EVERY1

Digitalisation and Sustainable Mobility: The EU Policy Framework

Case Study – EN

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About **EVERY1**

EVERY1

Every1 project sets the goal of delivering an impactful concept that includes all elements needed to enable an effective participation of all European stakeholders in the digital energy market. The project starts with a deep, data-informed understanding of stakeholders and ecosystems to map who they are, what they know, how they use information and where they look for it. Similarly, existing and emerging solutions will be assessed and validated, and use cases will serve to understand what stakeholders need to know in order to take on a role that matches their potential. This gap is used to develop learning pathways that lead to the identification of the needed capacity building material. In parallel, Every1 works on making a market by exchanging best practices with policy makers and energy regulators, enabling discussions on barriers, and developing joint communication material for their peers.

Want to dive deeper into the digital energy transition? Scan the QR code below or visit the EVERY1 project website at https://every1.energy/ for resources, case studies, and insights on how you can play a role in shaping a clean energy future.

Target audiences

This case study is primarily designed for policymakers, urban planners, transport authorities, and industry stakeholders across the European Union who are engaged in developing and implementing sustainable and smart mobility solutions. It offers a comprehensive overview of the EU's strategic approach, providing insights for informed decision-making, collaborative initiatives, and the integration of digital technologies into transport systems.

Furthermore, this resource is valuable for researchers, technology developers, mobility service providers, energy communities, and citizens interested in understanding the evolving landscape of digital mobility, its connection to the energy transition, and opportunities for engagement. By clarifying complex policy frameworks and highlighting key trends, it seeks to empower a broader audience to contribute to a cleaner, more efficient, and accessible transport future.

Introduction
Driving Sustainable Mobility through Digitalisation in the EU

Mobility is a cornerstone of European society and economy, enabling trade, tourism, and daily life. However, the transport sector remains a significant contributor to greenhouse gas emissions, posing a substantial challenge to the European Union's ambitious climate neutrality goals under the European Green Deal. To address this, the EU is championing a profound transformation of its mobility system, moving towards a more sustainable, smart, and resilient future. This transition is inextricably linked with the digital energy transition, as electrification, smart infrastructure, and data-driven services become central to decarbonising transport.

This case study delves into the EU's policy framework guiding the digital and sustainable mobility transition. It will explore how digital technologies are enabling the shift to cleaner transport modes, optimising existing networks, and fostering new mobility services. We will examine key strategies, legislative instruments, and funding mechanisms designed to accelerate the deployment of electric vehicles, expand charging infrastructure, digitalise public transport, and promote active and shared mobility solutions. By presenting hard facts, figures, and their sources, this document aims to provide a clear understanding of the progress achieved, the challenges that lie ahead, and the opportunities for innovation and collaboration.

The urgency of this transformation is clear: transport accounts for approximately one-quarter of the EU's total greenhouse gas emissions, with road transport being the largest contributor. This equates to roughly **770 million tonnes of CO$_2$ equivalent in 2021**, underscoring the critical need for systemic change within the sector. Digitalisation offers powerful tools to mitigate these emissions, enhance efficiency, and improve the user experience across all modes of transport. From smart charging of electric vehicles that balances demand on the grid, to real-time traffic management and integrated multimodal travel platforms, digital solutions are pivotal. The EU's commitment is reflected in its comprehensive Sustainable and Smart Mobility Strategy, which outlines a roadmap to achieve a 90% reduction in transport emissions by 2050. This ambitious target is crucial for the EU to meet its overall climate neutrality goal.

Transport's Share of EU Greenhouse Gas Emissions and the 2050 Reduction Target
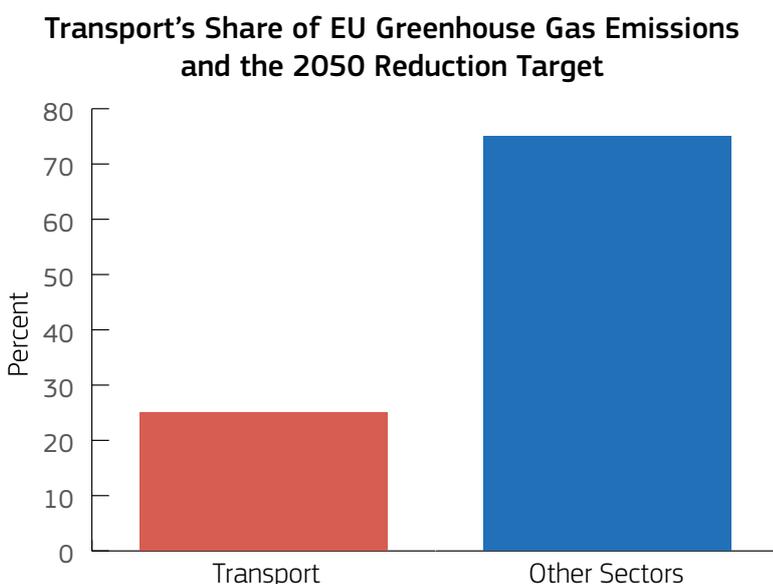
FIGURE 1: TRANSPORT'S SHARE OF EU GREENHOUSE GAS EMISSIONS AND THE 2050 REDUCTION TARGET. GRAPHIC CREATED BY EWORX.

> This case study serves as your strategic guide to the EU's vision for digital mobility, helping you bridge the gap between high-level policy and local implementation.

A | The European Green Deal and Mobility's Role

The European Green Deal, the EU's overarching growth strategy, aims to make Europe the first climate-neutral continent by 2050. Transport plays a pivotal role in achieving this ambition, as it is one of the sectors most reliant on fossil fuels. The strategy calls for **a 90% reduction in transport-related greenhouse gas emissions by 2050**, compared to 1990 levels. This translates to a need to cut emissions from transport by over 1.2 billion tonnes of CO_2 equivalent annually by mid-century. Digitalisation is recognised as a key enabler for this transformation, facilitating the shift to cleaner modes, optimising logistics, and enhancing connectivity across the entire transport ecosystem.

I. Decarbonising Transport: Targets and Digital Enablers

Achieving the ambitious decarbonisation targets for transport requires a multifaceted approach, with digital technologies providing crucial tools for efficiency gains and modal shifts:
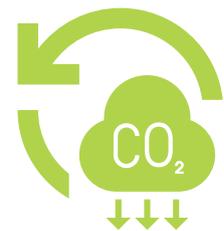
→ **Electrification of Road Transport:** The strategy heavily relies on the widespread adoption of electric vehicles (EVs) across all segments, from passenger cars to heavy-duty trucks and buses. Digitalisation is absolutely essential for managing the rapidly expanding charging infrastructure, optimising charging times to align with renewable energy availability (smart charging), and enabling Vehicle-to-Grid (V2G) capabilities, turning EVs into flexible, mobile energy storage units that can support grid stability. The EU aims for at **least 30 million zero-emission cars to be on European roads by 2030**, alongside 80,000 zero-emission lorries. This necessitates intelligent charging networks that can communicate with the grid and respond to real-time energy prices and availability.

→ **Shift to Sustainable Modes:** Digital platforms are instrumental in facilitating the shift from individual car use to more sustainable and collective modes like public transport, rail, cycling, and walking. Mobile applications for real-time journey planning, offering multimodal options (e.g., combining metro, tram, and bike-sharing), real-time information on public transport schedules and disruptions, and integrated ticketing systems (Mobility as a Service - MaaS) make these options significantly more attractive and convenient for citizens. Digitalisation also supports the shift of freight from road to rail and inland waterways through advanced tracking and logistics platforms.

