Sustainable and smart urban transport
Abstract
This study aims to provide the European Parliament’s TRAN Committee with an overview on the state of play of sustainable and smart transport, including recent developments/trends, challenges and opportunities, solutions/good practices and recommendations for EU policy makers. It also considers some recent developments related to the impact of COVID-19.
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<td>AFID</td>
<td>Alternative Fuel Infrastructure Directive</td>
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<td>AV</td>
<td>Autonomous vehicle</td>
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<td>B2C</td>
<td>Business – to - consumer</td>
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<td>BEV</td>
<td>Battery electric vehicle</td>
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<td>BHLS</td>
<td>Bus on High Level of Service</td>
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<td>BRT</td>
<td>Bus Rapid Transit</td>
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<td>CEF</td>
<td>Connecting Europe Facility for Transport</td>
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<td>CF</td>
<td>Cohesion Fund</td>
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<td>C-ITS</td>
<td>Cooperative intelligent transport systems</td>
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<td>CO2</td>
<td>Carbon dioxide</td>
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<td>CVD</td>
<td>Clean Vehicles Directive</td>
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<td>EASA</td>
<td>European Union Aviation Safety Agency</td>
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<td>EC</td>
<td>European Commission</td>
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<td>ECA</td>
<td>European Court of Auditors</td>
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<td>EEA</td>
<td>European Environmental Agency</td>
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<td>EFSI</td>
<td>European Fund for Strategic Investments</td>
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<td>EIB</td>
<td>European Investment Bank</td>
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<td>EIP-SCC</td>
<td>European Innovation Partnership on Smart Cities and Communities</td>
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<td>EIT</td>
<td>European Institute of Innovation and Technology</td>
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<td>EP</td>
<td>European Parliament</td>
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<td>ERDF</td>
<td>European Regional Development Fund</td>
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<td>ESIF</td>
<td>European Structural and Investment Funds</td>
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<td>EU</td>
<td>European Union</td>
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<td>Acronym</td>
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<tr>
<td>EV</td>
<td>Electric vehicle</td>
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<td>FCEV</td>
<td>Fuel-cell electric vehicles</td>
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<td>FUA</td>
<td>Functional urban area</td>
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<td>GDP</td>
<td>Gross domestic product</td>
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<td>GHG</td>
<td>Greenhouse gas</td>
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<td>GPP</td>
<td>Green Public Procurement</td>
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<td>IPCC</td>
<td>Intergovernmental Panel on Climate Change</td>
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<tr>
<td>ITS</td>
<td>Intelligent Transport Systems</td>
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<tr>
<td>LEZ</td>
<td>Low-emissions zones</td>
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<td>LRT</td>
<td>Light rail and tram</td>
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<td>MaaS</td>
<td>Mobility-as-a-service</td>
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<td>MS</td>
<td>Member State</td>
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<td>NCDs</td>
<td>Main non-communicable diseases</td>
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<td>NMT</td>
<td>Non-motorised transport</td>
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<td>NOx</td>
<td>Nitrogen oxide</td>
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<td>O3</td>
<td>Ozone</td>
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<td>PI</td>
<td>Physical internet</td>
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<td>PM</td>
<td>Particulate matter</td>
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<td>PPE</td>
<td>Personal protective equipment</td>
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<td>P&amp;R</td>
<td>Park and ride</td>
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<td>PT</td>
<td>Public transport</td>
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<td>RTTI</td>
<td>Real-time traffic information</td>
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<td>SME</td>
<td>Small medium enterprise</td>
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<td>SST</td>
<td>Sustainable and smart urban transport</td>
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<td>SSMS</td>
<td>Sustainable and Smart Mobility Strategy</td>
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</table>
**SUMP**s  Sustainable urban mobility plans

**TCO**  Total Cost of Ownership

**TEN-T**  Trans-European Transport Network

**UCC**  Urban consolidation centre

**UIA**  Urban Innovative Actions

**UMP**  Urban Mobility Package

**UN**  United Nations

**UVAR**  Urban Vehicle Access Regulation

**WHO**  World Health Organisation

**ZEV**  Zero-emissions vehicle

**ZEZ**  Zero-emissions zones

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EXECUTIVE SUMMARY

KEY FINDINGS

• Recent trends and developments indicate a growing user-centric approach to mobility, prioritising individual needs and interests of users. Disruptive emerging technologies and shared mobility solutions bring new actors to the urban ecosystem. COVID-19 changed behaviours, with walking, cycling and private car use increasing. E-commerce demand has increased significantly, and contactless solutions are still the preferred ones.

• The EU defines policies and develops tools to consistently tackle sustainable and smart transport (SST) challenges at EU level, in compliance with the principle of subsidiarity.

• Challenges are still related to the high levels of congestion, CO2 emissions, noise and air pollution, but also ensuring sustainable deployment of new disruptive technologies. Coordination between different key stakeholders and accessibility for all are considerable challenges in the digital era.

• As for the solutions, there are still some barriers to overcome, but also an extensive list of related opportunities.

• Recommendations focus on more integrated planning between the sectors, modes and (extra) urban areas; better governance mechanisms to improve policy coordination; evidence-based policymaking to ensure the benefits outweigh the costs, and a better blending of funds to support research and deploy innovation.

Main developments and trends

The last few years have seen a considerable change in the trends in passenger and freight transport, mainly due to disruptive emerging technologies (automation and urban air mobility, e.g. drones) and increase of micro-mobility solutions and shared mobility.

A more user-centric approach has been spreading, focusing on individual needs and preferences. This implies significant changes in mobility, transport network and traffic management. Transport infrastructure, vehicle technologies and digitalisation have been progressively improving, while the movement of people and deliveries of goods and services are expected to increase continuously. There is a growing trend, although not yet widespread, of a shift from vehicle ownership to shared mobility solutions. The use of zero-emissions or low-emissions vehicles for the last mile, mainly due to the car-free centre/environmental zones policies, is also increasing, although still limitedly.

COVID-19 affected the use of public transport and shared mobility services during, after and between lockdowns, as citizens prefer(red) private vehicles such as cars and bicycles, but also walking. Regarding freight distribution, this has proven to be an essential service during the
lockdown, providing food and goods to households. In the wake of new habits established during the lockdown, e-commerce is likely to keep growing.

The evolution of urban mobility trends will depend on the evolution of the pandemic, the pre-COVID-19 situation of each city and country, and on policies that will be promoted at the European, national and local level. There is an opportunity to continue promoting sustainable modes and allocate more city space for that purpose.

**Challenges and opportunities**

Urban mobility accounts for 40% of all CO2 emissions of road transport and up to 70% of other pollutants from transport. Air and noise pollution cause physical and mental health issues. Every year, dozens of thousands of citizens get killed in road accidents in the EU¹.

Besides generating traffic, private cars occupy a large part of the urban space, which is already increasingly scarce to the growing trends of urbanisation.

Freight movement is expected to grow significantly and change its configuration, also because of the changing purchasing habits caused by the COVID-19 pandemic.

The transport network, primarily the road network, suffers from congestion during peak hours. As the population grows, dynamic and flexible network management can accommodate the rising demand for travel and goods. New technologies can address challenges of interoperability and coordination of traffic management systems via integrated and interconnected services.

As for governance, different decision making bodies and institutions are involved from the international to the local level, but different authorities manage functions at the same time. Their articulation and coordination is a key challenge.

The trans-European network (TEN-T) and urban nodes are vulnerable and need further connectivity. Infrastructure improvements and cybersecurity protocols can make the system more resilient and prevent cyber attacks.

**New Mobility Solutions**

Public transport operators have started integrating and offering new mobility solutions, based on the Mobility-as-a-Service (MaaS)² approach. Several solutions and business models have been tested and adopted, such as on-demand ride-sharing services, peer-to-peer vehicle rental, taxi services, ride-sharing, and B2C vehicle short term rentals. Micromobility solutions include e-mopeds, (e-)bicycles, e-scooters.

As for access regulation and space design/management, car-free city centres are increasing. Restrictive measures imposed during the lockdown have shown that more space can be made available for walking and cycling, and it is up to local authorities to keep up with it also in the long term. Cities are reducing parking spaces and creating mobility hubs where it is possible to access a variety of shared services like electric car, bike and e-scooter sharing.

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² MaaS is a concept promoting the combination of different transport services into one single mobile platform.
Several cities are implementing low-emissions and zero-emissions zones, to accelerate the perspective demand for electric vehicles and charging infrastructure.

Automation and drones are still being experimented and are not common practice yet, as some issues related to regulation, safety, and security, still need to be adequately defined.

Innovative solutions for the last mile delivery vary from urban consolidation centres to parcel lockers. Pilots have demonstrated that in areas with a high receiver density and a fragmented demand, micro-depots and cargo bikes can be used efficiently.

Enhanced cooperation between metropolitan areas and stakeholders along the TEN-T network can align and better integrate planning activities, as well as generate new concepts and benefits for the integration of urban nodes along the TEN-T network.

Data collection, management and sharing principles are fundamental for evidence-based policymaking. This requires cooperation between different data providers and data-sharing protocols and principles agreed between city planners, transport operators, new mobility solutions providers, etc.

**Recommendations for EU policy-makers**

Research outcomes outline the strategic advantage of deploying a more integrated planning between sectors, modes and (extra) urban areas. In order to be effective, EU policy action in this domain should promote and be based on:

- Enhanced integrated planning of urban transport with extra-urban areas, and participatory policy planning approach steering behaviour change;
- Improved (multi-level) governance cooperation mechanisms to facilitate a continuous dialogue and policy coordination among EU, national and local levels;
- Appropriate cost-benefit analyses accompanying the introduction of any new transport measure, and integrating other sectors such as health, social inclusion, economic development, land-use planning, energy;
- Better use and blending of funds, including the complementary use of different funding lines, for example by requiring that applicants for funds for a specific programme clarify how these would be strategically integrated with previously used or allocated funds;
- Striking the appropriate balance between environmental, economic feasibility, and social equity criteria for new transport solutions;
- Introducing innovative tools and schemes (technological and non) to integrate passenger and freight, encourage the definition of data-sharing principles and the use of common EU standards and specifications;
- Promoting and funding the implementation of the most effective transport-related measures positively impacting the health of the citizens;

The EU can steer behaviour change and coordinate the response of local authorities and stakeholders, using the COVID-19 challenge as an opportunity for a new transport paradigm, in line with the European Green Deal targets. This can be done by strengthening existing policies and consolidated tools, as in the case of the COVID-19 Sustainable Urban Mobility Plan (SUMP) Practitioner Briefing, endorsed by the EC.
1. MAIN DEVELOPMENTS AND TRENDS IN EU SUSTAINABLE AND SMART URBAN TRANSPORT

KEY FINDINGS

- Urbanisation and motorisation continue to question the transition towards sustainable and smart urban transport systems.
- There has been a paradigm shift among service providers to provide user-centric approaches to transport, leading to new business models and services, such as shared mobility, micromobility and Mobility-as-a-Service.
- Demand has risen for zero-emission vehicles in the passenger market, though there is still uncertainty in the heavy-duty vehicles market.
- E-commerce practices have become more sophisticated, combining different consolidation and distribution strategies to innovate the retail sector.
- Digitalisation technology and big data analytics are pervading the transport sector, increasing process efficiency while enabling new innovative services.
- New traffic management systems coupled with disruptive vehicle technologies, such as automated vehicles and urban air mobility (drones), are being explored for niche transport segments.
- The COVID-19 pandemic has disrupted the gradual progression of mobility and logistics trends.
- These rapid developments and trends pose major challenges to the European transport sector, and should be anticipated together with stakeholders in the transport policy framework.

This section provides an overview of sustainable and smart urban transport (SST) in the EU, describing the state of the art in terms of main developments and trends characterising the sector. It also takes into account the significant impact of the current COVID-19 pandemic on the transport sector, establishing a “new normal” and creating both additional barriers and opportunities to sustainable and smart transport.

Urbanisation in Europe is an ongoing phenomenon and is expected to continue for the foreseeable future in line with the global urbanisation trend. In 2018, around 70% of the EU population resided in urban areas — comprising cities, towns and suburbs. Further, it is estimated that urban areas are responsible for generating over 85% of EU GDP. While there are certainly benefits to the high concentration of employment opportunities and economic activity with the urban area, it remains a challenge to ensure accessibility for freight and passenger transport.

When urbanisation is coupled with motorisation, particularly of private passenger and freight road vehicles, it directly causes several negative traffic impacts, such as congestion, deterioration of road

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5 https://ec.europa.eu/eurostat/web/products-eurostat-news/-/EDN-20200207-1
6 https://ec.europa.eu/transport/themes/urban/urban-mobility/urban-mobility-package_en
safety, air pollution and emissions of greenhouse gases. The negative effect of motorisation can be seen when comparing the social cost of passenger automobile use in the EU (around €500 billion per year) with the social benefits of cycling and walking (around €24 billion and €66 billion per year, respectively7).

Furthermore, there has been growing awareness of the fact that cities need to ensure social inclusion as well as accessibility, which has been included within European policy with the European Accessibility Act8, which requires consideration of accessibility for products and services. The new requirement poses a challenge to the current urban transport system, but offers opportunities for certain SST solutions to flourish.

In recognition of many of the benefits and the urgency for implementing and driving forward SST, EU policy has been developed to foster actions that stimulate the adoption of new mobility solutions and new sustainable urban mobility approaches. A deeper analysis of the state and influence of EU policy is provided in section 2.

Many technological and service innovations have been adopted by the EU urban transport sector in recent years, affecting trends in both passenger and freight transport. Several of these developments are discussed next.

**A key trend is the paradigm shift among service providers towards developing and providing user-centric approaches to transport.** The user-centric approaches are “at the heart of new mobility services and Mobility as a Service (MaaS), as well as the individual needs and wishes of citizens” 9. The so-called **new mobility, shared mobility and micromobility concepts** are among the most debated new transport service innovations at the moment, if only because they are easily visible on the streets. At the core of these services is the (very) short notice and short term rental of vehicles, usually complementing main public transport services within dense urban areas. The vehicles range from slow modes, such as electric-scooters and bicycles, to cars. The vehicle owners may be fleet operators or other individuals offering Peer-to-Peer sharing.

Similarly, **MaaS is a concept promoting the combination of different transport services accessible for booking and purchase from a single platform.** This greatly simplifies the usability and navigation of the diverse transport services in the urban transport system from the user’s perspective. It can be used to promote more sustainable transport options, such as public transport in combination with cycling or new mobility services.

In response to growing pressure for climate-friendly solutions and better air quality, there has also been a strong trend towards promoting and sales of zero-emissions vehicles, especially serving the passenger car market. Despite the general increase in the sales of electric vehicles10, the availability of **electric heavy duty vehicles** is still poor in Europe11 and prices remain prohibitive for public procurers such as local and PT authorities In order for electric vehicles and other alternative fuels

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(e.g. hydrogen) to be fully deployed, an extended, reliable and interoperable **charging infrastructure network** is required, and the use and intelligent management of clean energy.

On the freight and logistics side, e-commerce practices and acceptance is rapidly growing, even up to the offer of **instant delivery**. Especially noticeable during the COVID-19 outbreak, e-commerce increased to even higher levels, as the public was encouraged to practice social distancing. To strive for improvements in efficiency and delivery quality, various consolidation and distribution strategies and approaches have been developed, such as home delivery, use of collection/pick-up points, or so-called crowdshipping, which is a form of peer-to-peer delivery service.12

The transport business as a whole has also reaped benefits from the improvement of **digitalisation technology and big data analytics**. According to the EC, this combination has the potential to change the way cargo and traffic flows are organised and managed, identify new business opportunities, and plan for innovation, new services and business models13. Digitalisation brings a set of challenges and opportunities to public transport and transport networks, and enables a different planning approach for cities as well (e.g. Digital Twins14). Several digitally-driven solutions are emerging for parking data, providing drivers (or autonomous vehicles) with real-time local parking information15, and for the optimization of public transport by means of machine learning that maps ridership in real time, with a 99% accuracy rate16, etc. Machine learning is a tool that can support optimization and seamless multimodal mobility solutions.

Furthermore, Europe is currently exploring the potential of **Cooperative Intelligent Transport Systems (C-ITS)** to support city authorities to manage the transport network and influence travel behaviour more efficiently and safely, namely through the provision of static and real-time information services and integrated payment schemes.

Finally, there are potentially very disruptive innovations, such as automated vehicles, drones and **urban air mobility**, which are being explored as solutions for very niche transport demands. It is important that research and testing of potential applications estimate the impacts, positive and negative, that these new technologies have on the whole system, in order to inform decision makers of the relative advantages and disadvantages of their introduction.

These cutting edge smart transport solutions can support the transition towards sustainable and liveable cities. However, they must also be carefully planned and designed together with stakeholders to ensure a coherent urban transport system with public transport as serving as its main backbone. Furthermore, for each of these innovations, the debate on their role in and benefit to the urban transport system is still open. Nevertheless, it can be expected that there are no predefined optimal solutions, and that their effectiveness and their positive impacts depend on tailored policy packages responding to each specific context, which presents different characteristics and needs.

As the COVID-19 pandemic disrupted the expected development of urban mobility trends worldwide, it is important to understand both its impact during the prolonged crisis, as well as the

14 A Digital Twin is a digital replica of a complex real-world urban environment and represents the different processes, actors and their interaction. This approach is useful to test new measures and anticipate their impacts prior to actually implement them.
15 [https://www.parkbob.com/](https://www.parkbob.com/)
16 [https://www.webreathe.fr/](https://www.webreathe.fr/)
prospective effects after the crisis has subsided. Hence, the next section presents an overview of the impact of COVID-19 observed in the main developments and trends mentioned.

What changes with COVID-19?

On 11 March 2020, the World Health Organisation (WHO) declared COVID-19 a global pandemic. The pandemic has greatly impacted a number of different economic sectors, including transport, travel and mobility. The emergency has obliged several governments to prohibit unnecessary mobility circulation, and to adapt the mobility of essential workers and goods in order to safeguard health and contain the spread of the virus. Authorities and transport operators all over the world had to act quickly and find rapid and efficient solutions to guarantee safe mobility. All of these measures have had a significant impact, perturbing the traditional assets of mobility (e.g. roads, kerbside, sidewalks, public transport and shared mobility services), and shaping new trends which triggered a change in people’s mobility habits.

The most significant change in travel behaviour, which had an impact not only on mobility but on people’s lives during the lockdown period, was staying at home and therefore working remotely, when possible. As a result, it has been observed that access to public transport stations dropped by almost -70% in Europe, and there were global reductions of CO2 emissions ranging from 8% to 75%, depending on the city17.

With the core concern being physical distancing, several transport authorities limited the occupancy of vehicles in order to enforce safe distances between people. For example, Milan and Barcelona reduced occupancy to a maximum of 25% and 50%18, respectively, Ireland to 20%19, and Portugal to 66%20. Passengers were obliged to wear personal protective equipment (PPE). Regarding demand management, no substantial challenge was identified during phase 21 due to the fact that in many countries passengers were limited to essential workers or specific categories, while all others were required to stay home and telework, where possible.

Altogether, this had a major impact on public transport systems, which saw a drop of 40% to 90% in trips between February to March 202022. Figure 1 illustrates the changes in mobility trends for selected countries. Here, it is possible to observe that with the lifting of lockdown measures, these countries have been slowly returning to their previous mobility patterns. At the time when restrictions across Europe were almost totally lifted (September 2020), some countries were still quite far from the baseline. Others countries, such as France were above the baseline23, which refers to February and therefore does not consider the increased movements due to summer holidays. However, when looking at the situation of the end of October 2020, these trends prove to be volatile and dependent on the new (softer) lockdown measures, as well as on the arrival on the winter season. In fact, the drop of the movements is quite evident and homogeneous in all the countries report.

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20 https://www.visitportugal.com/nl/node/421175
21 Phase 1, or epidemic phase, consisted of national lockdown measures, which in many European countries have meant an almost total closure of non-essential commercial activities and a reduction in people’s freedom of movement. Phase 2 consists of a progressive reduction of the containment measures of phase 1. For an overview of global lockdowns click here.
23 This behavior could be also attributed to summer holiday travel, deferred trips, such as shopping for non-essential items, visiting relatives, running errands, doctor visits etc. - and not directly an effect of COVID-19.
Figure 1 – Mobility trends - Change in routing requests since January 13, 2020

- Italy
- The Netherlands
- France
- Sweden

Walking, Driving, Public Transport

It is noticeable that people’s mobility behaviour is changing, safety has become a priority when travelling and there is significantly less demand for mobility due to the current “working from home” policies and flexible hours. To reduce the pressure on public transport and avoid physical contact, cities have been implementing measures to provide additional space for walking and cycling. Several cities have narrowed certain roads to aid social distancing on the sidewalks, and to create temporary reserved lanes for bicycles, the so-called pop-up bike lanes. Sales of bicycles and cargobikes have increased almost everywhere.

**Micromobility services** (bike sharing, scooter sharing, etc.) have been severely impacted during the lockdown but while some have disappeared, others have managed to increase their ridership during the post lockdown phase. Lime stopped its services in 23 out of the served 30 countries, and Uber (Jump) and Bird (Circ) stopped their operations in almost all European countries\(^{24}\). Contrary to this, Budapest\(^{25}\) introduced temporary nearly-free fares for their MOL Bubi bike sharing service, but only for the first and stricter lockdown phase. According to a study by Shotl and Mobility Institute Berlin\(^{26}\), on-demand services quickly recovered and by July 2020 had reached 87 % of the pre-crisis level in the province of Barcelona, while PT recovered much more slowly, reaching only 45 % of the pre-crisis level.

Regarding **urban freight distribution** and **e-commerce**, the primary critical issue related to the lack of staff and inventory, due to reduced or cancelled production during the lockdown. However, movements of goods have not stopped. In particular, the growth of online shopping in many countries during lockdown led to a rise in deliveries within the cities, increasing the number of goods delivering vehicles. In Paris, although around 75% of B2C delivery companies reported a drop in activity, the increase in e-commerce, in particular for the food sector, has reached a rise between 10% and 40% compared to pre-crisis levels. Bpost, the Belgian company responsible for postal services, recorded a sharp increase in parcel deliveries compared to the pre-quarantine situation (+ 60% all types of sectors combined)\(^{27}\).

The trend is one where online shopping continues to grow, resulting in the significant accretion and penetration into previously unconquered customer segments. 51% of Belgians\(^{28}\) who have bought food online for the first time during lockdown say they will continue to do so after the pandemic. The delivery of parcels is partly shifting from home (in pre and during lockdown) to automatic lockers, preferred by both logistics service providers and consumers\(^{29}\) for contactless delivery methods.

