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SUSTAINABLE URBAN MOBILITY AND PUBLIC TRANSPORT IN ECE CAPITALS

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Transport Division

United Nations Economic Commission for Europe

The United Nations Economic Commission for Europe (UNECE) is one of the five United Nations regional commissions, administered by the Economic and Social Council (ECOSOC). It was established in 1947 with the mandate to help rebuild post-war Europe, develop economic activity and strengthen economic relations among European countries, and between Europe and the rest of the world. During the Cold War, UNECE served as a unique forum for economic dialogue and cooperation between East and West. Despite the complexity of this period, significant achievements were made, with consensus reached on numerous harmonization and standardization agreements.

In the post-Cold War era, UNECE acquired not only many new Member States, but also new functions. Since the early 1990s the organization has focused on analyses of the transition process, using its harmonization experience to facilitate the integration of Central and Eastern European countries into the global markets.

UNECE is the forum where the countries of Western, Central and Eastern Europe, Central Asia and North America – 56 countries in all – come together to forge the tools of their economic cooperation. That cooperation concerns economics, statistics, environment, transport, trade, sustainable energy, timber and habitat. The Commission offers a regional framework for the elaboration and harmonization of conventions, norms and standards. The Commission's experts provide technical assistance to the countries of South-East Europe and the Commonwealth of Independent States. This assistance takes the form of advisory services, training seminars and workshops where countries can share their experiences and best practices.

Transport in UNECE

The UNECE Inland Transport Committee (ITC) facilitates the international movement of persons and goods by inland transport modes. It aims to improve competitiveness, safety, energy efficiency and security in the transport sector. At the same time it focuses on reducing the adverse effects of transport activities on the environment and contributing effectively to sustainable development. The ITC is a:

- Centre for multilateral transport standards and agreements in Europe and beyond, e.g. regulations for dangerous goods transport and road vehicle construction at the global level;
- Gateway for technical assistance and exchange of best practices;
- Promoter of multi-country investment planning;
- Substantive partner for transport and trade facilitation initiatives;
- Historic centre for transport statistics.

For more than six decades, ITC has provided a platform for intergovernmental cooperation to facilitate and develop international transport while improving its safety and environmental performance. The main results of this persevering and important work are reflected in more than 50 international agreements and conventions which provide an international legal framework and technical regulations for the development of international road, rail, inland water and intermodal transport, as well as dangerous goods transport and vehicle construction. Considering the needs of the transport sector and its regulators, UNECE offers a balanced approach to and treatment of facilitation and security issues alike.

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INTRODUCTION

Cities, which are hubs connecting various markets, will continue to grow, especially if they are governed to address the various diseconomies that come along with the growth. These diseconomies are usually related to increasing costs of land, labor, housing, accessibility or pollution.

The conditions that can facilitate the growth and make sure that such is sustainable are established often with the legal and regulatory frameworks at the state level. However, these frameworks need further complementary policies at the city level to help create even more favorable conditions for enterprises to do business and for citizens to enjoy a good quality of life.

The complementary policies are related to public infrastructure and services provided at the city level, in particular: transport, housing, water and sanitation, waste management as well as access to work, information, education, i.e. access to opportunities.

Urban transport policies should be oriented at enhanced mobility for ensuring better accessibility to the various “markets”. At the same time, they should help reducing the transport externalities such as traffic congestion, road crashes and environmental pollution.

Many cities across the globe and the ECE region continue, however, to face challenges in reducing externalities. Due to traffic congestions the markets accessibility within urban areas deteriorates rather than improves. Road crashes and pollution cause not only large costs but also reduce the quality of life of citizens and hence impact negatively their well-being.

While challenges are faced, a knowledge base is developed to help authorities in implementing policies to foster more sustainable systems for urban transport and mobility. It addresses the role of public transport and non-motorized transport for urban mobility and transfers. It specifies how the quality of public transport and its infrastructure and networks as well as the infrastructure for non-motorized transport can impact the preferences for citizen’s mobility. It further shows the conditions necessary for preventing a false distribution of demand for mobility and urban transfers between the various transport modes.

The implementation of the available knowledge base supplies material for analysis to understand the degree of success and its underpinning conditions. It then helps to work out practical solutions for implementation scaled to the circumstances and size of a different city.

To this end, this study promotes both the available knowledge base and the lessons learned from its application. For the latter, it offers the results from the analysis of the urban transport systems in 36 ECE capital cities and draws attention to various features of the systems that may require changes for making the systems more sustainable.

The analysis looks, in particular, at the demand for urban mobility and its distribution between the different transport modes vis-à-vis the accessibility and comfort provided through urban public transport. It looks into the traffic congestions, road safety and environmental pollution including climate change as well as the popularity of the non-motorized transport for urban mobility. It further considers the affordability of urban transport.

The study is developed for the benefit of authorities at the different levels with the aim to provide them a knowledge and experience sharing tool on sustainable urban transport system and its application at hand. It is structured in the following way:

Chapter 1: reviews the existing knowledge base related to sustainable urban transport and mobility and draws attention to crucial issues for consideration in the process of system development,

Chapter 2: evaluates to an extent possible the degree to which various ECE capital cities were able to ensure sustainable urban mobility and transport. This chapter also identifies some weak points that may require further attention and actions,

Chapter 3: provides the profiles of 36 ECE capital cities on urban transport and mobility, and

Chapter 4: provides conclusions from the analysis given in chapter 2 as well as lists several recommendations for consideration by the authorities at various levels on how to further improve urban transport and mobility.

CHAPTER 1: Sustainable urban mobility and public transport development: an overview

1.1. Introduction

A developed country is not a place where the poor people have cars but it is where the rich people use public transport (Mayor of Bogota). Development of sustainable urban mobility and public transport networks leads by all means to radical improvement of citizens' quality of life. It improves access to markets and job opportunities, to education, to health care services, to leisure, to the things citizens need in everyday life; Citizens that use public transport walk more. Walking increases fitness levels, leading to healthier citizens and less strain on the health care systems. Quality of life is also affected by commuting times. In several cities commuters often travel more than an hour to and from work. This is time lost in their life.

While sustainable urban transport system should better handle the negative externalities, at the same time, it should be providing its main function, which is the enhanced mobility, including for the poor and vulnerable groups, which was an important element of the Millennium Development Goals.

In the existing reality the urban transport systems often fail in addressing the negative externalities. As a result of it, the traffic congestions deteriorate the accessibility. The air pollution and accidents impact negatively the quality of life in the cities and thus decrease the well-being of their citizens.

As it is being pointed out in ECE's publication on Transport for Sustainable Development[1] Government institutions and planning processes should emphasize accessibility over mobility. The process of achieving more sustainable urban transportation systems designed with the principle of accessibility at their core is dependent on the participation of all stakeholders in cities, the authorities, the private sector and the citizens, along the lines of principles of democracy. A successful process will depend on effective governance of land use and transportation, where new housing and commercial planning will entail simultaneous transportation systems design, careful neighborhood design, strategic infrastructure investments, and fair, efficient and stable funding.

In this context, it is crucial to address the issues that are key to establishing the sustainable transport systems, so that the traps in the development process are better understood and successfully avoided.

1.2. Objectives and challenges of urban transport and mobility

Whether or not cities, which are hubs connecting markets such as those on labour, investment, education, commerce, recreation and health care, etc. , can prosper depends, among others, on the accessibility of these markets. The accessibility, in turn, is influenced by the availability of an efficient and effective transport system. What is an effective and efficient urban transport system? It is one that can satisfy the numerous and diverse requirements of the metropolitan mobility, including minimizing travelling time between various locations, while at the same time internalises externalities to positively affect the well-being and the quality of life of the citizens of that area.

Among the most apparent externalities are traffic congestion, traffic accidents and environmental pollution including climate change.

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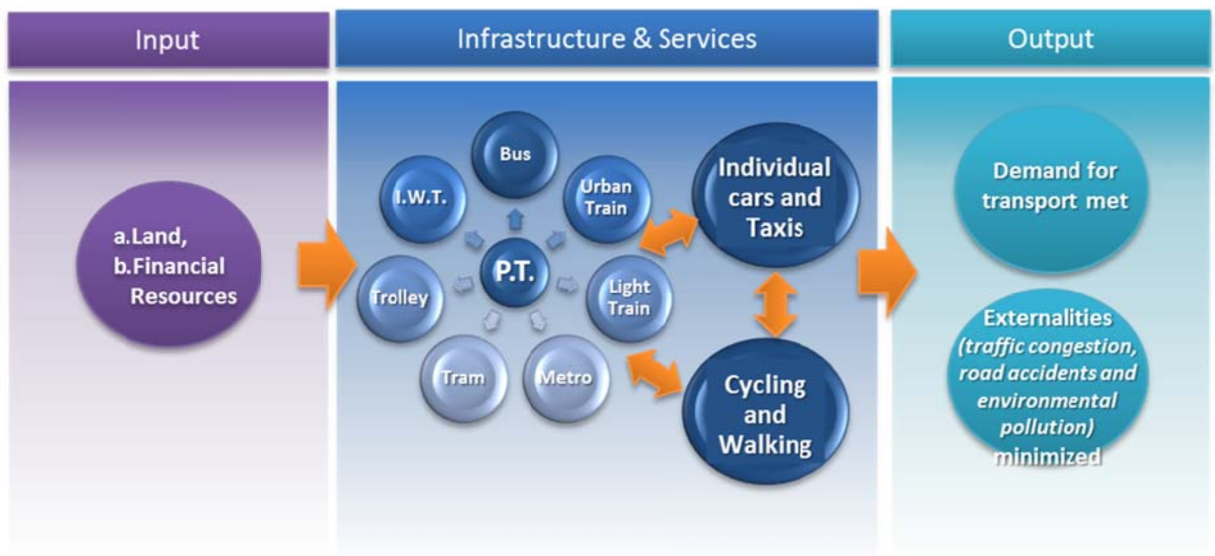
[1] UN ECE, Transport for Sustainable Development, 2011

The larger the metropolitan area, the greater is its complexity and the potential for transport externalities and therefore for transport disruptions.

Introducing and sustaining an effective and efficient transport system is therefore not an easy but possible task. This requires that the appropriate authorities transform the available land and financial resources, both limited capital inputs, into relevant transport infrastructure and networks to provide, what is considered, the right combination between the various motorized individual or collective/public and non-motorized transport modes, as well as easy transfers between them to meet the mobility demand (figure 1.1.).

Figure 1.1. Sustainable urban transport system, supply of infrastructure and services



Source: ECE Transport Division

The development of the infrastructure and networks, thus creating the urban transport supply side to meet the mobility demand is not the end of the challenging task. While the available transport options created through available infrastructure and networks can influence the shifts of the population between the various modes of transport, this in itself may not be sufficient to create an effective and efficient transport system. The authorities also need to create a relevant culture for mobility and through it influence the shifts between various transport modes (figure 1.2.). They can hence create demand for what is considered the right combination between the various motorized individual or collective and non-motorized transport modes.