→ **Smart Traffic Management:** Digital solutions, including AI-driven traffic management systems, real-time data analytics, and connected vehicles, can dynamically optimise traffic flow, reduce congestion in urban areas and on major corridors, and minimise idling times, leading to significant fuel savings and emission reductions. For instance, intelligent signal systems can adapt to traffic conditions, while digital platforms can guide drivers to less congested routes.

→ **Sustainable Aviation and Shipping:** While more challenging to electrify directly, digitalisation also plays a crucial role in decarbonising aviation and shipping. This includes optimised routing based on weather patterns and air traffic control data, efficient logistics for port operations, and the development of digital solutions for managing and deploying alternative fuels (e.g., hydrogen, sustainable aviation fuels) and advanced propulsion systems. **The EU aims for zero-emission large aircraft and vessels to be ready for market by 2035**, supported by digital design and operational optimisation tools.

→ **Digital Twins for Planning:** The concept of digital twins – virtual replicas of physical transport infrastructure or entire mobility systems – is emerging as a powerful tool for planning, simulating, and optimising transport networks before physical implementation. This can lead to more efficient infrastructure development and better integration of new mobility solutions.

> Digitalisation is not just an efficiency tool; it is the essential infrastructure required to turn Electric Vehicles (EVs) into flexible energy storage units via Vehicle-to-Grid (V2G) technology.

II. Smart Mobility for Enhanced Efficiency and Resilience

Beyond decarbonisation, digitalisation enhances the overall efficiency, safety, and resilience of the mobility system, creating a more seamless and reliable experience for users and operators.

→ **Optimised Logistics and Freight:** Digital platforms, real-time tracking, and advanced data analytics significantly improve logistics operations and freight management. This enables more efficient route planning, dynamic load optimisation (e.g., reducing empty truck runs), and better coordination across supply chains. Predictive analytics can anticipate disruptions and reroute freight, enhancing resilience. For example, platooning technology for trucks, enabled by digital communication, can reduce fuel consumption by up to 10%.

→ **Connected and Automated Mobility (CAM):** The development and deployment of connected and automated vehicles (CAVs) rely entirely on sophisticated digital communication technologies (e.g., 5G, C-ITS), advanced sensors, and Artificial Intelligence (AI). CAVs promise to revolutionise road safety by reducing human error, alleviate congestion through optimised traffic flow, and further reduce energy consumption through smoother, more consistent driving patterns and platooning. **The EU has set a target for large-scale deployment of automated mobility by 2030**, with a focus on safe and secure integration into existing infrastructure.

→ **Resilient Infrastructure:** Digital monitoring and predictive maintenance systems for transport infrastructure (roads, railways, bridges, tunnels, ports, airports) enhance their resilience to extreme weather events, natural disasters, and operational failures. Sensors collect data on structural integrity, traffic load, and environmental conditions, allowing for timely interventions and reducing downtime. Digital twins of infrastructure assets can enable real-time performance monitoring and scenario planning for potential disruptions.

→ **Interoperability and Multimodality:** Digital solutions are crucial for creating seamless multimodal journeys across different transport modes (e.g., train, bus, bike-sharing, car-sharing). This requires common data standards, interoperable digital platforms, and integrated ticketing systems that allow passengers and freight to easily switch between services, optimising journey times and convenience. The aim is to create a truly integrated European transport area.

Smart mobility, therefore, leverages digital tools to create a more responsive, adaptive, and robust transport network that can better serve citizens and the economy, while also contributing to environmental goals.

III. Just and Inclusive Mobility Transition

A just and inclusive transition ensures that the benefits of sustainable and smart mobility are accessible to all citizens, leaving no one behind, regardless of their socio-economic status, location, or physical abilities. Digitalisation can play a key role in achieving this:

→ **Improved Accessibility:** Digital tools can significantly enhance accessibility for people with reduced mobility or disabilities. This includes providing real-time information on accessible routes, identifying public transport options with ramps or lifts, facilitating on-demand accessible transport services, and offering navigation aids for pedestrians with visual impairments. Apps can help users find accessible parking or charging points.

→ **Affordable and Equitable Mobility Solutions:** Digital platforms can facilitate the widespread adoption of shared mobility services (e.g., car-sharing, bike-sharing, e-scooter sharing, ride-pooling), making sustainable transport options more affordable and accessible than private car ownership, particularly for urban populations and those with lower incomes. Optimised public transport routing and demand-responsive transit services, enabled by digital systems, can serve more diverse areas efficiently.

→ **Rural Connectivity and Bridging the Urban-Rural Divide:** Digital solutions are crucial for addressing mobility challenges in rural and remote areas, where traditional public transport services may be infrequent or non-existent. This includes enabling on-demand transport services (e.g., ride-sharing platforms for rural communities), optimising less frequent public transport routes based on real-time demand, and facilitating car-pooling initiatives through digital matching platforms. These solutions can combat transport poverty and ensure equitable access to essential services.

→ **Digital Skills for Mobility:** Ensuring that all citizens have the necessary digital literacy and skills to utilise smart mobility applications and services is crucial for inclusive participation. This aligns with the broader digital skills agenda of the EU's Digital Decade Policy Programme, aiming to equip citizens with the competencies needed to navigate and benefit from the digital transformation, including in transport. Targeted training and user-friendly interfaces are vital.

Impact of Digitalisation Across Transport Modes in the EU Mobility System
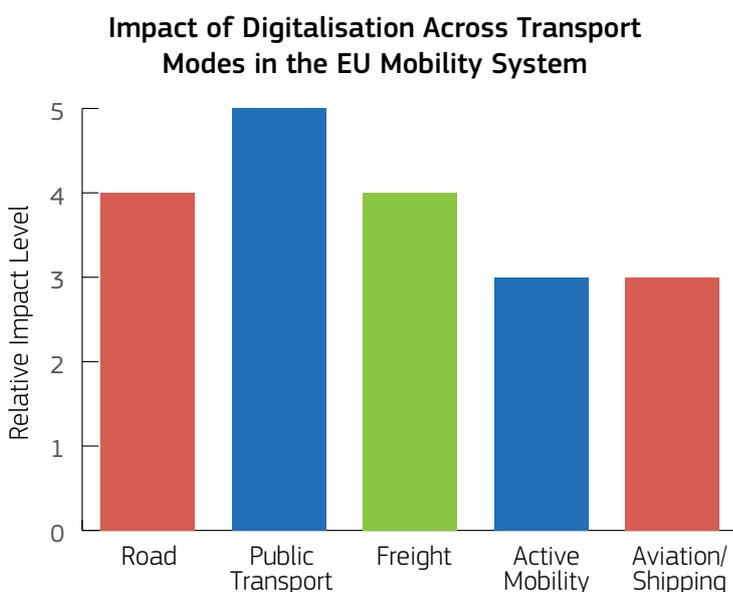
FIGURE 2: IMPACT OF DIGITALISATION ACROSS TRANSPORT MODES IN THE EU MOBILITY SYSTEM. GRAPHIC CREATED BY EWORX.

> The EU aims to ensure that the mobility transition contributes to social equity and cohesion, with digitalisation acting as an enabler for broader access, affordability, and participation across all segments of society.