The pandemic has also fostered a boost in the use and implementation of contactless solutions for public transport-related operations, e.g. ticketing\(^{30}\) and for deliveries\(^{31}\). The use of autonomous vehicles for the delivery of supplies to hospitals and drones, and to provide goods to nearby villages, increased in China and USA\(^{32}\).

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\(^{29}\) [https://www.capgemini.com/research/the-last-mile-delivery-challenge/](https://www.capgemini.com/research/the-last-mile-delivery-challenge/)


\(^{32}\) [https://www.weforum.org/agenda/2020/03/three-ways-china-is-using-drones-to-fight-coronavirus/](https://www.weforum.org/agenda/2020/03/three-ways-china-is-using-drones-to-fight-coronavirus/)
2. **THE EU POLICY CONTEXT AND DEBATES**

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<th>KEY FINDINGS</th>
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<tr>
<td>• The EU defines policies and develops tools to consistently tackle SST challenges at EU level. Transport is a shared competence between the EU and the Member States, implying the subsidiarity principle. Urban mobility regulation is essentially a local responsibility.</td>
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<tr>
<td>• There are sectors requiring direct action at European level, which cannot be replaced by initiatives at national or sub-national levels. In these cases, the EU has the right to intervene through legislation, in particular directives and regulations.</td>
</tr>
<tr>
<td>• In addition to defining policies and legislation, the EU has been financing research, scientific development and deployment of transport innovation.</td>
</tr>
<tr>
<td>• Funds allocated by the Horizon programmes are intended for research &amp; innovation projects. Other funding lines, such as the Connecting Europe Facility for Transport (CEF) and structural funds (ERDF and Cohesion funds), are available for solutions’ implementation, in particular for infrastructural improvements.</td>
</tr>
<tr>
<td>• From 2007-2013 to 2014-2020, urban transport has experienced an increase in dedicated structural funds, rising from 8.2 to 12.5 billion and representing 18% of the total.</td>
</tr>
<tr>
<td>• The EC facilitates the aggregation of cities, industry and academia through the establishment and support of long-lasting exchange and research communities and platforms, such the CIVITAS Initiative, the European Innovation Partnership on Smart Cities and Communities (EIP-SCC), and the European Institute of Innovation and Technology (EIT) for urban mobility.</td>
</tr>
</tbody>
</table>

This section describes the current EU strategies, policies and legislation, as well as tools and funding resources in place to help develop sustainable and smart urban transport. This mainly focuses on initiatives and projects developed by the European Commission and related bodies, reflecting on the multi-level governance system characterising the transport sector.

2.1. **Urban transport in EU**

The transport sector in Europe has several social, economic and environmental implications. Urban areas in Europe host around 70% of the EU population\(^{33}\) and generate over 85% of EU GDP\(^ {34}\). It is estimated that 84% people in Europe will live in urban areas by 2050\(^{35}\). Congestion produces inefficiencies generating losses of around 80 billion euros per year\(^ {36}\). European cities are facing daunting problems in meeting air quality legal standards\(^ {37}\). In recent years, pressure on national governments and the EU to reduce global warming has turned environmental issues into a priority, although this remains closely connected to the other two.

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\(^{33}\) Share of population in cities, towns and suburbs according to Eurostat: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/EDN-20200207-1

\(^{34}\) https://ec.europa.eu/transport/themes/urban/urban-mobility/urban-mobility-package_en


In 2016, more than 70% of passenger journeys were performed by car, and car trips represented 81% of the passenger-kilometres travelled in the EU-28, while road freight transport accounted for almost 73% of all tonne-kilometres driven. In 2017, the transport sector generated 27% of total EU-28 greenhouse gas (GHG) emissions, with road transport being accountable for approximately 72%. Of these road transport-related emissions, 44% were from passenger cars, 9% from light commercial vehicles, and 19% came from heavy-duty vehicles. The EU’s overall goal set out in the 2011 White Paper is to reduce greenhouse gas emissions from transport by 2050 to a level that is 60% below the one registered in 1990. However, data shows that instead of decreasing, emissions from transportation are increasing. In 2017, CO2 transport-related emissions increased by 2.2% compared to 2016. Road passenger transport is expected to grow by 16% during 2010-2030 and 30% during 2010-2050, while road freight transport will increase by 33% by 2030, and 55% by 2050. This will have a direct negative impact also on air pollution, road transport being one of Europe’s main sources, unless the transition to zero-emission vehicles is accelerated, combined with clean and renewable energy sources and the improvement and optimisation of the transport network.

2.2. European actors, strategies, policies and legislation

The European Green Deal, released by the EC in December 2019, aims at making Europe the first climate-neutral continent by 2050. For it to succeed, it must be supported by ambitious and concrete action plans with well-defined targets, and should be integrated with other policies at national and local level. Measures introduced at national, regional and local levels need to be coordinated to have a positive impact on the EU transport system, energy dependence and climate change – in line with the provisions of the Green Deal. New jobs creation and a sustainable urban development are other elements directly influenced by the development of mobility in urban areas, where public authorities play a crucial role to reduce congestion and pollution by introducing regulation and incentives for clean vehicles, active travel, shared mobility and public transport. The European Union is investing a considerable amount of resources into sustainable and smart urban mobility. For the 2014-2020 period, it injected some €16.5 billion of structural funds directly or indirectly affecting urban transport, mainly for modal shift towards metro and tramway, cycle paths and intelligent transport systems. Nevertheless, according to a recent report from the European Court of Auditors (ECA), there has been no significant reduction in private car usage, while air pollutants in many cities still exceed EU standards. Auditors claim that “no substantial improvement is possible without Member States’ commitment and further EU coordination”.

46 European Court of Auditors. 2019. Special report 06/2020: Sustainable Urban Mobility in the EU: No substantial improvement is possible without Member States’ commitment
47 https://www.eea.europa.eu/themes/air
2.2.1. European strategies and policies

The EU addresses transport challenges in comprehensive transport policy documents such as, for example, the 2011 White Paper on Transport. During the last two decades, urban transport began to gain interest at the European level, so much so that the EC began to introduce policies, guidelines and tools to support local authorities in its planning and organisation. Transport is a shared competence between the EU and the Member States, implying the subsidiarity principle. Urban mobility regulation is essentially a local responsibility. This potentially hinders the elaboration of common solutions between cities, which might be conveniently tailored towards different urban contexts, and produces a single market fragmentation risk when it comes to Intelligent Transport Systems (ITS), access regulations and discriminatory practices. For this reason, European funding, guidance, research, innovation, good practice exchange and capacity building activities represent effective means in the hands of the EC and Member States to support coordination of local policies and measures, and pave the way to positive outcomes. To facilitate the adoption of a more common approach, the EC encourages cities to develop a long-term vision and objectives for urban mobility. To improve the multi-level governance of urban development, the Urban agenda for the EU deals with the urban dimension of the EU, and with national policies and legislation. It focuses on concrete priority themes within dedicated Partnerships, set-up around 12 priority themes with European and urban relevance, including urban mobility, air quality, public procurement, circular economy, etc.

Regarding the legacy of EU strategies and policies on urban transport, the EC Communication on the Future Development of the Common Transport Policy (1992) represented the first attempt to address the transport sector through a policy-integrated approach and focussed on the sustainability dimension. Urban transport, in particular passenger transport at regional and local level, emerged as a new target in the EU common transport policy, associated with a new role for the EC as research funder and facilitator of exchange of best practice experience. The Citizens’ Network, released in 1995 and 1998, were the first European policy proposals in the area of urban mobility, aiming at exploring and exchanging best practices.

In 2000, the EC launched the CIVITAS initiative, which still exists and supports the development of innovative projects on clean urban transport, in particular, supports to reduce the use of private cars and develop solutions in three directions: demand management measures, the integration of urban transport services, and the promotion of low and zero emissions vehicles. In 2001, the EC launched the White Paper on Transport European Transport Policy for 2010: Time to Decide. This document addressed the rationalisation of urban transport, setting two objectives: on the one hand, establishing a new regulatory framework for alternative and sustainable fuels, also to encourage the use of alternative and renewable energies; on the other hand, promoting the exchange of good practices to optimise the use of public transport and existing road infrastructure.

In 2007, the EC adopted the Green Paper Towards a new culture for urban mobility, which aimed to identify measures to improve the quality of collective transport, increase the use of clean and energy efficient technologies, and to promote walking and cycling and protect the rights of 48

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48 Its legal basis is Article 5(3) of the Treaty on European Union (TEU): “Under the principle of subsidiarity, in areas which do not fall within its exclusive competence, the Union shall act only if and in so far as the objectives of the proposed action cannot be sufficiently achieved by the Member States, either at central level or at regional and local level, but can rather, by reason of the scale or effects of the proposed action, be better achieved at Union level”.

49 https://ec.europa.eu/futurium/en/urban-agenda


51 The CIVITAS Initiative is a European action supporting cities across Europe to test and implement innovative and integrated strategies to achieve energy, transport and environmental objectives - www.civitas.eu
public transport passengers. In this document, the EC referred to the integrated planning of passenger and freight transport together, and to participatory planning through the involvement of citizens and stakeholders. Intelligent transport systems (ITS) and (joint) green procurement were identified as tools capable of improving efficiency of movements and operations, and boosting the deployment of clean vehicles.

The Freight Transport Logistics Action Plan (2007) further developed the urban dimension of freight and logistics, in particular for the last-mile operations. In particular, the EC stressed the importance of sharing good practices and standards, at the same time defining common benchmarks and performance indicators at the European level to measure the efficiency and sustainability of urban freight solutions. Furthermore, the importance of integration not only between passengers and freight transport, but also between interurban (long-distance) and urban networks, was encouraged.

Based on the results of the consultation on the Green Paper of 2007, in 2009 the EC adopted the Action Plan on urban mobility, which for the first time presented a comprehensive support package of 20 measures in the field of urban mobility. This stressed the importance of urban areas as efficient interconnection points for the TEN-T network and places for well-organised last mile movements. Action 1 introduced the concept of Sustainable Urban Mobility Plans (SUMP), aiming to cover all types of transport. The Plan aimed to find new ways for improving and sharing data collection and statistics for urban transport and mobility (Actions 16 and 17).

In 2011, the EC released The White Paper on Transport, currently under evaluation in order to prepare the elements for a Strategy for a Sustainable and Smart Mobility (see below)\textsuperscript{52}. At present, the White Paper defines the priorities of the EC for transport in Europe. It sets a 10-year roadmap of 40 initiatives for the next decade to build a competitive transport system to increase mobility, foster growth and employment, reduce Europe's dependence on imported oil, and cut carbon emissions in transport by 60\% by 2050. It sets ten goals, three of which are related to urban mobility, namely: 1) halve the use of ‘conventionally fuelled’ cars in urban transport by 2030, and phase them out in cities by 2050; 2) achieve essentially CO2-free city logistics in major urban centres by 2030; 3) move close to zero fatalities in road transport by 2050, whilst halving road casualties by 2020.

In 2013, the EC released the Urban Mobility Package (UMP) Together towards competitive and resource-efficient urban mobility\textsuperscript{53}. The UMP addresses initiatives 31, 32 and 33 of the 2011 White Paper (i.e. Urban mobility plans; an EU framework for urban road user charging; a strategy for near-zero-emission urban logistics' 2030). It provides an overview of possible actions, including working documents on access regulations, urban logistics, urban road safety and urban ITS. It also released the SUMP Guidelines for local authorities (updated in 2019\textsuperscript{54}). The central element of the UMP is the Communication "Together towards competitive and resource efficient urban mobility", which encourages the establishment of coordination mechanisms between the public and private sector. It also stresses the need for coordinated deployment of urban ITS and the importance of urban nodes, considered the “starting point or the final destination (first/last mile) for passengers and freight moving on the TEN-T network”. The role of urban nodes is defined in the TEN-T guidelines (2013)\textsuperscript{55}, currently under evaluation and fitness check aimed at providing evidence base for a

\textsuperscript{52} https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/2080-Evaluation-of-the-2011-White-Paper-on-Transport


\textsuperscript{55} https://ec.europa.eu/transport/themes/infrastructure/ten-t_en
possible revision of the current TEN-T policy framework, and inform any further decisions on the
development of legislation in this area. 56 The Communication also defined the future scope of
action of the EU-funded CIVITAS initiative, which focuses on “tackling urban road congestion,
reducing the use of conventionally-fuelled vehicles in urban areas, reducing transport impacts and
costs, and strengthening the capacities of local authorities to develop and implement sustainable
urban mobility plans”. The new version of the SUMP guidelines (2019) takes into account the
significant developments (technological and non-technological) in recent years, and contains a
series of topic guides addressing specific aspects of urban transport. See factsheet on SUMP's
chapter 4.7 for further information on the SUMP. Based on the provisions of the UMP, in recent
years the EC commissioned various studies dedicated to deepening the priority topics of its
policies. Between 2017 and 2018, studies57 were published on: 1) innovative ways of sustainably
financing public transport, 2) urban logistics, 3) Urban Vehicles Access Regulations, 4) accessibility
of urban areas and 5) data collection and analysis of active modes use and infrastructure in Europe.

The European Green Deal (2019) is a strategy that includes a series of measures to make energy
production and the lifestyle of European citizens more sustainable for the environment. The
European Union has committed, in line with the 2015 Paris Agreement, to zero its net
polluting emissions by 2050, as a contribution to limiting the increase in global warming, which
according to the estimates of the Intergovernmental Panel on Climate Change (IPCC) of the UN
must remain within 1.5 °C compared to the pre-industrial era. The measures will consist of new
legislation and investments which will be implemented in the next thirty years. The Green Deal will
be financed through public and private resources. In the first ten years, the goal will be to mobilise
around 1,000 billion euros58.

For each objective of the Green Deal, the EC will first define a “strategic plan” and then a concrete
“action plan” to implement it. The measures will be of a different legislative nature: the most
important will be directives, i.e. legislation setting out a goal that all EU countries must achieve,
and regulations, i.e. a binding act to be applied in its entirety across the EU59. For example, by June
2021 the EC plans to revise the legislation on CO2 emission performance standards for cars and vans60.

As for transport, the European Green Deal includes a target to reduce transport-related greenhouse
gas emissions by 90% by 2050, and establishes that the EC will “ensure a clear pathway from
2025 onwards towards zero-emission mobility” by, inter alia, revamping the European agenda
for sustainable urban and regional mobility, including cycling, intermodal transport and on-
demand transport. The EC intends to adopt a “comprehensive strategy to meet this target and
ensure that the EU transport sector is fit for a clean, digital, and modern economy”. This is called
Sustainable and Smart Mobility Strategy (SSMS), and was presented on 9 December 2020. The
objectives of the strategy include 1) increasing the uptake of zero-emission vehicles, 2) making
sustainable alternative solutions available to the public and businesses, 3) supporting digitalisation
and automation, and 4) improving connectivity and access. The initial SSMS roadmap acknowledges that a fair and functioning internal market for transport is still not a reality. Adding
to the global nature of the challenges posed by climate change and the COVID-19 pandemic, it
claims that coordinated EU action is needed to supplement and reinforce national and local action.

57 https://ec.europa.eu/transport/themes/urban/studies_en
60 European Commission. 2019. The European Green Deal. COM/2019/640 final/
2.2.2. European legislation

Although regulatory interventions on urban mobility are generally considered a local competence, there are sectors needing direct action at European level and that cannot be replaced by initiatives at national or sub-national levels. This is the case of issues relating to the development of the internal market, such as the automotive, communications industry, or some technologies that require compatible and interoperable standards. In these cases, the European Union therefore has the right to intervene through legislation, in particular directives and regulations.

The ITS Directive⁶¹, currently under review, aims to encourage the development of innovative transport technologies to deploy intelligent transport systems. This objective is pursued by introducing common EU standards and specifications, which aim to establish interoperable and efficient ITS services. EU countries must ensure that the relevant specifications adopted by the EU are applied. However, individual EU countries and cities have the right to decide on which systems to invest in and on the use of such applications and services in their territory. The possible revision of current specifications for EU-wide real-time traffic information (RTTI) services⁶² addresses interoperable payment and ticketing, information on charging and refuelling points, access to in-vehicle data, continuity of traffic management services, etc. Once in place, this legislation will require local and transport authorities to establish systematic procedures to supply transport data to a national data point⁶³.

In the upcoming years, the EC will revise two provisions potentially supporting a carbon-neutral and emission-free road transport in Europe: the TEN-T guidelines and the Alternative Fuel Infrastructure Directive (AFID)⁶⁴. This is an opportunity to align their revisions, together with the UMP, so that the integration and interdependence between sectors extends uniformly to the TEN-T network and in particular in the stressed nodes, such as metropolitan areas, railways, ports, airports, logistics hubs, etc.

These closely follow the revision of the Clean Vehicles Directive (CVD, 2009/33/EC)⁶⁵, adopted by the European Parliament and Council in June 2019, aiming to promote clean mobility solutions in public procurement tenders and thereby boost the demand and deployment of clean vehicles. The Directive provides a definition for clean vehicles and sets national public procurement targets, which for buses will range from 24% to 45% in 2025, and from 33% and 66% in 2030 – depending on a country’s population and GDP. For trucks, the targets are much lower, ranging from 6% to 10% by 2025 and from 7% to 15% by 2030. The public procurement share for clean cars and vans was set between 18.7% and 38.5%. Until 2025, clean light vehicles are defined as cars or vans emitting less than 50gCO2/km. From 2026, only zero-emissions vehicles (0gCO2/km) will be considered clean light vehicles and count towards the targets. This means that European legislators take into account the evolution of the market, gradually adapting the definition of clean vehicle according to the category and the period. The more time passes, the more stringent the definition becomes, to the point of considering clean vehicles only those with zero emissions. This is consistent with

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the EC energy union package\textsuperscript{66}, which plans action on the further decarbonisation of road transport, in line with the 2030 climate and energy targets. In order to facilitate the procurement process, the EC has recently published the final \textbf{EU Green Public Procurement (GPP) criteria for road transport}\textsuperscript{67}. The GPP criteria aim to help contracting authorities in their purchase of green vehicles and road transport services. They provide a useful basis for establishing standards for vehicles used in product and service delivery as well.

In 2019, the European Parliament and the Council adopted two important regulations to reduce CO\textsubscript{2} emissions of vehicles circulating in Europe. The \textbf{Regulation on reducing CO\textsubscript{2} emissions from heavy-duty vehicles}\textsuperscript{68} sets a legally binding 30\% reduction target for the average fleet emissions of new trucks by 2030. An intermediary target of 15\% is set to be achieved by 2025. Zero and low-emission vehicles should reach a 2\% share of manufacturers sales by 2025. In 2022, the Commission will propose new post-2030 targets. Similarly, the \textbf{Regulation on CO\textsubscript{2} emission performance standards for cars and vans}\textsuperscript{69} require CO\textsubscript{2} emissions of new cars in 2030 to be 37.5\% below the targets for 2021. For new vans, the reduction target is fixed at 31 \% by 2030. The intermediate reduction targets for 2025 is 15 \% for both.

The \textbf{Eurovignette Directive}\textsuperscript{70}, introduced in 1999, aimed to achieve fair infrastructure charging mechanisms. In 2017, the EC adopted the proposal for a Directive amending it. The general objective of the proposed revision is to promote sustainable transport from an environmental and social point of view through a broader application of the “user pays” and “polluter pays” principles. The adoption of the revised version of the Directive is expected by the end of 2020.

The new \textbf{Directive on road infrastructure safety management}\textsuperscript{71} amends Directive 2008/96/EC. It requires regulators to take into account vulnerable users in road safety management procedures. EU countries will be required to carry out a network-wide assessment of the roads covered by the new law, at least every five years, to evaluate accident risk and to take further measures.

\section*{2.3. EU research and funding perspectives}

In addition to defining policies and legislation, the EU has been financing research, development and deployment of transport innovation for decades. The type, mechanisms and scope of the different funding programmes vary considerably. Some are managed directly by the EC and other European bodies, which autonomously decide which transnational initiatives are to be financed in order to ensure strategic exchange and coordination. Others are managed at regional and national level, to improve specific local situations, and are subject to agreement with the EC. Table 1 presents the EU transport budget allocations for the 2007-2020, broken down per funding instrument.

2.3.1. Horizon 2020, Green Deal call, Horizon Europe

**Horizon 2020 (H2020)** is the European Research and Innovation programme for which nearly €80 billion have been allocated for European research activities for the 2014-2020 programming period. H2020 will be followed by the new programme Horizon Europe (2021-2027), currently under definition.

One of the seven thematic areas of H2020 is dedicated to **Smart, Green and Integrated Transport**. The objective of H2020 is to create a transport system making efficient use of resources, which is environmentally friendly and safe.

A budget share of 8.2% (€6.3 billion) was allocated to the transport sector. To date, 300 million euros have been allocated to 52 urban transport projects, corresponding to approximately 4.7% of the total H2020 transport budget. This figure only considers projects under the sub-call **Mobility for Growth (MG)**, having the urban dimension of transport as their main target. Other sub calls such as **Automated Road Transport (ART)** and **Green Vehicles (GV)** are not considered, although in many cases they include urban issues among their research objectives. The budget is allocated every two years via a biannual Work Programme. In addition, all research projects dealing with urban mobility are coordinated under the umbrella of the **CIVITAS Initiative**, created in 2000 by the EC to support the development of innovative projects on clean urban transport and establish synergies and cooperation among them.
On 17 September 2020, the EC published the topics of the next H2020 call dedicated to the Green Deal, worth nearly €1 billion. The new call aims to finance projects demonstrating how research and innovation can provide concrete solutions for the main priorities of the Green Deal. In particular, the call will finance pilot applications, demonstration projects and innovative products; innovations for better governance of the green and digital transition; social and value chain innovation. The call is structured around 11 areas. Number 5 focuses specifically on green airports and ports as hubs for sustainable and smart mobility. Number 1 also touches upon urban transport in relation to Climate Neutral cities, while number 10 addresses behaviour change and tools enabling citizens to act on climate change and environmental protection, including mobility-related actions.

Built in the wake and continuity of H2020, Horizon Europe, the research & innovation programme for the seven-year period 2021-2027, presents some new elements. Unlike H2020, the new program does not dedicate a thematic area to transport, but groups it together with energy and climate thematic areas instead. Therefore, urban mobility will be presumably tackled in the Climate, Energy and Mobility cluster, one of the five clusters of Horizon Europe’s Pillar 2 Global Challenges and Industrial Competitiveness. This section of the program supports “research relating to societal challenges, reinforces technological and industrial capacities”, and sets EU-wide missions tackling the EU key challenges. Each mission is a mandate to solve a pressing challenge in society within a certain timeframe and budget. At the end of June 2020, five possible missions were proposed by the mission boards, one of which in particular has to do with urban transport: 100 climate-neutral cities by 2030. In their report, the “mobility revolution” is defined as the “main challenge of this mission”.