The efforts directed to creating the right transport supply and demand side, or rather recreating it, as both already exist, should be taken in parallel. A the same time, good understanding of the demand distribution depending on triggers such as mobility patterns, the level of income or the quality of service in terms of networks and routes, frequency, as well as the soft performance characteristics (e.g. seat availability), seem to be a good starting point in this work.

Furthermore connectivity should be ensured among different public transport modes with the national transport networks. Good connectivity is a prerequisite for efficient functioning of urban and national transport systems. Efficiency of urban transport for various transport modes depends on their interconnectivity and connectivity with national transport, especially in urban areas where people may choose to live outside the metropolitan areas and to commute every day. Often, these commuters are actually using the national or regional transport. No wonder that transport terminals started to become commercial centres where a number of daily life services are provided. Beyond the fact that these terminals became extra revenue sources for railways and for metro operators they facilitate commuters' life by covering daily needs while commuting.

1.3. Demand for urban transport and quality of service

An increase in income generates a rise in demand for goods and services except for inferior goods. For the latter, the increase in income will cause the demand to fall. This is linked with income elasticity of demand, which is positive for normal and luxury goods and services while negative for inferior ones. The concept is purely relative, which means that under certain circumstances any good or service could become an inferior one. This means that even a luxury good or service can become inferior over time. Typically, inferior goods and services exist if in a consumer perception, there are superior goods and services available. The superior good or service would serve the same purpose but provide more satisfaction, comfort or be of better quality, etc.

Since the demand for urban transport will increase taking into account that cities attract people to move in as they offer higher earning possibilities, the concept of superior goods and services should be carefully considered in urban mobility and transport today. This is because the modes of transport considered by consumers to offer superior urban mobility service would be those to absorb most of the demand for mobility.

Historically driving a car used to be perceived as a service superior to that offered by public transport, cycling or walking. However, it is less the case now, due to increasing parking constraints in city centres together with the attached cost implications, as well as due to diminishing time efficiency when Public Transport vehicles can move on dedicated lanes, while the rest of the traffic is stopped in the jam. In certain circumstances, a consumer today may or may not perceive a car to be a superior choice for urban mobility.

An analysis done by Buehler and Pucher (2012[2]) on the demand for public transport in Germany and the United States – two countries with a relatively high income per capita – shows that public transport has been far more successful in Germany than in the United States with much greater growth in overall passenger volumes and trips per capita. Even controlling for differences between the countries in demographics, socio-economics, and land use, logistic regressions show that Germans are five times as likely as Americans to use public transport. Moreover, public transport in Germany attracts a much broader cross-section of society and for a greater diversity of trip purposes. The authors explain the success of German public transport by the application of a coordinated package of mutually supportive policies that include: (1) more and better service, (2) attractive fares and convenient ticketing, (3) full multimodal and regional integration, (4) high taxes

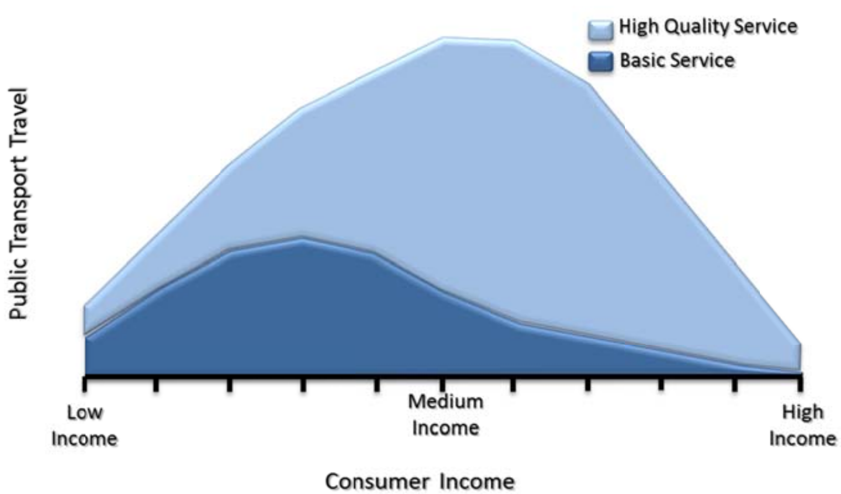
[2] Ralph BUEHLER and John PUCHER, Demand for Public Transport in Germany and the USA: An Analysis of Rider Characteristics, Transport Reviews, Vol. 32, No. 5, 541–567, September 2012

and restrictions on car use, and (5) land-use policies that promote compact, mixed-use developments.

The provision of a high quality public transport service in Germany combined with car deterrence policy clearly affects the perception of the car superiority for urban mobility among the German citizens, including the more affluent ones. Conversely, the lack of high quality service and a supporting policy package explains the continuing struggle of public transport in the United States and a car being the favoured mode for mobility. However, it should be noted that factors such as geographical coverage and distances, spatial planning and oldness of cities directly affect the development public transport and citizens' willingness to use their private cars.

The case of Germany shows that public transport does not need to become an inferior service when relatively high income is achieved. The demand for public transport can hence vary for the same level of income depending on the quality of service offered (figure 1.3.). This variation is shown in various studies[3],[4].

Figure 1.3. Public Transport demand by income



Source: Littman T.[5], APTA 2007, 2012[6]

The demand for basic quality transport service (such as e.g. sporadic bus routes) tends to be greatest for low-income population, which after initial increase declines as incomes rises. Demand for high quality transport service (such as e.g. express commuter buses or frequent rail transit, with public transport-oriented development) tends to increase with income until from a medium to medium-high income is reached. Moreover, the demand for a high quality public transport service is potentially much greater in total than for a basic service.

The studies prove the case for investing into high quality urban public transport to make it a mode in demand Furthermore, even if, as suggested in other studies[7], changes in income affect public

[3] Todd Litman, Evaluating Public Transit Benefits and Costs, Best Practices Guidebook, 2013
[4] American Public Transportation Association (APTA), 2012 FACTBOOK
[5] Ibidem
[6] Ibidem

transport demand either directly (positive impact) or indirectly through increased car ownership (negative impact), the indirect impact may be negligible for urban public transport. This is because car owners may still choose to use public transport for urban mobility instead of the car, or use both. The latter will be the case when connecting by car to a suburban public transport hub for a ride to the city centre. The issue lies therefore in establishing high quality urban public transport as a good alternative to car travel. However, a factor that will make car users to continue using their cars despite the high quality of urban public transport is culture. Driving an expensive car in many societies is a status quo directly connected in most of the cases with social recognition. Urban public transport can overpass the culture barrier through promotion and education focused on the positive effects that citizens and the societies have while using public transport.

What are thus the features that characterise high quality service for urban public transport? To such count in particular:

(a) Good accessibility:

Urban public transport offers good accessibility if it connects the locations where the citizens live with locations where they go to work, study, shop or go for recreation or medical care. These connections can be direct or interconnected within urban public or national public transport networks but they need to offer an overall satisfactory ride time. Moreover, these connections need also to be adequate in terms of options, capacity and intermodality they offer, expressed respectively by number of means of transport in the network and the number of multimodal nodes with which they are interconnected and by number of seats and circulation frequency. Sustainable accessibility requests public transport connection with other transport modes such as bicycles and cars or walking through providing dedicated routes to access to the stations and parking infrastructure at the stations.

(b) High reliability:

Urban public transport is reliable if it runs in accordance with the itineraries. Both the departure time from the station and the ride time between the stations to ensure the interconnectivity need to keep to the itineraries.

(c) Appropriate comfort, safety and aesthetics

Urban public transport is comfortable, safe and appealing if the means of transport are in appropriate technical and safety condition, clean, air-conditioned or heated, and protect from outside noise, etc. Moreover, the stations infrastructure should be such that protects from unfavourable weather conditions and it is separated from traffic to prevent from traffic injuries or fatalities. Availability of real-time information and monitoring in the vehicles and at the stations provided through intelligent transport systems (ITS) also adds to comfort and safety. So does the different variety of options for purchasing tickets. The vehicles and the stations should further have agreeable visual appearance and aesthetics.

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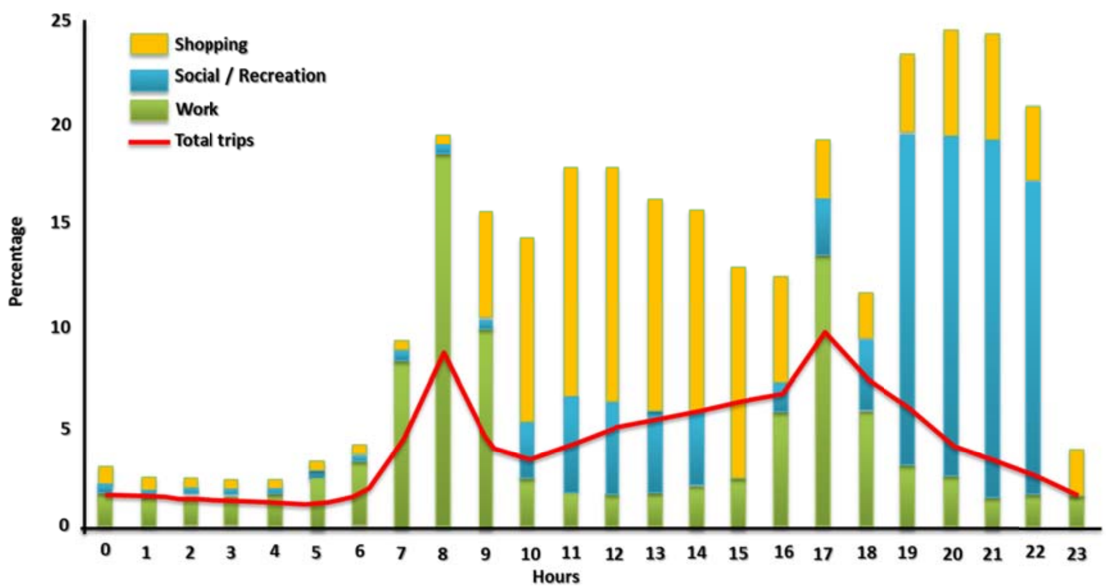
[7] Johan Holmgren, An analysis of the determinants of local public transport demand focusing the effects of income changes, 2013, Sprienger

Providing a high quality public transport is a challenging task. In terms of accessibility, an urban public transport planner needs to find optimal solution between satisfying the maximum demand for the service and minimizing the costs of operation. The demand for mobility is unequal during the time of the day with two peak hours around 8h00 and 17h00 corresponding to home-to-work and home-to school trips and vice versa. The demand for mobility varies also by purpose, with shopping trips mainly occurring in the afternoon and social/recreational trips are prevalent in the evening. The distribution of demand depends hence from the time of the day and purpose of travel (figure 1.4.). For the latter, it shows the percentage of a particular purpose travel of all travels occurring per every hour of the day.

