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URBAN SHIFT

Urban Shift for green innovations

URBAN MOBILITY

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MCRIT

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Foreword

Urban Shift (UShift) is an experimental, impact-based, and transdisciplinary education programme that focuses on creating lasting change by bringing together students from Higher Education Institutions (HEI), a Vocational Education Institution (VET), urban experts, and business partners. This is to be achieved by combining intersectional environmental education, knowledge exchange, transdisciplinary collaboration, and sustainable innovation.

By providing the learners with the necessary GREEN LABOUR MARKET SKILLS (digital, green, business and transdisciplinary/resilient skills), UShift is creating a LIVING ECOSYSTEM for 80 learners from diverse backgrounds (urban design, environmental engineering, media and business) that fosters the development of solutions to pressing urban challenges. The learners, divided into two batches, will create 10 startup teams working on urban challenges linked to urban heat islands (UHI)/cooling, and food waste/circularity, or climate/extreme weather predictability and mobility/circularity. Thus, the project allows students to successfully transform into change makers and EU GREEN DEAL AMBASSADORS by equipping them with the knowledge and experience needed to become green entrepreneurs and/or future employees of green jobs on the global market.

The culmination of this education programme are two sets of LIVING EXHIBITIONS (8 separate exhibitions) spread across Barcelona, Genoa, Copenhagen, Stuttgart, and Vienna. Their purpose is to showcase the solutions and success stories that flourished from the UShift project lifetime in order to raise public awareness for humanity's biggest challenges (i.e., pressure on planetary boundaries, resource scarcity, persistent poverty, social injustice, exponential population growth, urbanization boom, global pandemics, etc.) and interest in the UShift LIVING LABS curricula, the European Green Deal, and the United Nations (UN) Sustainable Development Goals (SDGs). This will be done through an interactive exhibition programme made up of panel and roundtable discussions, media discourse, artistic events, workshops and knowledge exchange via the exhibition of the developed courses and start-up prototypes. The goal is to inspire individual stakeholders such as NGOs, consumers, green start-ups, policy makers, and incubators to take part in the global Urban Shift as active change makers.

Even after the project's lifetime, UShift will continue to have a positive impact via the establishment of an easily adaptable LIVING CURRICULUM template and OPEN ONLINE TRAINING sessions that will be made available on YouTube to inspire future transdisciplinary collaboration. Furthermore, the establishment of an ALUMNI NETWORK serves as a tool to foster sustainable project outputs and the continuation of the start-up teams, as well as serves as a channel for peer-to-peer learning, support, knowledge and expertise exchange, collaboration, co-creation, and mentorship between the learners, start-up teams, business partners and urban expert during and after the project.

Urban Shift is a project developed by Wirtschaftsuniversitat Wien - WU (Austria), Institute for Advanced Architecture of Catalonia - IAAC (Spain), Hochschule Der Medien - HdM, (Germany), Wirtschaftskammer Österreich - WIFI (Austria), Multicriteria- MCRIT (Spain), Terra Institute - TERRA (Italy), Pretty Ugly Duckling - PUD (Denmark), Green Innovation Group A/S - GIG, (Denmark), and co-funded by the Erasmus+ Key Action 2 Partnerships For Innovation Alliances For Innovation 2021 Programme of the European Union.

1. Background

1.1 Mobility & Transport: interchangeable terms?

Transport and mobility are related concepts but have distinct meanings:

Transport refers to the physical movement of people, goods, or services from one location to another. It focuses on the means of transportation, such as vehicles (e.g., cars, buses, trains, airplanes), infrastructure (e.g., roads, railways, airports), and systems that enable the movement of people and goods. Transport is primarily concerned with the technical aspects of moving entities and ensuring efficient and safe transportation.

On the other hand, **mobility has a broader scope and encompasses the ability to move and access various destinations and opportunities**. It includes not only the physical act of transportation but also the social, economic, and behavioral aspects associated with movement. Mobility involves the choices people make regarding their travel patterns, the accessibility of transportation options, and the impact of transportation on quality of life, social inclusion, and environmental sustainability. Mobility also considers factors such as walking, cycling, and the use of public transportation, as well as the integration of different modes of transportation to create seamless travel experiences.

Definition
Mobility describes the way in which people and products move within and around cities, including the social, economic, and behavioral aspects associated with movement.

Table 1: Definition of mobility. Source: own elaboration.

In summary, transport focuses on the physical movement of people and goods, while mobility encompasses the broader concept of movement, including the social, economic, and behavioral aspects related to transportation choices and accessibility. Transport is a component of mobility, which encompasses a wider range of factors influencing movement and accessibility.

1.2 Europe's Mobility History

Mobility history in Europe has evolved over time, reflecting societal, technological, and economic changes. In ancient times, **mobility relied on walking and horseback riding**, limiting travel distances. The Roman Empire's road network enhanced mobility, enabling trade and cultural exchange.

During the Middle Ages, mobility primarily occurred through waterways, with rivers serving as vital transport arteries. Coastal shipping and maritime trade connected European regions, fostering economic growth and cultural interaction.

The Renaissance period witnessed **advancements in land-based mobility**, with the development of roads and the introduction of horse-drawn carriages. This expanded the range and comfort of travel for individuals.

The **Industrial Revolution in the 18th and 19th** centuries brought significant transformations. Steam-powered trains and locomotives revolutionized mobility, connecting cities, facilitating trade, and stimulating industrialization.

The 20th century saw the **rise of automobiles**, leading to a paradigm shift in mobility. Personal mobility became more accessible, as the mass production of cars and the development of road networks expanded travel possibilities.

Aviation also emerged as a transformative mode of mobility. The invention of airplanes and subsequent technological advancements enabled faster, long-distance travel, connecting Europe and the world.

In recent years, **Europe has been focusing on sustainable and multimodal mobility solutions.** Investment in public transportation systems, cycling infrastructure, and high-speed rail networks has increased. Efforts to promote walking, cycling, and public transport aim to reduce congestion, improve air quality, and foster healthier and more sustainable mobility options.

The history of mobility in Europe reflects a progression from limited mobility to the development of various modes of transportation. Europe continues to prioritize sustainable, accessible, and integrated mobility systems that enhance connectivity, environmental sustainability, and quality of life for its inhabitants.

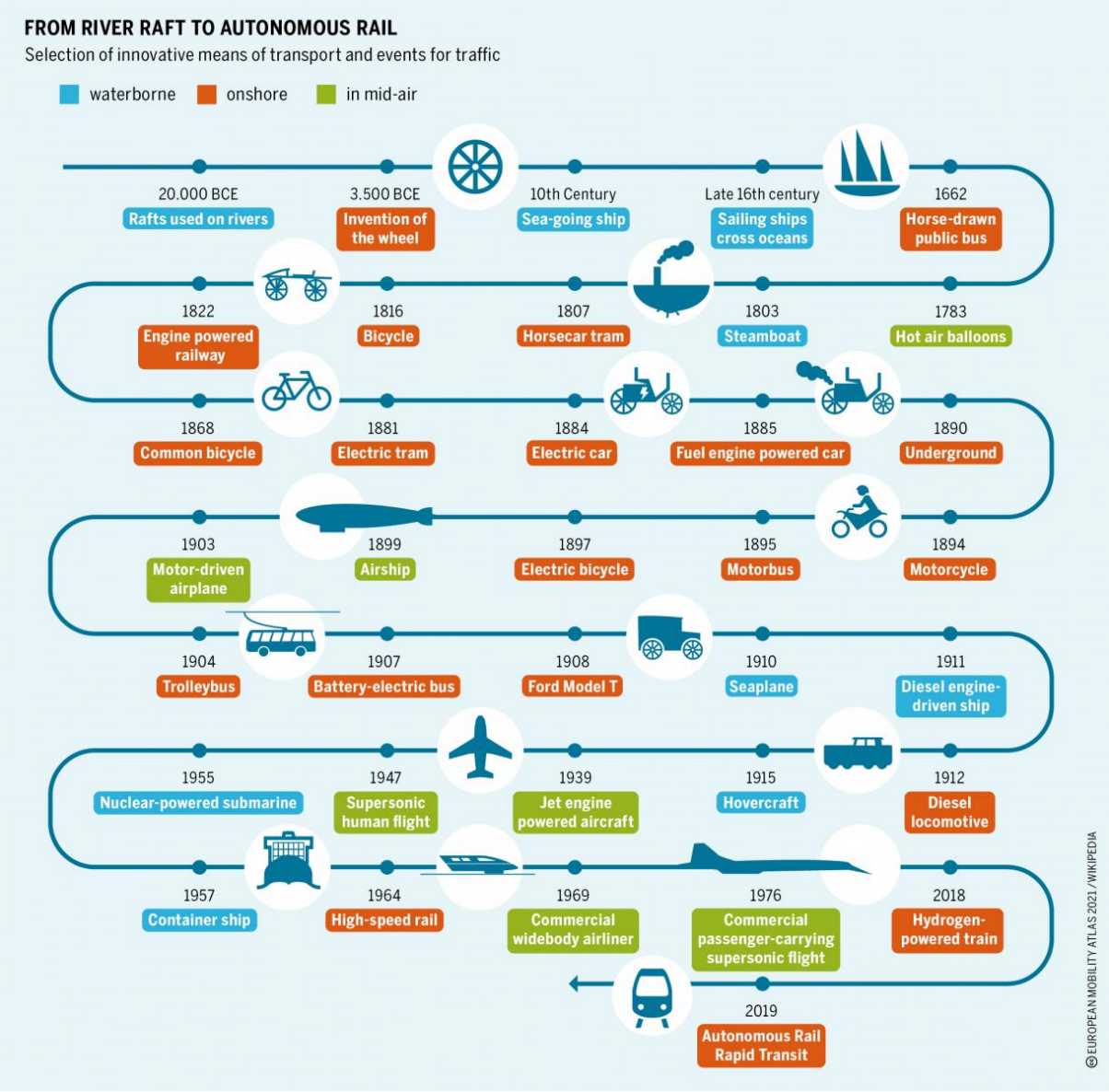


Figure 1: Innovations in the development of mobility triggered by entrepreneurial spirit or simply the desire for new ideas. Source: Heinrich-Böll-Stiftung European Union licence: CC-BY-SA 4.0

1.3 Towards Sustainable and Active Urban Mobility

Mobility of people and goods is one of the essential elements of sustainable urban and regional development. The way transport services and infrastructure are designed, operated and maintained, strongly characterizes the space they serve, with direct impact on safety, resilience and sustainability of communities, cities, and regions as well as on citizens' quality of life.

Currently, around 50% of the world population lives in cities; in the EU, that number jumps to 70% (EC, 2021). By 2050, two-thirds of the world population is expected to be urban-dwellers (CDP; International Transport Forum, 2021). As this number grows, so does the amount of people who use urban transportation. Be it walking, biking, driving, carpooling, riding the bus, or taking the metro, everyone commutes within and beyond the city limits every day. In 2005, an estimated 7.5 billion trips per day were made within cities worldwide. While such a high number of daily trips may make it seem so, mobility is not accessible to all and poses many challenges to the urban society. For example, just the cost of congestion is estimated to make up for around 1% of the EU´s GDP (i.e., €100 billion). Studies have shown that high levels of traffic also result in lower worker productivity.

To enhance accessibility, reduce carbon footprints, improve public health, and maximize economic productivity, cities need to develop and adopt sustainable transportation systems. This involves transitioning to active and micro mobility options, improving intermodality and mobility infrastructure, leveraging digital technology, optimizing energy usage, and promoting sustainable city logistics. Moreover, creating public realms and ensuring the accessibility of transportation services for all individuals, regardless of socio-economic factors, is crucial. These efforts aim to mitigate the ecological impact of urban mobility, reduce pollution, and create healthier and more liveable cities.

Urban mobility encompasses ten subcategories that are used as guidelines to improve it. These categories include active mobility, micro mobility, intermobility, mobility infrastructure, accessibility, city logistics, public realm, digital technology, energy, and ecological impact (EIT Urban Mobility, 2020).