B | Key EU Policy Instruments for Digital and Sustainable Mobility

The EU's vision for digital and sustainable mobility is underpinned by a comprehensive set of policy instruments, ranging from overarching strategies to specific regulations that drive innovation, investment, and harmonisation across Member States.

I. Sustainable and Smart Mobility Strategy

Launched in December 2020, the Sustainable and Smart Mobility Strategy is the blueprint for the EU's transport transformation. It sets out a roadmap of 82 initiatives across 10 key areas, aiming to achieve the Green Deal's transport emission reduction targets. Digitalisation is a cross-cutting enabler throughout the strategy, focusing on:

→ **Boosting uptake of zero-emission vehicles, vessels and planes:** This includes supporting the rapid deployment of charging and refuelling infrastructure for electric and hydrogen vehicles across all transport modes, enabled by digital payment systems and real-time information.

→ **Creating zero-emission airports and ports:** Digital tools are vital for optimising port and airport operations, managing energy consumption, and integrating renewable energy sources and alternative fuel infrastructure.

→ **Making interurban and urban mobility more sustainable and healthy:** This involves promoting active mobility (walking, cycling) and public transport through digital journey planners, real-time information, and integrated MaaS platforms, reducing reliance on private cars.

→ **Greening freight transport:** Digital solutions are used to optimise logistics, shift freight to more sustainable modes like rail and inland waterways, and deploy zero-emission heavy-duty vehicles.

→ **Pricing carbon and providing incentives for users:** Digital systems can facilitate carbon pricing mechanisms (e.g., EU Emissions Trading System for aviation and maritime) and manage incentive schemes for adopting cleaner transport options.

→ **Making mobility fair and just for all:** Digital tools enhance accessibility, provide affordable shared mobility options, and improve connectivity in rural areas.

→ **Making transport safer and more secure:** Connected and automated mobility, digital monitoring of infrastructure, and advanced cybersecurity measures contribute to enhanced safety and security across the transport network.

→ **Making transport more resilient:** Digital twins, predictive maintenance, and real-time information systems help transport networks withstand and recover from disruptions.

→ **Boosting research and innovation:** Significant EU funding (e.g., Horizon Europe) is directed towards developing cutting-edge digital technologies for all aspects of sustainable mobility.

→ **Strengthening global cooperation:** The EU seeks to promote its standards and collaborate internationally on digital and sustainable transport solutions.

The strategy identifies key milestones, such as doubling high-speed rail traffic by 2030, making automated mobility widely available by 2030, and deploying at least 3 million public charging points for EVs by 2030. Digital solutions are integral to achieving each of these milestones, from smart charging management to the complex data exchange required for automated driving.

II. Alternative Fuels Infrastructure Regulation (AFIR)

The [Alternative Fuels Infrastructure Regulation](#) (AFIR – Regulation (EU) 2023/1804), which entered into force in September 2023, is a cornerstone of the EU's efforts to accelerate the rollout of charging and refuelling infrastructure for alternative fuels. Digitalisation is central to its effectiveness and user-friendliness:

→ **Mandatory Public Charging Points:** AFIR sets binding, minimum targets for Member States to deploy publicly accessible charging points along main EU transport corridors (TEN-T network) and in urban nodes. For instance, **by 2026, EV charging stations for cars and vans must be available every 60 km along the TEN-T network**, with a total charging pool of at least 1 kW for each battery electric vehicle (BEV) registered in a Member State. For heavy-duty vehicles, charging stations with a minimum output of 1,400 kW must be available every 120 km along the TEN-T core network by 2028.

→ **Digital Payment and Information:** The regulation mandates that all newly installed public charging points must offer transparent pricing information, non-discriminatory payment methods (e.g., credit cards, QR codes, contactless payment), and real-time data on availability, pricing, and charging speed through digital channels. This significantly enhances user experience, reduces "range anxiety," and facilitates the widespread adoption of EVs.

→ **Smart Charging Readiness:** AFIR strongly encourages, and in some cases mandates, smart charging capabilities for charging points. This allows for dynamic management of EV charging sessions to optimise grid load, integrate with renewable energy sources, and respond to electricity price signals. This directly links sustainable mobility with the digital energy transition, ensuring that the increase in EV charging demand is managed efficiently and sustainably.
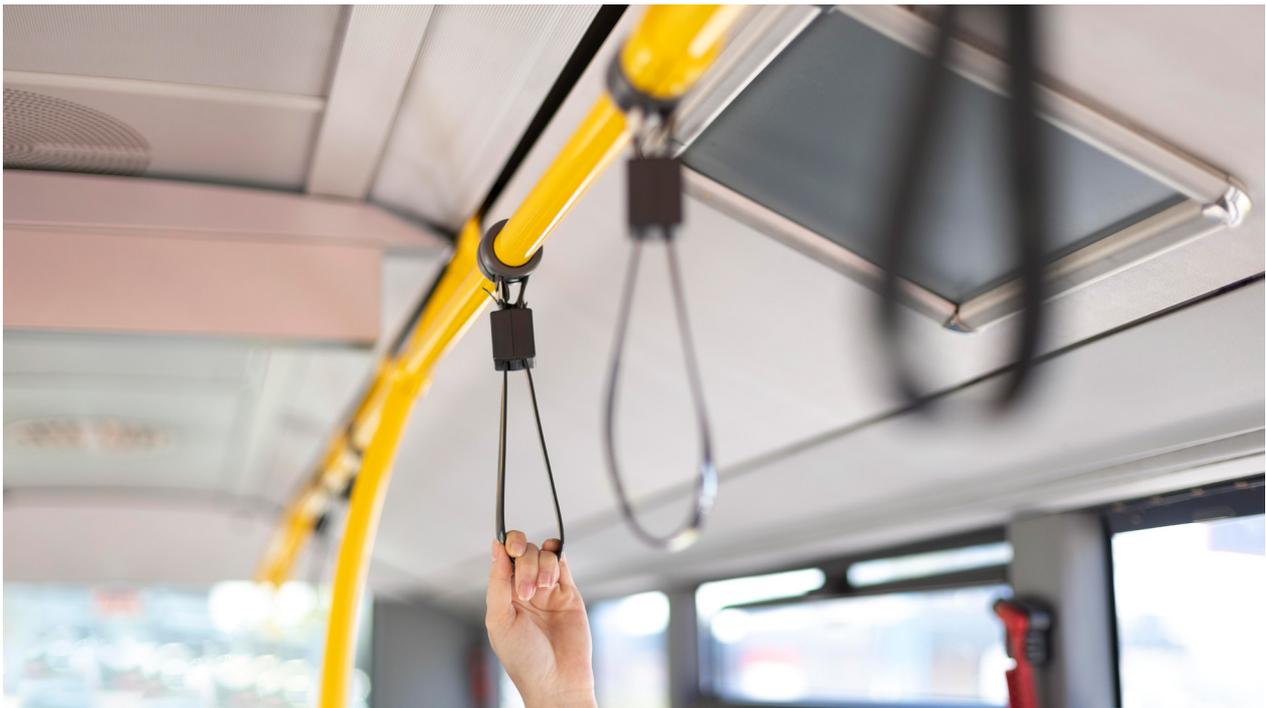

FIGURE 3: "[CLOSE UP PASSENGER ON BUS](#)" BY FREEPIK LICENSED UNDER [CC BY-SA 4.0](#)

III. Trans-European Transport Network (TEN-T) Regulation

The Trans-European Transport Network (TEN-T) policy aims to build a comprehensive, multimodal EU-wide network of railways, roads, inland waterways, maritime shipping routes, ports, airports, and rail-road terminals. The revised TEN-T Regulation (Regulation (EU) 2021/1153) places a strong emphasis on digitalisation and sustainability to ensure seamless and efficient cross-border transport:

→ **Digitalisation of Rail:** The regulation actively promotes the deployment of the European Rail Traffic Management System (ERTMS) across the TEN-T rail network, which is a standardised digital signalling and train control system designed to enhance interoperability, safety, and efficiency across national rail networks. It also supports the implementation of digital automatic coupling (DAC) for freight wagons, automating and digitalising coupling operations to improve efficiency and reduce manual labour.