Figure 1.4. Urban travel by purpose and by time



Source: adapted from Barber, G. (1995) "Aggregate Characteristics of Urban Travel", in S. Hanson (ed) The Geography of Urban Transportation, 2nd Edition, New York: The Guilford Press, p. 92.

The high quality features, including those under accessibility (options and adequacy), reliability, comfort, safety and aesthetics, depend on the finances available to invest into the urban transport vehicles and infrastructure including solutions such as those offered by ITS, e.g. for improving public transport flow with priority traffic signalisation for public transport vehicles, or for providing real-time information to passengers. At the same time, however, the ticket fare should not exceed the level at which the passengers would consider the ticket fare to be affordable. Too high prices can cause the demand for mobility shifting from public transport to other modes. The authorities need therefore to look for solutions that secure investments into public transport infrastructure and vehicles and keep the ticket fares at an affordable level. This would be important for all cities, however, it may be of particular importance for cities, where the proportion of public transport in comparison to car use is still negligible. To balance the needs for economic and social sustainability, cities have tried setting fares for cost-recovery and offering targeted subsidies for specific segments of the population. These subsidies, however, have not always lead to the intended results because of difficulties with accurately identifying the target population, potential abuse of the subsidy, and large errors of either exclusion or inclusion of the target population.

1.4. Urban transport and traffic congestion

The land that can be transformed into roadways is limited especially in the city centres. Therefore, as cities grow and their roadways cannot be expanded anymore, the volume of urban traffic needs to be managed within the given roadway capacity. Any surpassing of that capacity leads to traffic congestion – the most apparent transport externality.

Traffic congestions are quite costly, e.g. the costs of delay and extra fuel burned in congestion in the 498 urban areas analysed in the United States were estimated at US$ 121 billion for 2011[8]. These costs were up 5 times since 1982, when they were at the level of US$ 24 billion. Furthermore, the extra fuel burned causes unnecessary release of carbon dioxide, hence adding to the overall bill issued by congestion that societies have to pay in the end.

The challenge with congestions is that they tend to maintain equilibrium[9]: traffic volumes grow until congestion delays discourage additional peak-period car trips on a particular traffic corridor and make travellers to change route, travel time or shift to other mode of transport. Short-term increase in flow is soon filled with latent demand for travel by car on that traffic corridor and the same congestion equilibrium is returned to.

A way to tackle congestions is therefore by implementing solutions that would decrease the point at which the equilibrium is reached. Such is not a roadway expansion, as a greater roadway capacity would invite more motorists to use their cars, and thus move the equilibrium upwards instead of downwards. The need is to provide alternative options to car mobility that would be attractive enough to the motorists to shift to that alternative mode in a long-term. The important aspect is that the mode cannot be perceived as inferior compared to car, since in that case the downward move would not be achieved or it would be negligible only.

To make motorists to give up on their cars, a high quality public transport is necessary. A research[10] about Australian, European and North American cities on congestion relief from high quality public transport suggests that it is valued at an average of $0.45 (Aus$2008) per marginal public transport-vehicle km of travel, if both travel time and vehicle operating costs are considered. The relief can span however from $0.044 to $1.51 with higher values for urban areas or rather urban traffic corridors with greater degrees of traffic congestion.

Another study by Nelson, et al (2006)[11] using a regional transport model to estimate Washington DC public transport system benefits to users and congestion-reduction benefits to motorists, advices

[8] 2012 Urban Mobility Report and Appendices, Texas A&M Transportation Institute, http://mobility.tamu.edu/ums/report/

[9] Todd Litman, Victoria Transport Policy Institute (2013), Evaluating Public Transit Benefits and Costs

[10] Md Aftabuzzaman, Graham Currie and Majid Sarvi (2010), "Evaluating the Congestion Relief Impacts of Public Transport in Monetary Terms," Journal of Public Transportation, Vol. 13, No. 1, pp. 1-24; at www.nctr.usf.edu/jpt/pdf/JPT13-1.pdf.

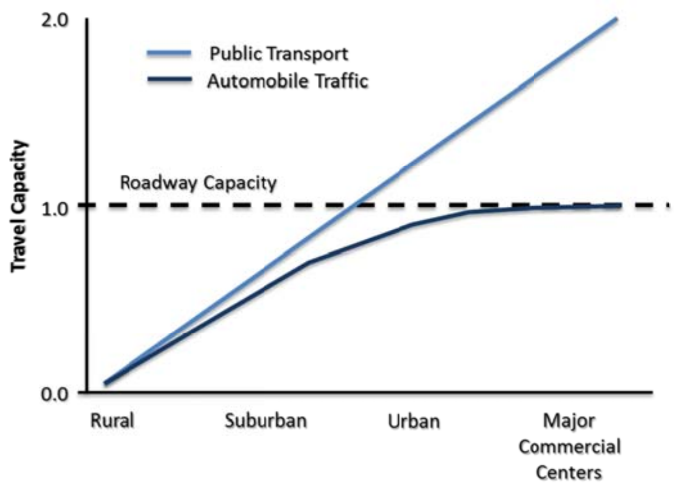
[11] Peter Nelson, Andrew Baglino, Winston Harrington, Elena Safirova and Abram Lipman (2006), Transit in Washington, D.C.: Current Benefits and Optimal Level of Provision, Resources for the Future (www.rff.org); at www.rff.org/rff/Documents/RFF-DP-06-21.pdf.

that rail transport generates congestion-reduction benefits that exceed rail subsidies. Furthermore, the combined benefits of rail and bus transport significantly exceed total public transport subsidies.

The analysis done for the 498 urban areas in the United States[12] shows that public transport attracted an average number of passenger trips in 2011 ranging from about 21 million passenger-miles in the small urban areas to about 2.9 billion in the very large ones. Overall, if these passengers were not transported by public transportation systems they would have contributed an additional delay of almost 865 million hours or about a 15 per cent increase in the total delay.

The studies and analyses prove the case for public transport to be a remedy for congestions. They however also show that the greater the urban area and more congestion-prone, the more the public transport is able to attract motorists (figure 1.5.).

Figure 1.5. Urbanization impacts on public transport use



Source: Littman T[13]

An interesting piece of information can be found in another analysis[14] exploring elements affecting impacts of the congestion relief. This is a factor analysis to identify the underlying dimensions of the measured elements from the readily available urban transport data for a broad international spectrum of cities. The multivariate data analysis shows three major dimensions of factors affecting congestion relief: public transport-oriented factor, car-deterrence factor and urban-form factor.

More use of public transport less congestion

[12] Ibidem

[13] Todd Litman, Victoria Transport Policy Institute (2013), Evaluating Public Transit Benefits and Costs

[14] Md Aftabuzzaman, Graham Currie and Majid Sarvi (2011), "Exploring The Underlying Dimensions Of Elements Affecting Traffic Congestion Relief Impact Of Transit," *Cities*, Vol. 28, Is. 1

A regression model proves that all the three dimensions positively influence congestion relief, with the strongest impact of car-deterrence factor followed by transit-oriented factor. The regression model also provides a quantitative link between city variables, its transport characteristics and congestion relief impact. The public transport-oriented factor is strongest for big cities. Their large-scale public transport systems have significant congestion reduction benefits. The benefits can further increase if the public-transport-oriented policies are combined with the car-deterrence policies. This combination of these policies would also prove successful for middle-size and smaller cities.

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An important message for authorities from this consideration is that car-focused urban transport development, due to traffic congestion, is a no go one. The availability of public transport, as an alternative to car mobility, attracts motorists to give up their cars for urban transfers. This relation is the stronger the larger and more congestion-prone an urban area is, although this rule can also apply to main traffic corridors for mid-size and smaller cities. The high quality public transport is much more successful in attracting and keeping motorists compared to public transport considered as inferior service. Finally, a combination of public transport-oriented policies combined with car-deterrence policies prove to be most successful in the shift from car to public transport urban mobility, and therefore keeping the car traffic within the roadways capacity.

However, reducing the number of cars entering cities by introducing congestion charges may not cut congestion as much as estimates have claimed. Poor traffic management schemes, lack of co-ordination of road works and traffic lights re-phasing, lack of accommodating parking policies and poor interconnections among the different public transport means can be some of the reasons that contribute to congestion. Congestion charging schemes could be successful when they are being implemented as supplement to sustainable public transport policies and not as stand-alone measure against congestion. Furthermore, it may not be the first measure to take in an urban and mobility reform.

1.5. Urban transport and road safety.

The socioeconomic costs of road traffic injuries are estimated to be about 2% of a country's gross domestic product (GDP). For EU countries alone, this means about €180 billion – twice the annual EU budget (2004). Furthermore, accidents are the most important category of external cost of transport in Europe: €158 billion a year or 2.5–3.0% of GDP in 17 Member States[15]. It is therefore in the authorities' interests to substantially improve road safety.

More use of public transport leads to less road fatalities and accidents!

Traditionally, road safety policies aim to reduce the likelihood of road crashes and their severities by improving road infrastructure; educating road users, improving vehicle technology and enforcing well designed traffic rules. While these are important actions, equally important should be a focus on the promotion of safer modes, such as public transport, and by reducing exposure[16]. Studies show that cities and regions with less private car travel have lower rates of crashes and fatalities[17]. Cities with high public transport mode shares tend to have lower citywide traffic fatality rates[18] (figure 1.6.). Sustainable form of urbanisation (e.g. higher density and better street connectivity that allow for lower speed) can also improve road safety[19].

Furthermore, the relation is also confirmed in other analyses, e.g. an analysis by Karim, Wahba and Sayed (2012)[20] of Vancouver region traffic crash data. They found that area crash rates decline significantly with increasing bus stop density, percentage of public transport-km travelled relative to total vehicle-kms travelled, and walking, biking, and public transport-commute mode share. Their modelling indicates that a strategic transport plan that encourages use of alternative modes tends to reduce total, severe, and property damage collisions.