	
Active Mobility	**Micro Mobility**
Active mobility is “a form of transport that only uses physical activity. The most common forms of active mobility are walking and cycling” (ECA, 2020).	Micro mobility is comprised of “very light vehicles (of a gross weight of less than 500 kg) equipped with an engine. It includes, among others, electric scooters, skateboards, and bicycles, as well as solowheels” (ECA, 2020).
	
Intermobility	**Mobility Infrastructure**
Intermobility combines the best qualities of various modes of transportation in the different parts of the cities to complete one trip (State of Green, 2016).	Mobility infrastructure encompasses the physical structures that facilitates and constrains the movements of people, things, information, and energy (Institut für ethnologische Forschung).
	
Digital Technology	**Energy**
Digital technology includes the use of artificial intelligence, 5G, sensors and smart infrastructure in mobility development and infrastructure construction.	The type of energy used in transportation systems is crucial to reducing the carbon footprint of mobility infrastructure.

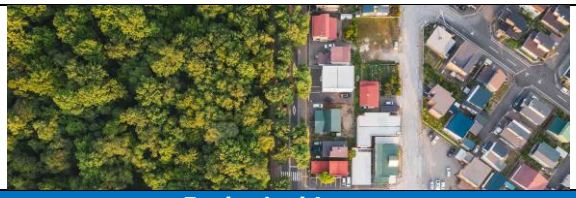
	
City Logistics	**Public Realm**
City logistics encompass the movement of goods within a city, including services such as mail delivery and waste management (Intech Open, 2022).	Public realm represents a complex space of social interaction that is generally open and accessible to all citizens, and is seen as key to urban livelihood (EIT Urban Mobility, 2022a).
	
Ecological Impact	**Accessibility**
Ecological impact of mobility refers to the emissions, pollution, and other environmental dangers that may be produced because of transportation.	Accessibility of transportation refers to who can utilize it. Mobility for all aims to improve physical and geographic accessibility for target groups and vulnerable travellers.

Table 2: Definition of the different subcategories that play into mobility.

KEY IDEAS

- The history of mobility in Europe has undergone significant changes, driven by societal, technological, and economic factors.
- Different modes of transportation, from ancient walking and horseback riding to modern automobiles and airplanes, have shaped European mobility.
- The Industrial Revolution brought about transformative advancements, such as steam-powered trains and locomotives, revolutionizing mobility and connecting cities.
- In the 20th century, automobiles and road networks became dominant, enabling personal mobility on a large scale.
- Recent years have seen a shift towards sustainable and multimodal mobility solutions, focusing on investments in public transportation, cycling infrastructure, and promoting healthier and more environmentally friendly modes of transport.

2. Effects: Why do we care about Mobility?

The current transportation system and practices within cities have significant socio-environmental and economic impacts. These impacts encompass various factors, including greenhouse gas emissions, equity and access, air pollution, noise pollution and vibrations, energy consumption, land use and infrastructure, cultural heritage, water pollution, and economic implications. Understanding and addressing these challenges are crucial for developing sustainable and inclusive transportation systems.

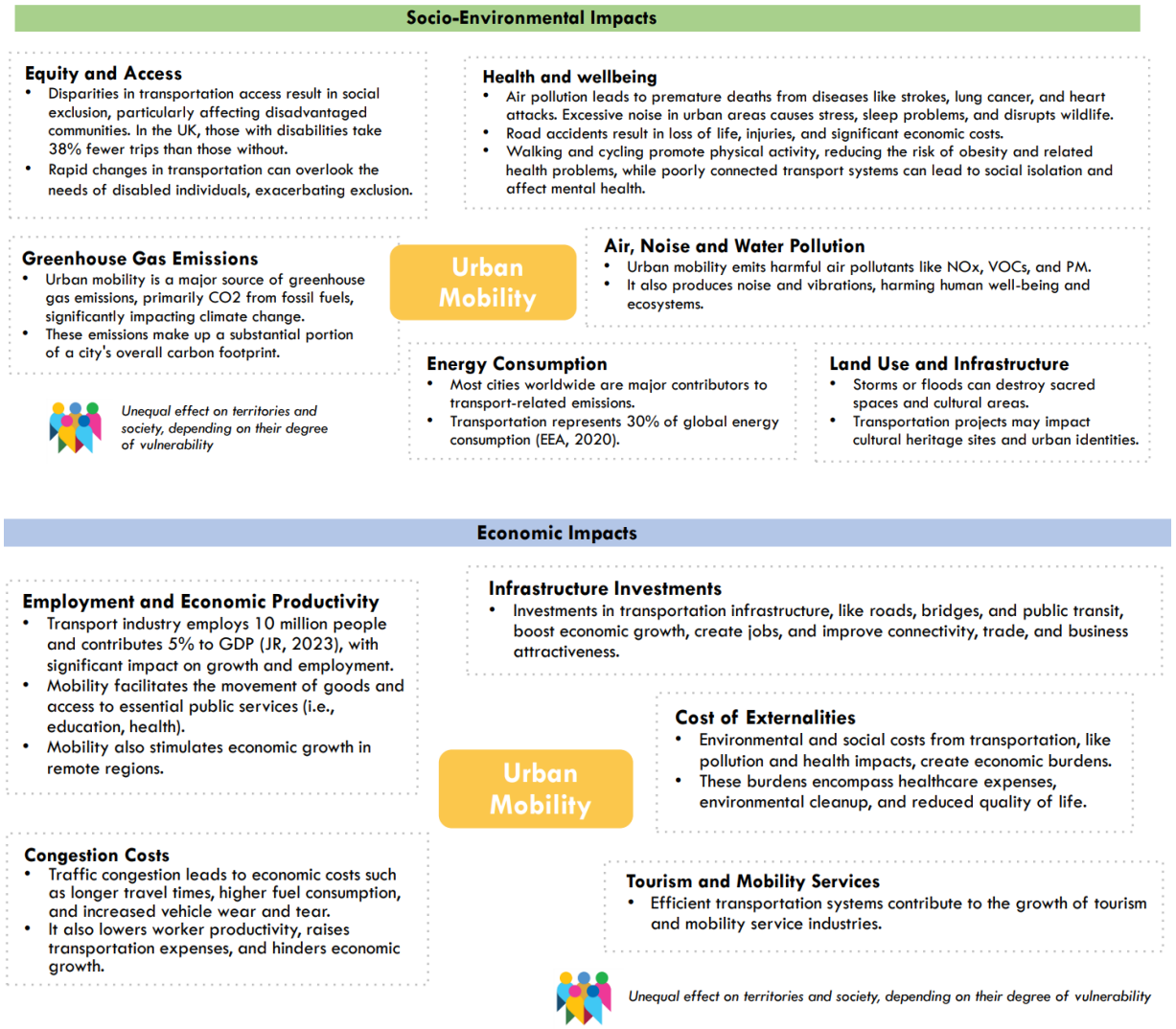


Figure 2: Socio-environmental and economic impacts.
Source: own elaboration.

Understanding and effectively managing the socio-environmental and economic impacts of mobility and transport are crucial for creating sustainable and inclusive transportation systems that promote economic prosperity, protect the environment, and enhance the well-being of communities.

KEY IDEAS

- Urban mobility has significant socio-environmental and economic impacts, including greenhouse gas emissions, air pollution, energy consumption, land use, and more.
- Equity and access are crucial aspects of urban mobility, ensuring that transportation services are affordable and accessible to all, regardless of socioeconomic factors.
- Transportation infrastructure and activities have adverse effects on air quality, noise levels, and ecosystems, impacting public health and well-being.
- Efficient and reliable transportation systems are vital for economic productivity, employment opportunities and trade facilitation.
- Sustainable transportation planning and practices are necessary to mitigate negative environmental and social impacts, promote social equity, and create liveable cities.

3. The Mobility Challenge in Europe

Europe is confronted with a range of interconnected demographic, public health, and environmental challenges that have implications for transport and mobility. These challenges include climate change, stagnating road deaths, increasing urbanization, air quality breaches in over 100 cities, rising obesity rates, and an aging population, between others.

3.1 Changing Climate

The challenges posed by urban mobility structures are exacerbated by climate change. Extreme weather events, intensified by global warming, can damage transportation infrastructure. Flooding risks impacting underground structures and surface infrastructure, leading to erosion and corrosion. Pluvial floods cause traffic disruptions, congestion, and decreased road safety. Heavy precipitation, hail, and high winds impact road transportation, increasing the risk of crashes and damage to vehicles. Wildfires and heat waves reduce visibility, worsen air quality, and pose health risks. Infrastructure damage, economic losses, and trade route disruptions are also expected.

Changes in the environment, such as melting permafrost, can further damage transport infrastructure. This impact is of particular concern in Nordic countries, as well as Russia, and parts of Canada and the US where the higher altitude and colder temperature has historically maintained high levels of permafrost (EEA, 2017). While milder winters may decrease damages and maintenance costs, longer shipping seasons may be offset by increased trade interruptions. Climate change significantly affects mobility and necessitates adaptation measures (EPA, 2022 a).

3.2 The Rise of Urbanisation

Over the next 30 years, nearly one in three European cities is projected to experience a **population increase of more than 10%.** This demographic growth is expected to lead to a surge in road traffic and greater utilization of underground and rail services, potentially straining their capacities.

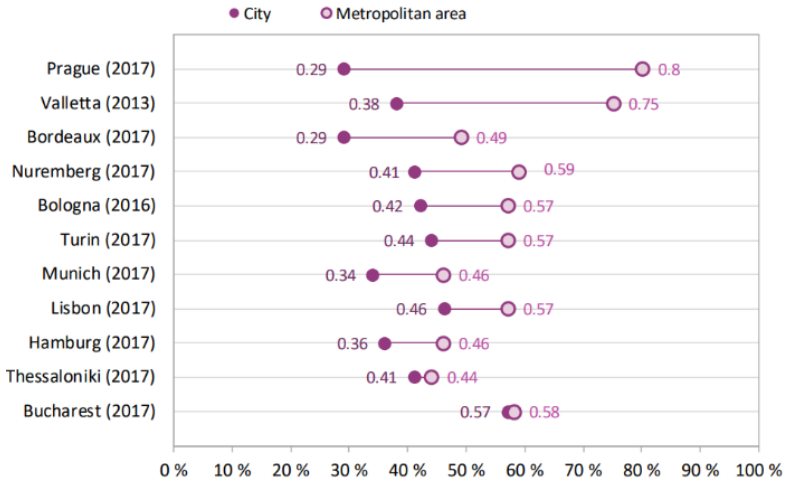


Figure 2: Modal share of private vehicles in 11 cities and metropolitan areas surrounding cities.
Source: ECA on replies to its survey on urban mobility.

Transport mode usage varies across countries, but several trends are consistent throughout Europe. **Cars remain the dominant mode of transport in the EU, accounting for 87% of all passenger kilometres travelled (Eurostat, 2022a).** However, within cities, people are increasingly opting for alternative transportation modes. Capital cities exhibit the lowest rates of car usage among residents, with significant variations observed among cities, ranging from over 70% in Lefkosia (CY) to less than 10% in Paris (FR) (European Union and UN-HABITAT, 2016).

Despite numerous initiatives and plans addressing mobility needs in Europe, much work remains to facilitate this shift. A study conducted by the European Court of Auditors (ECA) in 2020 revealed that out of 88 European cities analysed, only 27 provided data on modal share. Among those, only two cities, Antwerp and Bordeaux, demonstrated a significant decline in private car usage. Most areas experienced only slight reductions, and the majority witnessed an increase in private car usage, with Budapest experiencing an 80% rise (Figure 3). The study also highlighted that the modal share of private vehicles was typically considerably higher in the metropolitan areas surrounding cities than within the cities themselves (Figure 4). Without greater investment by cities in analyzing their modal transport and promoting the de-privatization of transport, it is unlikely that Europe will achieve its low emission mobility goals.