→ **Intelligent Transport Systems (ITS):** TEN-T supports the widespread deployment of ITS for road transport, including real-time traffic information systems, cooperative ITS (C-ITS) for vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication, and digital services for freight logistics (e.g., e-freight documents, digital consignment notes). These systems rely on robust digital infrastructure and data exchange.

→ **Multimodal Digital Information:** The policy encourages the development of digital platforms that provide seamless, real-time information across different transport modes, facilitating multimodal journeys for both passengers and freight. This includes digital booking systems, integrated ticketing, and real-time tracking of goods across different transport legs.

→ **Smart Ports and Airports:** The TEN-T framework also supports the digitalisation of port and airport operations, including smart logistics, digitalised administrative procedures, and the integration of alternative fuel infrastructure.

These digital components are crucial for optimising the use of the TEN-T network, reducing congestion, improving safety, and shifting traffic to more sustainable and efficient modes, ultimately contributing to the Green Deal objectives.
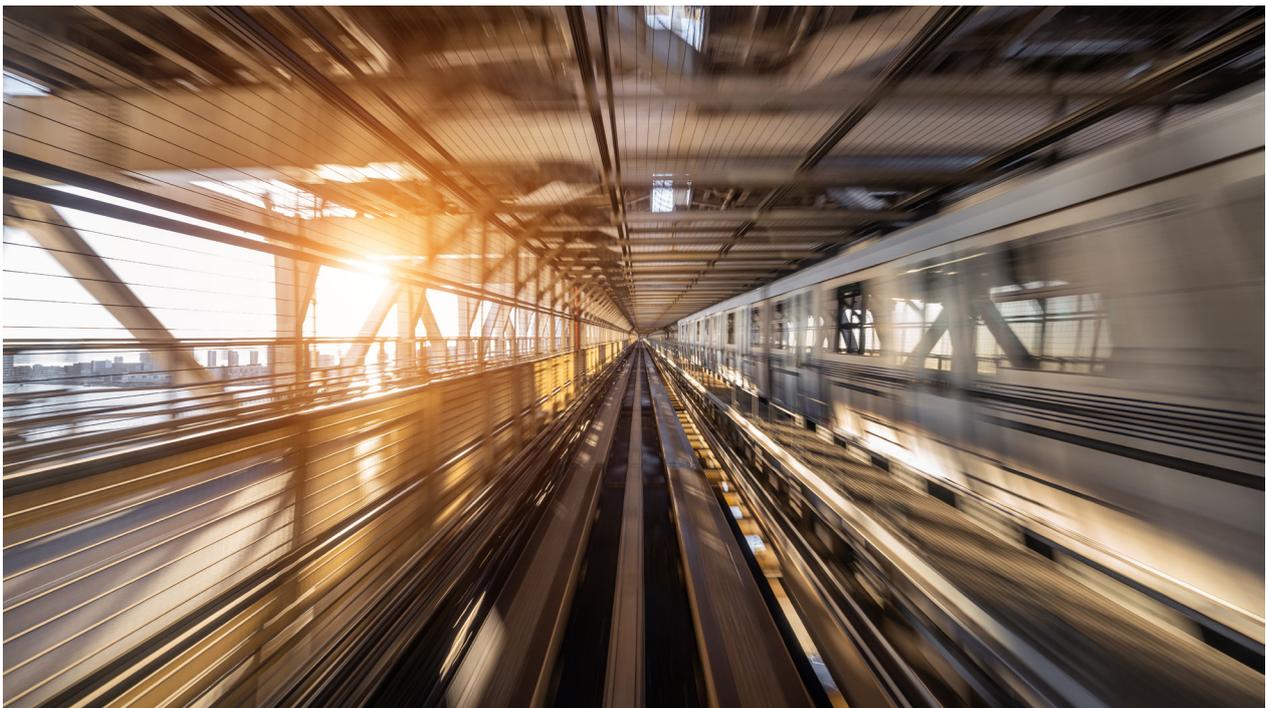
FIGURE 4: "MOTION BLUR OF AUTOMATIC TRAIN MOVING INSIDE TUNNEL IN TOKYO, JAPAN." BY TAWATCHAI07 LICENSED UNDER CC BY-SA 4.0

IV. Battery Regulation

The EU Battery Regulation (Regulation (EU) 2023/1542), which applies from August 2024, is a landmark piece of legislation that addresses the entire lifecycle of batteries, including those used in electric vehicles, from design to recycling. Digitalisation is integral to its implementation and the promotion of a circular economy for batteries:

→ **Battery Passport:** The regulation introduces a mandatory "battery passport" – a digital record containing comprehensive information about the battery's characteristics, performance, manufacturing process, carbon footprint, and lifecycle history. This digital passport will be crucial for tracking battery components, facilitating reuse and recycling, ensuring transparency in the supply chain, and enabling better management of battery assets.

→ **Performance and Durability Information:** Digital tools will be used to collect, store, and share data on battery performance, durability, and state of health throughout their operational life. This empowers consumers with better information, enables efficient second-life applications (e.g., stationary energy storage), and facilitates better management of battery assets.

→ **Circular Economy for Batteries:** Digitalisation supports the circular economy principles by enabling better traceability and sorting of batteries for recycling and reuse. The battery passport, for instance, will provide recyclers with essential information to efficiently recover critical raw materials, reducing the environmental impact of battery production and consumption. The regulation sets ambitious collection targets for waste portable batteries (e.g., 63% by 2027 and 73% by 2030) and specific material recovery targets for recycling.

This regulation ensures that the rapid growth of EV batteries is managed sustainably and responsibly, with digital tools providing the necessary transparency, traceability, and data for a truly circular battery value chain.

V. Digital Strategy and Digital Decade Policy Programme 2030

The broader EU Digital Strategy and the Digital Decade Policy Programme 2030 provide the overarching framework for Europe's digital transformation, directly impacting sustainable mobility by fostering a conducive environment for digital innovation:

→ **Gigabit Connectivity and 5G:** Ubiquitous high-speed and low-latency connectivity, particularly 5G, is absolutely essential for the advanced functionalities of connected and automated mobility (CAM), real-time smart traffic management, and the seamless exchange of data for complex mobility services. By 2030, all populated areas in the EU should be covered by 5G.

→ **Common European Data Spaces:** The development of common European data spaces, including a dedicated 'Mobility Data Space', will facilitate secure, trusted, and efficient data sharing across the entire transport ecosystem. This will unlock new services like comprehensive MaaS platforms, optimise multimodal logistics chains, and enable predictive maintenance for transport infrastructure.