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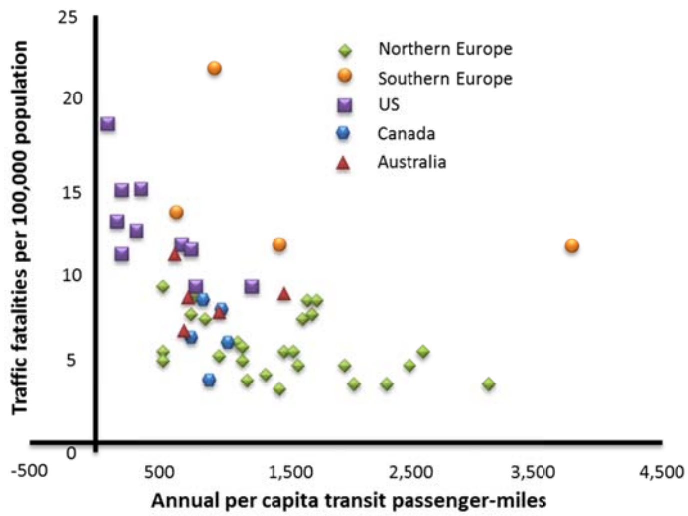
[15] World Health Organization, Economic cost of transport-related health effects
[16] EMBARQ, The Role of Sustainable Transport in Traffic Safety, 2013
[17] Kenworthy et al. 1997. Indicators of transport efficiency in 37 global cities: a report of the World Bank. Perth, W.A.: Institute for Science and Technology Policy, Murdoch University.
[18] Bhalla et al. 2007. A Risk-Based Method for Modeling Traffic Fatalities. Risk Analysis, vol. 27, no.1.
[19] Dumbaugh and Rae. 2009 Safe Urban Form. Journal of the American Planning Association, 75: 3, 309-329.
[20] Md. Ahsanul Karim, Mohamed M. Wahba and Tarek Sayed (2012), Evaluating the Safety Estimates of Transit Operations and City Transportation Plans, Transportation Research Board Annual Meeting (www.trb.org); at http://amonline.trb.org/1slsr0/1slsr0/1.

Figure 1.6. Comparison of International traffic fatalities and public transport



Source: Kenworthy and Laube 2000[21]

This consideration gives another important message for authorities. As confirmed by the international data available, crash rates decline with increased public transport use, see figure 1.6. Public transport – the high quality one – influences thus positively not only the decrease in congestions but also the decrease in road fatalities and injuries.

[21] Jeffrey Kenworthy and Felix Laube (2000), Millennium Cities Database For Sustainable Transport, Institute for Sustainability and Technology Policy, Distributed by the International Union of Public Transport (www.uitp.com); analyzed in Newman and Kenworthy (1999).

1.6. Urban transport and environmental pollution including climate change.

The transport sector is responsible for a portion of air pollutants release as well as emission of carbon dioxide (CO_2) and other global warming pollutants that contribute to climate change. A major portion of these releases and emissions is attributed to the older type of road vehicles that are powered by fossil fuels combustion engines, end that do not meet (yet) the new emission limits.

In the urban areas traffic, which is characterized by short but also slow, stop and start journeys, the air pollutants emissions as well as carbon emissions are much higher per km compared to free-flow longer journeys. This argues for separation of cyclists from motorized transport.

Air pollution is of particular concern in the urban areas, as the typical levels of air pollutant concentrations found in urban areas today could cause serious and quantifiable health damage. Logically, the higher the air pollution levels, the worse the associated health problems and their costs to the societies need to pay. The exposure to harmful levels of air pollution, as studies show (EEA, 2013), is significant, in particular for some pollutants in the EU countries, let alone other countries

The authorities have therefore an important role to play in leading actions also in urban transport to fight air pollution and climate change.

More use of adequate public transport leads to less emission

The various studies conducted[22,23] show that public transport provides energy conservation and emission reduction benefits. In terms of CO_2 emissions, assuming average occupancy rates for the various transport modes, even in the United States, whose public transport is characterized on average by low occupancy rates, a conventional bus will be minimum 15% CO_2 more efficient per passenger mile/km travelled compared to a conventional sedan car. This ratio increases several times in favour of the bus if compared to bus occupancy in peak hours. Similarly, for air pollutants, a conventional bus also achieves better results than a conventional car per passenger mile/km travelled.

Even if quantifying emission impact is a rather challenging task, due to several different pollutants and many possible combinations of vehicles, engines and driving conditions, it is evident that the public transport advantage over cars grows with its increasing ridership. Application of policies aimed at increasing the ridership of public transport can therefore turn today only successful in cutting the level of emissions and making the public transport more energy efficient per passenger mile/km travelled.

Public transport with high occupancy rate will keep its absolute emission advantage as long as zero tailpipe emissions road vehicles are marketable and commonly used[24], what will bring the transport-related problems of air pollution and CO_2 emissions in urban areas to a rather negligible level. Public transport will further keep its relative emission advantage as long as green energy will not be the dominant energy source. When planning public transport to help addressing air pollution and climate change, authorities should remember about a number of issues. The vehicle fleet, in particular for buses, should be renewed regularly so that advantages from the technology

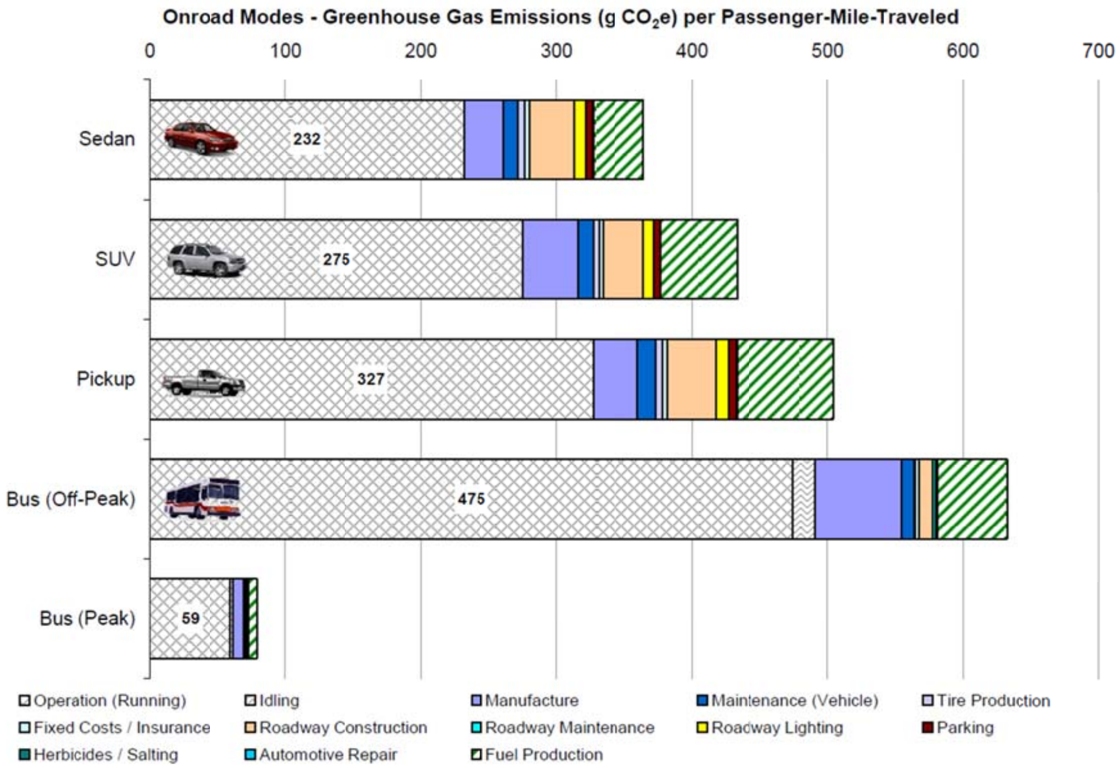
[22] Robert J. Shapiro, Kevin A. Hassett and Frank S. Arnold (2002), Conserving Energy and Preserving the Environment: The Role of Public Transit, APTA (www.apa.com)

[23] Mikhail Chester and Arpad Horvath (2008), Environmental Life-cycle Assessment of Passenger Transportation: A Detailed Methodology for Energy, Greenhouse Gas and Criteria Pollutant Inventories of Automobiles, Buses, Light Rail, Heavy Rail and Air v.2, UC Berkeley Center for Future Urban Transport, (www.its.berkeley.edu/volvocenter/), Paper vwp-2008-2; at www.sustainable-transportation.com and http://escholarship.org/uc/item/7n29n303#page-36

[24] The European Commission aims that cities be free from conventionally fuelled cars by 2050 in terms of passenger km in urban areas.

development and change are attained, e.g. hybrid electric bus could help cut significantly hydrocarbon and nitrogen oxides (NO_x) emissions compared to a diesel bus. A conventional bus carrying a limited number of passengers (figure 1.8.) is more polluting per passenger mile/km travelled than a conventional car, hence bus routes and itineraries should be planned so as to minimize if not avoid a low-occupancy bus circulation. In this regard, it should be kept in mind that land use planning policies aiming at rather compact cities are those, which would enable and result in a high-occupancy public transport service[25].

Figure 1.8. Greenhouse gases efficiency per passenger-mile travelled



Source: Chester and Horvath 2008[26]

Moreover, with regard to climate change, this work is not only about mitigation and hence decreasing the impact of transport on climate change but also about adaptation to it. In this context, establishment of effective and efficient urban transport system requires that the necessary infrastructure, including for the various public transport modes, be built so that it is reasonably resistant to the effects of extreme weather events caused by climate change. The authorities should in particular take into account the known vulnerabilities of the two main types of transport infrastructure:

Road:

- High temperatures may cause damage to road paving (melting of road surface),

[25] Transit cooperative research program, public transportation's role in addressing global climate change, March 2009

[26] Ibidem

- Strong rainfall resulting in local flooding, when the capacity of the drainage systems is exceeded to remove excess water, may cause structural damage to roads,
- Strong rainfall may cause erosion of embankment of road and landslides.
- thaw

Rail / Metro:

- Icing of electric tractions may cause disruption of power supply for tram, trolley or train,
- Extreme heat may cause track damage,
- Strong rainfall resulting in local flooding, when excess of drainage system capacity, may cause structural damage to railroad,
- Strong rainfall may cause erosion of embankment of railroad and landslides.

In addition, since various infrastructure systems such as energy supply, flood control and transport networks, often function as a whole or not at all, in order to avoid failures leading to potential disasters, the design threshold – "tipping point" – should not be considered separately for the

Box 1.3. The Urban Adaptation Support Tool, European Union

The tool is part of the European Commission's initiative of "Mayors Adapt" - the Covenant of Mayors Initiative on Climate Change Adaptation.

The Urban Adaptation Support Tool provides practical guidance and knowledge support to the signatories of the initiative as well as to any other interested cities, towns or stakeholders in Europe and beyond and supports urban adaptation decision-makers, practitioners and interested stakeholders with a quick-start step-by-step guidance through the adaptation planning and implementation cycles. It also facilitates easy access to in-depth, expert information and data by providing a comprehensive up-to-date database of literature and information sources for each step of the urban adaptation cycle.