The EU institutions reached a provisional agreement on Horizon Europe on 20 March 2019, endorsed by the European Parliament on 17 April 2019. However, the agreement does not cover the programme’s budget details, being part of the negotiations on the 2021-2027 multiannual financial framework (MFF) which took place on 17-20 July during the EU Council summit. The EC had originally proposed a budget of €94.4 billion for the programme. The EP raised the stakes, arguing that a budget of about €120 billion is necessary to achieve the set objectives, but the budget was cut down to €80.9 (€75.9 billion plus an additional €5 billion from the proposed boost of the pandemic recovery fund) during the EU Council summit in July 2020: this means Horizon Europe’s financial envelope had decreased by more than 15% as compared to the EC’s proposal of May 2020 (€80.9 from the traditional common budget and €13.5 from the new recovery fund), and was one third lower than the figure proposed by the EP. Nevertheless, there is still no yet a final outcome. The mid-November 2020 negotiations between EP and the Council led to a further €16 billion budget increase for the EU flagship programmes. This increase consists of €15 billion for sectors like health, research and Erasmus+, to protect citizens from the COVID-19 pandemic, provide opportunities to the next generation, and preserve European values. It also conveys €1 billion to provide for increased flexibility to address future needs and crises. In the intention of the the Parliament, at the forefront on this proposal, a legally binding roadmap to introduce Own

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80 Mission Board on Climate Neutral and Smart Cities. 2020. Report "100 climate-neutral cities report .pdf by 2030 - by and for the citizens".
Resources during the next seven years would ensure that additional funds are made available\textsuperscript{83} The new compromise needs to be endorsed by both institutions.

2.3.2. Structural, Recovery and other funds

The H2020 Work Programmes are specifically intended for research & innovation projects. Other funding lines, such as the Connecting Europe Facility for Transport (CEF), structural funds, European Investment Bank (EIB) grants (ELENA\textsuperscript{84}, JASPERS\textsuperscript{85}, and JESSICA\textsuperscript{86}), are available for the implementation of projects, in particular infrastructure improvements. InvestEU\textsuperscript{87} is the programme that in the EU budget 2021-27 will bring together all the EU financial instruments. The programme was established on the basis of the experience of the Juncker Plan and the European Fund for Strategic Investments (EFSI)\textsuperscript{88}, supporting investment in key sectors through financial guarantees. The EU intends to facilitate access to finance and guarantees and to promote investments for competitiveness, sustainable growth, social resilience and inclusion. The new Commission proposal increases the share of guarantees to over 75 billion euros, considering the crisis generated by the COVID-19 pandemic. Financing operations include sustainable and smart urban transport projects. Some examples of funded projects are EU support for electric mobility in South Eastern Europe through the rental of electric cars and the construction of a network of charging stations; and the development of intelligent and multifunctional bus stops\textsuperscript{89}.

Connecting Europe Facility (CEF)\textsuperscript{90} provides financial support for strategic investment in transport, energy and digital infrastructure. Transportation related goals consist of eliminating bottlenecks and building missing links on the TEN-T networks; ensuring sustainable and efficient transport systems; and improving accessibility to transport infrastructure, including urban nodes, seaports and airports. Project proposals for carrying out specific studies and actions are presented to the EC by one or more Member States or by other bodies with their consent. Strategic management of the program rests with the EC’s DGs Transport, Energy and Connect, while operational responsibility rests with the INEA Agency. The European Investment Bank manages the guarantee and financial support instruments.

The European Structural and Investment Funds (ESIFs)\textsuperscript{91} includes the Cohesion Fund (CF)\textsuperscript{92}, supporting projects reducing economic and social disparities and promoting sustainable development in 15 cohesion Member States, and the European Regional Development Fund (ERDF)\textsuperscript{93}, aiming to strengthen economic and social cohesion in the European Union by correcting imbalances between its regions. About 50% of the ERDF resources have been allocated to urban areas. This could increase even further, later in the period. Around 10 billion euros from the ERDF will be directly allocated to integrated strategies for sustainable urban development. Whereas Horizon funding is directly allocated by the EC, the ESIFs are jointly managed by the EC and the EU countries in a decentralised way: the EC and the Member States develop Partnership Agreements at the national level, and Operational Programmes at the regional level. The funds are

\textsuperscript{84} https://www.eib.org/en/products/advising/elena/index.htm
\textsuperscript{85} https://jaspers.eib.org/
\textsuperscript{86} https://www.eib.org/en/products/blending/jessica/index.htm
\textsuperscript{87} https://europa.eu/investeu/home_en
\textsuperscript{89} https://europa.eu/investeu/projects_en
\textsuperscript{90} https://ec.europa.eu/transport/themes/infrastructure/cef_it
\textsuperscript{91} https://ec.europa.eu/contracts_grants/funds_en.htm
\textsuperscript{92} https://ec.europa.eu/regional_policy/en/funding/cohesion-fund/
\textsuperscript{93} https://ec.europa.eu/regional_policy/en/funding/erdf/
then managed by responsible authorities in each Member State. In addition, cities have some funding at their disposal to implement integrated strategies for urban development. The INTERREG program is co-funded by the ERDF with a €10.1 billion budget. Its main objective is to improve regional development policies through the exchange of experiences and good practices already identified at European level. ERDF also promotes the Urban Innovative Actions (UIA), with €372 million for 2014-2020 to test new and unproven solutions to address urban challenges. The URBACT programme, funded with €96.3 million for 2014-2020, enables cities to develop integrated solutions improving urban policies by networking, learning from one another’s experiences, and identifying good practices.

To better support the losses expected for the transport sector due to the COVID-19 pandemic, the EC prepared a proposal to give additional support to the EU’s faster recovery. This foresees a temporary reinforcement of the EU’s 2021-2027 budget via a new recovery instrument – Next Generation EU. A Recovery and Resilience Facility of €672.5 billion94 will provide grants and loans to implement Member States’ national recovery and resilience plans supporting green, digital transitions and the resilience of national economies.

As can be noticed in Table 3, urban transport is a sector gaining increasing importance. From 2007-2013 to 2014-2020, in fact, it experienced an increase in dedicated ERDF and Cohesion funds, rising from 8.2 to 12.5 billion euros representing 18% of the total (compared to 10% of the previous period). The substantial decrease (-16%) of the total ERDF and Cohesion funds dedicated to transport – from €81.8 to €68.5 billion – must be contextualised in the diversification and expansion of EU programmes: €11.3 billion from the Cohesion fund was transferred to the CEF fund, which did not exist before and now accounts for €24 billion. Therefore, the funds for infrastructural interventions for transport have increased overall. Regarding the CEF, however, there is a further consideration to be made: in the 2014-2020 period, the total CEF-transport budget amounted to €24 billion of which €300 million was allocated to urban nodes, that is to projects with a focus on urban transport. This corresponds to approximately 1.25%, well below the share attributed to the urban dimension of transport by the ERDF and Cohesion (18%) and H2020 (4.7%) funds, respectively.

Figure 3 - ERDF and Cohesion Fund budget allocations by transport sector for 2007-2020 (€ billion)

<table>
<thead>
<tr>
<th>Sector</th>
<th>2007-2013</th>
<th>% of total</th>
<th>2014-2020</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road</td>
<td>42.6</td>
<td>52%</td>
<td>40.0</td>
<td>44%</td>
</tr>
<tr>
<td>Rail</td>
<td>23.1</td>
<td>28%</td>
<td>18.6</td>
<td>27%</td>
</tr>
<tr>
<td>Urban transport</td>
<td>8.2</td>
<td>10%</td>
<td>12.5</td>
<td>18%</td>
</tr>
<tr>
<td>Ports</td>
<td>3.2</td>
<td>4%</td>
<td>2.0</td>
<td>3%</td>
</tr>
<tr>
<td>Multimodal transport</td>
<td>1.8</td>
<td>2%</td>
<td>2.2</td>
<td>3%</td>
</tr>
<tr>
<td>Intelligent transport</td>
<td>1.0</td>
<td>1%</td>
<td>2.1</td>
<td>3%</td>
</tr>
<tr>
<td>Inland waterways</td>
<td>0.4</td>
<td>1%</td>
<td>0.7</td>
<td>1%</td>
</tr>
<tr>
<td>Air</td>
<td>1.6</td>
<td>2%</td>
<td>0.4</td>
<td>1%</td>
</tr>
<tr>
<td>Total transport</td>
<td>81.8</td>
<td>100%</td>
<td>68.5</td>
<td>100%</td>
</tr>
</tbody>
</table>

Source: European Court of Auditors95

95 European Court of Auditors. 2019. Special report 06/2020: Sustainable Urban Mobility in the EU: No substantial improvement is possible without Member States’ commitment
The ERA-NET Cofund Urban Accessibility and Connectivity (ENUAC) supports transnational projects that create challenge-driven innovation and research for sustainable urban passenger mobility, freight, transport and connectivity. The LIFE programme is the EU financing instrument for the environment and climate action, including urban initiatives. The current funding period 2014-2020 has a budget of €3.4 billion.\(^96\)

### 2.3.3. European urban mobility communities

In addition to the CIVITAS Initiative, the EC facilitates the aggregation of cities, industry and academia through the establishment and support of long-lasting exchange and research communities and platforms.

The European Innovation Partnership on Smart Cities and Communities (EIP-SCC)\(^97\) is a major market-changing undertaking supported by the EC bringing together cities, industries, SMEs, investors, researchers and other smart city actors. Its activity is developed around clusters, i.e. groups of partners working on specific issues related to smart cities, by sharing the knowledge and expertise with their peers; these identify Smart Cities-related projects, and group them under long-term initiatives pertaining to each cluster. The first SCC call was launched in 2014, and 14 projects have been funded so far in five calls, for a total EU contribution of around €300 million, including 40 lighthouse cities and 53 follower cities.\(^98\)

The European Institute of Innovation and Technology (EIT), a body of the EU, launched in 2019 the Innovation Community on Urban Mobility\(^99\) aimed at creating a European hub for the development of innovative technologies and solutions to rethink urban spaces and improve sustainable mobility. EIT Urban Mobility aims to accelerate this transition by gathering key players in the urban mobility field (cities, businesses, universities and research centres) and encouraging them to work together and develop innovative solutions for the mobility challenges that cities are facing. The action will last seven years and involves investments of 1.6 billion euros, with a maximum of 25% financed by the EIT. There are 48 partners involved: 13 cities, 17 automotive and ICT companies, and 18 universities and research centres. These are spread across five Innovation Hubs in Europe: Innovation Hub South (covering France, Greece, Italy, Spain, Portugal); Innovation Hub West (Belgium, France, The Netherlands, United Kingdom); Innovation Hub North (Denmark, Germany, Sweden, Finland, Estonia, Latvia, Lithuania, Poland, Norway, Iceland); Innovation Hub East (covering Czech Republic, Germany, Hungary, Israel, Poland, Romania, Serbia, Slovakia); and Innovation Hub Central (covering Germany, Italy, Switzerland, Turkey).

### 2.4. Policy Debates comprising sustainable and smart transport

This section summarises and presents the positions of the major European associations dealing with urban mobility. They display long-term experience in interacting with European institutions, towards which they represent the views of the various stakeholders, public and private, active in the urban transport ecosystem. Consequently, their positions regarding the priorities and the solutions to achieve a smart and sustainable urban transport system can vary considerably. It is the

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\(^97\) [https://eu-smartcities.eu/](https://eu-smartcities.eu/)

\(^98\) The lighthouse cities are cities that have to come already with a developed implantation plan. The follower cities can then adapt the plan and use a model that then could be further replicated. Source: [https://energypost.eu/europe-aims-to-have-300-smart-cities-next-year/](https://energypost.eu/europe-aims-to-have-300-smart-cities-next-year/)

\(^99\) [https://www.eiturbanmobility.eu/](https://www.eiturbanmobility.eu/)
task of the European decision-makers to combine them and find a compromise, creating a fair and productive policy exchange environment for a balanced regulation.

**Polis is the leading network of European cities and regions working together to develop innovative technologies and policies for local transport.** It contributes to EU policy and legislative initiatives in the field of transport that may have an impact at the local and regional level. Polis argues that city-level policy is becoming increasingly important, given the multi and cross-sectorial impact of sustainable urban mobility actions on different dimensions, like reducing CO2, achieving improvements in the field of air quality, reducing traffic jams and road safety risks, improving quality of life, and public health. A steady increase in urban transport demand is expected. At the same time, the dividing lines between public and private are blurring, and there’s an expanding role of the private sector in mobility and logistics service provision. Therefore, this paradigm change of urban mobility systems requires a role change for public authorities. However, according to Polis, public interest must lead, and cities must set the rules. Through public-private partnerships, cities gain leverage, and in turn the private sector has long term stability to grow and consolidate viable and profitable business and operational models. In an open letter to the new Members of the European Parliament (MEPs) Polis identifies five areas of action for their mandate, including 1) Tackle air quality and noise pollution, 2) A proper consideration of walking and cycling benefits in policy making, 3) Cleaner, safer vehicles adapted for the urban environment, 4) New governance models to regulate innovation, and 5) Championing investments in quality public transport.

**ERTICO is the Intelligent Transport Organization (ITS) that promotes research and defines ITS industry standards at European level,** connecting public authorities, industry and infrastructure operators, users and national ITS associations. ERTICO supports the widespread deployment of a new generation of cooperative, connected and personalised mobility services in complex urban environments. ERTICO promotes the harmonisation of tools for the interconnection and integration of transport systems, mobility data and related services which enable the so-called “plug-and-play city”. ERTICO’s goal is the total integration of MaaS by 2030, and it is to this end that it supports its urban mobility roadmap through projects and platforms developing innovative and attractive solutions. To make the exponential implementation of the MaaS possible, with the ultimate aim of offering an ever-growing pool of users the “sustainability as a profitable service”, ERTICO supports a city-business partnership framework including new organization and business cases. To achieve such partnership, ERTICO is working on guidelines and the framework for MaaS deployment and interoperability.

**UITP (International Union of Public Transport) is the worldwide network that brings together all the public transport stakeholders** and all the sustainable modes connected to it. The ultimate goal of UITP is to guarantee public transport the primary role of “backbone” of all mobility services. In 2019, UITP presented its priorities for EU policy 2019-2024, describing concrete actions to implement their EU Mobility Manifesto and achieve a modal shift to sustainable public transport. With this list, UITP aims to help EU decision makers improve mobility and the quality of daily life for all European citizens by achieving a modal shift to sustainable public transport. UITP calls on EU decision makers to recognise the major role public transport plays in our lives and cities. This list of actions is based on the four priorities: 1) ensure mobility is on top of all relevant new EU policies; 2)
prioritise an urban shift in the EU budget for mobility investments; 3) secure public transport’s role as the backbone of all mobility services; and 4) guarantee a tailor-made legal framework to keep mobility on top. As regards research and innovation, European programmes should support new technologies and the application of artificial intelligence and new propulsion technologies to mobility services, as well as promote their digitisation.

**IRU is the world’s road transport organisation, representing bus, coach, truck and taxi.** In recent years, IRU has expressed its members’ perspective on some specific issues for a smart and sustainable urban mobility sector; worthy of note is undoubtedly the theme of UVARs. IRU supports the creation of a binding legal framework at European level which deals with the introduction of new UVARs and which ensures the effective functioning of the existing ones. Regarding the deployment of MaaS, IRU argues that transport operators must be able to choose the MaaS systems they want to join. Furthermore, MaaS operators should be registered in the country in which they operate and should be controlled by public authorities, given that they manage local markets. The obligation to verify the satisfaction of requirements of all operators should be introduced. Public authorities should draw up a ranking of the various transport options on the basis of objective and transparent criteria; furthermore, the contractual responsibility of the MaaS operators for the effective provision of the mobility service and for their role as guarantors of the rights of passengers must be established, as well as the protection of commercial data, which must be strictly kept in undisclosed archives, ensuring timely information to operators on the use and reuse of their data.

**ACEA is the European Association of Automobile Manufacturers, and represents - more specifically - the 16 major manufacturers of cars, vans, trucks and buses in Europe.**

Regarding the debate on smart and sustainable mobility, ACEA has drawn up a position paper containing the 10 key priorities that European transport policies must commit to after 2020. Sustainability policies must find a compromise between reducing environmental impact and maintaining European competitiveness. Furthermore, policy development must be evidence-based, in particular when it comes to the comparison of the efficiency of the various modes of transport. According to ACEA, data and statistics are largely scarce in the area of transport policy, offering only a partial and often misleading overview. The presence of measures relating to road transport which diverge between the various governance levels (national, regional, local) cause the fragmentation of the market and the impediment of the effective functioning of the single market. Social, technical, safety and market regulations should therefore be implemented harmoniously within all EU Member States. Neutrality and competition between the various technologies could stimulate development and innovations capable of producing zero - or at least very low - CO2 emissions. New vehicles need the support of modern road infrastructures, the promotion of efficient use of roads, the internalisation of external costs and the construction of new safe and guarded parking lots. The policies supporting multimodality must also facilitate the development of innovative business models such as MaaS (Mobility as a Service) and LaaS (Logistics as a Service), ride pooling and car sharing.

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103 [https://www.iru.org/resources/iru-library/iru-position-urban-vehicle-access-regulations-eu-cities](https://www.iru.org/resources/iru-library/iru-position-urban-vehicle-access-regulations-eu-cities)
104 [https://www.iru.org/resources/newsroom/iru-adopts-position-mobility-service](https://www.iru.org/resources/newsroom/iru-adopts-position-mobility-service)
105 BMW, CNH, DAF, Daimler, Ferrari, FIAT, Ford, Honda, Hyundai, Jaguar, PSA, Renault, Toyota, Volkswagen, Volvo
The European Cyclists' Federation (ECF) is a federation that brings together about 60 associated organizations in 37 different countries to promote cycling as a sustainable and healthy means of transportation and recreation\textsuperscript{107}. Since 1983, ECF has been committed to promoting and encouraging the use of bicycles inside and outside Europe, introducing cycling policies at European level, supporting cycle tourism as a sustainable economic factor, enhancing a culture that favours environmentally friendly mobility, including bicycles as a health factor and the improvement of urban road conditions to ensure the safety for the most vulnerable users of the road\textsuperscript{108}. Today, an EU member state is under no obligation to adopt a national plan for cycling, and there are no mandatory legal or financial frameworks. According to ECF, national governments can contribute to the implementation of cycling policies in local areas in many ways, primarily by establishing a national policy framework or strategy that sets the legal and regulatory tools for safe and efficient cycling while providing financial aid, especially for bicycle infrastructure and the development of the cycling sector. To reduce the number of fatalities and accidents involving cyclists, it is essential to tighten up safety-related behavioural rules and provide safety-oriented infrastructure. The promotion of the use of bicycles must therefore be supported by a global vision in terms of urban planning. The urban reorganisation of a city must take into account the accessibility not only by cars or public transport, but also bicycles; and it must be compulsory to provide parking facilities for bicycles within the new commercial and residential centres. In 2017, ECF released the EU Cycling Strategy, providing “recommendations for delivering green growth and an effective mobility in 2030”\textsuperscript{109}.

WALK 21 is the international charity dedicated to guaranteeing the right to walk, a right they encourage for everyone and around the world. Their priorities\textsuperscript{110} can be summarised in the desire to formalise a global network of “walking cities”, extending this project to horizons such as Latin America, Asia and Africa. Fundamental in this sense is the development of the resources necessary for the implementation of “foot projects”, supporting all the action teams involved and encouraging the so-called “sidewalk challenge”, consisting in the construction of 100,000 km of new sidewalks.

Transport & Environment (T&E) is a European non-governmental organisation operating in the transport and environment sector collaborating with 63 members and supporting organisations operating in 24 countries. It deals with the promotion of sustainable transport in Europe. As regards the position of T&E within the debate on smart and sustainable mobility, in 2019 a study was carried out\textsuperscript{111} which highlights how the industry and governments of the European Union have allocated a fund of 60 billion euros to be used for the production of new electric vehicles, a sum 19 times higher than that allocated the previous year (3.2 billion euros), thus competing for global leadership with China. According the research, the electric vehicle market is growing, and the increase in investment over the past year has generated an unprecedented boom in electric vehicle sales in Europe in early 2020. The success of the electric car market therefore seems to be Europe’s best industrial policy today, and policy makers should contribute by instituting “bailout plans” to support a green recovery that prioritises electric vehicles production. Finally, T&E points out, to allow Europe to lead global electric mobility, EU policy-makers should

\textsuperscript{107} https://ecf.com/who-we-are/our-mission
\textsuperscript{108} https://ecf.com/news-category/position-paper
\textsuperscript{109} https://ecf.com/what-we-do/eu-cycling-strategy
\textsuperscript{110} https://www.walk21.com/about
\textsuperscript{111} https://www.transportenvironment.org/press/record-%E2%82%AC60bn-investment-electric-cars-and-batteries-europe-secured-last-year
review CO2 reduction targets for cars by 2030, and the EU should also ensure that, starting from 2035, only zero emission models can be sold in Europe.
3. CHALLENGES AND OPPORTUNITIES OF SUSTAINABLE AND SMART URBAN TRANSPORT

KEY FINDINGS

- The disproportional space used by private vehicles in cities hinders the development of other modes of transport, namely public transport, walking and cycling.
- Accessibility issues are related to people with disabilities, gender inequality, digital inequality, and the income divide.
- Freight movement is expected to grow dramatically and change its configuration, also because of the changing purchasing habits caused by the COVID-19 pandemic.
- The transport network, primarily the road network, suffers from congestion during peak hours. As the population grows, dynamic and flexible network management is required to accommodate the increasing demand for travel and goods.
- Urban mobility accounts for 40% of all CO2 emissions of road transport and up to 70% of other pollutants from transport, with a negative impact on the environment and global warming.
- Air and noise pollution cause physical and mental health issues for residents. Every year, thousands of citizens are killed in road accidents in the EU.
- Several decision-making bodies and institutions are involved from the international to the local level, but different authorities manage functions in parallel.
- If introduced based on purely business-oriented models, Intelligent Transport Systems, automated vehicles, drones, MaaS etc. are likely to have negative effects on the overall performance of the system, whilst they positively impact the system if operated in a framework aligned with sustainable mobility goals.

This section describes the challenges facing the current urban transport environment in relation to achieving EU targets, and the related opportunities for intervention to foster the development of a more sustainable and smart transport system. These are articulated around eight main dimensions of SST, which are interconnected and require a strategic interest and the clear competence of European policy-makers.