→ **Digital Skills:** A digitally skilled workforce is needed at all levels – from engineers developing autonomous driving algorithms to urban planners using data analytics for mobility solutions, and citizens who can effectively use smart mobility applications. The Digital Decade aims for **at least 80% of adults to have basic digital skills and 20 million ICT specialists employed in the EU by 2030**.

→ **Cybersecurity:** Robust cybersecurity measures are critical for protecting connected vehicles, intelligent transport systems, transport infrastructure, and digital mobility platforms from cyber threats. The NIS2 Directive and the Cybersecurity Act provide the framework for ensuring the resilience of these critical digital assets.

These overarching digital policies provide the foundational digital infrastructure, skills, and security capabilities necessary for the rapid and secure sustainable mobility transition.

# C | Funding and Investment Mechanisms for Digital Mobility

Achieving the EU's ambitious sustainable and smart mobility goals requires substantial and sustained investment in both physical infrastructure and digital technologies. The EU provides various funding and investment mechanisms to support the research, innovation, and deployment of digital solutions in the transport sector, often leveraging both public and private capital.

I. Connecting Europe Facility (CEF) Transport and Digital

The Connecting Europe Facility (CEF) is a key EU funding instrument designed to support investment in European infrastructure priorities. It has two particularly relevant strands for digital mobility:

➔ **CEF Transport (2021-2027):** With a substantial budget of **€25.8 billion**, CEF Transport primarily supports the development and modernisation of the Trans-European Transport Network (TEN-T). This includes significant funding for its digital components, such as the deployment of the European Rail Traffic Management System (ERTMS) across rail networks, the implementation of Intelligent Transport Systems (ITS) for road transport, the digitalisation of port and airport operations (e.g., smart port logistics, digital air traffic control), and the rollout of alternative fuels infrastructure (AFIR-compliant charging and refuelling points).

➔ **CEF Digital (2021-2027):** With a budget of **€2 billion**, CEF Digital specifically supports high-capacity digital backbone infrastructure, including 5G corridors along major transport routes and gigabit connectivity for transport hubs. This direct investment in digital connectivity is fundamental, as it enables the real-time data exchange and low-latency communication required for connected and automated mobility, smart traffic management, and other data-intensive mobility services.
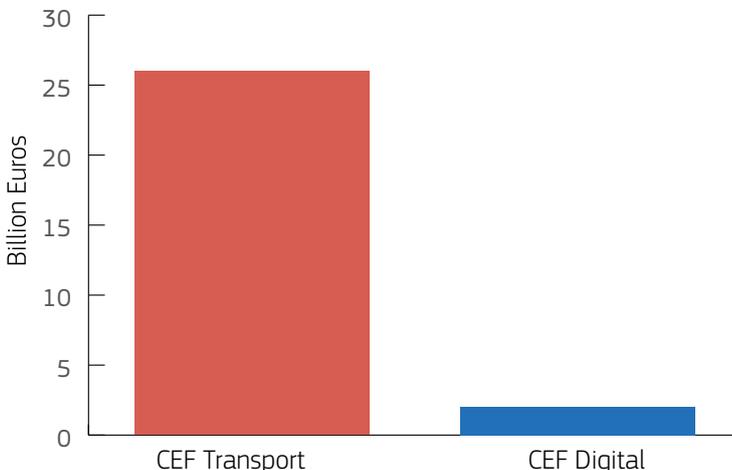
These CEF programmes are crucial for bridging investment gaps in cross-border and strategic digital transport infrastructure, fostering seamless connectivity across the Union.

Key EU Funding Instruments Supporting Digital and Sustainable Mobility

FIGURE 5: KEY EU FUNDING INSTRUMENTS SUPPORTING DIGITAL AND SUSTAINABLE MOBILITY. GRAPHIC CREATED BY EWORX.

II. Recovery and Resilience Facility (RRF)

The Recovery and Resilience Facility (RRF), the centrepiece of the EU's NextGenerationEU recovery plan, provides substantial financial support to Member States for reforms and investments aimed at making their economies more resilient and future-proof. Its dual focus on green and digital transitions makes it a powerful tool for accelerating sustainable mobility:

→ **Green and Digital Investments:** Member States' national Recovery and Resilience Plans (RRPs) must allocate at **least 37% of their total budget to climate-related investments and 20% to digital investments**. This dual allocation has led to significant RRF support for sustainable mobility projects across the EU. Investments include the rapid rollout of EV charging infrastructure, modernisation and electrification of public transport fleets (buses, trams, metro), expansion of cycling and walking infrastructure, and the digitalisation of various transport systems.

→ **Examples of RRP Investments:** Many RRPs include specific measures for digital mobility. For instance, Germany's RRP allocates significant funds to expanding charging infrastructure for electric vehicles and to the digitalisation of its rail network. Spain's RRP includes investments in sustainable urban mobility plans and the digitalisation of transport services. Italy's plan supports the development of smart roads and sustainable public transport. By leveraging the RRF, Member States can rapidly implement large-scale projects that might otherwise take years to materialise.

Navigating the Research-to-Deployment Gap

Municipalities often face barriers when transitioning from pilot research to full-scale deployment. Beyond Horizon Europe, public authorities should leverage the Connecting Europe Facility (CEF) for large-scale infrastructure and the Recovery and Resilience Facility (RRF) for local reforms.

Tip: *Partnering with private charging point operators (CPOs) can strengthen a municipality's application for EU subsidies by demonstrating commercial viability.*

> **The RRF provides a unique, large-scale opportunity to rapidly implement digital and sustainable mobility solutions as part of the post-pandemic recovery, contributing directly to the Green Deal objectives. These programmes ensure that the EU remains at the forefront of digital mobility innovation, translating scientific breakthroughs and pilot projects into deployable solutions that contribute to the Green Deal.**

FIGURE 6: "TRAMWAY ON STREET" BY BEARFOTOS LICENSED UNDER CC BY-SA 4.0

D | Impact and Progress: Facts and Figures

The EU's comprehensive policy framework and investment mechanisms are yielding tangible results in advancing digital and sustainable mobility across the continent, though progress varies across different areas and Member States.
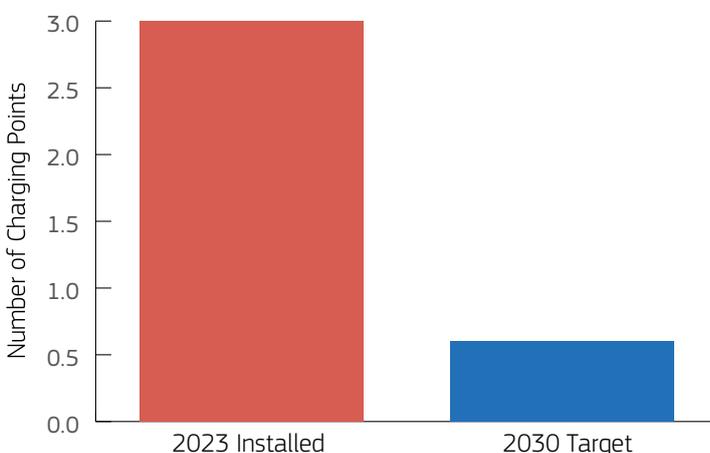
I. Electric Vehicle Adoption and Charging Infrastructure Rollout

The uptake of electric vehicles (EVs) and the expansion of charging infrastructure are critical indicators of progress towards decarbonising road transport:

→ **EV Sales Growth:** In 2023, battery electric vehicles (BEVs) accounted for approximately **14.6%** of new car registrations in the EU, a significant increase from just over **1%** in 2019. This rapid growth demonstrates increasing consumer acceptance, driven by improving technology, expanding model availability, and supportive national incentives. The total number of BEVs and plug-in hybrid electric vehicles (PHEVs) on EU roads **reached over 6 million by the end of 2023**.