The Urban Adaptation Support Tool is dynamic and constantly evolving, based on users' needs and feedback. It has been created through a stakeholder consultation process and aims to develop further in line with user needs.

The Urban Adaptation Support Tool consists of six steps that together help users to:

- explore risks and vulnerabilities to current and future climate,
- identify and assess adaptation options,
- develop and implement a climate change adaptation strategy and/or action plan, and
- monitor its results.

Under each step, several questions are listed that need to be answered in an adaptation planning and implementation process. A general summary of the issue is given for each question, followed by a quick answer and a list of links to relevant knowledge materials and tools for deeper understanding, as well as specific guidance relevant to urban areas. At the end of the list there is a link to the general Adaptation Support Tool, which provides broader relevant adaptation information not specifically targeted for application in urban areas.

Source: European Climate Adaptation Platform / http://climate-adapt.eea.europa.eu/tools/urban-ast/step-0-0 /

various infrastructure systems but together with the lowest tipping point of any of the infrastructure system characterising the interconnected systems of infrastructure as a whole.

The promoted approach to climate proofing of infrastructure is about making it more flexible and resilient as well as reducing its vulnerability to weather extreme events by compartmentalizing and redundancy.

Flexibility means that adjustments to infrastructure can easily be made to increase its initial design's tipping point and thus be further adapted to the changing climate. Resilient means that negative consequences of an extreme weather event can be easily restored. Compartmentalizing is about making compartments so that an infrastructure failure can be limited to a certain area. Finally, redundancy is about spare facilities that compensate for the failing of other infrastructure.

1.7. Cycling and walking: the "facilitators" of co-modality and well-being.

Before the motorization era, it was walking and, with the development of safe bicycle, also cycling that were the dominant forms of short distance transportation in the developed world. The bicycling era has not lasted too long, as especially in North America the automobile revolution starting at the beginning of the 20th century made the car a favoured form of transportation whether urban or sub-urban, while the bicycle become predominantly a children toy or means for pass-time. The situation looks different in developing countries, in particular, in Africa and Asia, where walking and cycling continuous to be the dominant form of mobility . This however is largely not by choice, but rather driven by lack of affordable and accessible alternatives, with many pedestrians and cyclist belonging to lower income groups[27].

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An increasing consciousness in the developed world about the value of physical exercise, energy efficiency in transport– the bicycle being the most energy-efficient mode of transport – and about the need to protect the environment, made as well as continues to make people to return to bicycling and walking for short-distance urban travel.

The promotion of cycling and walking for everyday physical activity is a win-win approach. It does not only promote health but can also lead to positive environmental effects, especially if cycling and walking replace short car trips. There is a large potential for active mobility in European urban transport, as many trips are short and would be amenable to be undertaken on foot or by bicycle[28].

Nevertheless, to attract people to cycling and walking, these types of transport have to be safe and convenient.

The safety aspects are linked to the infrastructure, in particular, the availability of good quality pedestrian pavements and dedicated bicycle lanes, which are separated from the motorized transport infrastructure and the provision of safe crossings. The safety aspects can be further associated with the protection from noise and pollution.

The convenience aspects can be associated with prioritization of walking and cycling and hence short waiting times at intersections with the motorized infrastructure, underground passages for motorized transport rather than for the non-motorized one, availability of parking infrastructure for bicycles, suitable connection to public transport stations. In addition, the visual appearance and aesthetics of the non-motorized infrastructure should not be underestimated.

The adequate land use planning policies favouring non-motorized over motorized transport are a key issue in providing safe and convenient walking and cycling types of mobility for short distance trips, while good connections to public transport could help ensuring the intermodal use of walking or cycling with public transport for longer distance trips.

The benefits of such approach can be substantial. Safe cycling and walking, replacing car trips, can positively impact transport safety in terms of less vehicle crash. This can further have a positive impact on environment, as both cycling and walking are non-polluting forms of transportation. The good connection of cycling and walking with public transport and the provision of services from public transport to cyclists and walkers – spaces inside P.T. means that accommodate bicycles, no more than ten minutes walking distance among stops etc - can further improve public transport efficiency. Thus public transport by offering integrated services to cyclists and walkers will make more citizens using its services, stop using their private cars and therefore decrease congestion.

Last but not least, walking and cycling have a significant positive impact through increased physical activity on the health of the population. In Austria, e.g. the modal share of cycling is 5%, with an average length of trips of 2 km (2009). It is estimated that this level of cycling saves 412 lives every year through regular physical activity. The corresponding average savings for Austria from this reduced mortality are estimated to amount to €405 million per year. In England, the costs of inactivity were estimated in 2002 to be €3–12 billion, including those to the health system, days of absence from work and loss of income due to premature death. This excludes the contribution of physical inactivity to overweight and obesity, whose overall cost might run to €9.6–10.8 billion per

[28] THE PEP / http://www.unece.org/thepep/en/welcome.html

year. In Switzerland the direct treatment costs of physical inactivity are estimated at €1.1–1.5 billion per year. Based on the mentioned examples, physical inactivity can be estimated to cost a country about €150–300 per citizen per year[29].

An important message from this consideration to cities administrations is that a return to cycling and walking as dominant forms of transportation for short distance trips on their own or as connecting trips to public transport network is very beneficial for the individuals and even more for the sociality. It is also possible to achieve. This requires that cycling and walking are made safe and convenient. This in turn requires implementation of adequate land use planning policies.

[29] World Health Organization data and statistics, www.who.org

Chapter 2: Urban Mobility and Public Transport situation in ECE capitals

2.1. Introduction

Sustainable urban transport has a vital role to play in contributing to sustainable development of cities and in ensuring the well-being of their citizens. It has to satisfy the numerous and diverse requirements for the metropolitan mobility, including minimizing the travelling time between various location, while at the same time it needs to internalize the externalities caused by transport.

Introducing and sustaining an effective and efficient urban transport system is a challenging task. While there is no-one-size-fits-all approach, as cities differ due to their size, micro-climates, structures, degree of urbanization and wealth, degree of exposure to extreme weather conditions, they have to introduce the solutions that would best address their local circumstances for sustainable development and urban transport.

In this context it is interesting to review the achievements of the ECE capital cities in applying sustainable urban transport solutions as a major component to their sustainable development.

The review looks first at the urbanization level in ECE countries and the urbanization related perspectives for the ECE capital cities. It examines the demand for urban transport and mobility and how it is distributed between the different transport modes. It assesses the quality of urban public transport in terms of its accessibility and comfort. It further looks into urban traffic congestions, road safety and environmental pollution including climate change. Also, cycling and walking as types of non-motorized transport as well as affordability and financing for urban public transportation are reviewed (figure 2.1.).

The review is based on the data collected with a survey on urban transport and mobility that was circulated to the authorities of ECE capital cities in October 2012. The survey was returned by 36 capital cities[30], while four more cities[31] provided more general descriptions with some data on their urban public transport networks.

The degree to which the questions of the survey were answered by the authorities differs and hence it was not possible to analyze every element selected for review for the group of 31 or even 35 capital cities.

In addition, data such as on wage level or urban road crash injuries and fatalities or air pollution or climate change have been used from other sources, including such as ECE own statistical database, European Environment Agency database, United Nations Statistical Division database. Yet some data, like e.g. such necessary to examine the demand for motorized and non-motorized transport were estimated based on modal spilt information available for many of the cities of the European Union region[32].

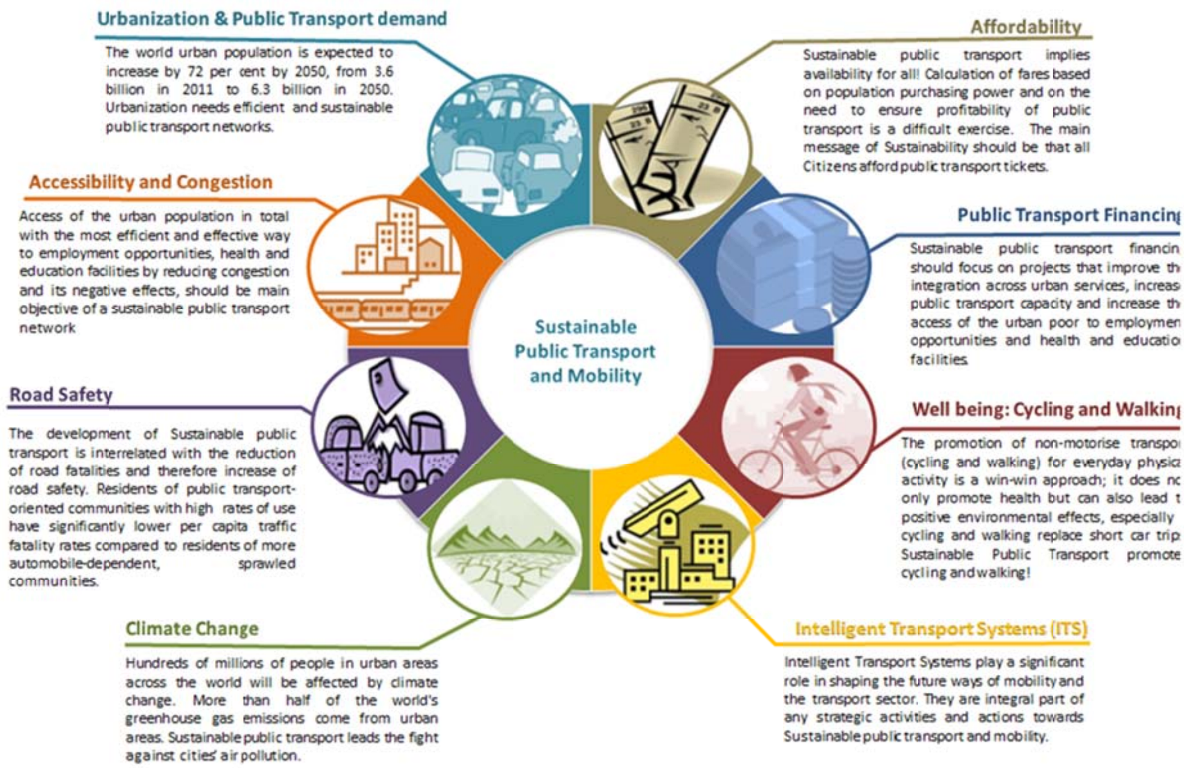
[30] Armenia-Yerevan, Azerbaijan-Baku, Belarus-Minsk, Belgium-Brussels, Bulgaria-Sofia, Canada-Ottawa, Croatia-Zagreb, Cyprus-Nicosia, Czech Republic-Pragha, Estonia-Tallinn, Georgia-Tbilisi, Greece-Athens, Hungary-Budapest, Iceland-Reykjavik, Ireland-Dublin, Italy-Rome, Kazakhstan-Astana, Latvia-Riga, Lithuania-Vilnius, Republic of Moldova-Chisinau, Netherlands-Amsterdam, Norway-Oslo, Poland-Warsaw, Romania-Bucharest, Russian Federation-Moscow, Serbia-Belgrade, Slovakia-Bratislava, Slovenia-Ljubljana, Switzerland-Bern, Turkey-Ankara and United Kingdom-London

[31] Austria-Vienna, France-Paris, Germany-Berlin, Tajikistan-Dushanbe,

[32] Data on modal split available from http://epomm.eu/tems/cities.phtml

Furthermore, the analysis trusts the correctness and validity of the data provided by the survey respondents. No further validation process has been implemented other than technical corrections (decimal errors).