3.1. Mobility and accessibility of passengers

The disproportional space used by private vehicles in cities hinders the development of other modes of transport, namely public transport, walking and cycling. Of primary concern are the needs of people with disabilities and subject to gender inequality, digital inequality, and the income divide. New mobility paradigms and Sustainable Urban Mobility Plans implementation can overturn the traditional priority scale.

According to recent studies, urban environments have reached a peak in car spread. Cities need to implement sustainable urban mobility strategies and actions having multiple impacts.

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such as reducing CO2 emissions, achieving improvements in the field of air quality, reducing traffic jams and road safety risks, improving quality of life, and public health. The planning exercise should be no longer limited to making the road network more efficient, but also ensuring accessibility of citizens and companies to places and activities. Although it is difficult to define the most efficient criteria for distributing road space among different transport modes, which cannot simply reflect the modal split, it is estimated that private cars remain parked for 92%-96% of their lifetime, which represents an inefficient use of resources and of urban space. Many cities have set modal share targets for balanced and sustainable transport modes like non-motorised modes (cycling and walking) and public transport. Measures should avoid and contain the demand for motorised transport and prioritise public transport and active travel, and support the deployment of clean and alternative fuels. This requires a more efficient use of road and urban space, applying multimodal design and access regulation.

Multimodality is greatly dependent on individual choices; however, the existence of certain infrastructure and services help people to combine modes of transport and swiftly pass from one to the other mode. In the vast majority of cities and towns in Europe, road infrastructure for motorised vehicles is existing and well-maintained, while other modes, namely walking and cycling, are often left behind in terms of dedicated or adapted infrastructure. The analysis of the challenges and the potential solutions should consider movement of people rather than vehicles, in line with the SUMP concept, thus enabling these soft modes to be on a more equal footing, and the benefits and costs added to the analysis. This gives the opportunity for new business models and service concepts for public transport, cycling and even walking to address the last-mile connectivity in a multimodal and integrated perspective.

A recent report from the European Court of Auditors (ECA) found “no indication that EU cities are fundamentally changing their approaches and that there is no clear trend towards more sustainable modes of transport”. Among the factors affecting the effectiveness of the EU policy efforts for more sustainable urban mobility, “cities display difficulties in developing coherent policies in the areas of parking, traffic-free zones and cycling.”

Gender-related differences, such as physical and social characteristics, result in inequalities in mobility opportunities. A recent report from the UK highlights that, whilst women are motivated to travel actively for health reasons, worries about their personal safety, convenience and appearance are all barriers to preventing them from cycling and walking. Women walk and use public transportation more than men, therefore their needs in terms or accessibility of vehicles, destinations and trajectories of PT, and safety and security are crucial issues to be considered.

People with disabilities are vulnerable users at risk of social exclusion. There are many barriers that hinder accessibility to key destinations and services, including the use of PT.

114 Nello-Deakin S. 2019. Is there such a thing as a ‘fair’ distribution of roadspace?, Journal of Urban Design
117 European Court of Auditors. 2019. Special report 06/2020: Sustainable Urban Mobility in the EU: No substantial improvement is possible without Member States’ commitment.
118 As an example, the EC declared 2018 the “Year of Multimodality”, to underline the importance of proposing a range of transport alternatives to citizens, who must be facilitated in choosing the right mix.
119 Sustrans. 2018. Are We Nearly There Yet? Exploring Gender and Active Travel
120 CIVITAS. 2014. Policy Note: Smart choices for cities: Gender equality and mobility: Mind the gap!
Although mobility services and infrastructures are becoming more and more common in Europe, services are not flexible enough to adapt to the needs and time requirements of disabled people\textsuperscript{121}. Furthermore, inclusion often depends on the behaviour and awareness of other users. A research investigating the challenges disabled people face when it comes to PT accessibility found that one in four disabled people do not use PT due to negative attitudes from other passengers\textsuperscript{122}. Although a SUMP objective is to “ensure that all citizens are offered transport options that enable access to key destinations and services”\textsuperscript{123}, people with disabilities are only mentioned twice in the guidelines – and a dedicated topic guide does not exist\textsuperscript{124}. The increased demand for these services due to the aging population can provide a boost to the systematic consideration of these users, who must also be actively involved in the identification of needs and in the design of solutions, as is happening in some European projects\textsuperscript{125}.

The digital divide and diversity between and within urban areas represent a challenge for local authorities, which should understand the needs of various vulnerable user and social groups, and consider the different needs of neighbourhood-level and peri/sub-urban level in order to support social and economic inclusion. Local authorities must also prevent gentrification processes when redeveloping an area, for example by introducing car-free measures. This is happening in various European cities, and is pushing the poorest people in society to the edge of the city\textsuperscript{126}. New transport solutions involving social innovation and ICT tools provide the opportunity to raise the level of accessibility, inclusiveness and equity of mobility.

### 3.2. Freight movements and logistics performance

The economic system and the different services within a city depend on a properly running logistics system. This in turn strongly relies on urban infrastructure and transport network performance. Freight movement is expected to grow dramatically and change its configuration also because of the changing purchasing habits caused by the COVID-19 pandemic.

Urban freight represents 15-20\% of vehicular traffic in cities\textsuperscript{127}, generating 30\% of road occupancy and 50\% of greenhouse gas emissions in cities\textsuperscript{128}. Cities are changing and so are freight customer demands. Consequently, the freight industry has adapted\textsuperscript{129}, featuring new trends:

- Customer demand: e-commerce, instant deliveries;
- Technology supporting the industry: clean fuel (including electric vehicles - EVs), telematics, use of real-time data;
- Business models and operations: internet ordering, ‘omni-channel’, near-sourcing, port-centric logistics;
- Fragmentation of supply chains: growth of number of vans;
- Higher political profile for freight, also because of safety issues (fatal accidents).

\textsuperscript{121} Transformative Urban Mobility Initiative (TUMI). 2019. Disability Inclusive Public Transport
\textsuperscript{122} https://www.scope.org.uk/campaigns/independent-confident-connected/
\textsuperscript{123} CIVITAS. 2019. Practitioner briefing. Parking and sustainable urban mobility planning.
\textsuperscript{124} https://www.eltis.org/mobility-plans/topic-guides
\textsuperscript{125} INCLUSION project: http://h2020-inclusion.eu/inclusion-pilot-labs/; TRIPS project: https://trips-project.eu/
\textsuperscript{128} Austrian Mobility Research, FGM-AMOR (2013). SMARTSET - A European project to improve the attractiveness of terminals and to reduce the energy consumption of goods transport in the city (Deliverable 7.3). SMARTSET project.
\textsuperscript{129} Wainwright I. 2015. Sustainable delivery and servicing - Lessons from London. Presentation at the UK Network Management Board. Friday 9th January 2015
The sector suffers from a substantial fragmentation: there are many professional operators that offer third party delivery services and many who, on the other hand, operate on their own. There is a large number of polluting and oversized vehicles compared to the actual demand. The strong presence of own account small operators makes it more complex to coordinate and reorganise the industry. Another issue comes from the organisational policies adopted by retailers. Because of the rising price of real estate in city centres, they want to maximise the area dedicated to sales and minimise storage needs: as a consequence, they pursue just-in-time (frequent deliveries of products) and zero stock (small quantities to minimise warehouse costs in the city centre) strategies, which can result in low vehicle load factors and a consequent increase of negative externalities caused by the sector. The fragmentation in loads and trips is accentuated by the recent expansion of e-commerce and instant deliveries, further accelerated by the COVID-19 lockdown, contributing to the increase in the number of deliveries and in terms of environmental impacts, and adding new types of soft modes (cargo-bikes, scooters) for freight movements. Empty returns represent a significant cost too for both transport companies and the community. In addition, the outdated freight vehicle fleet causes a high level of air and noise pollution.

Local authorities have recently developed a growing, yet probably marginal, awareness of the crucial role urban freight measures play within the overall urban mobility system. They should aim at balancing two apparently conflicting elements: a freight distribution system effectively and efficiently responding to market demand, and a satisfactory environmental sustainability level. The sector cannot be neglected, since it generates social and environmental costs for the community; on the other hand, excessive restrictions, regulations or taxation would lead to a reallocation of resources elsewhere, and ultimately to the deterioration of the city’s economy. It is therefore necessary to identify measures that could solve this trade-off by maximising the efficiency of the services and freight deliveries and minimising the number of trips and the derived environmental impact. Policy-makers need to conceive, develop and implement policy packages accounting for all the heterogeneous and conflicting preferences and interests that various stakeholders display in this complex environment. Digitalisation and new generations of freight vehicles offer the opportunity to rationalise and improve the performance of the sector. Technological and organisational innovations, such as Augmented reality and Digital Twins, blockchain and Physical internet (PI) will allow an even greater integration of the supply chain, with significant benefits in terms of last mile logistics services.

Due to the COVID-19 pandemic, home and instant delivery are growing with an excess of demand that the current offer is struggling to meet due to the lack of workforce in the specific segment. Inversely, given the reduced demand for mobility services, some startups and operators are diversifying their revenue streams by using their passenger vehicles for delivery services, which in the long run could lead to further integration of the urban transport system. Increased demand also requires new spaces for more frequent stops of logistics operators and further digitalisation. In this regard, further development of “contactless” delivery of goods to final consumers is needed to minimise the risk of contagion and increase efficiency.

130 http://tda-mobility.org/zero-emission-freight-vehicles/  
132 A Digital Twin is a digital replica of a complex real-world urban environment and represents the different processes, actors and their interaction. This approach is useful to test new measures and anticipate their impacts before actually implement them.  
133 Smart contracts offered by blockchain technology can support more efficient and secure collaboration among logistics players, and enable PI deployment. PI aims at realising full interconnectivity (information, physical and financial flows) of several (private) freight transport and logistics services networks and make them ready to be seamlessly usable as one large logistics network.
3.3. Transport network performance

The transport network, primarily the road network, suffers from congestion during peak hours. As the population grows, there is the need for dynamic and flexible network management in order to accommodate the increasing demand for travel and goods.

Congestion is responsible for negative economic effects: the costs of congestion in Europe correspond to about 1% of the annual gross domestic product (GDP), and costs to society are around €270 billion a year. Each European citizen spends on average between 18 and 39 hours per year stuck in traffic (depending on the country). Rome and Paris are the European cities where a person squanders most of the time stuck in traffic: 166 and 165 hours per year, respectively. Moreover, in Europe the healthcare costs of congestion-related dirty air are estimated at around €70 billion.

Cities and regions need to mitigate the negative consequences of traffic in order to benefit from the improved European interconnection in the framework of the TEN-T network. The challenge of the effective integration of the urban nodes in the TEN-T network is a key and urgent issue pointed out in TEN-T corridor studies, and the EU-funded Vital Nodes project. Planning such a system requires the integration of different governance levels, i.e. the European, national, regional and urban dimensions, and the involvement of all stakeholders – such as freight carriers and infrastructure providers. The need for a holistic and integrated strategy to effectively address bottlenecks within urban nodes is gaining relevance, especially as it is not entirely clear which entity is responsible for connecting cities with the network, and there are multi-level governance and institutional issues to take into account (see section 4). As reported in the Vital Nodes recommendations, within urban areas people and freight often share the same road and rail infrastructure, with the result that different sectors compete for the same space. Nevertheless, planning and management are organised in silos. When focusing on the spatial and network implications for passenger and freight flows, stakeholders should take the opportunity to look at a different spatial scale which goes beyond administrative boundaries. In recent years, the concept of the functional urban area (FUA), composed “of a densely inhabited city and of a surrounding area (commuting zone) whose labour market is highly integrated with the city”, has raised the interest of policy-makers. The EC, within the framework of the SUMP guidelines, has issued a Topic Guide dedicated to planning mobility in functional urban areas and metropolitan regions.

At the city level, as the population grows so will the demand, but urban space is scarce and expanding or building new roads and other facilities is costly and time consuming. Therefore, public authorities need to maximise the performance of the existing networks. There are several ways to achieve this, for example via access regulation, parking fee or congestion charges, which allows regulators to modulate the transport demand and spread it outside peak hours. However, although pricing measures are generally effective, they are not well received by users. They must be properly designed to accurately correct the price of driving, considering the external

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134 European Court of Auditors. 2019. Special report 06/2020: Sustainable Urban Mobility in the EU: No substantial improvement is possible without Member States’ commitment.


136 INRIX. 2019. Global Traffic Scorecard


138 www.vitalnodes.eu

139 OECD. 2013. Definition of Functional Urban Areas (FUA) for the OECD metropolitan database.

effects and to reflect its actual social and environmental cost. Moreover, their potential higher impact on low-income citizens should be taken into account by including equity and fairness considerations\textsuperscript{141}.

**Tram, light rail and underground are efficient and clean transport systems.** More than 200 cities around the world have set up underground systems, offering the highest capacity and most efficient urban transport, since they require less land use, and produce less environmental impact. However, the capital and fixed costs of underground systems are high, works are very invasive for the urban system and eventually require a great deal of time. For this reason, trams and light rail systems, forgotten for many years, are surging in many European cities. They also allow fast speed and high capacity, and are cheaper alternatives to underground systems, especially in smaller cities\textsuperscript{142}. Between 2015 and 2018, 420 km of new light rail and tram (LRT) lines opened in Europe. This makes up for 36% of LRT lines worldwide\textsuperscript{143}. With the increase in trips (+ 6.9% between 2015 and 2018) and therefore the need to increase and improve the service, transport authorities and operators will also have to ensure maintenance, modernisation and replacement of assets which are expensive.

The transition towards connected, automated and shared mobility in a mixed environment with conventional vehicles represent an opportunity for improving the performance of transportation networks, but it requires more efficient traffic management solutions to dynamically optimise them via the monitoring of live traffic conditions, and flow performance and real-time traffic information sharing. The design and optimisation of such an advanced network and traffic management capability give the opportunity to produce new dynamic mobility services for passengers and freight. **The emergence of digital technologies will make it easier to influence real-time demand, and will enable dynamic and flexible use of curb space** and help manage it. However, consistent and widespread regulatory schemes and further testing at EU level are needed to enable the implementation of disruptive technologies and business models in transport systems, so that international competitiveness of the European economy is not affected\textsuperscript{144}.

### 3.4. Environmental and climate change impact

*Urban mobility accounts for 40% of all CO\textsubscript{2} emissions of road transport and up to 70% of other pollutants from transport\textsuperscript{145}, with a negative impact on the environment and global warming. The growing attention to the issue, especially from new generations, and the correct implementation of the EU Green Deal can favour a radical change of direction.*

Although this capital challenge can only be solved through a radical change of policies at European (see Green Deal) and global (Paris Agreement) level, cities also play a key role, being one of the main generators of emissions. Transportation generates about 27% of the total EU-28 greenhouse gas emissions\textsuperscript{146}. This is mainly due to the circulation of polluting vehicles for both public and private transport, commercial and individual. Local authorities must therefore introduce policies to decrease vehicle emissions. On the one hand, they could reduce their circulation, through access

\textsuperscript{141} Using data from four European cities, Eliasson (2016) shows that, although high-income groups pay more than low-income groups, low-income groups pay a larger share of their income.

\textsuperscript{142} Pulling N. 2008. *Light Rail – the Solution to Inner-City Chaos?* Railway Technology


\textsuperscript{144} [http://h2020-gecko.eu/](http://h2020-gecko.eu/)

\textsuperscript{145} [https://ec.europa.eu/transport/themes/urban/urban_mobility_en](https://ec.europa.eu/transport/themes/urban/urban_mobility_en) (spacing to be able to open the hyperlink)

regulation, reallocation of public space and measures that encourage the use of PT (see chapter 4 factsheets). On the other hand, they can introduce incentives and subsidies for citizens and businesses who decide to scrap their vehicle and buy a clean one. In addition, public bodies must intervene on their bus and city fleet through new procurement approaches that encourage the purchase of vehicles and goods with low environmental impact. However, the market for electric and hydrogen vehicles\textsuperscript{147}, despite the significant resources dedicated at European level for research and investments, is struggling to establish itself. This means prices remain prohibitive and triggers a chicken-egg problem which is difficult to solve. However, the production of large-scale electric vehicles is not the only challenge for the sector. Local authorities need to ensure that the urban area is ready for the transition, especially with regards to the simultaneous planning of transport and the energy infrastructures. Grid constraints, integration of renewable energy, and availability of green hydrogen are important bottlenecks to circumvent in order to achieve a full-scale deployment of electricity-powered vehicles, and considering different urban contexts. Although studies claim that the overall environmental impact of an electric car powered by electricity produced with coal is still less than a diesel car\textsuperscript{148}, it is necessary to rethink policies for the transition to renewable sources at European level. As far as electricity grids and networks are concerned, these must be adapted and made smarter to meet the growing demand for electricity for the supply of electric vehicles, even heavy-duty ones (buses, trucks, vans, etc.). Smart charging technology is an important aspect of charging infrastructure that will need to be further developed, standardised and implemented. The upscaling of e-mobility solutions requires cross-sectorial interventions in order to reduce capital and operational costs related to infrastructure; to encourage the usage of renewable energy; and to improve electricity grids.

### 3.5. Health and safety of residents and traffic actors

Air and noise pollution cause physical and mental health issues of residents. Active modes and green spaces are touted as an important way to improve their health. In 2016, 5,320 pedestrians were killed in road accidents in the EU, which is 21% of all deaths caused by road crashes. New technologies and space design can support traffic safety between road users, with specific focus on Vulnerable Road Users.

In the EU-28, road transport is responsible for harmful pollutants such as nitrogen oxide (NOx), being the highest emitter among all sectors with 39%, and particulate matter (PM10, PM2.5) of which road transport is responsible for 11%. \textbf{The European Environmental Agency (EEA) considers air pollution to be the main threat to environmental health}\textsuperscript{149}, resulting in high costs for health systems and unhealthy workers. Estimates of the health impacts attributable to exposure to air pollution indicate that PM2.5 concentrations in 2016 were responsible for about 374,000 premature deaths originating from long-term exposure. The estimated impacts of exposure to NO2 and O3 concentrations on the population in the EU-28 in 2016 amounted approximately to 68,000 and 14,000 premature deaths per year respectively\textsuperscript{150}. In order to show the magnitude of these figures, as of 20 August 2020, 180,231 deaths attributable to COVID-19 pandemic have been

\textsuperscript{147} Battery-Powered Electric Vehicle (BEV) has an electric motor using batteries that are recharged by plugging in to an electric power source. Fuel Cell Electric Vehicle (FCEV) use fuel cells which can produce electricity as long as the fuel is supplied. The vehicle obtains electricity directly from a hydrogen chemical process, which emits only water and heat.  

\textsuperscript{148} \url{https://www.transportenvironment.org/press/electric-cars-emit-less-co2-over-their-lifetime-diesels-even-when-powered-dirtiest-electricity}  

\textsuperscript{149} “Environmental health addresses all the physical, chemical, and biological factors external to a person, and all the related factors impacting behaviours”. Source: \url{http://origin-searo.who.int/topics/environmental_health/en/}  

\textsuperscript{150} European Environment Agency. 2019. \textit{Air quality Europe - 2019 report}
reported in the EU/EEA and the UK\footnote{https://www.ecdc.europa.eu/en/cases-2019-ncov-eueea}. It would be demagogic to compare the data on air pollution and COVID-19, but it is useful to show the extent of a phenomenon that should be treated as an emergency by governments. Moreover, studies highlight the potential role of PM in the spread of COVID-19\footnote{Comunini S, Dongo D, Milani C, Palestini P. 2020. \textit{Air Pollution and COVID-19: The Role of Particulate Matter in the Spread and Increase of COVID-19’s Morbidity and Mortality}. International Journal of Environ. Res. and Public Health, volume 17, issue 12.}, and argue that long-term exposure to nitrogen dioxide (NO2) pollutant may be one of the most important contributors\footnote{Ogen Y. 2020. \textit{Assessing nitrogen dioxide (NO2) levels as a contributing factor to coronavirus (COVID-19) fatality}. Science of the Total Environment. Elsevier B.V., 726, p. 138605.} to fatality caused by the COVID-19. Air pollution also has considerable economic impacts, since it increases the costs of public health and decreases the productivity of workers becoming sick more often.

According to an ICCT study from 2019\footnote{ICCT. 2019. \textit{A Global Snapshot of the Air Pollution-Related Health Impacts of Transportation Sector Emissions in 2010 and 2015}. Washington, DC: International Council on Clean Transportation.}, when normalised by population, the \textbf{ten cities with the highest air pollution-related health impacts of transportation sector emissions in 2015 were all located in Europe.} Car-centred transport policies exacerbated the inactivity of citizens, which has produced a significant impact on their health. \textbf{Sedentary behaviour and physical inactivity have been indicated by WHO as one of the four main, shared, and avoidable risk factors leading to the four main non-communicable diseases (NCDs)}\footnote{Cardiovascular, diabetes, cancer and chronic respiratory diseases}. In some cases, the risk deriving from physical inactivity is even higher than smoking and obesity in terms of reduction of healthy years\footnote{Stenholm S, Head I, Kivimäki M, et al. 2016. \textit{Smoking, physical inactivity and obesity as predictors of healthy and disease-free life expectancy between ages 50 and 75: a multicohort study}. International Journal of Epidemiology, 2016;45:1260-70.}. An estimated 2.8 million people die each year due to being overweight or obese\footnote{https://www.who.int/features/factfiles/obesity/en/}. The increase in the number of citizens affected by NCDs has a direct economic and social cost since it squeezes health budgets.

Lower air and acoustic pollution provide greater opportunities for social interaction and the decrease in road accidents, with measurable benefits in terms of overall citizen’s quality of life. Active mobility presents additional opportunities in terms of both sustainability and health outcomes. It is scientifically proven\footnote{Warburton D, Nicol C, Bredin S. 2006. \textit{Health benefits of physical activity: the evidence}. Canadian Medical Association Journal, 174(6), 801-809; Sustrans website, Health benefits of cycling and walking: https://www.sustrans.org.uk/our-blog/get-active/2019/everyday-walking-and-cycling/health-benefits-of-cycling-and-walking/} that citizens who move actively are healthier. The reduction of the number of all motorised vehicles, both private and public, contributes to support health objectives by fostering greater physical activity via walking and cycling. However, \textbf{when introducing policies and measures to encourage the use of light vehicles, there is a challenge in terms of road safety.} Among all road users, cyclists and pedestrians, defined as vulnerable road users (VRUs), constitute 30\% of the victims of fatal road accidents, while 70\% of cyclists who died on the road in 2015 in the Netherlands had a collision with a motorized vehicle. Moreover, the average accident risk of VRUs is higher than any other road users\footnote{European Environment Agency. 2019. \textit{The first and last mile — the key to sustainable urban transport Transport and environment report.}}. Therefore, interventions should be carried out both at the infrastructural and communication level by policy-makers, who should rethink the urban space and consequently the mobility ecosystem in a safer, more modern and sustainable way, and by taking into account the inequalities to be surmounted.