→ **Charging Point Deployment:** By the end of 2023, there were over **630,000 public charging points available in the EU**. While this represents substantial growth (a more than tenfold increase since 2017), it still falls significantly short of the EU's target of 3 million public charging points by 2030, highlighting the need for accelerated deployment under AFIR. The distribution of charging infrastructure also remains uneven across Member States.

→ **Smart Charging:** The increasing number of EVs necessitates intelligent smart charging solutions to manage grid load effectively and integrate EVs with the broader energy system. While comprehensive data on smart charging adoption is still emerging, the regulatory push from AFIR and the revised Electricity Market Directive is driving its integration into new charging installations and vehicle models. This ensures that EVs can charge when renewable energy is abundant or demand on the grid is low.
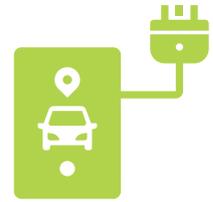

**FIGURE 7:** PUBLIC EV CHARGING POINTS IN THE EU: 2023 DEPLOYMENT VERSUS 2030 TARGET. GRAPHIC CREATED BY EWORX.

II. Public Transport Digitalisation and MaaS Initiatives

Digitalisation is transforming public transport services, making them more efficient, attractive, and user-centric, and enabling new mobility services like Mobility as a Service (MaaS):

→ **Real-time Information:** Most major European cities and many regional public transport networks now offer real-time public transport information via mobile applications and digital displays at stops, enhancing user convenience and reliability. This is a direct result of investments in Intelligent Transport Systems (ITS) and digital data platforms.

→ **Mobility as a Service (MaaS):** MaaS platforms, which integrate various transport services (public transport, ride-sharing, bike-sharing, car-sharing, taxi services) into a single digital application for journey planning, booking, and payment, are gaining traction. Cities like Helsinki ([Whim](#)), Vienna ([WienMobil](#)), and Hanover ([GVH mobil](#)) have implemented successful MaaS pilots or commercial services, demonstrating the potential for seamless multimodal travel and reduced reliance on private cars. While still in early stages of widespread adoption across the EU, EU funding and policy support are crucial for scaling these initiatives and ensuring interoperability.

→ **Digital Ticketing and Payment:** The shift towards digital and integrated ticketing systems (e.g., contactless payments, mobile tickets, account-based ticketing) is progressing across Europe, making public transport more user-friendly and encouraging multimodal journeys by simplifying payment across different operators and modes.

→ **Optimised Public Transport Operations:** Digital tools are also used by public transport operators for real-time fleet management, predictive maintenance of vehicles and infrastructure, and demand-responsive routing, leading to more efficient and reliable services.

Growth of Electric Vehicle Adoption in the EU (2019–2023)
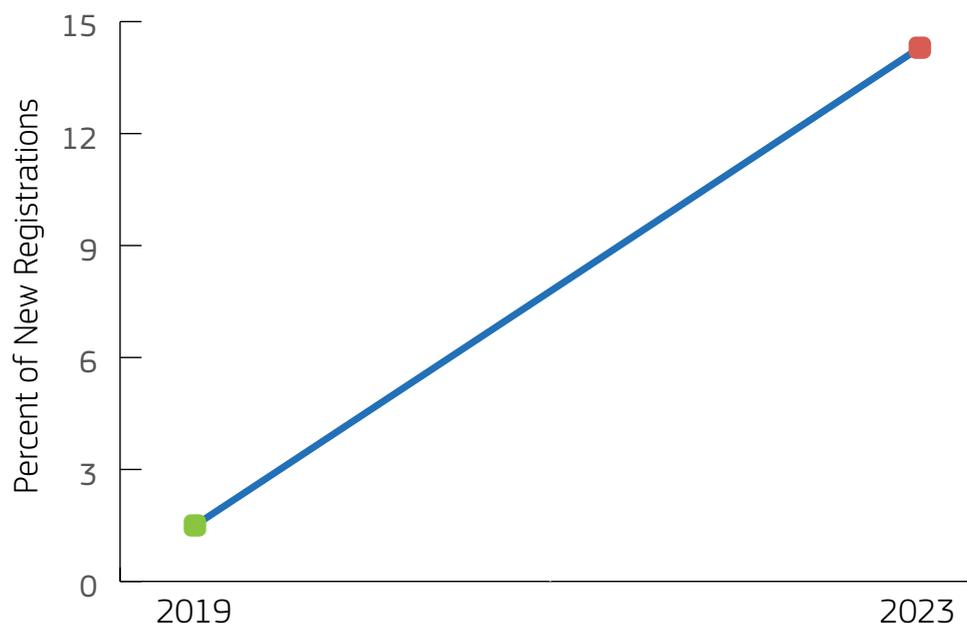
FIGURE 8: GROWTH OF ELECTRIC VEHICLE ADOPTION IN THE EU (2019–2023). GRAPHIC CREATED BY EWORX.

III. Active Mobility Promotion

Digital tools also play an increasingly important role in supporting and promoting active mobility modes like cycling and walking, contributing to healthier lifestyles and reduced urban emissions:

→ **Cycling Apps and Infrastructure:** Navigation applications optimised for cycling (e.g., showing bike lanes, safest routes), smart bike-sharing systems (e.g., Vélib' in Paris, Donkey Republic across multiple cities), and digital tools for tracking cycling infrastructure development and usage contribute to making cycling more attractive, convenient, and safer. Many cities use apps to manage their public bike fleets and provide real-time availability.

→ **Urban Planning Tools:** Digital urban planning tools, incorporating GIS data and mobility analytics, allow cities to analyse pedestrian and cycling patterns, identify gaps in infrastructure, and design more pedestrian and cyclist-friendly environments (e.g., wider pavements, dedicated bike lanes, green corridors).

→ **Gamification and Incentives:** Some cities and companies use digital platforms to incentivise active mobility through gamification, challenges, or rewards for walking or cycling, further encouraging modal shift.

→ **Health and Environmental Benefits:** Increased active mobility directly contributes to public health by promoting physical activity and further reduces transport emissions and urban air pollution, complementing the electrification efforts for motorised transport.

FIGURE 9: "PERSON USING ELECTRIC SCOOTER IN THE CITY" BY FREEPIK LICENSED UNDER CC BY-SA 4.0

E | Challenges and Opportunities in Policy Implementation

Despite the significant progress, the implementation of the EU's digital and sustainable mobility policies faces several complex challenges, which, in turn, present substantial opportunities for further refinement, innovation, and strategic action.

I. Infrastructure Gaps and Grid Integration

The rapid electrification of transport, particularly road transport, creates new and substantial demands on both charging infrastructure and the underlying electricity grid:

→ **Charging Infrastructure Gaps:** While deployment is accelerating, there are still significant geographical disparities and insufficient charging capacity in certain areas, particularly for heavy-duty vehicles (lorries, buses) and in rural regions. The current pace of public charging point rollout is not yet sufficient to meet the EU's 2030 targets, requiring a massive acceleration of investment and streamlined permitting processes. For heavy-duty vehicles, the challenge is even greater, requiring high-power charging solutions along major corridors.