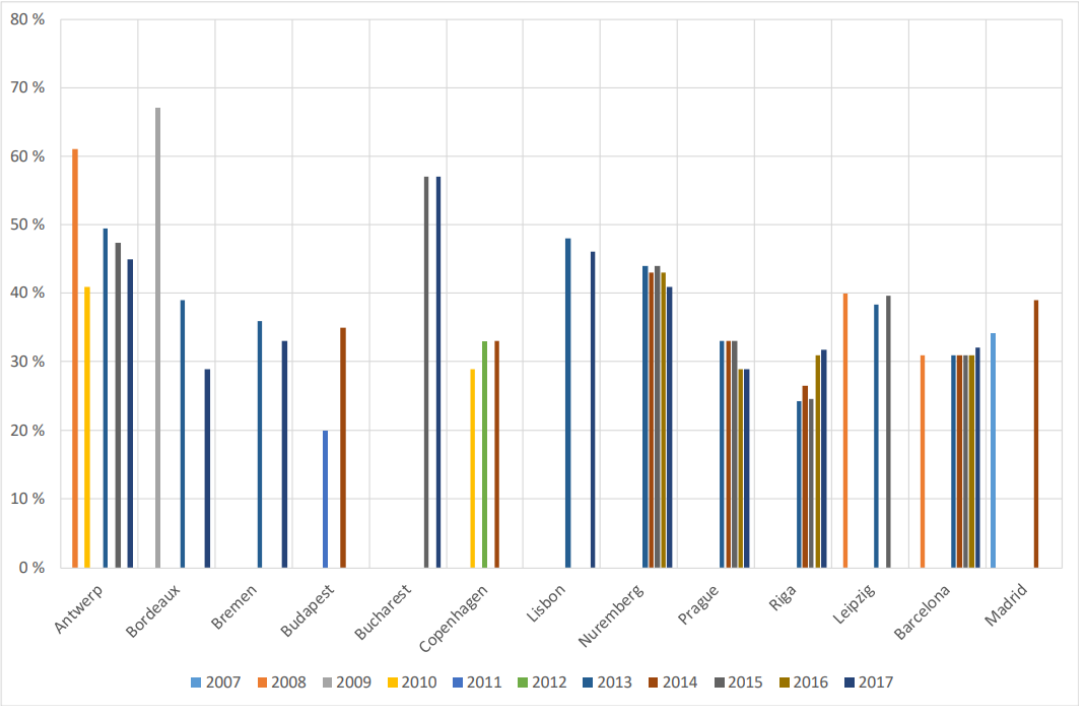


Figure 3: Modal share of private vehicles in 13 cities between 2007 and 2017.
Source: ECA analysis based on based data provided by cities and EPOMM.

3.3 Aging Population

The global society in which we all live is being transformed at an unprecedented pace. With fewer births and a greater proportion of people surviving into adulthood and then into later life, population ageing is now taking place in almost all the countries of the world.

This will also impact mobility as, according to the European Commission, specific age groups are more inclined to use certain modes of transportation than others. A study from the Netherlands found that **older generations spend the highest proportion of their journeys walking (34%), while 18- to 24-year-olds utilize public transport more than any other group**. This low usage of public transport could be attributed to limited access.

	0-11	12-17	18-24	25-29	30-39	40-49	50-59	60-74	75+
Pedestrian	29%	18%	20%	19%	18%	17%	18%	25%	34%
Bicycle	29%	52%	23%	17%	20%	23%	22%	24%	17%
Moped/mofa	0%	3%	2%	1%	1%	1%	1%	0%	1%
Motorcycle/scooter	0%	0%	0%	0%	0%	0%	0%	0%	0%
Passenger car	40%	17%	37%	56%	56%	55%	54%	46%	38%
Bus	1%	5%	8%	2%	1%	1%	2%	2%	4%
Tram/metro	0%	1%	3%	2%	1%	1%	1%	1%	1%
Train	0%	2%	6%	3%	2%	2%	1%	1%	1%
Other	1%	1%	0%	0%	0%	0%	0%	1%	3%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

Figure 4: Modal split by age group in the Netherlands. Source: Wegman & Aarts, 2005.

A 2012 report indicated that 20.4% of EU citizens experience 'high' or 'very high' levels of difficulty accessing public transport. This lack of access restricts their mobility within city centres and limits their ability to reach essential services such as jobs, schools, healthcare facilities, and stores, which represents a challenge for a society that is ageing (UITP, 2019).

3.4 Accessibility of Public Transport in Rural Areas

Efforts to improve public transport have focused on addressing ease of access, frequency, speed, and a high degree of connectivity within the public mobility network. EU funds have enabled cities to expand their public transport networks by investing in metro, tram lines, and railways. **While access to public transport is often high within cities, areas just outside of city limits often find themselves lacking access.** Many of these people commute into the city or to other suburbs daily and lacking the public transport coverage to get transport them, they must turn to other travel alternatives, such as private vehicles. Such trends reveal the need for increased public transport coverage beyond city centres.

Especially since public transport takes significantly longer, private transport is still a more efficient option for most travellers. Very few mobility plans have increased the use of public transport while decreasing private vehicle use. Such results demonstrate the need to not only make public transport more attractive, but to actively invest in dissuading people from using private transport as well (ECA, 2022).

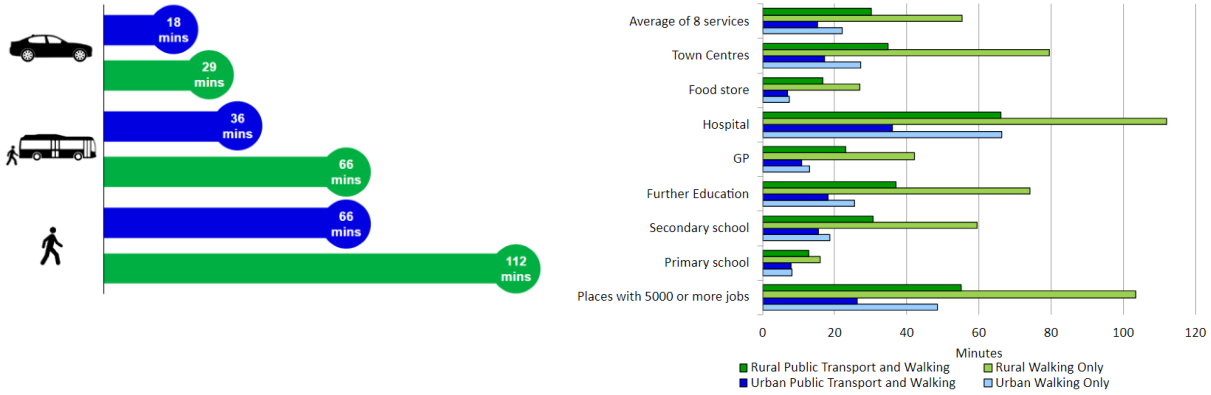


Figure 5: Average minimum travel time to reach the nearest key services by mode of travel, by Lower Super Output Area rural urban classification, in England, 2019. Source: Rural Accessibility 2019 Report.

3.5 The Escalating Scarcity of Urban Space

As cities grow and more space is needed for housing, business, commercial activities, public spaces, streets, and parking needs, less space is available for mobility users. Private vehicle transport takes significantly more space than any other form of transportation, making it the least space efficient mode of transportation (Figure 7). **Cars, which are usually parked for 95% of the day, occupy space that could alternatively be used for other functions.**

Figure 6: Karl Jilg / Swedish Road Administration. Source: The Climate Change Review.

With the way highways and roads are laid out, a trip from home to work uses 90 times more space in a car than it would via metro. Bus and trams trips take up 20 times less space than cars. In many cities, a significant portion of public space is for cars. In central London, parking makes up 14% of road space (UITP, 2021). Whether you are in a quit suburb or an urban downtown, most public spaces are designed for cars instead of pedestrians.

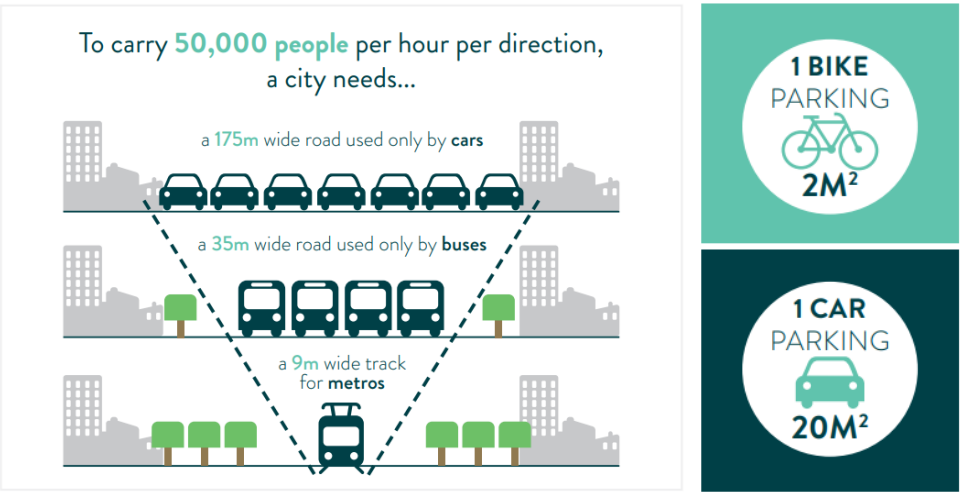


Figure 7: Wide of the road needed by different modes of transport. Source: UITP (Union Internationale des Transports Publics.

Investing in active mobility and public transportation would not only help increase health, accessibility, and environmental friendliness of urban mobility, but it would enable the more efficient use of land, making room for more housing, hospitals, parks, and other public realms.

3.6 Congestion and Noise Pollution in Cities

With an increase in road users, studies have found that **congestion has increased significantly, making urban mobility less efficient for all**. From 2013 to 2018, congestion worsened in 25 of 37 cities. In Barcelona, it now takes drivers the same amount of time to travel significantly less than was the case in 2012 (ECA, 2020). Accordingly, 60% of EU citizens consider congestion to be the greatest issue affecting roads in Europe (European Commission, 2016).

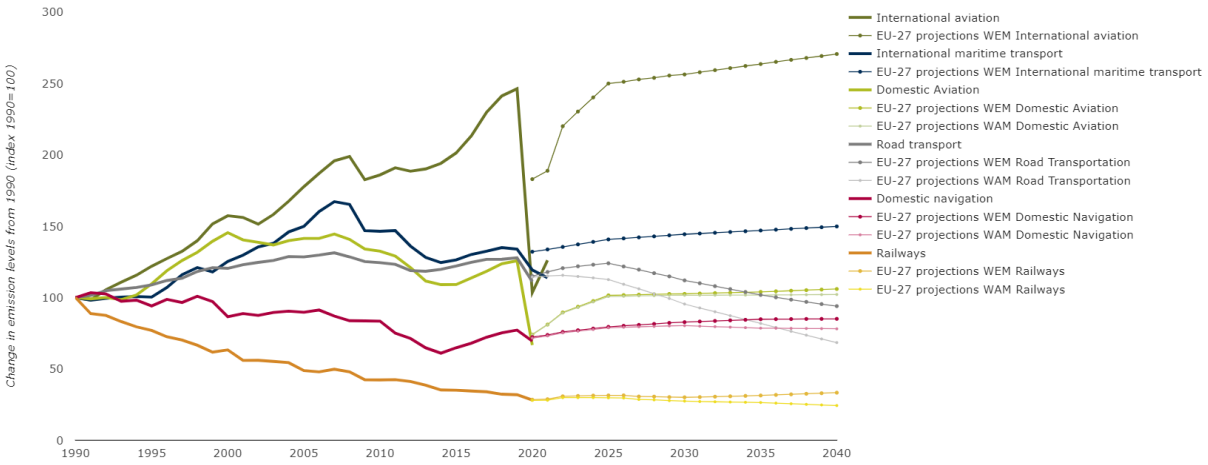
Congestion is estimated to result in an annual economic loss of €270 billion in Europe. With a 10% decrease in journey time, productivity could increase by 2.9%. In highly congested regions, that could translate to up to 30% gains in productivity (ECA, 2019). Despite the obvious benefits of reducing congestion, urban congestion continues to increase, partially because of increasing road capacity, which has been proven to only increase congestion. As of 2019, 15 out of 28 European countries had established strategies to address congestion.

One solution that has been implemented is the congestion charge. Passenger cars travelling during hours of high congestion must pay a toll, discouraging the high use of private road transport. Cities such as Stockholm, Sweden and Valletta, Malta have reported decreases in congestion since implementation of the toll and the money collected from congestion charges has been used to improve public transport. Still, much more work needs to be done to make road transport more efficient and increase economic potential of cities with high congestion (ECA, 2020).