\section*{3.6. Effective and efficient transport governance}

\textit{Governing authorities face several challenges in steering the urban transport system towards sustainability. This ranges from planning support to real-time transport management. Different}
decision-making bodies and institutions are involved from the international to the local level, but functions are managed by different authorities in parallel. An effective multi-level governance mechanism should be reinforced in order to set a consistent policy-making flow.

At local as well as European level, policy-makers suffer from the lack of coordination and clarity of competences between the various government authorities. Cross-border policy coordination, in particular regarding freight and logistics, is an issue hindering seamless movements across Europe. Improved multi-level governance cooperation mechanisms are needed to establish a dialogue and undertake joint actions, both vertically (with different levels of governance, from the EU to local communities) and horizontally (with different authorities in the same cities, and with private stakeholders). This requires the elaboration of a shared vision of the mobility of the future.

The use of new technologies and the growing digitization in different areas enables the application of new ideas and concepts. This has led to a rapid transformation of urban mobility, also regarding the governance processes. While until a few decades ago the offer of transport and travel information for people was mainly provided and regulated by the public sector, today operators of new mobility services, such as sharing of cars and bicycles, carpooling, scooters, etc., provide and directly manage their services. Inversely, the logistics sector requires a more convincing planning intervention by the local authorities, claiming their public service function and the lack of spaces and rules for the movement of goods in the city.

Furthermore, open data management has led to a stronger role for smartphone app developers and digital companies and data providers (Google, INRIX, Tom, etc.) in providing information services for travellers. These operators, together with vehicle manufacturers and telecommunications companies, often have a better picture of the state of the transportation network than the transportation authorities themselves. Agreements and data-sharing principles are needed to enable cities and regions to properly manage their transportation systems, maintaining a coordination role that guarantees a holistic vision of all mobility services, while also protecting the competitiveness of the companies.

### 3.7. New technologies and services

Intelligent Transport Systems, automated vehicles, drones, MaaS etc. should be wisely integrated into the broader transport systems as a means to support a sustainable and smart vision for urban mobility. When introduced based on purely business-oriented models, they can have negative effects on the overall performance of the system, whilst they positively impact the system if operated in a framework aligned with sustainable mobility goals.\(^{160}\)

The application of new technologies such as computer science, electronics and transport engineering to urban transport facilitates various management and control operations for some key areas such as road safety (road and accidents monitoring); congestion reduction (traffic flows monitoring, parking management); regulations compliance (limited traffic zones management, speed limit control) and supply chain management (loading/unloading bays management). Cooperative Intelligent Transport Systems (C-ITS) improve delivery efficiency by enabling communication between vehicles and the infrastructure in a standardised and trusted environment. Despite the clear opportunity to make the local transport system more efficient, there are technical challenges which are system-specific. More in general, there is the challenge

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for cities to group their traffic management systems under a common ‘umbrella’ (e.g. common architecture, traffic control centre) and integrate them as much as possible. Moreover, the management of the systems and devices requires the definition of an appropriate operational procedure and the management of a suitable organisational structure.

Big data can enable extraction of previously unknown patterns to anticipate demand, improve efficiency and enhance the level of service. However, this huge inflow of data generates challenges related to coordination, standardization and privacy, in combination with legal issues (e.g. on privacy and data protection). As described in the governance section, the ownership and availability of the data collected by private service operators must be clarified, so that this information is functional to an evidence-based planning of the transport system.

Driverless and connected delivery vehicles are slowly making their appearance in the urban mobility ecosystem. The opportunities in terms of faster deliveries, crash prevention, reduction of traffic congestion and pollution are promising, thanks to digitalisation and sharing technologies. Nevertheless, public authorities must set appropriate policy framework to address the difficult integration of connected and automated vehicles and forms of mobility in a mixed environment with conventional vehicles161. Social and behavioural implications of the roll-out of connected and highly automated or autonomous vehicles according to different scenarios, events and characteristics of the drivers pose essential ethical questions. As regards to drones, the EC recently set a framework of rules for developing drones162 and requirements for operators163. Nevertheless, there is a need to identify business models, applications and suitability of air mobility solutions in urban areas ensuring safe, secure, quiet and clean roll-out.

In addition to the general issues related to data, such as coordination, standardization, protection and privacy, other challenges to be faced for a broad and inclusive development of the MaaS systems are the adaptation of MaaS to the general public, including elderly and people with reduced mobility, and development of interoperable services that can be used across different cities and countries.

3.8. Resilience and security

Main transport (TEN-T) nodes and intersections such as highways, bridges, railways, stations, airports, and ports must become more resilient to new pandemics, natural disasters linked to climate change, and increasing freight movements. Cybersecurity plays a key role in overcoming terrorist and hacker attacks to transport-related technologies such as drones, automated vehicles and GPS.

The increase in urban population poses challenges not only in terms of efficiency, but also in terms of system and network stability and resilience. The improvement in the performance of the TEN-T network and an ever greater integration of the single market produces as an undesirable effect the unprecedented pressure on the metropolitan areas representing the connection points of the network. The related increase in traffic and the use of heavy vehicles leads to the deterioration of infrastructure. However, local authorities often do not have direct competence over the maintenance and monitoring of infrastructure. Moreover, while building new infrastructure is a

161 https://www.h2020-coexist.eu/  
Sustainable and smart urban transport

political priority, the same cannot be said for maintenance and repair operations, which often receive residual funds\textsuperscript{164}.

In addition to infrastructural resilience, ever-increasing \textbf{natural disasters linked to climate change, such as fires and floods, can have devastating effects on local transport systems}. The COVID-19 pandemic has produced a change in flows and use of urban networks (e.g. decrease in use of public transport, increase in logistical operations), and highlighted the \textbf{need to strengthen the level of health security}, e.g. with constant sanitization and contactless payments.

In some ways, this trend can be an opportunity to accelerate the digitization and integration of the system. Besides the technologies described in section 3.7, smart contracts offered by blockchain technology can support more efficient and secure collaboration among logistics players, and enable Physical internet (PI) deployment. PI aims at realising full interconnectivity (information, physical and financial flows) of several (private) freight transport and logistics services networks\textsuperscript{165}. Freight would be “encapsulated in containers acting as globally standardised packaging. As for the Internet, which is fully interoperable between all providers, in a similar fashion Physical Internet builds on horizontal collaboration”\textsuperscript{166}.

Nevertheless, further risks arise related to security and the need to reinforce the control of urban movements to thwart any terrorist attacks or hackers. In fact, \textbf{the exposure of the network to cyber threats increases significantly with the automation of transport management systems that enable remote controlling and communication with vehicles and infrastructures}. So far, inadequate importance and resources have been allocated to data protection and cybersecurity, since there is a lack of awareness of these types of threats. Moreover, as already discussed, there is no common approach to collaborate and exchange information when it comes to the organisation of the transport system. This leads to inadequate data exchange between public authorities and operators\textsuperscript{167}. The debate on cybersecurity and the risks associated with the transport sector requires further research, development and resources, which must be rolled out at a European level given the extreme interconnection of physical and virtual transport networks.

\textsuperscript{164} https://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetailDoc&id=34586&n=1

\textsuperscript{165} ALICE Technology Platform. Roadmap to Physical Internet

\textsuperscript{166} Mervis, J. (2014) The information highway gets physical: The Physical Internet would move goods the way its namesake moves data.. The information highway gets physical: The Physical Internet would move goods the way its namesake moves data. Science, Vol. 344, No. 6188, pp. 1104-1107.

\textsuperscript{167} ENISA study. 2016. Cyber Security and Resilience of Intelligent Public Transport.
4. SOLUTIONS AND GOOD PRACTICES FOR SUSTAINABLE AND SMART URBAN TRANSPORT

KEY FINDINGS

- Public transport: new business models allow public transport companies to change their approach and offer also new mobility solutions, such as MaaS or on-demand ride-sharing services. Zero-emission buses have been increasing and some pilots for automated buses are starting to appear.

- Non-motorised transport: car-free city centres continue to spread, and new apps (such as sightseer technologies) that guide tourists and locals to their destinations are becoming quite an interesting solution to boost these modes. Such apps make the use of non-motorised modes convenient and pleasant. COVID-19 has shown that space can be made available for walking and cycling and it is up to local authorities to keep up with it afterwards.

- Shared mobility, micromobility and MaaS: several solutions and business models have been adopted/tested, as peer-to-peer vehicle rental, taxi services, ride sharing, B2C vehicle short-term rentals. Micromobility solutions include e-scooters, bicycles, e-mopeds. MaaS can integrate all available transport services, from public transport to micro and shared mobility services.

- Transition to zero-emission vehicles: several cities are switching to low-emission and zero-emission zones, which will accelerate the demand for electric vehicles and e-charging infrastructure.

- Consolidation practices for last-mile deliveries: solutions vary from urban consolidation centres to parcel lockers. Pilot projects have demonstrated that, in areas with a high receiver density and a fragmented demand, micro-depots and cargo bikes can be used efficiently.

- Integration of urban nodes in the TEN-T network requires solutions for strengthening communication and cooperation between cities and stakeholders along the TEN-T corridors. This fosters the opportunity to align and better integrate the planning, as well as to generate new concepts and benefits for both long-distance and urban transport.

- SUMPs: the number of urban mobility plans that followed the SUMP Guidelines has increased to 1,000 in Europe. This is an evidence that urban mobility planning is focusing on sustainable and smart solutions for the cities.

- Access regulation and space design/management reduce parking spaces to create mobility hubs where it is possible to access a variety of shared services like electric cars, bikes and e-scooters, as well as charging points.

- Data collection and management and sharing principles: cooperation between different data providers and the use of this data for better planning are gradually gaining ground, but guidelines are needed.

- Automation, drones and cybersecurity: several pilot projects and tests for autonomous vehicles and drones have been put forward and issues such as cybersecurity are being tackled.
Building on the challenges and opportunities identified in section 3 and in line with the developments and trends already described in section 1, this section portrays the most suitable solutions and good practices developed, i.e. technologies, services and approaches to further promote SST. Solutions for SST usually contribute to solving more than one of the challenges & opportunities identified in chapter 3. Each factsheet presents a summary about a type of solution and identifies the challenges that the solution addresses.

The solutions presented are either being tested or have been successfully implemented in EU urban areas. These are presented in a factsheet format to favour easy and consistent reading. The factsheets frame the solutions in a standardised way, always including references to concrete case studies with a wide geographical scope and potentially being scalable and replicable in other EU urban areas. It presents an overview of the solution(s) addressing the motivation for implementing such technology or service, the opportunities for making it more successful and effective (based on success factors), in the addition to the barriers hindering its adoption as well as the means to overcome them. Finally, it describes the expected future developments and identifies the key stakeholders.
Table 1 – Challenges addressed by each topic/solution

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4.1. Public transport

**Challenges addressed:** 1. Mobility and accessibility of passengers, 3. Environmental and climate change impact, 4. Health and Safety of Residents and Traffic Actors, 5. Effective and Efficient Transport Governance 7. Resilience and Security

**Topics covered:** Digitalisation of transport, non-motorised modes, micro-hubs, MaaS, energy transition, SUMPs

**Description and Overview**

One of the main solutions to accomplish sustainable mobility in cities and regions is to provide a public transport system that is well organised, efficient, affordable and which has good quality standards in terms of user service. The provision of good public transport supports urban areas in realising their economic, environmental and social ambitions. Europe has a variety of public transport modes, ranging from buses to metros and trams.

In 2012, according to UITP statistics, the most used public transport in the EU28 was urban and suburban bus+trolley systems, which accounted for approximately 56% of total journeys. Rail-based modes make up the remainder.

In general, increasing the share of public transport has proven to be a more sustainable alternative than car use. The public transport system is environmentally friendly and efficient in terms of fuel consumption and carbon emissions, and it increases the attractiveness of urban centres and does not harm citizens’ health.

European cities, especially in Western Europe, are introducing new vehicle technology (i.e. electric, hybrid), which is being driven by growing concerns over urban air quality, carbon emissions and potential operational cost savings. However, some countries still have outdated fleet that do not fulfil basic European standards.

**Motivation**

Public transport is essential to provide accessibility to every service of an urban area and it is, in terms of transported passengers, the most efficient mode. It is widely known that the lack of a proper public transport systems encourages citizens to use less sustainable modes such as the car and motorcycles, which occupies more space and, in some cases, is more polluting. Promoting and supporting the expansion of public transport and its new technologies ensures transport for all as well as a reduced impact on the environment.

**Opportunities**

It is important to continue redefining the public transport of urban areas by updating their sustainable urban mobility plans and involving relevant stakeholders’ opinion, taking into account gender and disability assessments.

Light rail and trams (LRT) in Europe increased 3.9% between 2015 and 2018. Light rail now carries as many passengers as metros and regional/commuter rail, and 10 times more passengers than air travel in Europe.
LRT has no operation related emissions and is space efficient. However, the related cost for maintenance, modernisation and replacement of parts might hinder the development of more of these systems. Hence, there is an opportunity to study other transport modes that could provide the same benefits of light trains or trams but with less maintenance costs, as for example Bus Rapid Transit (BRT).

Bus is the most used mode in Europe. Implementing Bus Rapid Transit (BRT) and Bus on High Level of Service (BHLS) systems should be considered as a mass transport system for European urban areas due to their relatively low infrastructure costs, flexibility and scalability compared to rail-based systems. The BRT in Bogotá (Colombia) achieved the highest peak loads on a single BRT corridor, carrying 45,000 passengers per hour in each direction which is comparable to a metro system. Furthermore, some European vehicle manufactures (i.e. Volvo) have developed electrical articulated buses which can contribute to emission reductions in urban areas.

In Europe, almost 50% of the population lives close to the sea or along rivers. Water buses, water taxis and/or ferries are also a good public transport option. In Rotterdam, the Waterbus is an efficient and fast solution to improve the connectivity between the north and the south of the city. The Waterbus transports 1.9 million passengers annually, making it the largest public transport provider by water in the Netherlands.

Public transport can also promote sustainable mobility in areas with low demand. Munich has implemented an on-demand service called IsaTiger which facilitates the provision of public transport in areas with low demand. Social measures are also important, especially during the COVID-19 pandemic.

Public transport subsidies and monthly subsidies should be a priority of cities and governments. This social opportunity can benefit and encourage the society to make massive use of the system. Luxemburg, for instance, is the first country in the world to provide free transport for its citizens and visitors.

With the surge of new business models, more and more public transport companies are able to change their mind-set and offer new mobility solutions such as MaaS or on-demand ride-sharing services. This indicates that with the right governance framework and the right demand analysis, a convergence of actors points of view towards the most promising services to complement mass public transport solutions can rise. Hence the importance of focusing on multimodality and options such as park and ride (P&R). This guarantees that people minimize the use of less sustainable modes such as the private car. One example, is the P&R facility of Dolgi in Ljubljana (Slovenia). The parking has a capacity for 363 vehicles, 11 spaces for tourist buses, 10 spaces for caravans and 6 charging stations for electric vehicles (EVs). There is also parking for private and rental scheme bicycles.

Public transport plays an important role towards the goals of the Green Deal. Shifting the bus fleet towards more sustainable fuels or zero emission technologies provides good opportunity to support the goals of the Green Deal and ultimately reduce pollution levels. The electrification of the fleet, for example, has an important impact on the cost structures of the operators. However, funding mechanisms and subsidies from governments could be studied in order to further promote this technology. Furthermore, challenges such as regulating the charging grid should be studied and properly tackled in Europe in order to speed up the implementation process.

**Barriers**

- Lack of access to a public transport modes, for example, some people still need to walk several kilometres to access a bus stop.
- Reduced or non-existent public transport options for areas with low passenger demand.
- Lack connectivity between the current public transport modes.
- Integration of public transport with a common fare system and paying mode.
Future Developments
The H2020 project FABULOS (Future Automated Bus Urban Level Operation System) aims to accelerate the introduction of new types of automated last-mile solutions in Europe (Helsinki, Gjesdal, Tallinn, Lamia, and Helmond).

Several airline companies have commercial ambitions to offer services such as air taxis. EASA has published the first regulations to enable the safe operation of hybrid and electrical vertical take-off and landing aircraft. Last year, for instance, the Munich-based start-up Lilium revealed its new five-seater air taxi prototype which should be fully-operational in various cities around the world by 2025.

Personalised mobility services through data-driven transit design and the application of artificial intelligence for public transport are trends that will last. This allows integration and optimization of the user experience and the use of various systems. One example is from the Municipality of Amsterdam, where renting cars from Green Wheels can also be carried out by using the public transport card, thus making it easier for the user to use various modes with one single payment system.

In relation to the gender perspective, it is expected that further studies and public transport projects will include a detailed gender assessment. Prague has developed an accessibility strategy to support disabled users on the public transport system.

Integration of public transport and other modes is a must for governments. New technologies and service providers such as MaaS will continue operating in various urban areas. Hence, there is a need to establish clear regulations to ensure that fair rules are set to avoid unfair competition. These rules could also include the sharing of data patterns between the various operating modes in the city, hence improving their influence on the Public Transport. The electrification of public transport is a confirmed trend, i.e. the progressive implementation of ambitious programmes for the deployment of electric bus fleets in Europe.

It is important to highlight that the COVID-19 pandemic has reduced the attractiveness of the public transport system. Operators have seen a reduction in their income, which hinders the purchase of new vehicle technologies. Passengers have decided to use their private car or use other modes such as the e-bike or e-scooter. New demand estimations are needed to renegotiate operator’s contracts to prevent a financial deficit. Furthermore, it is essential to study options to guarantee the safe (health wise) travel of the user.

Stakeholders
• Local and national authorities
• Public Transport Operators
• Producers of Public Transport Vehicles
• User associations – users (passengers)
• International financial institutions
4.2. Non motorised transport

Challenges addressed: 1. Mobility and accessibility of passengers, 4. Health and Safety of Residents and Traffic Actors, 5. Effective and Efficient Transport Governance

Topics covered: Micro-hubs, Energy Transition, SUMP$s$, Public Transport, Micro-mobility, MaaS

Description and Overview
Non-Motorised Transport includes two main modes - walking and cycling - and variants such as skates, push scooters, steps, and skateboards. These modes can be desirable for relatively short distances, which in general make up the highest number of trips in European cities.

Motivation
Although it is acknowledge that non motorised transport is important to support sustainable urban transport, it is noticeable how little specific attention is given to the topic in various urban areas in Europe. Given the above mentioned benefits, it is clear that these modes should be promoted and encouraged. After all “Cities are for people, not for cars”, meaning the priority should be given to the most vulnerable mode in the mobility chain.

Opportunities
Although European urban areas display a variety of different pedestrian and cyclist infrastructure, there is still room for improvement. It is important to support and promote the development of non-motorised transport modes by planning and designing a network which is 1. coherent (based on demand and travel purposes), 2. direct (fastest route possible), 3. comfortable (minimum width and adequate pavement), 4. attractive (surrounded by a good environment) and 5. safe (adequate signalling, maintained and with police presence if necessary). In order to launch implementation, the best approach is to develop a pilot project relating to the planned network. Pilot projects also allow cities without pedestrian or cycling routes to experience the advantages of these modes, or envision how their streets can look without motorized vehicle influence. Examples of this can be car-free days (Tivat, Montenegro), car-free main squares (Lindau, Germany), or simple experiments such as closing crossing junctions (Rotterdam, the Netherlands). The COVID-19 pandemic has affected the normal routine of citizens around the world. In Europe that has been reflected in the decreased usage of public transport and an increase in cycling trips and bike purchases. For some countries, this will imply setting these sort of modes in the political agenda. In the Netherlands for example, the sales of electrical and race bikes increased by 60%. This is the perfect opportunity for cities that are reluctant to implement a cycling network to start developing cycling pilots.
Historical centres in Europe are complex structures, characterized (in some urban areas) by "tensions" between old and new functions. New mobility patterns that are in place as a result of the pandemic present a perfect opportunity to study the possibility for a long-term proposal to make city centres exclusive for pedestrian and cyclist areas. This can be achieved by analysing the land-use of the cities and creating urban zoning. A good example is the mobility plan for the city of Utrecht in the Netherlands. The ABC principle: A-Zone, neighbourhoods and city centres (access roads) which have priority for pedestrians and cyclists; B-Zone, general urban area (distributor roads), segregated cycling lanes and Intensifying the mixed use of boulevards; and C-Zone, general urban/suburban area (where cars holds priority). A number of citizens and tourists depend on walking and cycling as first and last mile trips (before and after making use of a public transport mode).

It is therefore essential to invest in studies, plans and infrastructure to create tailor-made solutions (sidewalks, green lines, cycling lanes, parking stations, signalling etc.). Financial incentives are also an opportunity to increase the daily use of the bicycle. Since January 2020, the Netherlands has a mileage allowance for cyclists for which employers may pay cyclists a (tax-free) mileage allowance of up to EUR 0.19 per kilometre, the same rate available to staff who travel to work by car. In Belgium, employers can pay this allowance up to EUR 0.22 per kilometre free of taxes and social security contributions. Furthermore, the employee only pays 7% for the private use of a bike that is leased through the employer. This applies for bikes, e-bikes or a high-speed bike.

Barriers

- Lack of proper sidewalks for pedestrians with accessibility for reduced mobility people.
- Blocked sidewalks or cycling routes because of commercial use or parking.
- Lack of proper cycling infrastructure (routes, signaling, parking).
- Reduced connectivity to other modes such as Public Transport.
- Non-existence of a non motorised transport plan which leads to poor network connectivity (i.e. patches of cycling routes).
- Low society perception towards NMT and preference to the private car.
- Little or no governmental support towards NMT.
Future Developments
Planning for non motorised transport is as essential as planning for another transport mode. People in various cities in Europe have embraced walking and cycling as their main mode and are addressing their governments demands for proper infrastructure. It is expected cycling corridors increase in the coming years. Hence, it is important to plan for this mode, implement/change the necessary regulations and develop cultural campaigns to further promote this mode as well as to prevent conflicts with other motorized vehicles.

Car-free city centres are expected in various urban centres. It is promotes liveable and accessible cities. This shift reduces congestion levels, improves the air quality and health, develops the economy and improves the quality of public space. The ideal (future) scenario is to achieve a focus on non motorised transport and public transport. Also, the result of no cars in the city centres is the creation of new transport facilities such as the park and ride (P+R) and multimodal integration.

