sector, is what converts digital and green gains into social ones, particularly for under-represented groups and underserved territories. For training and skills policy, the implication is that programmes should be designed against integrated, cross-dimensional competences rather than against single-transition skill lists; the framework in Section 9 offers one operational way of doing so. For further research, the most valuable next steps would be primary data on workforce experience and on employer demand, and comparative work on implementation divergence between Member States, both of which lie beyond the reach of desk research.

The redefinition of AI proposed here treats it not as a tool but as an infrastructure that needs to be developed and aligned with democratic values, public accountability, institutional alignment and collective benefit. Creativity, in this vision, is a collective and relational capacity that is AI-enhanced and drives transformation — innovation that must be not only technologically advanced but, above all, socially inclusive and environmentally responsible.

Within the transport and mobility sector, AI is a crucial element of strategic autonomy and technological sovereignty, shaping how Europe manages, plans and delivers sustainable, fully digitalised mobility. This sector is among the most affected in the EU's industrial ecosystem. The analysis of the triple transition and of AI-enhanced creativity presented here highlights the challenges ahead but also reveals opportunities that can be harnessed through cutting-edge AI technologies. AI serves as an integrative force linking infrastructure optimisation, environmental sustainability and social inclusion, forming a sector-specific transformation agenda. It enables predictive, resilient and adaptive systems that support workforce shifts, reskilling, upskilling and innovative development, turning challenges such as workforce shortages and emission reduction into opportunities for innovation and fair, cleaner economic growth.

By embedding human-centred creativity, accountability and fairness at the core of AI governance, the transport and mobility sector has the potential to serve as a model for how Europe envisions and enacts technological progress in the service of the public good. AI as infrastructure in this sector is not only a way to modernise it, but also a cornerstone of Europe's future mobility paradigm; a sustainable, innovative and creative model. Europe's mobility and transport sector can be creatively leveraged during the triple transition, reflecting European values and strengthening long-term strategic independence. What is at risk if Europe fails to act is not only a missed climate target or a delayed technological rollout, but a two-speed mobility system in which the benefits of transition accrue to those who already have access, and its costs to those who do not.

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Data availability

No new data were generated for this study. All sources cited are publicly available and listed in the references.

AI Use

The use of AI tools in the production of this report was to establish the theoretical basis of this report, and all the final outcomes listed in this report had human agency.

Conflicts of interest

The author(s) declare no conflict of interest. The funder had no role in the design of the study; in the collection, analysis, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

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