In addition to increased levels of congestion, **many cities with motorised vehicles suffer from high levels of noise pollution**. Noise pollution can have **many negative impacts on human health, including delayed cognitive development in children, increased heart rate, poor hearing, and darker moods** (Healthline, 2023; El Pais, 2022). WHO reported that 360 million people suffer from disabled hearing due to the constant noise exposure. High noise levels can also impact sleep. In the EU, 30% of the population experiences disturbed sleep due to city noise pollution (UITP, 2021). Reducing the presence of mobilised vehicles in cities could be one way to address this issue.

3.7 Looming Threat: Urban Air Pollution Endangers Human Health

Between 2013 and 2019, emissions caused by transport have increased despite the decrease of emissions in most other sectors[1]**.** Of all transport emissions 23% are attributed to urban areas (ECA, 2020). Road transport emissions increased more than any other transport type and in 2020, it accounted for 77% of all EU transport emissions. For this reason, many EU states are focusing on road transport as the first area which they plan to decarbonize (EEA, 2022a).



[1] European Environment Agency, Annual European Union greenhouse gas inventory 1990- 2017 and inventory report 2019, 27 May 2019.

Figure 8: GHG emissions from transport in the EU, by transport mode and scenario. Source: EEA, 2022a.

With so many emissions produced by urban mobility and pollution's subsequent concentration in cities and near roads, urban air pollution has become harmful to human health. 96% of EU citizens are exposed to levels of air pollution below the level deemed safe by WHO (ECA, 2020). In 2018 alone, four million new cases of asthma and two million pre-mature births were reported globally because of high levels of air pollution (UITP, 2021). Air pollution is now on par with smoking and poor diet in its effect on human health and poses as the single biggest environmental risk to human health in the EU (WHO, 2021; ECA, 2018). Annually, billions of euros are spent in health costs because of the effects of air pollution. Biodiversity has also been impacted by the lower air quality.

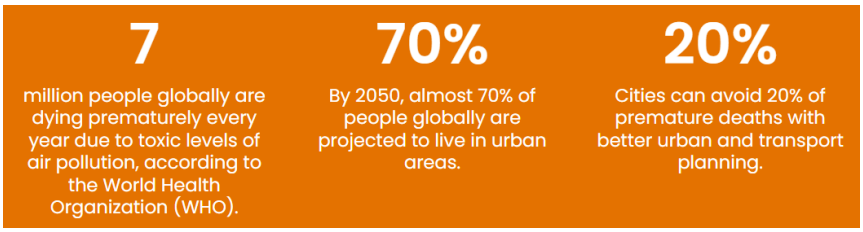


Figure 9: The connection between the health of the population and the environment. Source: ISGlobal, 2022.

Efforts to reduce NO2 and particulate matter emissions by reducing private transportation and through a variety of other strategies have helped, however, breaches of the standards set in Ambient Air Quality Directives continue to be widespread in EU cities. Further action must be taken to ensure the safety and health of urban-dwellers (ECA, 2020).

3.8 Encouraging Sustainable Travel Habits

There is an increasing recognition at local, national, and EU levels that promoting active mobility, particularly walking and cycling, can address many of the challenges previously discussed. In response to the Covid-19 pandemic, **major cities in Europe implemented infrastructure changes to encourage cycling and walking**. Temporary widening or creation of new cycle lanes and the implementation of lower speed limits such as 30km/h or 20km/h zones were introduced to ensure safe overtaking and physical distancing.

The pandemic has led to a decline in overall travel frequency and duration. Studies in the United Kingdom have shown a nearly 15% decrease in private car ownership since 2019, accompanied by an 18% reduction in trips made by private car occupants. Public transportation usage has also significantly decreased due to concerns about contracting the virus in public spaces. Following the lockdown, public transport lost around 80% of ridership (UITP, 2021). This decrease was paired with a slight rise in private transport users, increasing global transport emissions and contribution to climate change (Figure 11) (Eurostat, 2022a).

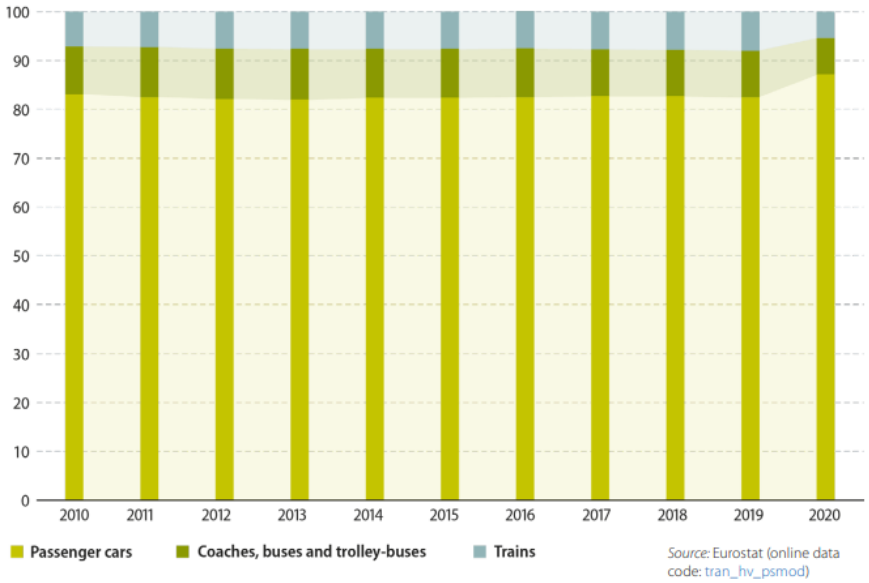


Figure 10: Development of modal split of inland passenger transport (% based on passenger-kilometres, EU, 2010–2020). Source: Eurostat, 2022a.

The pandemic has also resulted in **more flexible work habits**, with 40-70% of jobs now capable of being performed remotely. This shift offers an opportunity to encourage people to live outside of cities, reducing the need for daily commuting. However, to meet the travel needs of the population, public transport systems should extend beyond city centres. Failure to do so may lead to an increase in private transport usage, resulting in the need for more highways and parking. Such a scenario would lead to inefficient city planning, loss of valuable space, increased greenhouse gas emissions, reduced air quality, compromised public health, and higher transportation costs.

As the population recovers from the pandemic and annual trips increase, **it is crucial to encourage sustainable travel habits among returning travellers before they revert to their previous reliance on private transport**. While transportation usage has increased in most countries surveyed between 2020 and 2021, it has not yet reached pre-pandemic levels. Private passenger cars continue to dominate the modal split across all countries. Turkey had the lowest level of private transport usage, with 68.5% of all travel performed by passenger cars, while Montenegro (96.5%), Lithuania (90.4%), and Portugal (89.5%) had the highest levels (Eurostat, 2022 b). To counter these trends, there must be a greater push to increase public transport usage and promote active mobility.

Active and micro mobility options, such as walking and cycling, provide economical, sustainable, and healthy means of travel. These modes offer cost savings on fuel and parking, reduce greenhouse gas emissions, and encourage physical activity, which has been negatively impacted by excessive motorized vehicle use. Since the pandemic, there has been an increase in walking and the use of micro mobility options. Studies conducted in 2023 have shown a significant rise of 33% in the use of dockless bikes, which offer convenient and fast travel experiences. Scooters have also gained popularity, albeit to a lesser extent. While the use of mopeds is increasing in some countries, they are not as popular as other micro mobility vehicles (Mobility Innovation Marketplace, 2023). This shift toward active mobility is beneficial in addressing the global health crisis of obesity, with approximately half of adults and one-third of children affected (WHO, 2022). However, it is important to ensure that this shift does not result in a decrease in public transport usage in favour of private cars. Therefore, it is crucial to simultaneously make public transport and active mobility appealing while implementing measures to make private transportation less practical.

3.9 Strengthening Traffic Safety Measures for Safer Roads

Almost 20,000 people lost their lives in road accidents in the EU in 2021, with pedestrians, cyclists and moped riders accounting for over 32% of those fatalities (EC 2021).

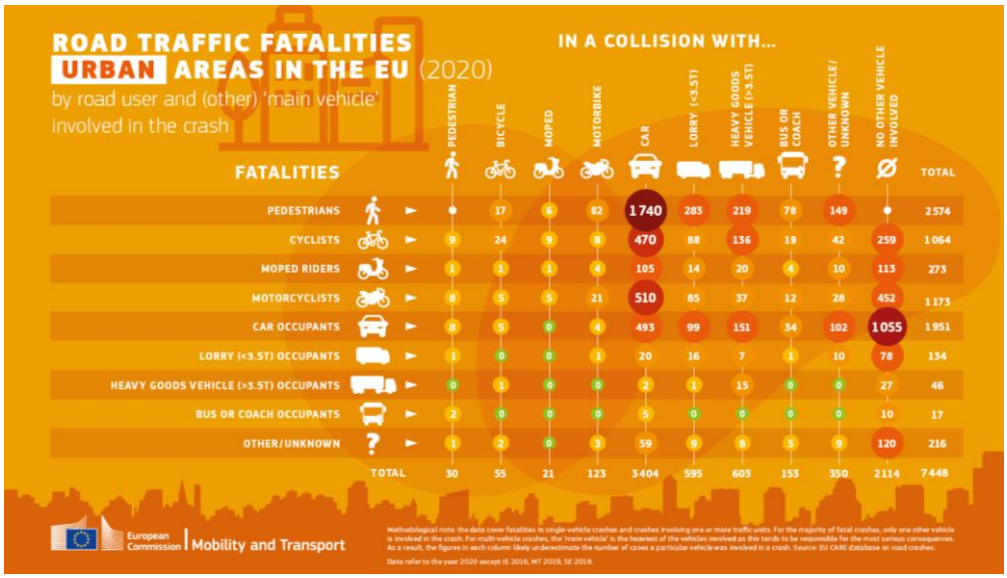


Figure 11: Road Traffic Fatalities Urban Areas in the EU. Source: EC-Mobility and Transport, 2020.

The situation is even worse in urban areas, where vulnerable users faced alarming risks. In cities, **52% of all traffic-related deaths involved pedestrians, cyclists, or moped riders, with car collisions being the primary cause** (EU figures, 2020). These numbers underscore the urgent need to enhance traffic safety measures, especially for pedestrians and cyclists who play a vital role in sustainable mobility strategies.

Creating safe environments where people can confidently walk, and cycle is crucial for encouraging the adoption of active transportation modes. This requires addressing the specific needs of mobility, public space design, and safety concerns for women, children, and people with disabilities. Additionally, clear guidelines should be provided to cities and Member States on integrating the safety and accessibility of vulnerable road users into infrastructure planning. This includes implementing digital and smart tools to enforce speed limits, regulate vehicle access, and improve the design and operation of services and public spaces, such as mobility hubs, public transport, and shared mobility options.

3.10 The Paradox of Modern Mobility: Balancing Efficiency, Quality of Life, and Meaningful Journeys

In the face of modern paradoxes, including increased traffic congestion, social distancing within massive flows, and the surveillance-fuelled freedom of movement, we witness a cultural shift where **mobility profoundly impacts quality of life**. While acknowledging the potential benefits of autonomous vehicles and optimized cities, it is the prevailing culture of speed, not just technological innovation that contributes to our collective sense of time loss. Our culture values being active and efficient, often at the expense of reflection and leisure. However, the quality and meaning of time should be prioritized over its sheer quantity.

To achieve this, seamless transport should not overshadow the significance of purposeful journeys and reducing compulsory travel. A life-centred mobility approach should focus on enhancing people's lives, promoting walking, establishing traffic calm zones, and **designing public transport systems with hospitality and conviviality in mind**. Recognizing the diverse needs of individuals, a people-centred and sensitivity-driven approach to transport policies is crucial for creating inclusive and sustainable mobility systems.