The increasing sales and use of electrical bike, is seen now as an option to avoid the traffic jams and/or use the public transport. Its wide performance range offers citizens and tourist a new way of mobility. Although sales are significant mainly in Northern Europe, it is expected that this trend will spread to the rest of the continent.

Thus, it is important to implement cycling routes (previous a cycling mobility study with a network vision). Furthermore, it is expected that local, national and trans-national governments set clear regulations for this mode (speed, width of the routes, parking, etc.) in order to avoid conflicts with normal cyclist and pedestrians.

New technologies and apps are those that make a visit more efficient as well as enjoyable. Implementing a new way-finding app that guides tourist and citizens to their destination and provides information/tips about the main attraction points, is becoming an attractive option for both locals and visitors. These sort of applications allow the tourist to always stay up-to-date with the best hotspots, and have all the travel guides and routes in one app, including free maps and different language guides, and the option to navigate through the city using offline GPS (i.e. Malta). On the other hand, these apps can be useful to tackle overcrowded touristic points.

Stakeholders
- Local and national authorities
- Cycling and Pedestrian User associations
- Neighbors associations
- Education centre’s board members
4.3. Shared mobility, micromobility and MaaS


Topics covered: Digitalisation of transport, Mobility as a service, Non-motorised modes, Micromobility and new and shared mobility

Description and Overview

Shared mobility, micromobility and Mobility-as-a-Service are different transport service concepts that overlap.

Shared mobility, in general, is a subset of the sharing economy, which aims to decouple the ownership of cars from its use. There are different business models under the concept, including Peer-to-Peer (P2P) vehicle rental (e.g. SnappCar), taxi services or ride sharing (e.g. Bolt Estonia, BlaBlaCar), and B2C vehicle short term rentals (e.g. Car2go, Greenwheels). These services are typically booked via mobile apps.

Micromobility is a type of shared mobility, but only involving slow and light vehicles such as electric push scooters (e.g. Bird), bicycles (e.g. OV-Fiets, MOBIKE) and scooters (e.g. Felyx Electric Scooters). As a relatively slow mode, it is mainly used for short access and exit trips to and from transport hubs. These vehicles are relatively small-sized and their weight allows them to be picked up and dropped off anywhere, i.e. without requiring specific stations. Booking and unlocking of vehicles only work using mobile apps.

Mobility-as-a-Service (MaaS) is about booking and information services that aim to integrate all available transport services, from public transport to micro- and shared mobility services. This focuses on mobility or travel rather than simply the transport mode or specific service provider.

MaaS is an important means supporting new mobility services, especially to provide information on the best services available, whether in terms of cost or travel distance. Transdev is an example of a public transport operator providing MaaS solutions.

Motivation

The concepts and technology have risen mostly organically through private sector actors and private investment. Shared mobility and micromobility, if integrated well with a functioning public transport system using MaaS, improve the accessibility and mobility of passengers without increasing vehicle ownership and car traffic. This leads to performance, environmental and social benefits.
Opportunities
Governance of shared and micromobility solutions is crucial to ensure an accessible and high quality urban transport system. These solutions could serve as add-ons to public transport, especially when integrated with MaaS to serve specific niches. Urban and transport planning should be prepared to support sustainable growth of these services.

Ensure accessibility to transport services for all. Improving accessibility of digital apps will ensure that every resident and tourist can access these urban transport services.

Digitalisation of transport services and integration with the city’s ITS. Integration of these services with the city’s ITS will provide new information sources to improve transport planning and real-time traffic operation within the city.

Legal clarity to approve business models will need to be provided to investors and services by public authorities. The city or national public authorities will need to work together to provide legal clarification about the operation of these new services within the city. Stakeholder discussions should be conducted regularly to test the reactions of transport associations representing taxi and public transport operators, labour unions, the general public and user segments in the municipality.

Barriers
- Finding the right balance between safeguarding today’s public interest and still fostering service innovations that can ultimately benefit consumers and the broader transportation system is a challenge. Some of the business model innovations in the sharing economy have only become successful because they exploit legal loopholes.
- Shared and micromobility could decrease the use of public transport, thus affecting revenue. It is important that these solutions do not “cannibalize” the market away from public transport services.
- Conflicts on (bicycle) roads and footpaths may pose safety issues. The influx of bicycle sharing have posed problems for the allocation of bicycle parking space.
- Digital inequality due to technological or income gaps reduces transport accessibility to the overall system. Adequate attention should be provided to guarantee more “manual” access to services.
- There is a need to rethink the design and characteristics of new vehicles, specifically tailored for the urban environment and in the light of shared functioning, complementary to PT.
- There is a need to define new business models and service concepts for PT, cycling and walking to address the last-mile connectivity in a multimodal and integrated perspective with respect to emerging (shared) modes.

Future Developments
Extension of micromobility services can be also expected to other major cities, besides existing ones. This will likely only be limited to highly populated cities with a higher customer pool.

Shared and micromobility is also being extended to logistics services. Some of the services are cargo e-bikes on demand rental services or on-demand Uber-like van services. This also includes restaurant delivery services and crowdshipping.

Stakeholders
- Users (passengers)
- Local authorities
- Platform providers and specialized technology providers
- Public transport providers
- Policy makers
- Vehicle manufacturers
## 4.4. Transition to zero-emissions vehicles

**Challenges addressed:** 2. Freight movements and logistics performance, 4. Environmental and climate change, 5. Health and safety of residents and traffic actors, 7. New technologies and services

**Topics covered:** Energy transition in urban transport, TEN-T, SUMPsd

### Description and Overview
Zero-emissions vehicles do not produce emissions where and when the vehicle operates. There are two main zero-emissions vehicles: battery electric vehicle (BEV) and hydrogen fuel-cell electric vehicles (FCEV). Both are propelled by an electric drivetrain, but have different on-board energy sources.

The key characteristics of the BEV and the FCEV are compared below.

<table>
<thead>
<tr>
<th>Aspects</th>
<th>BEV</th>
<th>FCEV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy source</td>
<td>Battery is recharged with electricity from an external source, usually the grid or local renewable energy systems</td>
<td>Electricity is produced on-board by the fuel cell using hydrogen as fuel. Hydrogen is often called an energy carrier.</td>
</tr>
<tr>
<td>Energy supply process</td>
<td>Charging proceeds usually at stationary charging pole, although new technology allows dynamic charging as well. Electricity is transferred from charging pole to battery. The speed of charging is slow compared to refueling of conventional vehicles, depending on the charger used and size of the battery.</td>
<td>Hydrogen tanks are filled with hydrogen at filling stations, much like current petrol stations. The speed is comparable to refueling of conventional vehicles.</td>
</tr>
<tr>
<td>Energy supply equipment</td>
<td>Charging speeds range from 3 kW (slow) to 350 kW (ultra fast), depending on the need and specification of BEV. Plugs are standardized either using the SAE or ChaDeMo standards.</td>
<td>Hydrogen supply at filling stations are provided at 350 or 700 bar. Filling of liquid hydrogen is being tested. Empty hydrogen tanks can also be replaced with full ones.</td>
</tr>
<tr>
<td>Energy supply location</td>
<td>Slow charging points can be installed even at residential locations. Faster charging points with 11 kW and above may require local electrical system upgrades.</td>
<td>Filling stations can be located in dedicated areas and most industrial locations.</td>
</tr>
<tr>
<td>Vehicle types</td>
<td>The light duty vehicle segment, both passenger cars and vans, is growing consistently, replacing new vehicle sales. Electric buses are also built and operated across Europe. Numbers are slowly growing. These are operated with very high charging power. Medium to heavy duty electric vehicles, some of which regularly operate within urban areas, have been announced by major manufacturers. Current vehicles are built by retrofitting companies.</td>
<td>The light duty segment is very insignificant. BEVs are more interesting in this segment. Fuel-cell buses are increasing slowly. There are a number of makers in Europe. Trials for HDVs are proceeding around Europe, for heavy and long distance transport. These are being tested as competitors to heavy duty electric vehicles.</td>
</tr>
</tbody>
</table>
Motivation

Zero-emissions vehicles are primarily being used to reduce local air pollutants, to improve air quality, and to reduce greenhouse gas emissions. Carbon dioxide emissions reduction depends on how electricity or hydrogen is produced. In Europe, the emission factor is generally lower than the emission factor for petrol and diesel combustion engine vehicles.

There are two low emission hydrogen types: blue hydrogen, which is produced from fossil fuels, but using carbon capture and storage (CCS) technology; and green hydrogen, this one produced from electrolysis, which is completely carbon dioxide emissions free.

Gray hydrogen is still the most common and affordable, which is made from fossil fuels, without carbon capture and storage.

BEVs are also used for silent deliveries and for buses traveling at night within residential areas.

Opportunities

Increasing customer demand for zero-emissions transport services. Passenger transport apps for car sharing or taxis should prioritize ZEVs. Tenders issued for public transport should also require higher proportion of zero-emissions buses as laid down in the Clean Vehicle directive and supported by the European Clean Bus deployment initiative. These should electricity/hydrogen from clean sources. Initiatives such as eco or green labels could be introduced to increase awareness and provide options to logistics customers. This could also apply on deliveries made to government buildings.

Regulations to reduce or restrict access of fossil fuel vehicles to urban areas. This primarily targets private passenger or freight vehicles. Low-emissions zones (LEZ), or zero-emissions zones (ZEZ), focuses on outcomes without favouring a specific technology. These impose financial fines/fees or access restrictions to high emissions vehicles intending to access the city (centre), and could be combined with methods to reduce congestion such as congestion charging, or prioritize public transport with high occupancy lanes.

Subsidise the purchase and use of ZEVs. Purchase subsidies are often provided at the national, but cities can provide other favourable conditions, such as free and exclusive parking or charging locations, free or subsidised charging, and waiving congestion charges or road tolls for entry to city. Purchase and installation of charging poles could also be subsidized by municipalities to increase the charging service network density.

Support the provision of fast charging stations and services for inner city and urban area. Fast charging stations are usually commercial ventures. Fast charging stations require sufficient space, upgrade of the building or district feeder system, and permission to operate. Urban planners will need to plan for sufficient space for charging service providers to build the stations. Public authorities will need to work with electricity distribution service operators to facilitate and subsidize the electrical upgrades, which could be more expensive than the charging systems themselves. This is particularly the case in older cities. Regulations regarding semi-private charging service networks could be developed to improve utilization of expensive private charging stations. Digitalisation of the services will provide data on availability and type of charging stations and enable booking services.

Support the logistics operators in modifying their operations. Off-peak deliveries, i.e. night time deliveries, should be allowed to make use of the low-noise vehicles.
Barriers

- Current vehicle ecosystem is still petrol and diesel-vehicle focused. Ecosystem actors, ranging from charging service providers, parking areas, repair and maintenance service networks, will need to be in place to support ZEVs.

- Public transport and cycling policies are important strategies to reduce emissions, but also to serve other objectives. These should be prioritised, but smartly combined with ZE private vehicles policies to be holistically beneficial for the urban area.

- Subsidies targeting private cars often needlessly subsidize the higher income group. The cost for ZEVs for passenger have stabilized and is low enough, such that the subsidies are unwarranted. Subsidies could be provided instead to city logistics operators, especially of the medium and heavy duty classes.

- Subsidies should also target the development of energy infrastructure, both charging stations and the local electrical upgrades. This is partially carried out at the corridor level, e.g. Alternative Fuel Infrastructure Directive, but not within the urban area itself.

- Holistic planning and upgrades of the energy system will take a long time and are expensive. CEF funding is made available, but usually for corridor level upgrades (i.e. the TEN-E).

Future Developments

The light duty BEVs market is expected to grow. Many electric HDV manufacturers have also announced production plans for the coming years. These HDVs are still expected to be expensive compared to diesel HDVs. Global supply chains are scaling up and are increasingly efficient.

Hydrogen fuel cell electric vehicles, which are electric vehicles using fuel cells as range extenders, are slowly being introduced with a number of commercial developments. These vehicles are expected to be more expensive than BEVs. Ensuring a blue or green hydrogen supply will also be a challenge, though necessary for a proper transition to zero emissions.

Several cities in the Netherlands and across the EU are switching to low-emissions and zero-emissions zones, which will accelerate the demand for electric vehicles and charging infrastructure. Other guidelines for electrification have been incorporated into SUMP guidelines, which would be increasingly adopted across the EU cities.

Stakeholders

- Local authorities
- Logistics Service Providers
- Bus transport companies
- Passenger car owners
- Vehicle manufacturers
- Charging service providers
- Energy system operators
4.5. Consolidation practices for last-mile deliveries

**Challenges addressed:** 2. Freight movements and logistics performance, 3. Transport network performance, 7. New technologies and services

**Topics covered:** Digitalisation of transport, Non-motorised modes, Micro-hubs, crowdshipping, e-commerce, instant and last mile deliveries

**Description and Overview**

In order to mitigate the fragmentation of deliveries in urban areas, there are several freight consolidation practices. An urban consolidation centre (UCC) or hub is a logistic platform where orders from suppliers are received, re-consolidated and dispatched with low-emission vehicles for the last mile, i.e. to shops and retailers of the city centre or a dense commercial area.

By means of IT and telematic systems, the goods are catalogued and aggregated according to the destination. A UCC can be managed by a single private operator (single-company UCC), or by multiple carriers (multi-company UCC), which delegate the final deliveries to a third party that manages the centre. A UCC is typically located at the outskirts of the city, in a strategic area easily accessible by both road and rail transport. A micro-hub is a UCC located inside the city, serving a limited urban area for smaller deliveries and via soft transportation modes (e.g. walking or cargo bikes).

Parcel lockers are automatic boxes that allow the collection and delivery of goods 24/7. Lockers are usually located in high density areas such as shopping centres, train or refuelling stations, they can also be located in buildings and offices. It is a flexible and efficient delivery system, as deliveries for multiple users are grouped together in a single point, and more environmentally sustainable.

Although to date it covers only 12% of the e-commerce sector, delivery via lockers is suitable for a scenario of social distancing due to its contactless characteristics. Public transport-based crowdshipping schemes could reinforce the use of parcel lockers. Crowdshippers are passengers who peer-deliver a good to another consumer and would use the transit network anyhow for other activities (e.g. home-to-work), thus avoiding additional trips.

**Motivation**

Also because of the COVID pandemic, reduced demand for traditional purchases in nearby stores and the consequent boost of e-commerce platforms, increase the demand of deliveries and, therefore, the need to improve efficiency and make deliveries more sustainable through consolidation and distribution with alternative vehicles. This avoids unnecessary movements by optimizing the load of vehicles and routes, therefore reducing the number of trips and emissions, with a positive impact on congestion and pollution.
Opportunities

The establishment of new logistics facilities in inner urban areas can support the regeneration of brownfields and unused stores as a shared logistical micro-hub with different logistic service providers. This is the case of the CityLab project in Amsterdam and the KoMoDo project in Berlin. These pilots both demonstrated that, in areas with a high receiver density and a fragmented demand, micro-depots and cargo bikes can be used efficiently.

Public-private collaboration increases the chances of success of the UCC. Local authorities should implement environmentally friendly policies, such as extended delivery times or dedicated unloading areas for low-emission vehicles and operators joining the platform.

Research bodies and local universities can monitor and assess the performance of these new models, and run living labs to involve all relevant stakeholders to co-create efficient and sustainable solutions.

Sharing and interoperability between the locker networks of delivery operators or the spread of multi-operator networks improves their efficiency and public utility.

Location is key: depending on whether it is a traditional UCC (therefore with vans) or a micro hub (with cargo bikes), the distance from the centre must be reduced enough to avoid too long journeys - not sustainable with alternative vehicles – or too short journeys, which would imply the access to the city centre of large trucks supplying the hub.

Circular economy and reverse logistics should be included in supporting new business models for consolidation, such as pick-up services to avoid empty trips as tested in Rome.

Barriers

- Need to identify and distinguish among variety of operational models, e.g. bundling deliveries or simply space sharing.
- Need to define incentives for multi-sectoral collaboration of competing logistics operators and clarify ownership of the last-mile distribution services.
- Need to strengthen the role of public authorities, e.g. using the hub for supply consolidation of procured deliveries, designing regulations that accompany the establishment of a UCC or financially supporting the operations.
- Need to carefully select the operator(s), to avoid situations of monopoly and inefficiency. Public-private partnerships (for example the Cityporto of Padua), should be able to guarantee a good level of service and trust by stakeholders.
- Need to overcome security risks for lockers in metro/train stations, where it is illegal to leave parcels unattended, and legal/personal liability for crowdshipping.

Future Developments

Described in the ALICE’s Roadmap, the Physical Internet is a concept that uses the internet as a metaphor for the development of sustainable, interacting and collaborative freight transport (see section 3.7). Long-term and solid PPPs should test this theoretical approach in real conditions and upscale it via regulation and technology developments.

The development of new technologies, such as tracking systems (GPS, GALILEO), vehicle routing and monitoring (geofencing), favours a Fairer and more efficient implementation of these systems.

The way urban space is distributed and designed has a major impact on the way people and goods move in the city. The rise of new mobility services and other innovative mobility solutions require to manage curb-side space more efficiently, in a shared and dynamic way.
A systematic inventory of the availability and ownership of (un/under-utilized) urban spaces facilitates their reconversion into logistics areas: their use is not optimized and the current type of business is deteriorating (exploit garages for private cars in the night, postal/bank depot – because of digitalisation, etc.).

**Stakeholders**

- Local authorities
- Logistics Service Providers and Couriers
- Producers / shippers
- Freight/service receivers
- Real Estate owners
4.6. Integration of urban nodes in Trans-European Transport Networks (TEN-T)


Topics covered: TEN-T, SUMP, transition to zero-emissions vehicles, consolidation hubs, interchanges

Description and Overview

The TEN-T policy "addresses the implementation and development of a Europe-wide network of railway lines, roads, inland waterways, maritime shipping routes, ports, airports and railroad terminals. The main purpose is to close gaps and to remove bottlenecks and technical barriers, strengthening social, economic and territorial cohesion in the EU, as well as improving accessibility. Besides the construction of new infrastructure, the TEN-T policy also fosters the adoption of innovation, new technologies and digital solutions to all modes of transport, aiming to improve the use of infrastructure, reduce environmental impact of transport, enhance energy efficiency and increase safety. TEN-T policy has been focusing on the long-distance mobility for persons and freight, with the Core Network Corridors" as the main arteries of development.

Urban nodes have been recognized as key elements on TEN-T and according to the Regulation (EU) 1315/2013: “Urban node means an urban area where the transport infrastructure of the trans-European transport network, such as ports including passenger terminals, airports, railway stations, logistic platforms and freight terminals located in and around an urban area, is connected with other parts of that infrastructure and with the infrastructure for regional and local traffic”. The regulation considers 88 urban nodes on the TEN-T network.

To be able to better integrate urban nodes into the TEN-T network, besides the above mentioned, TEN-T European Coordinators Catherine Trautmann and Mathieu Grosch state that “a stronger connection with Sustainable Urban Mobility Plans (SUMP) should contribute to improving last mile connections for people and freight; urban nodes shall make best use of their exemplary roles on multi-level governance and as forerunners of innovative and low-carbon solutions.”
Motivation

The TEN-T core network corridors (where transport flows are more intense) have their origin/destination in urban nodes, where, according to TEN-T work plans, the biggest capacity bottlenecks also occur. Transport planning in urban nodes has an impact on flows along the corridors (e.g. on modal distribution) and also the other way around.

This makes the effective integration of urban nodes with TEN-T quite relevant to ensure, on the one hand, a more sustainable development of Europe’s urban areas, and, on the other hand, ensure that urban areas support the construction and intelligent use of the European transport network.

Urban nodes are struggling to develop themselves into well-connected multimodal and multi-usage nodes for sustainable and smart mobility, while at the same time they are being affected by urban and extra-urban areas trends such as urban sprawl, densification, digitalisation, increasing pressure from freight movements and a shift to a service-oriented economy.

The EC study on improving the efficiency of the transport system in urban nodes of the TEN-T core network, mention the potential of urban nodes as follows:

• “Urban nodes offer a great potential for economic development and spillover effects.
• Bearing in mind the potential synergies of European, national, regional and local transport flows, they usually provide excellent conditions for establishing value-added logistics services and multimodal platforms.
• Good cooperation in and between cities and surrounding regions is needed to make traffic flows in urban nodes as efficient as they can be, to conceive and deploy relevant concepts and to generate mutual benefits.
• Exchange of best practice can support the further development of innovative solutions for sustainable transport in urban nodes.”

Opportunities

Urban areas offer opportunities to test transport innovation projects (e.g. electromobility, cargo electric bikes for last mile, ICT, automation, innovative mobility services, etc.). EU funded projects under HORIZON 2020 have been showing that the tested solutions could be scaled-up faster at the level of urban nodes, generating benefits for urban mobility and TEN-T policy.

By strengthening communication and cooperation between cities and stakeholders along the TEN-T network, there is the opportunity to align and better integrate planning, as well as to generate new concepts and benefits for both long-distance and urban transport. These mutual benefits can comprise: “the removal of ‘urban bottlenecks’ (physical, technical, organisational) along the main TEN-T network; allowing to reduce congestion and to improve long-distance traffic flows, as well as better connections between TEN-T and the local transport network; boosting multi-modal transport solutions and seamless connections, with a shift towards more sustainable transport modes and urban freight solutions; the mitigation of negative effects related to the modal shift from rail to road transport on the urban area (e.g. pollution, noise, safety, etc.).”

Several solutions have been developed in the latest years aiming to support the better integration of urban nodes in TEN-T and the project Vitalnodes, has clustered them into optimizing or adding terminals; optimizing or adding infrastructure; optimizing or adding transport mode; spatial planning; and governance/ cooperation between MS to develop urban nodes. NUVIt (Networking for Urban Vitality), is an initiative from The Netherlands, Sweden, and Belgium for smart collaboration between national road authorities and urban regions to integrate land-use, mobility and infrastructure.
Planning across all levels. The approach is based on the dialogue between the different stakeholders at various level (local/regional, national), to build on common interests for the (inter)national networks, and ameliorate the quality of life in the local and peri-urban fabric.

The Northern Growth Zone collaboration in Turku (Finland) is facilitating collaboration between the state and 14 municipalities and 6 regional councils, and the Northern Growth Zone provides a semi-polycentric platform with 5 sub-regions.

The living lab for city logistics in Rotterdam where the city works together with partners on technical, logistic, behavioural, law, policy and communication aspects.

Turku has developed the concept of CaaS (Corridor as a Service) as a solution which optimizes infrastructure by adding services.

An example of a new transport mode is the People Mover project in Bologna that provides a driverless monorail connection between the railway station and the international airport.