Figure 2.1. Sustainable urban mobility and public transport pillars



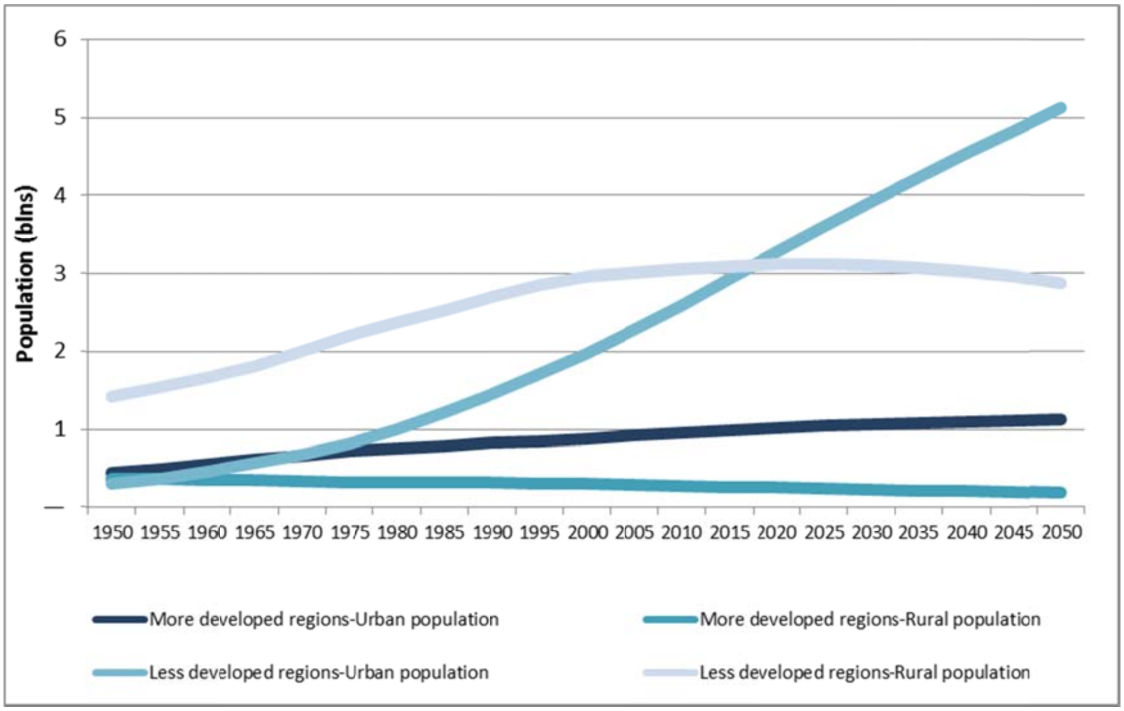
Source: ECE Transport Division

2.2. Urbanization level and demand for urban transport and mobility in ECE capitals

2.2.1. Urbanization level

The world urban population is expected to increase substantially over the next decades. By mid-century the world urban population will likely be the size of the current total population (figure 2.2).

Figure 2.2. Global Urban and rural populations by development group, 1950-2050



Source: UNDESA, World Urbanization Prospects: The 2011 Revision

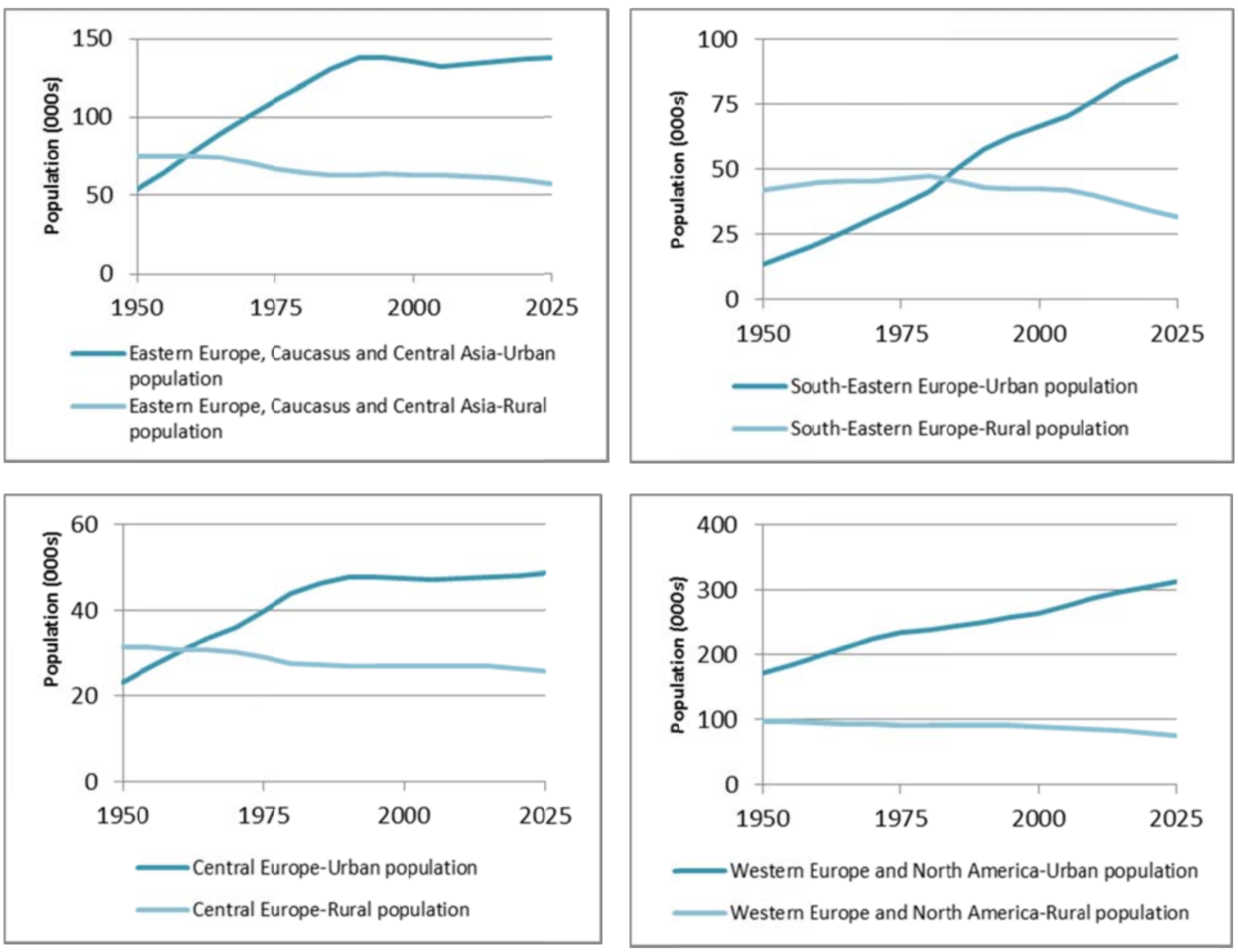
Essentially, the lion's share of the expected growth will be concentrated in the urban areas of the less developed regions, whose rural population is expected, at the same time, to decline slightly. In the more developed regions the changes, respectively an increase in urban and a decrease in rural populations will be rather moderate.

Major disparities have been existing for many years in the level of urbanization among the different development groups. While the urban population in the less developed regions has been seeing a strong increase since 1980, it will only reach the level of their rural population during the next five years. For the more developed regions, the urban population has been exceeding the rural one already since 1950 (figure 2.2.) and the difference has been continuously increasing.

Taking a look at the situation in the ECE region (figure 2.3.)[33], the increase in urban population has been much steeper over years compared to the decline in the rural population. Both of these trends show uninterrupted continuation since 1950.

The trends change, however, if the typical ECE sub regions are analyzed (figure 2.4.). The ECE situation is mainly presenting the trend in Western Europe and North America, which is most populous compared to the other three sub regions. The latter ones saw urban population exceeding in number the rural population in late 1950 in Central and Eastern Europe, Caucasus and Central Asia and only in mid-1980 in South Eastern Europe. While the difference was widening in the subsequent years, it has been relatively flat over the last two decades in the first two sub regions but continued widening in South-Eastern Europe. The situation in the sub regions is nevertheless impacted by its most populous countries, like e.g. the South-Eastern Europe and Turkey.

Figure 2.4. Urban and rural populations aggregated per ECE sub regions, 1950-2025



Source: ECE Transport Division based on data from World Urbanization Prospects: The 2011 Revision

[33] The trend is based on aggregation of data for 36 ECE countries

Therefore, it is interesting to look at the trends in various countries separately (figure 2.5.).