KEY IDEAS

- Europe faces interconnected challenges in demographics, public health, and the environment that impact transport and mobility.
- Climate change exacerbates urban mobility challenges through extreme weather events and infrastructure damage.
- Urbanization leads to increased road traffic and the need to expand transportation capacities.
- The aging population has specific transportation needs, with limited access to public transport hindering mobility.
- Accessibility of public transport in rural areas needs improvement to reduce reliance on private vehicles.
- Urban space scarcity requires efficient use through investment in active and public mobility.
- Congestion, air and noise pollution are significant issues in cities that impact efficiency and public health.
- Encouraging sustainable travel habits, such as walking and cycling, is crucial for addressing challenges in urban mobility.
- Strengthening traffic safety measures, particularly for pedestrians and cyclists, is essential to reduce accidents and fatalities.
- Balancing efficiency, quality of life, and meaningful journeys is important in designing inclusive and sustainable mobility systems.

4. The role of Mobility in a Circular Economy

Mobility is a key element for fostering a successful urban economy; however, many current urban mobility practices result in substantial economic losses. The reason for these losses? The linear structure of urban transport systems.

The idea of a linear economy was adopted during the industrial revolution and was based on the idea of "extract-manufacture-consume-dispose" (ICTP-CSIC, 2021). In recent years, this philosophy has been adapted, switching "dispose" with "restore" and creating what is now known as the circular economy. Despite having developed this new framework, most cities and mobility systems still follow the principles of the linear economy, leading to many urban challenges. High dependence on private cars and fossil fuels are two examples of linear practices that lead to issues like congestion and pollution. **To maximize economic growth for present and future generations, urban mobility must be adapted to fit the guidelines provided by the philosophy of the circular economy.**

Definition
The circular economy is a systems solution framework that tackles global challenges by focusing on eliminating waste and pollution, circulating products and materials (at their highest value), and regenerating nature.

Table 3: Definition of the circular economy. Source: Ellen MacArthur Foundation, 2019.

Individuals, organizations, companies, and governments all lose money from poorly designed mobility systems. An estimated 2-5% of global GDP in the form of time, fuel waste, and increased business costs is lost annually from congestion (UN Habitat, 2015). Car ownership alone accounts for 20% of the average European and United States gross household income and mobility makes up 13%

of global resource consumption. Once out of use, vehicles are usually thrown out rather than recycled, constituting 8-9 million tonnes of waste in the EU[2].

Tires are one of the many car parts that are wasted in the linear economy. Every year, around 1.5 billion (or 5 billion as of 2030, experts say) tires are wasted (Elsevier Ltd, 2022). Despite the high potential recyclability of tires, due to their high concentration of steel and rubber, they are still sent to landfills year after year. By recycling tires, many resources would be saved, and emissions avoided. For each tire that is retreated twice, 70% of natural resources that would traditionally be extracted, would not be withdrawn, 21% of air pollution and 19% of water consumption would be avoided, and 30-50% of spendings would be saved. End of life tires could alternatively be used for other functions, like building insolation and artificial coral reefs. Many countries and regions are already working on reducing their tire waste. The EU, for example, recovers 52% of tire material and sends 10% of used tires to landfills or disposes of them in some other unspecified way. Of the five regions surveyed, India wastes the least tires, with only 2% going to landfills or unknown locations (ICTP-CSIC, 2021). **By closing the loop from manufacturing to end of life for tires and all other products, cities could greatly reduce their carbon footprint, while increasing economic savings.**

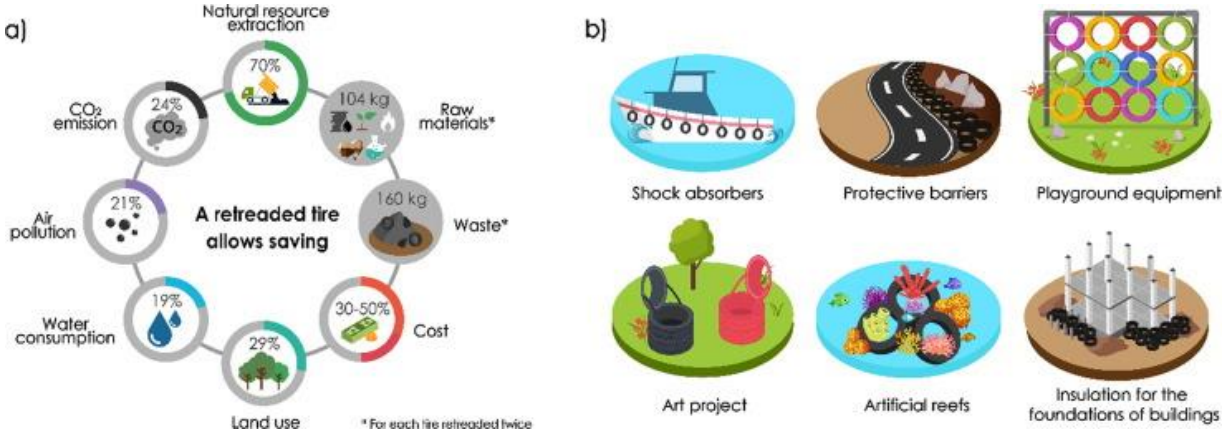


Figure 12: a) savings made by retreading end of life tires twice. b) alternative functions for tires after use. Source: ICTP-CSIC, 2021.

Space and potential real estate profit is lost from the amount of land used for parking and roads. In European cities, 50% of land is used for roads and parking, even though during peak hours, only 10% of urban roads are used. European cars spend 92% of their time parked and when driven, only 1.5 of 5 seats are occupied. With so much land paved for road transport, cities become hotter, and risk of flood and other disasters increases. Each of these forms of resource, time, and monetary losses are detrimental to the urban economy (Ellen MacArthur Foundation, 2019).

Urban mobility practices not only contribute to urban heat island effects, the depletion of finite resources, and productivity losses but also result in high levels of pollution. Vehicle emissions alone cause 90% of city air pollution, with freight accounting for 60% of those emissions. The resulting low air quality, coupled with significant noise pollution, adversely affects public health. These impacts escalate healthcare costs and reduce productivity, further damaging city economies.

4.1 How can Circular Economy approach address these challenges?

The adoption of circular economy principles can mitigate these issues by promoting sustainable mobility planning that diversifies modes of transport, reuses materials, eliminates waste and pollution, and reduces operating costs. For instance, Pontevedra, Spain, implemented a city-wide car

[2] Ellen MacArthur Foundation, SUN, and McKinsey Center for Business and Environment, Growth Within: a circular economy vision for a competitive Europe (2015), p. 18

ban that resulted in a 70% reduction in greenhouse gas emissions, increased sales in local stores, and attracted 12,000 new inhabitants to the city. In Shenzhen, China, the transition to electric buses saved 70% in fuel costs and has the potential to generate further savings in maintenance expenses. Implementing permeable asphalts, concretes, and pavers can create cleaner environments, preventing up to 99% of pollutants from contaminating stormwater and groundwater systems. Investing in the circular economy can also create job opportunities, such as the example of the Central Denmark Region, where the shift to locally produced biogas for public heavy vehicles led to the creation of 100 new jobs for infrastructure development. By sourcing more products locally, freight distances can be significantly reduced, allowing for improved traffic flow and increased road space. Now, more than ever, it is crucial to invest in transitioning from linear urban mobility practices to circular ones. Such a shift would boost local economies, improve public health, and reduce environmental harm (Ellen MacArthur Foundation, 2019).

By harnessing and combining opportunities such as compact urban development, digital optimization of mobility services, innovative manufacturing and construction techniques, new business models, and advancements like remote working, cities can shape a new urban mobility system that supports overall economic, environmental, and social prosperity.

4.2 Examples of Circular Economy Opportunity

Planning

- Compact city development for effective mobility
- Urban freight strategies for effective reverse logistics and resource flows
- Infrastructure for zero-emission vehicles and energy storage
- Using big data solutions to optimise mobility systems

Designing

- Designing vehicles for adaptable and shared use
- Design for zero-emission transport vehicles and energy grids
- Designing transport infrastructure for adaptable use
- Designing regenerative and energy positive, mobility infrastructure

Making

- Sourcing infrastructure materials strategically
- Manufacturing vehicles using resource-effective techniques
- Building infrastructure with new construction techniques

Accessing

- Alternatives solutions that reduce transport needs
- Active and low-impact mobility solutions
- Multimodal transport as an integrated service
- Optimising freight capacity through shared solutions and dis tributed centres

Operating & Maintaining

- Minimising trip length, duration, and operational energy use via digital solutions
- Mobility assets operated and maintained in new business models
- Refurbishing and repairing vehicles to extend material cycles
- New techniques for infrastructure operation and maintenance

5. Future Trends

Mobility is undergoing one of the most transformational shifts of a generation, with far-reaching implications for the way we live our lives. Below are some of the most relevant trends that will shape future mobility.

5.1 Future mobility emissions

Depending on the steps taken to reduce transport emissions in the coming years, the predictions for this sector vary greatly. Global emissions must be reduced by 7.6% every year until 2031 to keep global warming to 1.5° C, as promised by the Paris Agreement (UITP, 2021). With ambitious climate policy, urban transport emissions could be reduced by 80% by 2050 compared to 2015 rates. However, if policies continue as is, emissions will only decrease by around 5% (International Transport Forum, 2021). Further efforts must be made to reduce mobility contribution to climate change, including limiting the number of private vehicles on the road.

5.2 Towards urban growth and urban sprawl

Urbanisation is not uniformed around the world: some cities are densifying while others are expanding through urban sprawl. In cities that are shrinking, it will be important to integrate sustainable innovations into their transport systems, while growing cities should focus on adopting sustainable land-use planning and transport policies (UITP, 2021). Overall, however, trends have shown an overall increase in city populations. As noted previously, half of the world population currently lives in cities and **in just twenty-five years, cities will likely contain two-thirds of the world population.** This densification will increase mobility needs and pressure on the transport network. Since many cities are expanding without proper land management, the dependence on private cars is increasing and other trends will pose as challenges for sustainable urban development. Urban passenger transport is projected to grow by 60-70% by 2050 (OECD Library, 2021; Myllyvirta, 2020), which means a growth in traffic if no effective measures are taken. Congestion is expected to double from 2015 levels by 2050 (UITP, 2021). Cost of travel will also rise. The total cost of urban journeys is related to density of travellers, the lower the density the higher the cost. In North American

cities, this varies from 5% of the GDP in dense cities to 15% for low density. As cities expand, it will be ever more important to implement sustainable mobility measures into cities starting from their design phase and continuing through construction and afterwards, indefinitely.

5.3 Reduced reliance on private transport and a push for alternative modes

A study in France, Germany, and the United Kingdom done by McKinsey (2023a) shows that each generation has different hopes for the future of transportation. **Some of the trends that they noticed about Gen Z include a desire to become multimodal, increase their use in public transport, invest in cheaper, more sustainable cars, and refrain from purchasing cars.** Data points to a decline in private car reliability, with Gen Zers wanting to increase use in public transport, micro mobility, and shared mobility.

Already using these forms of transport more than any other generation, Gen Zers are likely to drive the push towards intermobility within cities. Gen Zers also want more sustainable cars, with 50% of respondents planning for their next car to be fully electric. Surveys show a preference for smaller cars, with many Gen Zers guiding their purchases by price of car. This generation is also more likely to purchase cars online rather than going to the dealership, a choice that many fewer older generations would make (McKinsey & Company, 2023a). To accommodate these preferences, the transport industry will have to invest more in public transport needs and sustainable mobility infrastructure.

In accordance with these trends, McKinsey predicts that use of private transport in Europe will decrease drastically by 2035 (Figure 14). Due to policies that discourage private car use, like Munich's ban of high-emission vehicles in city centres, a drop in private car use is already being observed. McKinsey also projects that shared mobility, like ride hailing, could generate close to €1 trillion by 2030, demonstrating potential economic benefits that could be reaped from the shift away from private transport. Global micro mobility is poised to reach a total market worth of €440 billion by 2030, more than double its current worth. Reductions in private transport would also lead to less noise and air pollution, increasing population health and lowering city health costs.

According to another source, however, the number of private vehicles is poised to grow by more than 30% between 2020 and 2030 and by 60-70% by 2050 (OECD Library, 2021; Myllyvirta, 2020). This increase may be a result of population growth or a shift towards private vehicle. Regardless of the cause, it is essential that further action is taken to reduce private vehicle use. Continued discouragement through financial incentives and encouragement of private transport use via development and expansion of public and micro mobility infrastructure will accelerate the shift to increased public modality in Europe (McKinsey & Company, 2023b).