→ **Grid Integration Challenges:** The massive increase in electricity demand from millions of EVs requires robust and smart grid infrastructure to prevent grid overload, manage peak demand, and ensure efficient integration with renewable energy sources. This necessitates close coordination between the transport sector (EV manufacturers, charging point operators) and the energy sector (grid operators, energy suppliers). Without smart charging and V2G, uncontrolled charging could strain local grids, especially during peak hours.

→ **Opportunity:** Continued targeted investment under CEF and RRF is crucial to bridge charging infrastructure gaps, focusing on high-power charging for heavy-duty vehicles and expanding coverage in underserved areas. Furthermore, fostering innovation in smart charging, Vehicle-to-Grid (V2G) technologies, and grid-friendly EV charging solutions presents a significant opportunity to seamlessly integrate transport electrification with the broader digital energy transition. Policies promoting bidirectional charging, dynamic electricity tariffs for EVs, and local energy communities that can manage EV charging are key to optimising grid load and maximising the use of renewable energy.

II. Data Governance, Cybersecurity, and Privacy

The increasing reliance on digital technologies in mobility generates vast amounts of sensitive data, raising critical concerns regarding data governance, cybersecurity, and privacy:

→ **Data Silos and Interoperability:** Data generated by different mobility service providers (e.g., ride-sharing, public transport, car-sharing), vehicles, and infrastructure often resides in isolated "silos." This fragmentation hinders the development of fully integrated Mobility as a Service (MaaS) platforms and efficient, real-time traffic management systems. A lack of common data standards, interoperability protocols, and data sharing frameworks remains a significant challenge, preventing the creation of a holistic view of urban mobility.

→ **Cybersecurity Risks:** Connected and automated vehicles (CAVs), smart traffic management systems, and digital mobility platforms are increasingly vulnerable to sophisticated cyberattacks. Such attacks could compromise vehicle safety (e.g., remote hijacking), disrupt transport services (e.g., traffic signal manipulation), or expose sensitive personal data. Protecting this critical digital infrastructure is paramount, requiring continuous vigilance and investment in advanced cybersecurity measures. The NIS2 Directive explicitly extends its scope to parts of the transport sector, reinforcing cybersecurity obligations.

→ **Privacy Concerns:** The collection and use of vast amounts of personal mobility data (e.g., real-time location tracking, travel patterns, payment information) raise significant privacy concerns. Ensuring compliance with the General Data Protection Regulation (GDPR) and building public trust in data handling practices is essential for widespread adoption of digital mobility services. Users need assurance that their data is protected and used responsibly.

→ **Opportunity:** The development of common European data spaces for mobility, coupled with strong data governance frameworks (e.g., the Data Act, which promotes fair and secure data access and use) and robust cybersecurity measures (e.g., NIS2 Directive, Cybersecurity Act), offers a significant opportunity. These frameworks aim to unlock the value of mobility data for innovation while simultaneously protecting privacy and ensuring security. Fostering collaboration between transport authorities, industry players, cybersecurity agencies (like ENISA), and research institutions is vital to address these challenges effectively.

III. Regulatory Harmonisation and Interoperability

Ensuring consistent implementation of EU policies and technical interoperability across Member States is vital for creating a truly seamless and efficient European mobility area:

→ **Fragmented National Implementation:** While EU regulations and directives set common rules and targets, national interpretations and implementation of digital mobility policies (e.g., for MaaS licensing, ITS deployment standards, rules for autonomous driving trials) can still vary significantly. This fragmentation creates barriers to cross-border services, hinders the scalability of innovative solutions, and increases complexity for businesses operating across multiple Member States.

→ **Technical Standards and Certification:** The rapid pace of technological development in areas like connected and automated driving, digital freight logistics, and smart public transport requires continuous adaptation and harmonisation of technical standards. Ensuring interoperability across different vehicle manufacturers, infrastructure providers, and digital service platforms is crucial to avoid vendor lock-in and foster competition. The EU's cybersecurity certification framework (Cybersecurity Act) plays a role here, but broader technical harmonisation is needed.

→ **Opportunity:** Strengthening EU-level coordination, promoting best practices through guidelines and recommendations, and investing in common digital platforms and open standards (e.g., for MaaS data exchange, C-ITS protocols, digital identity for transport users) are crucial. The ongoing review of the ITS Directive and the development of new regulations for connected and automated mobility aim to address these challenges by providing clearer legal and technical frameworks. Furthermore, promoting sandboxes and pilot projects that test cross-border digital mobility solutions can help identify and overcome regulatory and technical barriers.

F | Future Outlook and Recommendations

The EU's policy framework for digital and sustainable mobility is a dynamic and evolving landscape, constantly adapting to technological advancements, market developments, and the urgent need to decarbonise transport. The future outlook points towards a highly integrated, intelligent, user-centric, and ultimately climate-neutral mobility system.

I. Emerging Technologies and Mobility Services

Future policy developments and innovation efforts will likely focus on:

→ **Fully Automated Mobility:** Advancing the regulatory framework, ethical guidelines, and testing environments for higher levels of driving automation (Level 4 and 5), including fully autonomous public transport (e.g., driverless shuttles in urban areas) and automated logistics operations (e.g., autonomous trucks on dedicated corridors). This requires robust digital infrastructure and advanced AI.

→ **Urban Air Mobility (UAM):** Exploring the potential for drones and eVTOL (electric Vertical Take-Off and Landing) aircraft for passenger and cargo transport in urban areas. This emerging sector will require entirely new digital air traffic management systems, robust cybersecurity measures, and a comprehensive regulatory framework to ensure safety and efficiency.

→ **Hyperloop and High-Speed Rail:** Continued investment in and digitalisation of high-speed rail networks across Europe, including advanced digital signalling and traffic management. Furthermore, the potential exploration and regulatory preparation for hyperloop technologies, offering ultra-fast, low-carbon intercity travel, will rely heavily on digital control and communication systems.

→ **Advanced Logistics and Supply Chains:** Leveraging cutting-edge digital technologies like AI, blockchain, and advanced IoT for highly efficient, transparent, and resilient freight logistics. This includes autonomous delivery systems, real-time cargo tracking, and blockchain-enabled secure data exchange for supply chain optimisation.
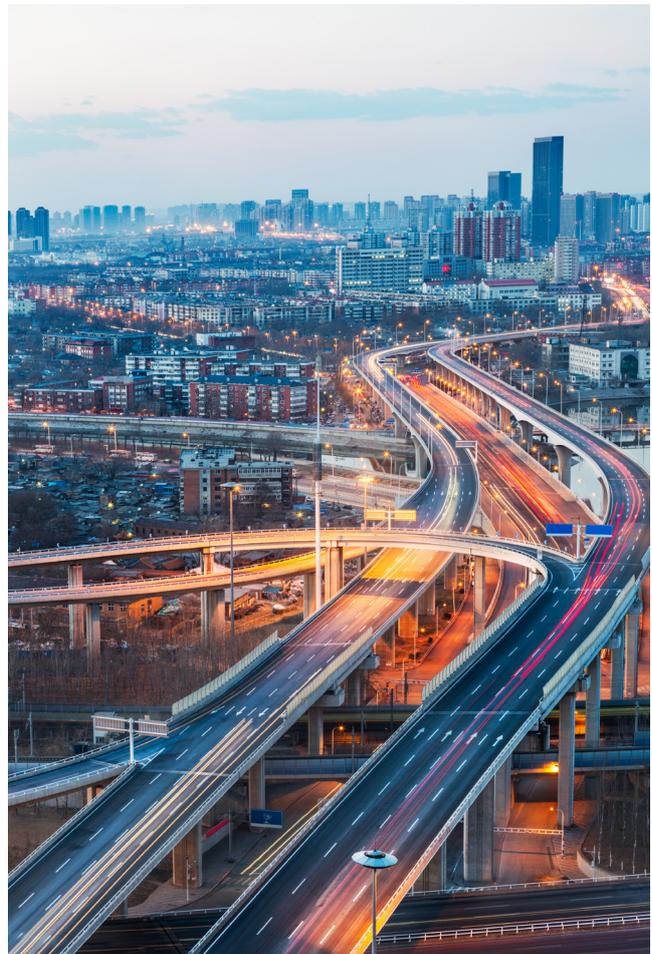
FIGURE 10: "URBAN TRAFFIC VIEW" BY FANJIANHUA LICENSED UNDER CC BY-SA 4.0