Figure 2.5. Urban and rural populations in 36 ECE member States, 1990-2020

Country	Region	Population change 1990-2020, 1990=100			Urban to Rural	
		Total	Urban	Rural	1990	2010
Eastern Europe, Caucasus and Central Asia	Armenia				2.07	1.78
	Azerbaijan				1.16	1.15
	Belarus				1.94	2.94
	Georgia				1.22	1.12
	Kazakhstan				1.29	1.16
	Moldova				0.88	0.88
	Russian Federation				2.76	2.80
	Tajikistan				0.46	0.36
South-Eastern Europe	Bulgaria				1.97	2.64
	Croatia				1.18	1.36
	Romania				1.14	1.12
	Serbia				1.02	1.27
	Turkey				1.45	2.39
Central Europe	Cyprus				2.01	2.37
	Czech Republic				3.04	2.77
	Estonia				2.46	2.27
	Hungary				1.93	2.22
	Latvia				2.25	2.10
	Lithuania				2.09	2.03
	Poland				1.58	1.56
	Slovakia				1.30	1.21
	Slovenia				1.02	1.00
Western Europe and North America	Austria				1.92	2.07
	Belgium				26.64	38.24
	Canada				3.27	4.14
	Denmark				5.60	6.57
	France				2.85	5.77
	Germany				2.72	2.82
	Greece				1.43	1.58
	Iceland				9.63	15.00
	Ireland				1.32	1.62
	Italy				2.01	2.15
	Netherlands				2.19	4.80
	Norway				2.57	3.79
	Switzerland				2.73	2.79
	United Kingdom				3.57	3.88

Source: ECE Transport Division based on data from World Urbanization Prospects: The 2011 Revision

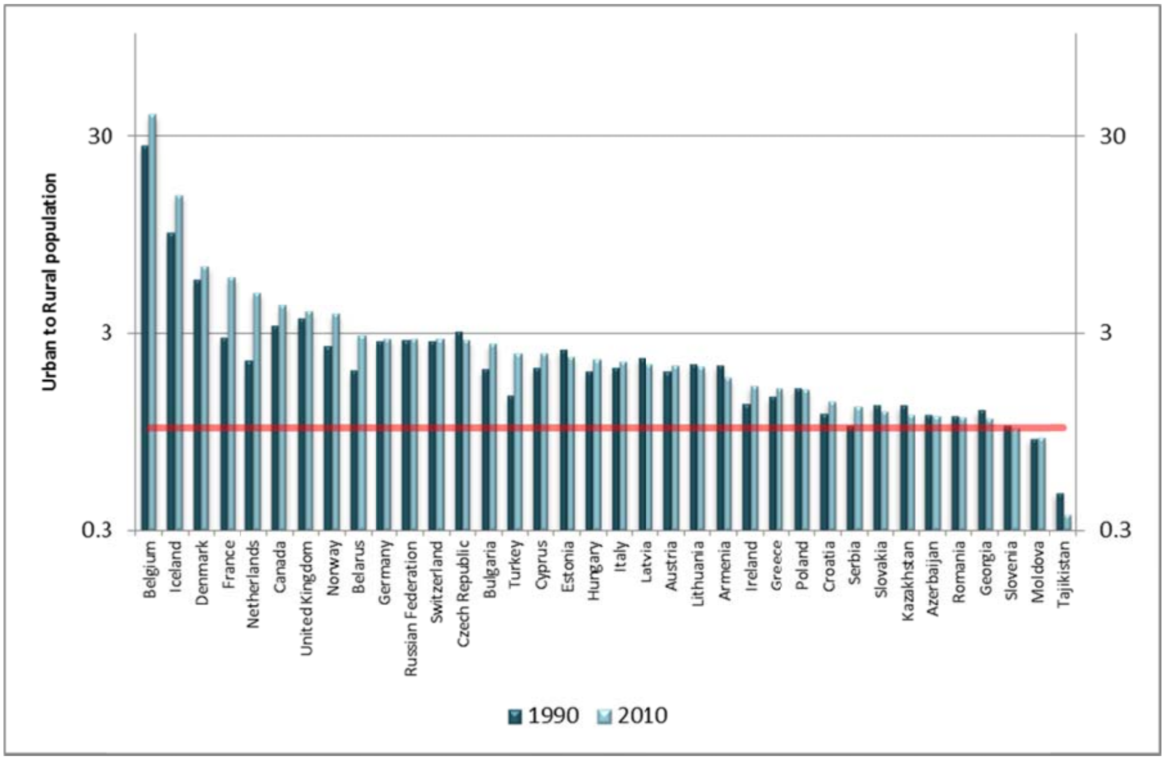
Looking at the time period between 1990 and 2020, the majority of countries from the Eastern Europe, Caucasus and Central Asia and from South Eastern Europe and Turkey, as well as nearly half the countries from Central Europe have been dropping in total population. Most of these countries have been seeing decreases in both rural and urban population, with the latter one being even steeper, which resulted in lower rates of urbanization in 2010 compared with 1990. The explanation for such a development can be the migration of population related with the collapse of the communist system and the disintegration of the Soviet Union in the early 1990, and in later years, for countries that joined the European Union, the job migration to Western Europe and for the Eastern European and Central Asian countries, the job migration to Russian cities. Usually, the urban population is considered less tied to the ground, which can explain its stronger migration.

There is also a number of countries in these regions, in which the increase in rural population was stronger than in urban population and hence the urbanization rate decreased. Such a development may be explained by urban population, in particular from the bigger cities, moving for living to the vicinities of the cities, which often are registered as rural areas.

In the case of the Western European countries the total population is increasing mainly as a result of growth in urban population. In a number of cases also the rural population’s growth has been positive. In each case, however, the urbanization rate further increased between 1990 and 2010.

While there are different trends in the 36 ECE countries under review, it needs to be noted that in all but two cases (Republic of Moldova and Tajikistan) the urban population exceeds that one in rural areas (figure 2.6.). In more than two third of cases the urban population was in 2010 at least 50% higher with the most extreme situation in Belgium and Iceland, where the urban population was respectively 38 and 15 times higher than rural population, which makes more than 90% of these countries total population living in areas with urban status.

Figure 2.6. Relation between urban and rural population in 36 ECE countries

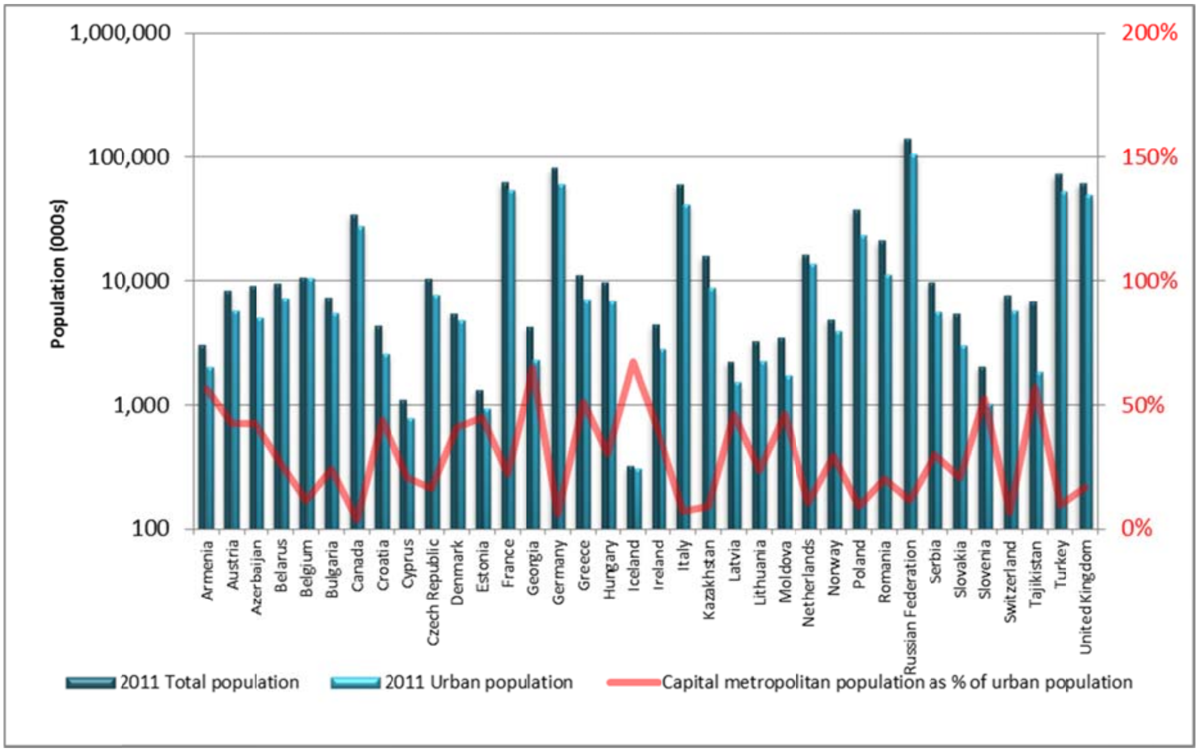


Source: ECE Transport Division based on data from World Urbanization Prospects: The 2011 Revision

Furthermore, in a number of countries, in particular Western European ones, which had already relatively high urbanization rates, urban population has increased substantially between the period 1990 to 2010, e.g. in France, Iceland, the Netherlands or Norway. Similar development took place in some countries from the other sub regions such as Belarus, Bulgaria or Turkey.

The metropolitan population particularly in capitals takes a major share in the countries urban population (figure 2.7.). For smaller countries, the share of urban inhabitants can exceed 50% (Yerevan, Tbilisi, Reykjavik, Ljubljana or Dushanbe). For some bigger countries that share may be also well above 10% (Paris and London) or around 10% (Warsaw and Moscow). The rate is the higher the more centralized a country is with the capital city being the major business and industry hub attracting the various enterprises, while the jobs they create attract workers to move there. At the other end are countries with more decentralized or federal structures, like Canada, Germany or Switzerland, where the population of the capitals is under 6% of the urban population, and where there are other cities with the role of major business or industrial hubs.

Figure 2.7. Total, urban and capital population in 36 ECE member countries, 2011

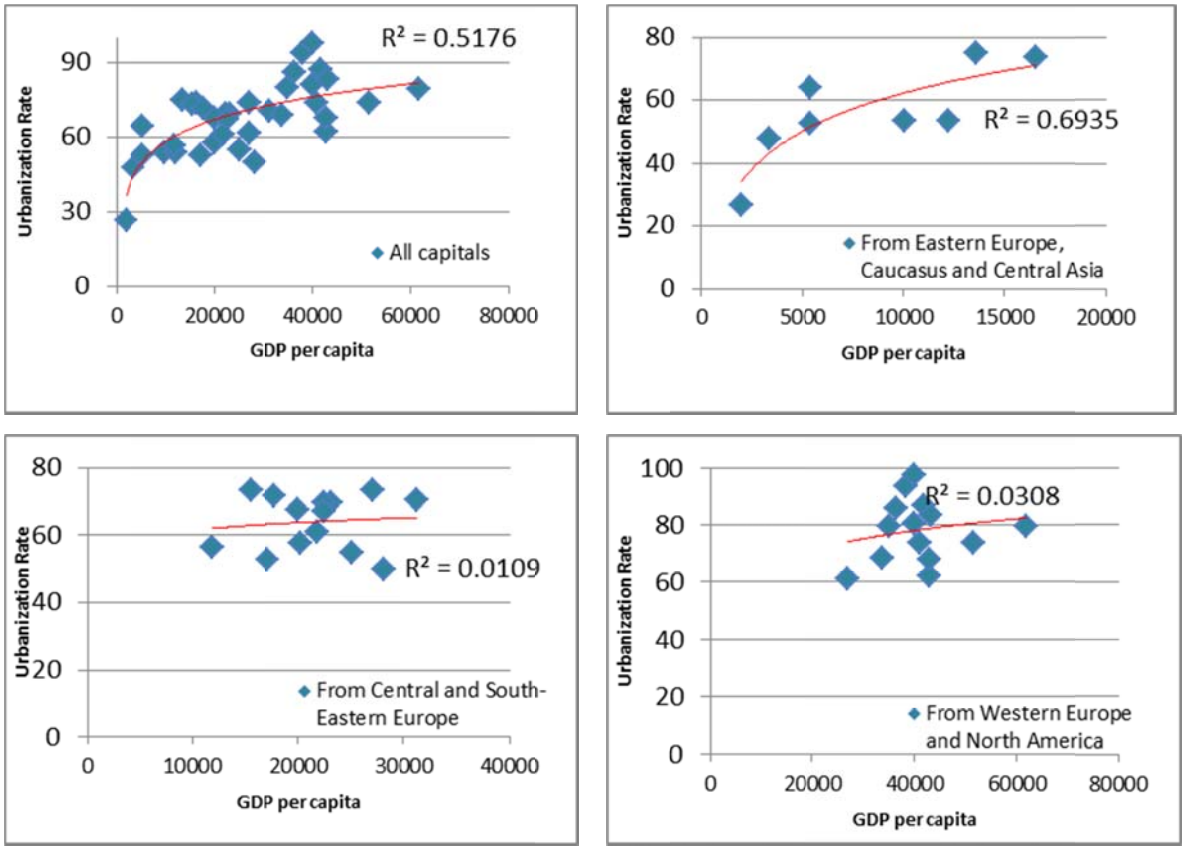


Source: ECE Transport Division based on data from World Urbanization Prospects: The 2011 Revision