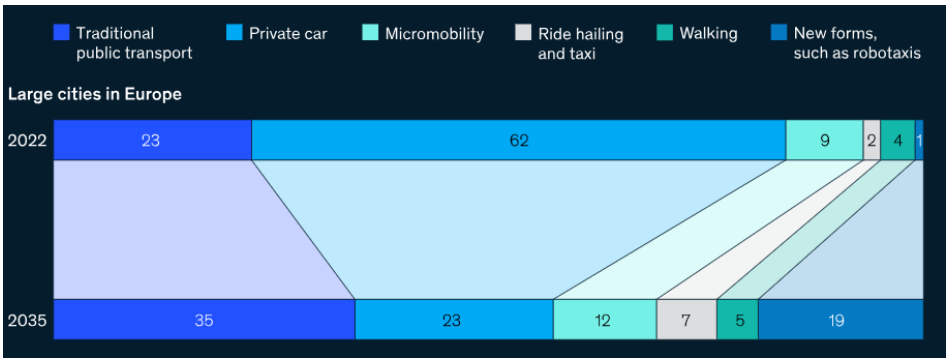


Figure 13: Mobility split by mode of transportation, % (figures may not add to 100% due to rounding). Source: McKinsey & Company, 2023b.

5.4 Technological advancements

Every year, more and more mobility innovations are developed and soon, these products will reach the public market, changing urban mobility drastically. McKinsey estimates that autonomous

vehicles will make it onto highways and in cities by 2025, becoming popular in urban areas like Beijing, New York, and London (McKinsey & Company, 2023b). Other advancements, like ultra velocity trains and flying taxi services, could make urban travel faster, increasing efficiency and attracting more urban travellers. Today, cities already have contactless ticketing for public transport, so that to board a bus or train, all that's needed is a phone or credit card. The increased use and production of electric and hybrid vehicles is also reducing air contamination and noise pollution in cities. These innovations and the many more that are yet to come will help improve urban mobility systems and create a new sector for innovation and economic potential.

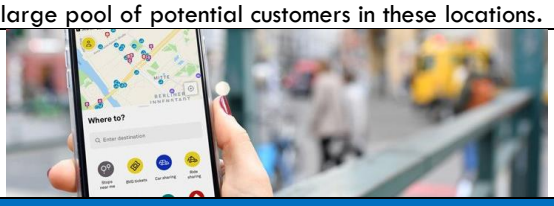
	
Autonomous vehicles (AVs)	**Rise of micromobility**
Passenger vehicles in Europe and North America will have an increased amount of level-three (conditionally automated driving) and level-four (highly automated driving) automation features. Major urban areas, such as Beijing, London, and New York, could become top markets for shared autonomous vehicles, given the large pool of potential customers in these locations.	The global micromobility market is worth about 160€ billion today. McKinsey analysis shows that the value could more than double by 2030 to reach about $440 billion (McKinsey, 2023).
	
Development of intermodal applications	**Transition towards shared or pooled zero-emission vehicles**
Intermodal journeys involve more than one type of transportation. Platforms that integrate all possible mobility combinations for a particular route are already starting to emerge, allowing travellers to plan their journeys more easily. Jelbi, for instance, shows possible routes involving various mobility modes, as well as their time and cost.	Shared mobility (including ride hailing) is on the rise, as consumers look for transportation options that are convenient, cost-effective, and sustainable. This segment could generate up to $1 trillion in revenues by 2030 (McKinsey, 2023).

Table 4: Technological disruptions in future mobility.

KEY IDEAS

- As population grows and more people move to cities, the modal transport demands will increase greatly.
- This rise in transport use will lead to more emissions, congestion, and space produced and used by urban mobility.
- Younger generations are eager to have more sustainable and efficient transportation, specifically wanting an expansion of shared rides, public transport, and active and micro mobility.
- New technological advancements will greatly change urban mobility, likely making it more efficient, accessible, and sustainable.
- There is a move to reevaluate mobility values involving a critique of the culture of speed and the prevailing focus on efficiency and productivity. It recognizes the importance of valuing the quality and meaningfulness of time.

6. Strategies for Urban Mobility

Many governments, organizations, and individuals have made urban mobility one of their top priorities when addressing climate change. Of the 195 countries in the 2015 Paris Agreement, 40% have committed to urban passenger transport-related measures in their contributions to the agreement (United Nations Climate Change). Globally, 167 cities are determined to reduce GHG emissions in transport (International Transport Forum, 2021). This section outlines the various factors, strategies, and solutions that have been and should be considered when addressing urban mobility challenges.

6.1 Ensuring Social and Climate Justice in Urban Mobility Development

One fundamental element that must be incorporated into such problem solving is the inclusion of all individuals impacted. Certain communities are disproportionately impacted by the inaccessibility and other challenges of urban mobility. **Groups that may be considered more vulnerable include children, pregnant woman, older adults, ethnic minorities' people with outdoor jobs, low-income households, and persons with disabilities or with pre-existing health conditions.** According to a UN study, 10-20% of the world's population that are minorities also suffer from lower access to transport and experience discrimination (UN, 2023). Such groups need special protection and assurance when developing sustainable urban mobility plans.

Definition
Climate justice links human rights to climate action and development with the aim of protecting the environment without sacrificing the needs of society.

Table 5: Definition of climate justice. Source: UNICEF, 2022.

Climate justice is one philosophy that can be used to help achieve equity when addressing urban mobility. It links human rights to climate action with the aim of protecting the environment without sacrificing the needs of society (UNICEF, 2022). **To achieve climate justice, existing inequalities must be addressed to ensure that the same opportunities and outcomes are realized by all.** Actions that invest in vulnerable communities will result in a more equitable solution, bringing everyone to the same level, rather than providing everyone with the same resources from which some will benefit more than others (see Figure 15).

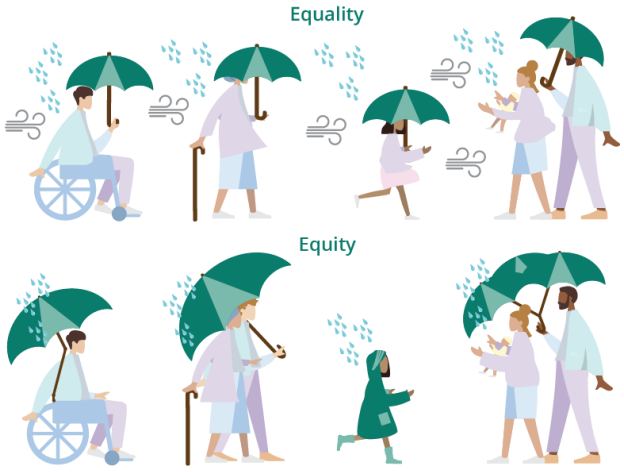


Figure 14: Juxtaposition of equality and equity. Source: EEA, 2023.

6.2 Federal Commitments to Urban Mobility Development

Many European cities have committed to adapting their transportation systems to make them more accessible, foster a healthy commuting population, lower environmental impact, and increase efficiency.

In 2021, European Commission published **The New EU Urban Mobility Framework which aims to make urban mobility more sustainable.** It requires all major cities (of which they list 424) to develop a plan to address urban mobility and provides a list of measures and initiatives that these cities can adopt. Their framework encourages the increased use of public transport and active mobility, implementation of low-energy and emission technology, urban logistics, and infrastructure, continued collaboration between cities and programs with the eventual goal of establishing 100 climate-neutral and smart-cities by 2030, heightened support for private transport companies and drivers to make their services more sustainable, the use of integrated data monitoring systems to ensure proper monitoring of progress and outcomes of these changes, and civic awareness of and engagement in problem-solving for urban mobility (EC, 2021).

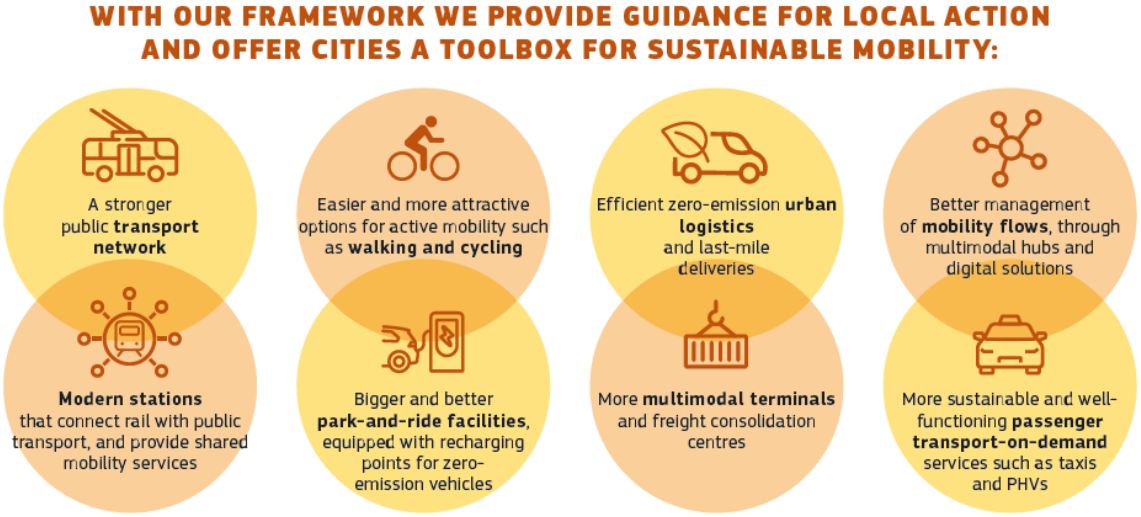


Figure 15: The New EU Urban Mobility Framework. Source: EC, 2021.

Since its publication, many cities have developed their own Sustainable Urban Mobility Plans to meet these goals (EC, 2021). Vienna is one such example. In 2015, Vienna released the Urban Mobility Plan, which sets out the ambitious goals of the City of Vienna for a viable transport system of the future and describes the steps to be taken in the next ten following years so these goals can be reached. The motto of the Urban Mobility Plan is "Together on the move" and it banks on a variety of approaches which help seize the many opportunities opening up. Another example is Stuttgart's action plan "Sustainable mobility in Stuttgart", which field of action include local public transport, motorised individual transport, walking or cycling, commercial transport, commuter traffic, and intramodality and networking.

In the context of the action plan, the city council took the decision to remove 200 public parking lots located in the city centre in order to create more space for cycling and pedestrian infrastructure as well as playgrounds and green areas. The municipality also released a new procedure to enable and regulate initiatives from civil society and other stakeholders to create and implement temporary "Parklets" in the central city districts. Also, a lot of initiatives and technical developments have already been realized to improve air quality and noise. These measures involve limited access zones, traffic calming zones, speed reduction on main roads, parking management, public transport priority schemes, traffic management, and mobility information services.

In Spain, Madrid released Plan A in 2017, which analyses the historical and current impacts of transportation and other sectors on city emissions and details potential solutions to these issues. In it, Madrid commits to upgrade public transportation vehicles to low-emission buses, financially incentivize taxi companies to invest in low-emission vehicles, and limit access to parking to deter investments in private transportation. Madrid has also implemented bike rates on buses, facilitating ease of intermobility on a few major routes in the city. Not only does this change encourage use of public

transportation and cycling, but it also ensures access to active transportation for those who may be limited by ability to bike hills or encounter poor weather (ECF, 2017). Such measures are supposed to reduce annual average concentration of NO_2 by 23%. These changes were made possible by political and social consensus around the issue (EEA, 2022_b).

6.3 Urban Projects: Government Solutions

New urban models to make cities healthier

Many cities are working on increasing active mobility and public transport use by simply providing the infrastructure and making the transport modes more accessible. One example is Salvador, Brazil, which rather than promoting active mobility through health campaigns and advertising, constructed 15 elevated bridges, 3 roundabouts, 6 new avenues, 18 footbridges, a 12km bike and jogging track, as well as a 670,000m² green area with 6,000 new trees. They also installed 17 bike-sharing stations along metro lines to facilitate intermobility and increased accessibility with tactile floors, accessible walkways, elevators, braille signalling, and adapted restrooms (UITP, 2021). As of 2022, foot travel accounted for 38% of Salvador´s modal split and public transport, another 35.9% (TUMI, 2022). Such high rates of public and active transports mean significantly lower levels of air and noise pollution and an overall more sustainable society.