In the area of spatial planning, there is the example of the Ringland in Antwerp and the Vienna productive city.

There are several opportunities for EU funding via CEF, Horizon 2020, Interreg, ESIF, EFSI, loans from EIB, etc.

Barriers

- Transport infrastructure between the transport modes is fragmented. This it puts pressure on terminal infrastructure and their integration in the wider supply chain.
- Pressure of the TEN-T network traffic on the urban areas which struggle to evolve into well-connected, multimodal and multi-usage nodes for smart and clean mobility.
- Cooperation at all governmental levels is still fragmented and a barrier to overcome. Several projects as NSB CoRe, Scandria®2Act and TENTacle reported this barrier, whilst developing new ways of interregional strategic cooperation across national borders, and bringing multilevel governance actions into close collaboration with EU-level policy making in transport and regional development.

Future Developments

A smooth trans-European transport network will be achieved only if underpinned by urban nodes in a pro-active manner and if integrated with the respective urban realities, which consist of spatial structure, existing infrastructure, local economy, and the needs of the population. Accessibility, sustainability, and intermodal connections are important elements and run high on the agenda of urban nodes' development.

Cooperation at different levels of governance seems to be the right way to reach effective integration of urban nodes that maximize the benefits that TEN-T aims to bring.

Connecting the planning of transport infrastructures with territorial planning is a crucial future development. This also needs to connect local economy with the needs of the citizens, so that benefits are maximized for both and solutions can be put forward.

Connecting SUMP's to TEN-T action in urban nodes, especially along the main lines of TEN-T, should support this better integration.
Stakeholders

- Local authorities
- Cross-border entities
- TEN-T Coordinators
- Terminal and logistics centres operators
- Freight and logistics sector
- Financing bodies
- European institutions
- Infrastructure managers at urban node, regional and national level
4.7. Sustainable Urban Mobility Plans


Topics covered: SUMPs

Description and Overview

The EC encourages cities to develop a long-term vision and objectives for urban mobility. In 2013, it released the guidelines on Sustainable Urban Mobility Plans (SUMPs), a strategic plan conceived as a framework in which already existing planning tools are inserted and integrated, and provides a clear vision and realistic objectives to be achieved in the medium-long term. The EC guidelines provide local authorities with concrete indications and suggestions for the preparation of plans, based on common principles that promote participation, integration, evaluation and a long-term sustainable vision.

A 2nd edition of updated guidelines was published in 2019, accompanied by sectorial topic guides. Every year, the SUMP Award of the EC recognises local authorities that have developed a Mobility Plan that satisfies the diverse transport needs of people and businesses whilst improving quality of life.

Motivation

The priority of the EC guidelines is to establish the essential principles guiding the planning activity at local level. In the case of sustainable mobility plans, the basic motivations are the concepts of liveability and accessibility. The emphasis has to be shifted from ‘transport’ to ‘mobility’. ‘Transport’ refers to different types of modes, services and infrastructures that allow the accomplishment of individual trips, while ‘mobility’ refers to a set of individual movements from one point to another, regardless of the transport service or infrastructure used to perform it.

The support provided by the EC, therefore, aims to complement rather than replace existing regulatory frameworks and policies, providing methods, tools and process-oriented support to the local sustainable urban mobility planning, to integrate and articulate different needs and perspectives.
Opportunities
Plan for sustainable mobility in the “functional urban area”.
SUMP needs to pursue the general aim of improving accessibility and providing high-quality, sustainable mobility for the entire functional urban area, interpreted as population density to identify urban cores, and on travel-to-work flows to identify the hinterlands whose labour market is highly integrated with the core.

Cooperate across institutional boundaries.
SUMPs should be complementary to mobility policies ensuring cooperation between different level authorities and between private and public sector. SUMPs should involve citizens and stakeholders in their development and implementation.

Active involvement can make policies more likely to succeed and be accepted.

Assess current and future performance.
SUMPs should help in the assessment of the current situation and monitoring progress towards established targets through performance indicators. Local authorities should define a long-term vision and a clear implementation plan.

A SUMP has to cover all modes and forms of transport, including a clear timetable of targets and a clear allocation of budget and responsibilities.

Barriers
• Lack of attention to the role of national governments by the EC, providing limited guidance for national legislation design.
• Limited coordination at the national level across ministries, leading to inconsistencies between the policies of national government departments.
• Low level of political will and commitment from decision makers.

• Poor culture of monitoring and evaluation with limited or no quality control.
• Insufficient professional support, training, and professionals who are able to convey the required competencies.

Future Developments
The needs of people and goods mobility are changing continuously due to the transformation of the urban landscape. That’s why SUMPs guidelines need constant update over years and should be rethought in the light of the assessed successes and failures.

Research carried out in 2018 by CIVITAS shows that the number of SUMP increased to 1,000 in Europe.

Regarding the former, they should aim to improve and intensify monitoring and evaluation. Regarding the latter, future developments are dependent on institutional, legislative, and financial support.

Stakeholders
• Cities
• Local Authorities
• Central Governments
• European Commission
• Private operators
4.8. Access regulation and space design/management

**Challenges addressed:** 1. Mobility and accessibility of passengers, 4. Environmental and climate change, 5. Health and safety of residents and traffic actors, 6. Effective and efficient transport governance

**Topics covered:** SUMPs, Non-motorised modes, Public Transport, Digitalisation

**Description and Overview**

Several cities have reached peak levels of congestion due to the high number of vehicles circulating. These traffic flows cause huge externalities and worsen the liveability of cities.

Urban space management represents an effective tool, supporting the shift to less polluting transport modes.

Reduction of street capacity for cars, access regulation, removing parking spaces, are only some of the possible measures to rethink urban spaces and incentivise more sustainable practices such as walking and cycling.

**Motivation**

The traditional response to car ownership and use has often been to increase supply of road space. This is no longer sustainable given the scarcity of urban space. Access and space management have a key role in adapting urban areas to more sustainable ways of mobility. Fewer cars means not only less pollution, but also safer streets and often more efficient mobility. Redesigning urban spaces means combining easier and more sustainable mobility with physical health. This may be achieved through healthier environments and good practices like active mobility, giving more space to

**Opportunities**

Access and space management uses different tools that give different opportunities to manage transport supply and demand.

Urban Vehicle Access Regulation (UVAR). UVAR is a form of traffic management that regulates access in specific urban locations according to vehicle type, age, emissions category, or other factors such as time of day, or day of the week. The main reasons to implement UVARs are the improvement of air quality, safety, congestion and liveability. Recently, London adopted an Ultra Limited Emission Zones (ULEZ) that deeply changed behaviour towards public transport, lower emission vehicles and increase active mobility. Public space management and streets design. These solutions concern urban roads, city streets, and public areas in general. One of the main purposes is to reduce parking spaces to create mobility hubs where it is possible to access a variety of shared services like electric car, bike and e-scooter sharing. E-Hubs are on-street areas close to major transport stations,
where people can book different shared electric mobility services so as to discourage citizens from owning private cars.

Tactical Urbanism is a type of low-cost, temporary change to the urban environment, intended to improve local neighbourhoods and public places. This approach involves different types of actions - sometimes carried out directly by citizens, other times by local authorities - that change the configuration of streets and squares, reshaping the space and its intended uses to promote sociability.

These can take the form of painting the street or inserting decorative elements such as tables and benches, or bollards in the form of flower boxes. One of the best-known examples is that of the Living Streets concept developed in Ghent and Rotterdam.

Geofencing is a technology based on telematics and satellite that can monitor vehicles entering to and exiting from a perimeter through installed sensors. This tool enables transport authorities to regulate and manage accesses to specific zones. In Gothenburg (Sweden) this is used to enforce speed limits and force buses to switch to electric drive when entering specific areas.

**Barriers**

- Lack of working groups where different stakeholders and city authorities can discuss and find shared solutions. In particular, UVAR design requires a strong stakeholders involvement.

- Different peculiarities of every city means that there are no one-size-fits-all solutions for everyone. European guidelines have a fundamental role directing national and local policies, but every city should take account of its specific needs.

- Tactical urbanism is an excellent approach for quick interventions and to experiment with new configurations. However, if not converted into permanent measures, their effectiveness is extremely limited.

- Geofencing requires active approval from users, who must be willing to share information on their movements. Geofencing can involve risks related to data protection and cybersecurity.

**Future Developments**

The main developments in access regulation and space management are related to the evolution of the role of local authorities as “space managers”. They are required to systematically involve all relevant stakeholders in the co-creation of the schemes and the co-design of the space.

Other upgrades should be focused on solutions oriented to digitalisation and simulations. In order to be successful, these should be supported by data-driven policies, mobility data collection, and data-sharing protocols.

**Stakeholders**

- Cities
- Local Authorities
- Data Scientists
- Urban Planners
- Civil society
4.9. Data collection and management and data sharing principles

**Challenges addressed:** 2. Freight movements and logistics performance, 6. Effective and efficient transport governance

**Topics covered:** SUMPs, Digitalisation, MaaS, Micro & shared mobility, E-commerce, instant & last mile deliveries

**Description and Overview**

Decisions relating to new transport interventions should be based on local data and evidence, intended as resources to support sustainable mobility strategies. Data-sharing and planning should maximize impacts and address knowledge gaps. To fill these knowledge gaps, cities should work with other departments to understand what type of data other departments may hold, as well as with chambers of commerce, industry and citizens representatives, and private companies that could provide data to inform the policy design.

**Motivation**

Urban transport is a complex system made up of numerous activities. Thus, data from a large quantity of operators and actors is required to understand the main drivers of economic and leisure activities, any inefficiencies in the system, and, ultimately, how systems may be improved and behaviours changed. Cities can identify specific opportunities and partners to work with in order to address the existing knowledge gaps.

**Opportunities**

The rise of new technologies increases the quantity of data about transport habits and trajectories. A framework allowing aggregation of new sources of data from infrastructure, vehicles, smartphones and more is needed, as well as data-sharing principles to facilitate the exchange of data and information, enabling an evidence-based policy-making processes. In cooperation with service providers and operators, i.e. the data owners, public bodies should define data-sets requirements for specific use cases. In order to obtain them, they should make agreements with data owners, offering benefits and incentives such as favoured access, allocation of loading/unloading spaces, etc.

Certain cities and regions have resorted to the introduction of new access restrictions or charging schemes as an opportunity to collect more data. These efforts can be launched as voluntary initiatives, providing companies with certain benefits for providing short-term real-time data. Such schemes involving logistics operators have been established in Turin, and positively evaluated in terms of increased operational and environmental performance.

**Barriers**

- Cities’ access to data is often very limited. Transport and logistics operators are often reluctant to share detailed information about their operations. Data owners might have an incentive to keep them confidential, or to sell them.
- Transport data analysis within the municipalities requires new skills. The processes of integrating data from different sources and in an automated way are complex, and their interpretation requires the involvement of experts.
Future Developments
National and sub-national governments are often in possession of vast amounts of transportation data. Integrating this with urban data collection and ensuring that information is widely available can help streamline the local planning process. Setting up platforms for urban data sharing through national or sub-national governments is another means of improving information efficiency, and hence the success of planning and implementation efforts.

The World Business Council for Sustainable Development (WBCSD), in partnership with member companies Bridgestone, Deloitte, Microsoft, Pirelli and Toyota, recently released a position paper on emerging principles for data-sharing in urban mobility. A similar report by POPULUS presents a basic overview of mobility data sharing practice and policy issues for regulatory agencies such as cities and mobility operators.

The Polis-ALICE dialogue group has agreed upon specific principles and key messages when it comes to data sharing:

- Data sharing (or consolidation) is required to achieve any increase in efficiency beyond optimization at company level.
- Clarify data sharing principles: for which purposes they should be used – they should not be misused.
- Define data sharing benefits for industry: e.g. cost reduction, increased margins, decision making, access facilitated.
- Anonymized data sharing should be possible for volumes, structure, points of destination, hours, frequency, etc.
- Data analysis is needed in order to gain behavioural insights.

Stakeholders
- Local authorities
- Logistics Service Providers and Couriers
- Public transport operators
- New Mobility Service providers
- Technology developers
- Vehicle manufacturers
4.10. Automation, drones, and cybersecurity

Challenges addressed: 2. Freight movements and logistics performance, 6. Effective and efficient transport governance

Topics covered: Digitalisation, MaaS, drones and air mobility, E-commerce, instant & last deliveries

Description and Overview
An autonomous vehicle (AV) is capable of sensing its environment and operating without human involvement. Autonomous vehicles vary in relation to the scale of automation. All in all, six levels of driving automation are defined, ranging from 0 (fully manual) to 5 (fully autonomous). At the present time, the first level-3 systems (Conditional Driving Automation) are reaching the markets. This means that the vehicles can perform most of the driving tasks although human override is still required. Nowadays, autonomous vehicles are also able to communicate between each other and with the network infrastructure.

Automated vehicles are conceived for both passenger travel and freight deliveries. In this regard, delivery robots and droids are also tested. These are small autonomous vehicles that deliver parcels moving on the pavements. A separate sector of automation is represented by urban air mobility, which adds a further dimensional level to the urban transport system. Drones have begun to appear in urban and extra-urban airspace for policing, monitoring, or delivery purposes. In particular, during the lockdowns some police forces used it to control compliance with physical distance in open spaces. The European Parliament recently backed legislation on ensuring the safe use of drones in the European Union.

The increasing use of these automatic and interconnected systems exposes the system to increasing risks of intrusion. For this reason, new means and technologies of protection, attributable to cybersecurity, must be developed to defend computers, servers, mobile devices, electronic systems, networks and data from external attacks.

Motivation
When properly integrated into mobility plans, autonomous vehicles have the potential to optimise movement and thus reduce city traffic. They can be shared, thus freeing up streets and parking lots. Drones have the potential to efficiently cover some tasks related to traffic management and monitoring, as well as super-fast deliveries of emergency goods, such as medicines.

Opportunities
Forecasts estimates significant potential of shared automated vehicles (SAVs) in terms of CO2 emissions reduction: up to 90% when replacing private trips. Shared vehicle fleets could free up a significant amount of space both on and off-street. Changes to make AVs a sound business include management strategies such as restricting access, delivery bays, bicycle tracks or enlarging sidewalks.

An increased attractiveness of public transport due to shared automated vehicles could lead to a reduction of pollution and to an improvement of road safety, provided that automated vehicles will not replace high-capacity public transport. The CoEXist project shows that reduction of externalities is related to penetration rate and spatial conditions, i.e. if there will be a significant share of AVs and the urban space will be adapted to facilitate their integration.
Automated delivery could be transformational for the industry, reducing delivery costs by 80% to 90% compared to a human doing it, depending on the vehicle and the platform.

For droids, Starship industries estimate a delivery cost reduction up to 10-15 times per shipment and the possibility to complete local deliveries within 5-30 minutes from a local hub or retail outlet.

Two researches forecast positive effects for GHG emissions of drones compared with vans, as long as the shipments are small and close to the consolidation centre, delivery addresses are not grouped and emission of materials and manufacturing are not taken into account.

**Barriers**

- Lack of public acceptance. Many users are unwilling to ride in AVs either for a short or long distance. Citizens fear that drones might be misused, used by criminals or cause accidents.
- Lack of shareability. Insurance issues, flexibility in schedules and coordination, risk of attacks and accidents and personal space enjoyment are barriers to shared use of AVs.
- Security issues. The risk of cyber-attacks and hacking is high for civil drones. Civil drones may be weaponised for criminal purposes.
- Privacy issues. Drones can easily collect imagery, record conversations and intercept electronic communications, and engage in face-recognition.
- Disruptions in public spaces. There were several incidents that raised concern about drone impacts in public spaces (Newark in 2019, Gatwick in 2018). There is no clear insurance scheme for potential damage or accidents. There are also worries about drone traffic in the near future, and noise pollution.

**Future Developments**

In order to bring the benefits described, the introduction of SAVs and drones should be framed in the general planning of Cooperative Connected and Automated Mobility (CCAM). It is not enough that the vehicles are ready from a technological point of view. For their large scale deployment, which is the only way for them to be sustainable from an environmental and economic point of view, their introduction should be combined with an established automation-ready planning framework, prepared road authorities (knowledge wise), a sound modelling framework, and interconnected road infrastructure.

After introducing legislation to reinforce cybersecurity, the EC is committing around €38 million to deal with cybersecurity issues through Horizon 2020. The programme will support projects in the field of protection of critical infrastructure against cyber and physical threats to make cities smarter and safer.

Some protection and mitigation of threats for metro and railway networks, ground space infrastructure and satellites, as well as e-commerce and delivery services. Other initiatives will focus on enhancing the resilience of cities’ infrastructures and services while protecting citizens in case of security incidents in public spaces.

**Stakeholders**

- Local authorities
- Logistics Service Providers and Couriers
- Public transport operators
- Education centres’ board members
- New Mobility Service providers
- Technology developers
- Vehicle manufacturers
5. RECOMMENDATIONS FOR EU POLICY-MAKERS

KEY FINDINGS

- Enhance integrated planning of urban transport with extra-urban areas, and therefore with other administrations, but also with other sectors such as land-use planning, energy, climate, etc.
- Improve (multi-level) governance cooperation mechanisms to facilitate a continuous dialogue and policy coordination among EU, national and local levels. This is needed to undertake joint actions, both vertically and horizontally.
- Support evidence-based policy-making to ensure that decisions are based on the needs and configurations of local ecosystems, and that the benefits of new measures outweigh their costs. All new interventions should be integrated into a coherent and balanced transport mix.
- Support a better blending of funds to favour research, deploy innovation and cohesive implementation of solutions. The EU should encourage the complementary use of the different funding lines available at European level.

This section presents a selection of high-level policy recommendations to promote the SST solutions as effective measures in dealing with the challenges and opportunities highlighted in section 3. As a first step, a set of the general recommendations on policy approaches and principles is provided, in particular at EU level, to further support sustainable and smart transport. Secondly, specific interventions are recommended, distinguishing between sustainable and smart transport, although the two are strongly intertwined. The section on sustainable transport focuses on the action lines to be pursued to satisfy the three indivisible dimensions of sustainable (transport) development – i.e. economic, social and environmental. The section on smart transport highlights the innovative tools and schemes (technological and non) enabling the urban transport ecosystem to go in that direction – in particular at a European level.

The recommendations take into due consideration the literature review, including scientific papers, position papers of the main European actors (section 2.4) as well as the CIVITAS policy briefs and the recommendations of the main CIVITAS projects on urban transport, funded by the Horizon 2020 program.

5.1. Policy approaches and principles

5.1.1. Enhance integrated planning of urban transport between sectors, modes and (extra) urban areas

The evolution of urban transport implies a shift from managing traffic flows to improving accessibility of spaces and services. This requires enhanced integration of urban transport policies with extra-urban areas, and therefore with other administrations, but also with other sectors such as land-use planning, energy, climate, etc. It has become increasingly important to redefine cross-cutting priorities and to

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168 https://civitas.eu/content/civitas-policy-briefs
169 TRACE, FLOW, CIPTEC, CREATE, PROSPERITY, SUMPs-UP, SUITS, NOVELOG, CITYLAB, SUCCESS, U-TURN, ELIPTIC PARK4SUMPS, MUV, CITYCANGERCARGOBIKE, EBSF_2
intertwine different planning and policy domains. This allows policy makers and planning authorities to develop new instruments to design and support new mobility and logistics business models.

**Integration between urban mobility and TEN-T corridor management.** Urban nodes are a constitutive element of the TEN-T network and foster the integration of the network into urban ecosystems. The governance and the planning approaches establishing the interface between the urban nodes, the functional urban areas (see section 3.3), and the corridors, need to be strengthened to mitigate the negative consequences of traffic, and to benefit from the improved European interconnection. As transport actors do not draw a sharp distinction between travelling on corridors and entering or exiting the urban area, neither should the transport policy making and planning: for example, when a municipality defines an e-charging infrastructure strategy, it should consider the impacts on the neighbouring municipalities at a regional level, and address the transport needs in the entire functional urban area\(^{170}\). This can be extended to include considerations of extra-urban travel. Some cities, like Bologna and Ljubljana, have already adopted this approach\(^ {171}\). However, it is necessary that local authorities, when preparing or revising a plan, systematically consider this extra-urban and regional dimension. The EC, within the framework of the SUMP guidelines, has issued a Topic Guide dedicated to planning mobility in functional urban areas and metropolitan regions\(^ {172}\). The Vital Nodes project has also prepared a toolbox that helps cities to take into account the extra-urban dimension of freight policies\(^ {173}\).

**Future development in Europe should consider transport, energy and digital sectors simultaneously.** For instance, the transition to zero-emissions vehicles will be stunted without a corresponding development in green electricity and hydrogen. Digital means are also necessary to enable smart charging, vehicle-to-grid activity, and to deal with peak electricity demand. Ensuring that these three domains are always aligned will encourage new policies to further unlock the potential of other forms of SST.

The disruptive impacts of COVID-19 have further highlighted the importance of integrating different policy domains: for example, encouraging teleworking and e-governance means redefining the trajectories of movements of people and goods, but it also requires improving broadband infrastructures and mitigating the negative impacts on some commercial sectors such as those bars and restaurants located in the proximity of offices.

### 5.1.2. Improve (multi-level) governance cooperation mechanisms to facilitate policy coordination among EU, national and local levels

At the level of policy making for urban transport at the EU level, the subsidiarity principle applies, as described in chapter 2. This means that EU institutions exercise residual competence on the matter, and in many cases the EU releases policy documents and guidelines which are taken up at the discretion of the Member States and local authorities. In this case, the EU should keep facilitating the sharing of best practices, ideas and innovations for safe mobility in urban and sub-urban areas. Improved multi-level governance cooperation mechanisms are required to establish a continuous dialogue, ensure policy coordination, and undertake joint actions. This is needed both vertically (with different levels of governance, from the EU to local communities) and horizontally (with different authorities in the same cities, and with private stakeholders). In this regard, the EU hould

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172. CIVITAS. 2019. *Topic guide: Sustainable urban mobility planning in metropolitan regions*

coordinate the COVID-19-related response of local authorities and stakeholders active in the field of urban mobility, using this challenge as an opportunity for a new, more sustainable mobility in the EU and in line with the European Green Deal. This is the aim of the COVID-19 SUMP Practitioner Briefing\textsuperscript{174}, endorsed by the EU.