→ **Personalised and Predictive Mobility:** Using advanced AI and big data analytics to offer highly personalised travel recommendations, predictive insights into traffic congestion, public transport delays, and charging point availability. This will enable dynamic pricing and demand management, optimising resource allocation across the transport network.

II. Policy Evolution and Cross-Sectoral Synergies

Future policy will aim for:

→ **Deeper Energy-Mobility Integration:** Strengthening the policy nexus between the transport and energy sectors. This is particularly crucial regarding smart charging infrastructure, Vehicle-to-Grid (V2G) capabilities, and the role of EVs as flexible energy storage assets contributing to grid balancing and renewable energy integration. This includes aligning energy and transport infrastructure planning and investment.

→ **Circular Economy for Transport:** Expanding policies to promote the circularity of transport components and materials, moving beyond just battery recycling (as per the Battery Regulation). This includes sustainable materials for vehicle manufacturing, extended product lifecycles, and efficient recycling of all vehicle components.

→ **Data-Driven Policy Making:** Increasingly using real-time mobility data and advanced analytics to inform urban planning, infrastructure investment decisions, and policy interventions. This requires robust data governance frameworks and secure data sharing platforms.

→ **International Cooperation:** Continuing to collaborate with global partners on developing common standards, sharing best practices, and addressing shared challenges in sustainable and digital mobility. This is essential for cross-border transport and for promoting European leadership in green and digital transport solutions globally.

The digital transformation of mobility is not merely a technological upgrade; it is a fundamental shift towards a more sustainable, efficient, and inclusive transport system. The EU's comprehensive policy framework provides the necessary direction, but its success will depend on continuous innovation, sustained investment, and strong collaboration across all stakeholders to realise a truly smart, green, and resilient mobility future for Europe.

For project-specific technical assistance, consult the ELENA (European Local ENergy Assistance) facility or the CIVITAS Initiative for best practices in sustainable urban mobility planning (SUMP) and data-sharing interoperability.

Glossary

Active Mobility
Modes of transport that involve physical activity, such as walking and cycling.

Battery Electric Vehicle (BEV)
A type of electric vehicle that uses only chemical energy stored in rechargeable battery packs, with no secondary source of propulsion.

Battery Passport
A digital record containing information about a battery's characteristics, performance, and lifecycle, introduced by the EU Battery Regulation.

Connected and Automated Mobility (CAM)
Transport systems involving vehicles that communicate with each other and with infrastructure, and that can operate with varying degrees of automation, relying heavily on digital technologies.

Cooperative Intelligent Transport Systems (C-ITS)
Systems that enable vehicles to communicate with each other (V2V) and with road infrastructure (V2I) to improve safety, traffic efficiency, and comfort.

Decarbonisation
The process of reducing carbon emissions, particularly carbon dioxide, from energy sources and industrial processes, crucial for the transport sector.

Digital Automatic Coupling (DAC)
A technology for freight wagons that automates and digitalises coupling operations, enhancing efficiency and safety in rail transport.

Digital Energy Transition
The transformation of the energy sector towards a more sustainable, efficient, and secure system, driven by the integration and application of digital technologies, closely linked to transport electrification.

Digital Twin
A virtual replica of a physical asset, process, or system, used for real-time monitoring, simulation, optimisation, and predictive maintenance in the energy and transport sectors.

Electric Vehicle (EV)
A vehicle that is powered by an electric motor, using energy stored in rechargeable batteries or another energy storage device.

European Green Deal
The EU's overarching growth strategy launched in 2019, aiming to make Europe the first climate-neutral continent by 2050, with transport decarbonisation as a key pillar.

General Data Protection Regulation (GDPR)
An EU regulation (Regulation (EU) 2016/679) on data protection and privacy in the European Union and the European Economic Area, relevant for handling sensitive mobility data.

Intelligent Transport Systems (ITS)
Advanced applications that aim to provide innovative services relating to different modes of transport and traffic management and enable various users to be better informed and make safer, more coordinated, and 'smarter' use of transport networks.

Mobility as a Service (MaaS)
A concept that integrates various forms of transport services into a single mobility service accessible on demand, typically through a digital platform, offering journey planning, booking, and payment.

Smart Charging
The intelligent management of electric vehicle charging processes to optimise grid load, utilise renewable energy, and respond to electricity price signals.

Sustainable and Smart Mobility Strategy
The EU's blueprint for transforming its transport system towards sustainability and smartness, aiming for a 90% reduction in transport emissions by 2050.

Trans-European Transport Network (TEN-T)
A planned network of roads, railways, airports, and water infrastructure in the European Union, designed to facilitate efficient transport across the continent.

Urban Air Mobility (UAM)
The concept of using air vehicles (e.g., drones, eVTOL aircraft) for passenger and cargo transport within urban and suburban areas.

Vehicle-to-Grid (V2G)
A technology that allows electric vehicles to communicate with the power grid to either draw electricity for charging or feed electricity back into the grid, acting as distributed energy storage and a component of smart energy management.

Zero-Emission Vehicles
Vehicles that do not emit any greenhouse gases or pollutants from their exhaust pipe (e.g., battery electric vehicles, hydrogen fuel cell vehicles).

Acknowledgements

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Further Resources

Alternative Fuels Infrastructure Regulation (AFIR)

An EU regulation (Regulation (EU) 2023/1804) setting binding targets for Member States to deploy publicly accessible charging and refuelling infrastructure for alternative fuels.

Battery Regulation

An EU regulation (Regulation (EU) 2023/1542) addressing the entire lifecycle of batteries, including those used in electric vehicles, with provisions for digital battery passports.

Connecting Europe Facility (CEF)

A key EU funding instrument supporting strategic infrastructure investments in transport, energy, and digital sectors.

Digital Decade Policy Programme 2030

The EU's strategic framework for digital transformation, setting targets for connectivity, digital skills, and digital public services, impacting the mobility sector's digitalisation.

European Rail Traffic Management System (ERTMS)

A set of European standards for railway signalling and train control, designed to enhance interoperability, safety, and efficiency across European rail networks.

Recovery and Resilience Facility (RRF)

The EU's key financial instrument under NextGenerationEU, supporting reforms and investments in Member States, with significant allocations for sustainable transport and digital transitions.

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