Barcelona's Superblocks became a part of global best practices. They are becoming the street transformation model for the entire city by prioritising people over cars with a focus on accessibility. The basic idea is to identify a 3 x 3 grid of 9 city blocks and restrict vehicle traffic to the streets on the perimeter.

Following this model, over 500 superblocks are planned in Barcelona, which reduce motorized traffic in some streets of a block and provide space for people, active travel, and green space. Following small-scale initiatives carried out in areas such as Poblenou, Horta and Sant Antoni, Superblocks are now taking a leap in scale and pace, with the creation of a network of green hubs and squares where pedestrians have priority.

Figure 16: Superblocks in Barcelona. Source: Barcelona City Council, 2023.

On the other side, **Paris is introducing the 15-minute city**, where work, school, entertainment and other activities are reachable within a 15-minute walk of the home. The 15-minute city will require a fairly radical re-think of our cities and a mixing of different population groups rather than the current zoning by social economic status and therefore likely to reduce inequalities. It will also reduce the need for long distance travel and thereby CO_2 emissions, and air pollution and noise levels.

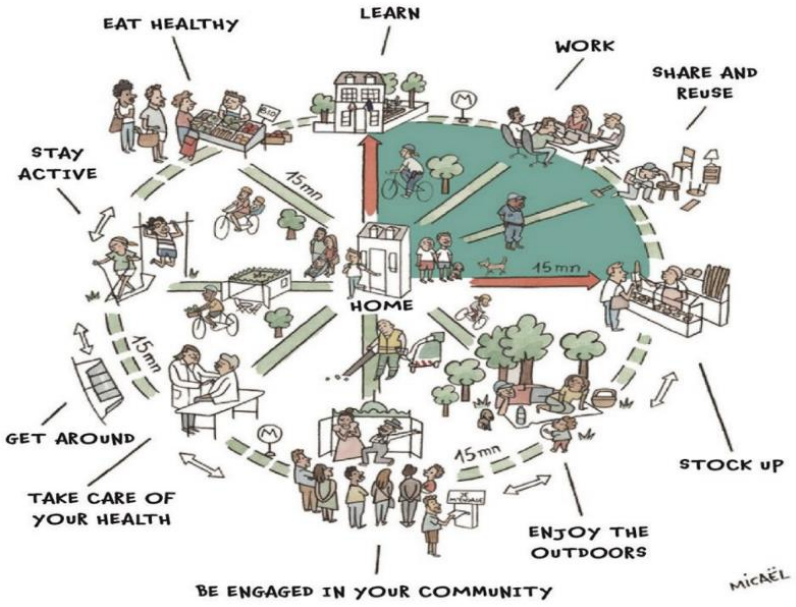


Figure 17: 15-minute city, Paris. Source: Ubique.

London, UK is also taking monumental steps to improve air quality and travel safety in the coming years. **Healthy Streets for London is constructing bicycle superhighways, providing extra space for walking and biking paths, and developing public transport stations and public realm** (Figure 19). Their final goal is to increase sustainable mode share to 80%, integrate 20 minutes of active travel into everyone´s commutes, reduce road danger to zero, and decrease private travel by 3 million private car trips by 2041. Such actions should result in overall improved health, air quality, and security.

Figure 18: London's bike superhighway. Source: Evening Standard, 2019.

Optimal transport planning pyramid

By making active mobility more attractive, cities around the world are observing a rise in modal share of active mobility. A few strategies to attain these goals include increasing access to green spaces that can be used for social, commercial, and leisure activities and are connected to transport networks, designating paths for each type of transport mode, constructing wide roads with no kerb drops (a tactic used to make streets more pedestrian than car friendly), planting trees along sidewalks to provide shade, installing bike parking, limiting access to passenger vehicle parking, taxing private car purchases, reducing speed limits in pedestrian busy areas, designating certain areas as Low Emission Zones (LEZs) and restricting access to them from high emitting vehicles, providing better lighting to increase safety and visibility especially at night, developing safe pedestrian intersections (such as

raised crosswalks known as "table-top crossings"), and increasing access to public amenities (including water, restrooms, waste bins, and wayfinding signage) (UITP, 2021). Each of these tactics can help make active mobility more comfortable, safe, and efficient and would be made even more effective if matched with actions that simultaneously discourage private transport travel.

The integration of LEZs alone have been shown to reduce transport emissions significantly. In Berlin, Germany, diesel emissions dropped by 58% while nitrogen oxide fell by another 20%. Brussels, Belgium experienced similar results after implementing these zones nitrogen oxide by 9% and black carbon by 38%. Combined with urban tolls, access to certain areas becomes restricted by vehicle type and car traffic as well as emission are reduced. In Area C Milan, Italy, these tariffs have reduced incoming traffic by 30% and simultaneously increased speed of public transport. A program in Helsinki, Finland facilitates intermobility between cars and public transport by locating parking near transport stations. These facilities are called Park & Ride and are often free or discourage parking in city centres with progressive parking prices getting more expensive closer to the centre. Some parking areas are only accessible by public transport ticket, further incentivizing the populous to take advantage of the intermobility infrastructure. This program has reduced congestion in Helsinki and kept cars out of the city centre. **All these successes demonstrate the potential to reduce mobility emissions by decreasing private car use. If LEZs, urban tolls, and Park & Ride were implemented together, it is likely that the positive effects that have been noted would be even greater.**

Bern, Switzerland is taking public transportation a step further and bringing it outside of main city lines. They are developing extensive public transport networks that connect city centres to their periphery. Main transfer stations will be turned into mobility hubs, with access to regional bus lines, rental bicycles, e-scooters and other services. Such measures will facilitate access to jobs and reduce reliability on cars. Goiânia and Fortaleza, Brazil have also integrated an innovative solution to increasing public transport accessibility and efficiency. With a new app and 40 and 18 buses in each city respectively, riders can call the service and be picked up at a designated bus stop. These programs (i.e., CityBus 2.0 and TopBus+ respectively) are integrated in the city´s official bus network and managed by the same operators. Of all users, 81% had relied on their personal car for transport before using the on-demand transport service (UITP, 2021). **Each of these cities serve as models that which others cities can follow to similarly increase public and active mobility, reduce their emissions, and improve public health.**

Gender Equality initiatives in mobility

When trying to maximize accessibility of public transport, planners must take geographical coverage, affordability, physical access, and information availability into account. Women make up the majority of public transport riders in many cities. In France, they account for two-thirds of public transport users and in the US cities of Philadelphia and Chicago, over 62% (Ceccato, 2017). Public transport, though welcoming to women riders, does not have the necessary safety measures to ensure safe travel for women. In London, over 50% of women experience unwanted sexual attention while using public transport. Reporting rates of these incidents are catastrophically low at only 2% (Figure 20). Policies must be passed to increase safety of women in transport and prevent sexual harassment.

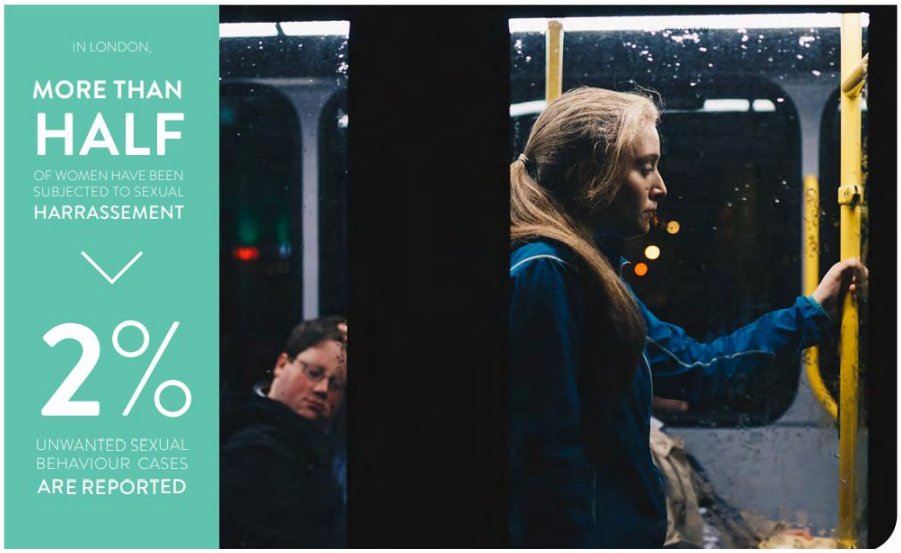


Figure 19: Women's safety in transit environments. Source: YouGov Survey Results, 2019.

In Paris, one of the public transport providers, RAPT, has focused on female safety in transport. During a crisis they may call the police, escort the victim by taxi if needed, help the victim file complaints, and provide access to professional after care. RATP also accompanies female users on public transport to reduce feelings of insecurity in and around the infrastructure. The following table demonstrates a few measures that can be taken to increase accessibility of public transport and the related performance indicators (Figure 17) (UITP, 2021).

	PRACTICAL MEASURES	OPERATIONAL ASPECTS	URBAN ENVIRONMENT	COMMUNITY INVOLVEMENT	POLICY/LEGAL ASPECTS	CAPACITY BUILDING
COMFORT	Improve waiting environment	✓	✓	✓	-	-
	Maintain shelters with AC and ventilation	✓	-	-	-	-
	Clean public toilets	✓	-	-	-	-
EASY-TO-USE	Services between stops	✓	✓	✓	✓	-
	Control camera, panic buttons	✓	-	-	✓	-
	Women-only services	✓	✓	✓	✓	-
	Process for harassment reports	-	✓	✓	✓	✓
SAFTEY & SECURITY	Better lights and pavements	-	✓	✓	-	-
	Trained and professional staff	✓	-	-	-	✓
	Enforce rules and regulations	-	✓	✓	✓	✓

Figure 20: A consideration of the different aspects for practical measures related to performance indicators. Source: UITP, 2021.

Better monitoring and planning

Many cities are not only attempting to make their transport more sustainable, but the planning processes behind them as well. In Toronto, Canada, they have created a Business Case Guidance to help measure and predict outcomes of transport plans through a business perspective. It analyses

strategy, economic impacts, finances, deliverability, and operation of any initiative. When used to analyse Go Rail – a project which aims to improve travel time, make roads safer and less congested, and reduce emissions – the business case calculated that the region would gain an equivalent of around €2.18 worth in benefits from every €1 invested. By analysing transport plans in this way, the city can maximize benefits and efficiency of each plan.

In Antwerp, Belgium, their Smart Ways of Antwerp programme works with employers and mobility service providers to get the same result. Their work enables companies to develop mobility policies that take into consideration employee travel behaviours and encourage the use of more sustainable transport modes. With such close collaboration between the implicated actors, different mobility offers could be made available including public transport, bike leasing, car-sharing, and car-pooling. As a result, 26% of employers now commute to work using one of these alternative transport modes instead of driving to work (UITP, 2021). Other **planning systems that incorporate the needs of the public and consult residents in their development have the potential to be more positively received and could increase success outcomes.**

Integrating economic activities with public transport

One method used to increase efficient city land-use integrates lifestyle and business with public transport. In Japan, malls, restaurants, offices, and hotels are built in and around stations. Such land-use increases real estate revenue. By 2027, revenues may rise by 150% compared to 2017 levels. If set up by the state or transport departments, these profits could be used to fund public transport operation and development costs.

Nottingham, London took a different approach to fund the transport system: levies. Offices with over eleven employers are charged a tax on parking spaces. From 2011 to 2021, this program raised around €87 million enabling the city to expand their tram system and redevelop their central station and bus networks. In addition to benefiting the public transport system, this policy actively discourages the use of private transport, potentially taking more cars off the road and increasing air quality and reducing noise pollution. Both the Japan and Nottingham funding strategies ensure constant and reliable revenue for the transport system.