For some sectors requiring coordination at the European level, the EU intervenes through regulations and directives, as described in chapter 2. To highlight the implications of the various legislation for cities, they could contain, or be amended with, specific reference to the interventions required at urban level. Alternatively, urban mobility plans could include direct references to these European legislative instruments, e.g. to the TEN-T regulation or the AFID directive. This would favour a certain awareness and consistency in the deployment of the solutions. In order to facilitate this process, co-legislators could set up a one-stop-shop for Member States and local authorities, collecting all urban transport-related provisions as required in these legislative instruments. For instance, for the benefit of reinforcing the provision of interoperable and efficient ITS services in Europe, the EU establishes the development of EU-wide real-time traffic information (RTTI) services. Data pertaining to the urban dimension should be identified and communicated, so that local authorities and transport authorities are facilitated to collect and share them.

At the city level, users (citizens and businesses) should be better involved in the governance of complex multimodal transport systems, especially in the rollout of innovative mobility solutions. Public authorities have the opportunity to define and coordinate the role of all actors\textsuperscript{175}. Local Living Laboratories (‘Living Labs’) are spreading as tools which support participatory co-creation\textsuperscript{176}, experimentation and deployment of the innovative solutions envisaged in the local SUMPs. Innovating and testing new mobility concepts and services favours the introduction of technologies supporting transport sustainability, avoiding negative effects that new forms and models of transport could generate when not integrated into a shared and coherent vision of mobility (for example, risk of additional congestion, unwanted mode shift or digital divide caused by shared vehicles, new apps, drones).

5.1.3. Support evidence-based policy making to ensure that decisions are based on the needs and configurations of local ecosystems

Definition and implementation of key urban transport policies should be data-driven and based on evidence. This means making proper use of collected and shared data, and collaborating with companies and citizens to co-create policy at all governance levels. Advanced data collection techniques and modelling are essential for the data to be reliable and interpreted to develop policies that are neutral and not prejudicial to any category or mode of transport. Indeed, the “development and use of modelling tools is necessary to better understand the economics and behaviour and assess the impact of (...) policy measures”\textsuperscript{177}. Thus, implementation of (smart) access regulation, low/zero emission zones, parking space allocation, and dynamic space management should be based on understanding of passenger and freight movements and estimation and measurements of their impacts. Although monitoring and evaluation are actions required by the European SUMP guidelines, for various reasons they often do not take place, nor do they relate to any initial baseline of reference. The EU could make funding conditional on the ex-ante and ex-post assessment of local policies.

\begin{itemize}
\item \textsuperscript{174} https://civitas.eu/news/covid-19-sump-practitioners-briefing-now-available
\item \textsuperscript{175} https://ec.europa.eu/jrc/en/facts4eufuture/future-of-road-transport
\item \textsuperscript{176} The principle of co-creation is the process of creating new public policies and services with people. The EU Quality of Public Administration “Toolbox” further elaborates the principle in section “User-centered consultation and co-responsibility (cocreation)”
\item \textsuperscript{177} ALICE / ERTRAC. 2014. Urban Freight research roadmap. Urban mobility WG.
\end{itemize}
requiring a well-proportionated but coherent effort by public authorities. However, discrimination or administrative burdens for small municipalities or those with fewer resources should be avoided. For these, funds to set up local SUMPs and monitoring mechanisms should be available.

**All new interventions should be integrated into a coherent and balanced transport mix.** Also in light of the new dynamics generated by the COVID-19 pandemic, it is necessary to distinguish between short-term buffer measures and long-term strategies. Taking the example of encouraging active travel, if on the one hand benefits are evident (physical distancing, active citizens, less pollution), this implies costs as well (less space for other modes, contraction of the automotive market, etc.). **An appropriate cost-benefit analysis, integrating other sectors such as health, social inclusion, economic development, should accompany the introduction of new transport measures.**

5.1.4. **Support a better blending of funds to favour research and deploy innovation**

As described in section 2, the EC has introduced various funding programmes and instruments to support the coordinated development of smart and sustainable transport systems. The programmes have a diverse scope, as well as funding and management processes and objectives, ranging from research and innovation to infrastructure deployment. However, these tools are not always used in a coordinated manner. The EC encourages a blended use of these instruments, and has begun to include this factor in certain H2020 calls. **Horizon and CEF funding is important to pilot new solutions and assess their feasibility, however they should be blended with structural funds for upscale and deployment.** This also implies a solid multi-governance dialogue, since the Horizon funds are grants directly managed by the EC, as well as the CEFs (which, however, must be agreed with Member States), whilst Structural funds are managed by the Member States and their regions and on the basis of Partnership Agreements and Operational programmes (OPs), negotiated with the EC. The EU should encourage the complementary use of the different funding lines available at European level, for example by requiring that applicants for funds for a specific programme clarify how these would be strategically integrated with previously used or allocated funds.

5.2. **Sustainable transport**

5.2.1. **Evaluate user preferences and induce behaviour change within a participatory policy planning approach**

The COVID-19 crisis has shown that radical behaviour changes are possible, even in the short term. It is also evident, however, that these cannot be entirely delegated to the citizens or to single companies. **Behaviour changes should rather be induced (or guided) by bold public policies, in the interest of, and discussed with, the community.**

**Research methods to better evaluate drivers in behaviour change, and user and purchaser preferences, should be upgraded** especially in deploying trade-offs to users and purchasers willing to pay in order to support new policies. This challenges the existing practice of preference surveys, and replaces it with more advanced techniques, such as Participatory Value Evaluation, the

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178 See H2020 LC-MG-1-12-2020 call: “Clear commitments and contributions to Europe-wide take up during and beyond the project are expected, which could for example be in the form of follow-up actions funded by CEF or similar programmes”.


combination of discrete choice modelling and agent-based modelling to evaluate stakeholders’ policy acceptability, taking into account their heterogeneous preferences and interactive behaviour. The aim would be to provide more contextual analysis in the results of these surveys, thus improving the accuracy of the predictions.

Socially-responsible management of price increases. Several initiatives, such as the transition to zero-emissions transport services, logistics consolidation, and automated transport, are expected to lead to higher transport service prices, which may affect access to transport services and increase transport inequality. Policies that support such initiatives should be bundled with other initiatives to reduce the imbalanced burden on disadvantaged groups, such as those with low income, disabilities or the elderly. A potential approach is the provision of subsidies or tax-rebates, based on the calculated increased burden on individuals caused by the specific transport policies. Other initiatives that improve customer choices, for instance through MaaS and infrastructure development, could also alleviate the overall burden.

Rights to access sustainable passenger and logistics services. Current transport-related rights primarily refer to quality of services. Research should be carried out to clarify whether access to clean urban transport or logistics should become a matter of user’s interest or passenger rights. This may have wide-ranging impacts to the market, both positive and negative, and should be evaluated carefully.

5.2.2. Consider all dimensions of sustainability, i.e. economic growth, environmental protection and social equity, for the deployment of new transport services

As illustrated in section 2, European policy has focused its line of action for the coming decades on the Green Deal, with the overarching aim of making Europe climate neutral by 2050. The focus on environmental aspects should not overshadow the socio-economic aspects of the innovations that the EU will support in the coming years. In 1987, the Report of the World Commission on Environment and Development *Our Common Future* identified the three main pillars of sustainable development: “economic growth, environmental protection, and social equality”. These three dimensions must coexist for every new sustainable policy or measure. Therefore, there cannot be a new transport solution that is sustainable from an environmental point of view, but does not guarantee economic feasibility (e.g. financially viable business models of many UCCs depend explicitly on government subsidies – see section 4.5) or social equity (e.g. exploitation of drivers by ride-hailing companies or riders by instant delivery companies). Policy makers must pursue the accomplishment of all these dimensions when allowing for the deployment of new transport services.

5.2.3. Review and update air quality indicators and consider the adoption of health impact assessment tools in decision-making process

As reported by the European Court of Auditors, the air quality standards at EU level were set almost 20 years ago and need to be updated and adapted to the latest scientific evidence on human health impacts. The European Commission has proposed to align them to the WHO guidelines and has been

186 European Court of Auditors. 2018. Air pollution: Our health still insufficiently protected
further developing the EU Clean Air policy framework. Moreover, although current rules on monitoring provide a good basis for obtaining comparable and reliable air-quality measurement data, monitoring systems designated by Member States should be further harmonised, while local authorities should be more closely involved in identifying the location of measurement sites.\(^{187}\)

The new version of the European Sustainable Urban Mobility Plan (SUMP) Guidelines features a topic guide linking transport and health.\(^{188}\) This supports the inclusion of health provisions and methodologies in urban mobility policy and planning documents. Public authorities should consider the adoption of Health Impact Assessment (HIA)\(^{189}\) tools and indicators to integrate health evidence, objectives and measures in the decision-making process, establishing a link between active mobility and health risk reduction. National frameworks and local mobility plans should not only promote policies for air quality, noise, green spaces, physical activity, social interaction patterns, and road safety, but these should also include mechanisms quantifying their impact on the health of citizens.

The EC should monitor the uptake of the solutions proposed in the SUMP Topic Guide in national and local planning frameworks, and encourage the replication of successful approaches of countries and cities having successfully included these methods and indicators in their policy and planning documents. The EU should consider promoting and funding the implementation of the most effective transport-related measures positively impacting the health of citizens, such as traffic restrictions and bans, active travel, speed limits, etc., favouring the most health-friendly modes in the framework of cross-sectoral cooperation and coherence of relevant policy areas. EU vehicle emission limits should be fitted to real-world driving.

5.2.4. Support multimodality: use the momentum to give more relevance to walking and cycling in transport policies. Update public transport policies at EU level

Multimodality refers to “the use of different modes (or means) of transport during the same journey,”\(^{190}\) taking advantage of the strengths of each mode. The EU has declared 2018 the “Year of Multimodality”,\(^{191}\) aiming to efficiently mix transport modes for an EU sustainable and integrated transport system. The EU should develop an official EU Cycling Strategy following the approach of the one released by the European Cycling Federation\(^{192}\) and presented in 2017.\(^{193}\) Similarly, the EU should deliver a European Walking Strategy as a framework in which cities can plan walkable routes and incorporate the principles of multimodality and equity\(^{194}\) among transport modes. Guidelines for standardised data collection methods for walking and cycling should be promoted to give them equal relevance as modes of transport and compare them in terms of efficiency, environmental and economic impacts on other modes such as public transport and private vehicles.\(^{195}\)

In order to avoid conflicts between modes, it is necessary to adapt infrastructure and reorganise the management of spaces, possibly in a dynamic and flexible way. If the separation from the

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187 Committee of Regions. 2020. *Outlook opinion. The future of EU Clean Air Policy in the framework of the zero-pollution ambition*
188 CIVITAS. 2019. *Topic Guide: linking transport and health in SUMPs: How health supports SUMPs*
189 [https://www.who.int/health-topics/health-impact-assessment](https://www.who.int/health-topics/health-impact-assessment)
192 [https://ecf.com/eu_cycling_strategy](https://ecf.com/eu_cycling_strategy)
194 In transportation planning and analysis, equity refers to the fairness with which impacts (benefits and costs) are distributed. Source: Litman, T. 2020. *Evaluating Transportation Equity: Guidance for Incorporating Distributional Impacts in Transportation Planning.* Victoria Transport Policy Institute, Victoria, BC
sidewalks for pedestrians seems obvious, the opportunity to design separate lanes and spaces between normal bicycles and electric soft vehicles should also be considered, as well as reserving the necessary space for the movement of freight, which grows together with e-commerce. An increasingly widespread network of secondary roads with speed limits between 20-30 km/h (see example of Brussels\textsuperscript{196}) makes it possible to make room for soft modes on the roads. In the short term, this type of interventions favours rapid changes in the allocation of urban space and in the prioritisation of different modes. In the medium and long term, technological innovations for the dynamic kerbside management can make space organisation more efficient and modulate the offer based on contingent needs\textsuperscript{197}.

5.2.5. Enhance coordination at European level of national and local policies, incentives and subsidies for clean vehicles and infrastructure

The European Green Deal aims at making Europe the first climate-neutral continent by 2050. For it to succeed, the Green Deal strategy must be supported by ambitious and concrete action plans with well-defined targets and be integrated with other policies at national and local level. So far, as also reported by the European Court of Auditors, “there has been no significant reduction in private car usage”, and air pollution in many cities still exceeds the legal limits. Auditors claim that “no substantial improvement is possible without Member States’ commitment and further EU coordination”. It is therefore a question of giving priority and further thrust to existing plans: a green restart is an opportunity for sustainable and smart transport strategies to regain momentum\textsuperscript{198}.

The EU should strongly support the development of financing schemes for the purchase and procurement of zero-emission vehicles and other non-polluting technologies. EU funding instruments such as InvestEU\textsuperscript{199} and Connecting Europe Facilities (CEF)\textsuperscript{200} could steer private and commercial investments into zero-emission vehicles and deployment of related charging infrastructure. Scrappage or purchase subsidy schemes should be extended to electric bicycles, possibly with similar approaches at European level, as they have been successfully applied in Germany, France and Italy. For buses and city fleets, prices of clean vehicles remain prohibitive. Aid for the recovery of the automotive sector could be conditioned to a shift towards zero-emission mobility, and not simply to reinvigorate the traditional pre-COVID-19 market.

Although the White Paper contains these types of objectives (see section 2) and some cities have undersigned common statements such as the C40 Fossil Fuel Free Streets Declaration\textsuperscript{201}, at the European level there is a need for cities to set more coordinated decarbonisation targets and timelines to phase out conventionally-fuelled vehicles. This would give a clear signal to the industry, in particular freight industry players and vehicle manufacturers, shifting to e-mobility, and would help them to plan their large-scale investments since they would have less uncertainty regarding policy fragmentation, for example regarding Urban Vehicle Access Regulation (UVAR) schemes: for cities it is easier to agree on common targets rather than solutions, each urban

\textsuperscript{196} https://etsc.eu/brussels-to-become-a-30km-h-city/
\textsuperscript{197} Urban ITS Expert Group. 2013. Guidelines for ITS deployment in urban areas
\textsuperscript{198} Transformative Urban Mobility Initiative (TUMI). 2020. COVID-19 and Sustainable Mobility - Early Observations and Documentation on first developments
\textsuperscript{199} https://europa.eu/investeu/home_en
\textsuperscript{200} https://ec.europa.eu/inea/en/connecting-europe-facility
\textsuperscript{201} https://www.c40.org/other/green-and-healthy-streets
environment being different from the others. Initiatives such as ecolabelling\textsuperscript{202} can be applied to both vehicles\textsuperscript{203} and services\textsuperscript{204}. EU policy could support these initiatives at a broader and coordinated level.

5.3. **Smart transport**

5.3.1. Investigate new models and schemes to better integrate passenger and freight

In urban areas, passenger and goods transport share the same infrastructure. However, they are considered as two separate systems, and their planning often takes place in silos\textsuperscript{205}. **EU and local authorities should investigate new models and schemes integrating passenger and freight transport in urban areas** from an institutional, infrastructural, operational and business perspective. As an example, as a response to the COVID-19 pandemic, an integrated approach is needed to intervene on the “time–space rhythms of the city”\textsuperscript{206} and encourage smart working so to avoid concentrations of flows during peak hours.

Some solutions are currently being tested on a small scale: integration of passenger and freight transport services by some emerging operators\textsuperscript{207}, exploration of models for sharing the electric charging infrastructure between freight and public transport vehicles\textsuperscript{208}, flexible and shared use of the kerbside\textsuperscript{209}, car parks and depots for goods transhipment operations during the day and parking buses or private cars at night. However, **these solutions should be conceived as part of a planning approach that sees freight and passengers as different elements of a single system**. For these models to be successful, private sector stakeholders, such as (freight) service providers and (charging, parking) infrastructure managers, should be involved in strategic consultation. **The EU should systematise research and innovation pathways for these shared solutions at the European level**, which must then be tailored at the local level according to the different characteristics of the cities.

5.3.2. Encourage the use of common EU standards and specifications to establish an interoperable and efficient Intelligent Transport System network

In recent years, many European cities have introduced Urban Vehicle Access Regulation (UVAR) schemes to combat congestion and / or pollution. The new trend is to co-create these regulations together with the citizens and businesses concerned in order to increase their effectiveness. However, greater integration of approaches and information relating to these regulations is needed. The EC has published studies and recommendations on how to approach UVARs\textsuperscript{210}, and some European projects\textsuperscript{211} are putting forward a paradigm to guide cities in their definition, and to inform European road users in a coherent and user-friendly way about existing schemes. Although a EU-funded website that collects this information in a static format is already in place\textsuperscript{212}, **interoperable EU-wide real-time traffic information should be made available to service providers and developers**, who would use it to build travel information websites, online journey planners and other applications and services for...

\textsuperscript{202} \url{https://ec.europa.eu/environment/ecolabel/}
\textsuperscript{203} \url{https://ec.europa.eu/clima/policies/transport/vehicles/labelling_en}
\textsuperscript{204} \url{https://www.smartfreightcentre.org/en/how-to-implement-items/what-is-glec-framework/58/}
\textsuperscript{207} \url{https://www.polisnetwork.eu/news/post-lockdown-mobility-webinar-report-urban-logistics-in-lockdown/}
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\textsuperscript{210} European Commission. 2017. Study on Urban Vehicle Access Regulations
\textsuperscript{211} \url{https://civitas-reveal.eu/}
\textsuperscript{212} \url{https://urbanaccessregulations.eu/}
citizens and logistics operators. Furthermore, the collection and sharing of this data can accelerate the rollout of Mobility-as-a-Service (MaaS) and Logistics-as-a-Service (LaaaS), thus enhancing the flexibility, reliability and overall efficiency of the mobility network. **To facilitate this process, the EU should encourage the use of common EU standards and specifications to establish an interoperable and efficient Intelligent Transport System (ITS) network.** Together with solid data sharing protocols (see 5.3.4), this would facilitate the exchange at the EU level of information and data regarding interoperable payment and ticketing, information on charging and refuelling points, access to in-vehicle data, continuity of traffic management services, etc.

5.3.3. **Systematise the usage of common key performance Indicators (KPIs) and scoreboards for statistics deployment**

Although the importance of adopting evidence-based policies has been highlighted, it is currently difficult for a city to objectively assess the effects of specific measures and technologies and to make use of lessons learned from other cities. These cities often lack some set of widely accepted performance measures and methodologies. The integrated decision making for urban transport at local, regional, national or EU level should be supported by a coordinated data, statistical, monitoring and evaluation system. **The definition of a minimum set of key performance indicators (KPIs), from the EU to the local level, should be introduced by the EC and actively sustained by all co-legislators. This would also serve as a benchmark to compare progress of urban areas across the EU.** The European Commission (DG MOVE) funded the SUMI (Sustainable Urban Mobility Indicators) project which developed “a comprehensive set of indicators that support cities to perform a standardised evaluation of their mobility system and to measure improvements that result from new mobility practices or policies”. Although an e-course to support cities with the application of this sustainable mobility indicator set exists, its use should be encouraged as much as possible, and the results aggregated and used as an information tool for upcoming European transport strategies.

5.3.4. **Prepare non-binding guidelines to encourage the definition of data-sharing principles for public authorities and urban transport operators**

An EU framework encouraging aggregation of new sources of data from infrastructure, vehicles, smartphones and more is needed. This could be achieved through the establishment of data-sharing principles to facilitate the exchange of data and information enabling an evidence-based policy-making process. Public-private agreements are needed to enable cities and regions to properly manage their transportation systems, maintaining a coordination role that guarantees a holistic vision of all mobility services, while also protecting the competitiveness of companies. Incentives for private service operators to share the collected data should be designed, so that they are requested or encouraged to participate and inform the policy-making process. **The Parliament should push the EC to prepare non-binding guidelines to encourage the definition of secure data-sharing principles for local authorities and urban mobility operators, to facilitate the secure exchange and sharing of data that generates benefits for both the public and the private sector.**

5.3.5. **Establish a recognised EU value chains for key technology and services**

In several areas, such as electric vehicles and provision of data services, the EU-based value chains are destabilised by external suppliers especially from the US and China. This has an influence on the take-

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214 https://ec.europa.eu/transport/themes/urban/urban_mobility/sumi_en
up and long term sustainability of the SST solutions. In order to support a fair and competitive market in the EU and the long term viability of the EU suppliers, the EU could intervene in different areas.

**Mandating due diligence for life cycle assessments in procurement**\(^{215}\). Procurement should not be geographically restricted, but should consider sustainability at a broader scale, not simply locally. This is particularly important for climate change considerations. Greenhouse gas emissions should be calculated and benchmarked based on Scope 3 assessments\(^{216}\). Other core EU values, emphasising the social aspect of production or provision of services\(^{217}\), should figure into the comparison of procurement alternatives, where the key parameters can be reliably estimated. This would lead to a level-playing field for EU-based suppliers, but more importantly it would promote social and ethical practices at the global level.

**Support relevant skills development.** Innovation will require differently skilled human resources. Current training and education focuses on knowledge and skills needed for conventional transport. Concerted policy across the EU will need to provide the future labour force with the right digital skills\(^{218}\) that currently are often self-taught and not framed into an EU long-term strategy for capacity and knowledge building in the transport sector of the future.

**Support disruptors and entrepreneurship.** The transition to a sustainable transport service business model is a major challenge, in opposition to developing a model from scratch in start-ups (or spin-offs) and focusing only on profitability. EU policy can support the emergence of a conducive environment for new and sustainable mobility and logistics services by reducing barriers to the market and providing funding\(^{219}\). The European Startup Prize for mobility\(^{220}\) is an acceleration programme that supports each year the 10 best European startups developing sustainable mobility innovations, with the aim of providing them with the resources necessary to scale up in Europe. These type of initiatives should be exploited not only to support new disruptors and entrepreneurship, but also to reinforce the dialogue at EU level and collect inputs that can directly inform the EU policy making priorities of the sector.

\(^{215}\) [https://ec.europa.eu/environment/gpp/lcc.htm](https://ec.europa.eu/environment/gpp/lcc.htm)

\(^{216}\) Scope 3 assessments accounts also for greenhouse gas emissions along their value chains. This broadens the scope of accountability of emissions beyond the direct emissions produced by the company (Scope 1) and indirect emissions from energy use (Scope 2) to emissions caused by upstream and downstream activities. See [https://ghgprotocol.org/scope-3-technical-calculation-guidance](https://ghgprotocol.org/scope-3-technical-calculation-guidance) for further description.


\(^{220}\) The European Startup Prize for mobility is a public-private initiative co-founded by the European Parliament’s Transport and Tourism Committee Chairwoman, Karima Delli, Boston Consulting Group and Via ID. More information: [https://startupprize.eu/](https://startupprize.eu/)
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This study aims to provide the European Parliament’s TRAN Committee with an overview on the state of play of sustainable and smart transport, including recent developments/trends, challenges and opportunities, solutions/good practices and recommendations for EU policy makers. It also considers some recent developments related to the impact of COVID-19.