To decrease the cost of installing new mobility infrastructure, many cities have transformed abandoned or unused infrastructure into pedestrian walkways and parks. In New York City, the Manhattan High Line, an old railway, has been reutilized as a 2.33km green space, lined with real estate development projects and museums (Figure 22). Similarly, in Seoul, South Korea, a highway became the Seoul Skygarden, which is adjacent to a main public transport station and features many green pathways for active mobility travellers (UITP, 2021). **The reutilization of space is a great option for saving funds and is a solution that can be implemented anywhere.**

Figure 21: New York City Highline (left) and Barcelona's Highline in Sants Neighbourhood. Source: Go City.

7. Case Studies: What will be needed in the future?

In addition to the actions taken by governments to improve the mobility possibilities of population, **many smaller companies and start-ups have taken it into their own hands to develop technology and systems that help address Urban Mobility**. The following table details just some of the many startups that have taken the initiative to develop their own solutions to the problem.

Chainge - Designing low-emissions delivery services

Many companies have been working on designing low-emissions delivery services. **Chainge**, a company founded in Copenhagen, Denmark, uses bike-driven vans to ship foods and subscription goods without creating as much noise and air pollution. Another startup, **Homerr** (Amsterdam, Holland), invites private people and companies to serve as intermediate deliverymen and reducing the van trips needed to verify if the receiver is home (EU-Startups, 2022). Other similar startups include **Magway** (Wembley, UK), **Onomotion** (Berlin, Germany), and **Bolt** (Tallinn, Estonia).

Figure 22: Chainge Start-up. Source: Chainge.

Upway – Pushing for sustainability by recycling used or unwanted vehicles

Upway, founded in 2021 in France, refurbishes e-bikes and e-scooters, selling second hand micro mobility vehicles and reducing their ecological footprint. Their business model not only encourages micro mobility but pushes for sustainability by recycling used or unwanted vehicles (Upway, 2023). Other companies provide rentable electric micro mobility vehicles or offer trading platforms for people to sell micro mobility vehicles, such as **Bicing** (Barcelona, Spain), **Dott** (Amsterdam, Netherlands), and **Voi** (Stockholm, Sweden).

Figure 23: Upway: making electric mobility accessible to everyone. Source: Chainge.

Lilium - Developing an electric flying taxi service

A company based in Wessling, Germany, **Lilium**, is in the process of developing an electric flying taxi service. The jet takes off vertically, limiting space consumption, and produces zero-emissions after production. For long distance transport, Lilium provides a cheaper service than taxis in the USA (Lilium). Other similar startups include **Volocopter** (Bruschall, Germany) and **Joby Aviation** (Santa Cruz, USA).

Figure 24: The Lilium Jet. Source: The Lilium Jet.

BlaBlaCar – Connecting drivers with passengers for a collective mobility

BlaBlaCar, headquartered in France, is a long-distance ride-sharing platform that connects drivers with passengers traveling in the same direction. It offers an affordable and sustainable alternative for intercity travel (Seedtable, 2023). Similar startups include **Ants** (Oslo, Norway), **flinc** (Berlin, Germany), **Heetch** (Paris, France), **Ride Joy** (California, USA), and **Toogether** (Noord-Holland, Netherlands).

Figure 25: BlaBlaCar. Source: BlaBlaCar.

ParkBee - Reutilizing underused parking spaces and giving them back to the city

In Amsterdam, Netherlands, **ParkBee** is reutilizing underused parking spaces and making them available to the public. Users can book their spot online or pay by the minute. Their work takes more drivers off the road, makes parking more affordable, and makes use of underutilized areas, benefiting real estate owners and drivers (ParkBee). **Get My Parking** (Bengaluru, India), **ParqEx** (Chicago, USA), and **Just Park** (London, UK) are other startups that also provide public parking services.

Figure 26: ParkBee. How Parkbee gave space back to the city. Source: Parkbee.

Ride Vision - Enhancing motorcycle safety

Ride Vision is a company from Herzliya, Israel that produces lights and cameras that riders can attach to their motorcycles to enhance motorcycle safety. It uses artificial intelligence and computer vision technology to provide real-time warnings of potential hazards on the road. The device also records all rides, and they are developing a system to make emergency calls in times of crisis (Ride Vision). Other

companies addressing rider safety include **Brake Free Technologies** (Denver, USA) and **Cosmo Connected** (Paris, France).

Figure 27: Ride Vision. Source: Ride Vision.

MUV B Corp – Playing to move, moving to play

MUV B Corp is an Italian company in 2012 that aims to promote sustainable mobility through a sport-based transport app. Players gain points whenever they move in a sustainable way and can participate in training sessions, challenges, and team tournaments. When using the app, users give permission to anonymously share their data to help policy makers improve mobility around the world. MUV also has a corporate version that allows companies to encourage their employee´s sustainable transport habits (MUV).

Figure 28: MUV App. Source: MUV.

Cling – Pushing for sustainability by recycling used batteries

Founded in 2020 and based in Stockholm, **Cling** provides a solution for the soon to be excess of used batteries from electric vehicles. The company connects manufacturers, workshops, and dismantlers to end-of-life batteries so that once used, batteries can be reused and recycled. Their program will look for the ideal partners in this trading system to optimize trade efficiency (EU Startups, 2022). Other companies developing similar recycling systems include **Circunomics** (Mainz, Germany), **Akksel** (Therwil, Switzerland), and **Reneos** (Tienen, Belgium).

Figure 29: Cling. Source: Cling.

Hövding 3 –The next generation in Swedish safety technology

As an innovative alternative to the traditional model, Swedish company Hövding created their world's first "inflatable helmet" with an airbag in November 2011 after years of researching. Hövding 3 is an airbag that is worn round your neck as you cycle. In the event of an accident, just like a car airbag, it will do its utmost to protect you. The helmet can be also connected to the smartphone via Bluetooth for extra features, including automatically notifying contacts should you be involved in an accident, analysis of personal and collective bicycle data, and battery status with a charging reminder.

Figure 30: Hövding 3. Source: Hövding.

KEY IDEAS

- Many countries have committed to reducing their carbon emissions and improving their mobility systems, though much more work needs to be done to reach these objectives.
- Climate and social justice must be taken into consideration when developing mobility solutions and innovations to ensure equitable access to transport.
- Cities across the world are developing urban mobility plans to increase public transport use and active mobility and discourage private car use.
- Municipalities are partnering with companies to develop concrete plans to improve urban mobility.
- Urban mobility projects raise funds through levies and other fees on private car owners as well as by reutilizing urban spaces.
- Many individuals have taken it into their own hands to develop projects to address urban mobility challenges, founding startups to implement their innovative solutions.

8. Barriers to Urban Mobility Initiatives

Sustainable urban mobility initiatives are often met with challenges of different types. One of the main issues that comes up is funding. Transport funds usually come from passenger fares, authorities, local taxes, levies – such as congestion charging, revision of parking policies, and land-value capture mechanisms – and commercial revenues. While public transportation used to be a growing industry, operation costs have increased significantly with the drop of riders since the pandemic. With less money flowing into the system, it can be hard to gather funds to support public transport expansion.

Municipal organization is another common issue to implementing such plans. In developing cities, institutions may not have the systems in place to facilitate easy coordination, slowing down the planning and implementation processes. Similarly, in fast growing cities, mayors may not have enough power to integrate such changes into policies with such divided priorities within the given administration (UITP, 2021).

When it comes to the legal arena, some challenges may arise when trying to initiate and impulse mobility strategies. These include:

- **Privacy and data protection laws**: The European Union has strict laws regarding data protection, such as the General Data Protection Regulation (GDPR), which can make it difficult to collect and use data in smart city projects.
- **Regulatory barriers**: Different cities and regions in the EU have different regulations and requirements for deploying new technology. This can make it difficult to roll out pilot projects on a larger scale, as each city or region may have its own unique set of rules and regulations that must be followed. For example, some cities may have specific regulations regarding the use of drones, while others may have more restrictive regulations on the use of cameras in public spaces. These regulatory barriers can make it difficult for companies and organizations to develop and deploy smart city projects that are consistent across different cities and regions.
- **Liability and safety concerns**: When deploying new technology in public spaces, there are potential liability and safety concerns that must be addressed. For example, if a self-driving car were to be involved in an accident, there may be questions about who is responsible for the accident. Additionally, there may be concerns about the safety of the technology, particularly if it is being used in a way that it has not been tested or validated. These concerns can make it difficult to secure funding and insurance for pilot projects, as investors and insurers may be hesitant to invest in or ensure a project that carries significant liability or safety risks.
- **Procurement laws**: EU countries have different procurement laws and regulations which can make it difficult for companies to bid for and win contracts for urban projects.
- **Interoperability**: lack of standardization of infrastructure and software across EU countries can make it difficult to ensure that different smart city systems can work together effectively.

These barriers can be overcome by developing clear regulations and guidelines, securing funding, and building partnerships between public and private sector organizations. To mitigate these concerns, it's important to conduct thorough testing and evaluation of the solutions before deployment, to develop clear guidelines and regulations for the use of the technology, and to establish clear liability and safety protocols. Additionally, partnerships between public and private sector organizations can help to mitigate these concerns by sharing the risk and responsibilities.

There may be specific regulations or guidelines that govern the use of certain strategies or pilots regarding mobility. For example, there are legal regulations for installing sensors in European cities. The European Union has strict laws and regulations regarding data protection, such as the General Data Protection Regulation (GDPR), which applies to the collection, processing, and storage of personal data. These regulations can have an impact on the deployment of sensors in European cities, as they can limit the types of data that can be collected, how it can be used, and how long it can be stored.

Additionally, there are regulations and laws that govern the installation of sensors in public spaces. For example, there may be regulations that prohibit the installation of cameras in certain areas, or that require certain types of notifications to be provided to the public before sensors are installed.

Furthermore, different cities and regions may have their own regulations regarding the installation of sensors in public spaces, so it's important to check the specific regulations that apply in the location where you plan to install the sensors.

To comply with these regulations, it's important to conduct a thorough data protection impact assessment (DPIA) before the deployment of sensors, to ensure that the data collected, processed, and stored complies with the GDPR and other regulations, to provide clear information to the public about the sensors, and to establish clear protocols for data management, security, and retention.

9. Suggested Sources

To learn more about urban mobility, please see the links below (all of which have been referenced in this document). In addition to these sources, consider reviewing those found in the reference page of this document.

The Urban Mobility Playbook

The International Association of Public Transport (UITP) published this playbook 2021 to support the transition to better urban mobility. This packet provides a thorough review of different strategies that can be used to improve urban mobility and promote sustainable city planning with case studies for each recommendation.
https://cms.uitp.org/wp/wp-content/uploads/2022/02/Report-BETTER-URBAN-MOBILITY-PLAYBOOK.pdf

Urban Mobility Next 6 Urban vehicle access regulations: from design to implementation

This 2022 report on urban mobility policy making was produced by the EIT Urban Mobility. The document provides detailed information on urban vehicle access regulations (UVARs) and their current and potential use and impact in Europe.
https://www.eiturbanmobility.eu/wp-content/uploads/2022/10/EIT-UrbanMobilityNext6_HD2.pdf

Sustainable Urban Mobility in the EU

This report, published by the European Union, provides extensive detail on the actions and commitments needed to be taken by member states to reach international climate goals, focusing on mobility.
https://op.europa.eu/webpub/eca/special-reports/urban-mobility-6-2020/en/

Future of Mobility

McKinsey produced this site to provide more information on the future of mobility, including projected advancements in the sector and predictions for a few specific regions.
https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/the-future-of-mobility-mobility-evolves

Circular Economies in Cities: Opportunity and Benefit Factsheet

The Ellen MacArthur Foundation released a report in 2019 that details the benefits of transitioning to circular urban mobility practices. It provides statistics on current urban mobility practices, examples of possible and realized solutions, and the subsequent results of these changes.
https://op.europa.eu/webpub/eca/special-reports/urban-mobility-6-2020/en/

Improving the convenience of public transport

Interreg Europe published this report on public transport in 2020. It outlines the benefits of using public transport, as well as possible measures that can be and concrete examples that have been taken to improve public modal accessibility and convenience.
https://www.interregeurope.eu/sites/default/files/inline/Public_Transport_TO4PB_final.pdf

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