Moreover, since urban areas are considered to be the motors for economic development, it is expected that countries with higher urbanization rates achieve higher level of gross domestic product (GDP). This correlation is indeed visible when putting together all the 36 ECE countries under review and it is even more visible for the countries of the Eastern Europe, Caucasus and Central Asia sub-regions. However, there is no correlation when putting together countries from Central and South-Eastern Europe or Western Europe and Turkey, as well as North America (figure 2.8.).

If in the group of sample countries belong such with relatively low level of GDP and low urbanization rate then correlation seems to exist. The correlation finds hence application more in the developing regions rather than in the developed ones, such as the ECE region. This can be explained by the fact that the developed regions possess the necessary infrastructure and the population achieved an income level which allows them to work in the agglomerations that produce the highest economic outputs while living in relatively distant rural areas or smaller towns. In the developing regions, the rural population usually has no opportunities for commuting to urban areas for work and is employed or self-employed in relatively low productivity agriculture activities, hence, the correlation between low urbanization rate and low economic development can be rather strong there.

Figure 2.8. Correlation between urbanization rate and the level of GDP per capita, 2011



Source: ECE Transport Division

For the ECE countries, whose urbanization rate, apart from a few exceptions, is already high, the issue of whether or not they will develop further and in a sustainable way will depend on how successfully they are able to minimize diseconomies in operation of their agglomerations. If they are able to achieve this goal, on the one hand, their agglomerations can stay competitive at national and international levels in attracting new and maintaining existing businesses that create jobs. On the other hand, they can be attractive places for living which offer the population high degree of well-being.

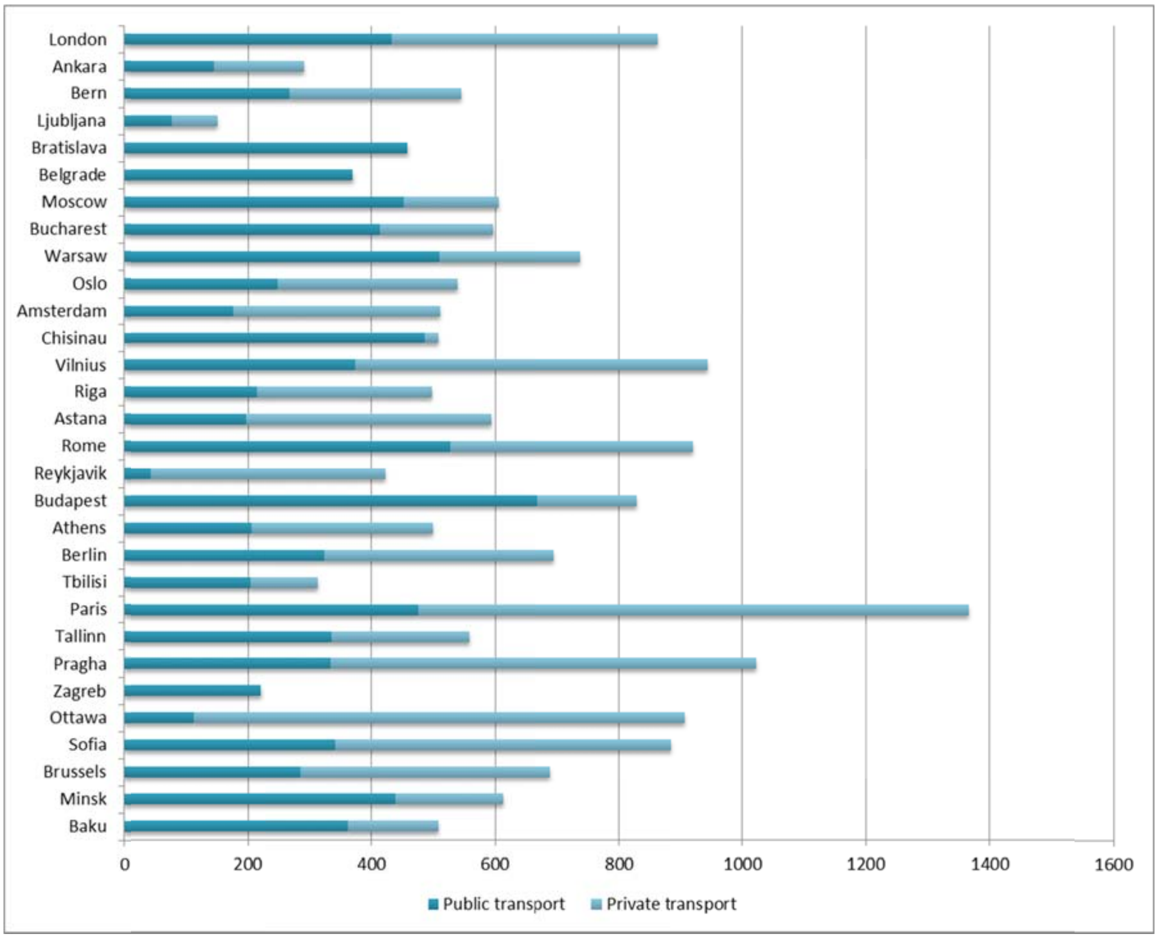
An effective and sustainable urban transport system and mobility play an important role in minimizing the diseconomies related to markets accessibility within agglomerations.

2.2.2. Demand for urban transport and mobility in ECE capitals

The ECE capital agglomerations vary among each other at every level, whether the size of the population or the geographical area they cover and the resulting density, historical developments or wealth, etc. Therefore, the analysis made needs to be put in relation to those characteristics mentioned above to provide a more clear and relative picture of the situation with urban transport system and mobility in ECE capitals, rather than considering absolute numbers.

The demand for motorized transport ranges from 200 trips per capital capita per annum or less (Ljubljana) to 1300 trips or more (Paris) (figure 2.9.). The first value means that an average citizen of the capital agglomeration makes as few as one trip every second day throughout the year, while in the second case more than 3 trips are made every day. However the difference in size of the two capitals still has to be born in mind. .

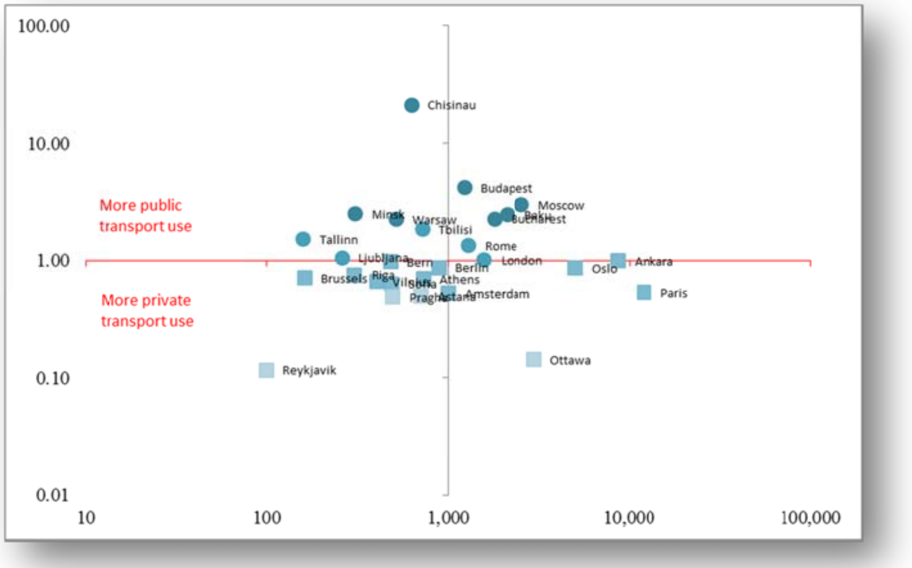
Figure 2.9. Demand for urban transport: public and motorized private transport in ECE 30 capitals, 2011

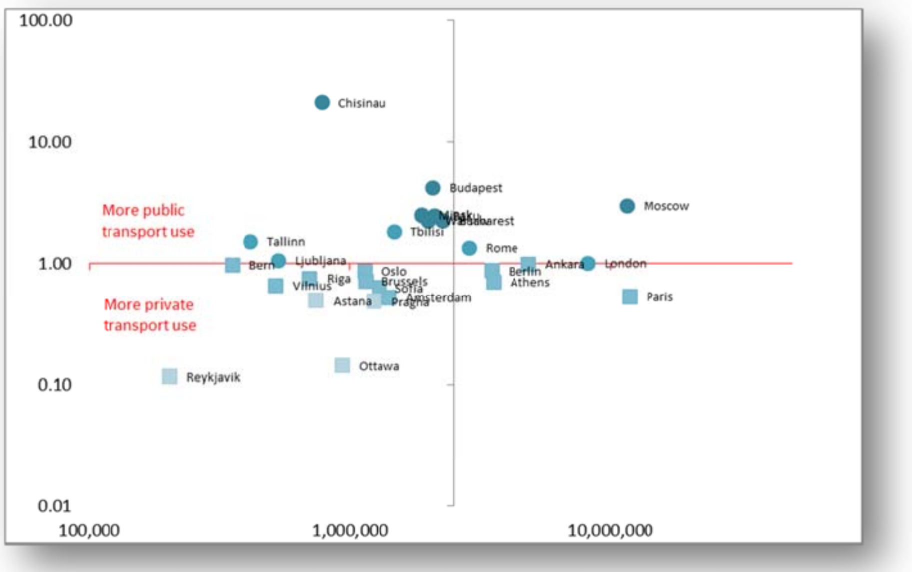


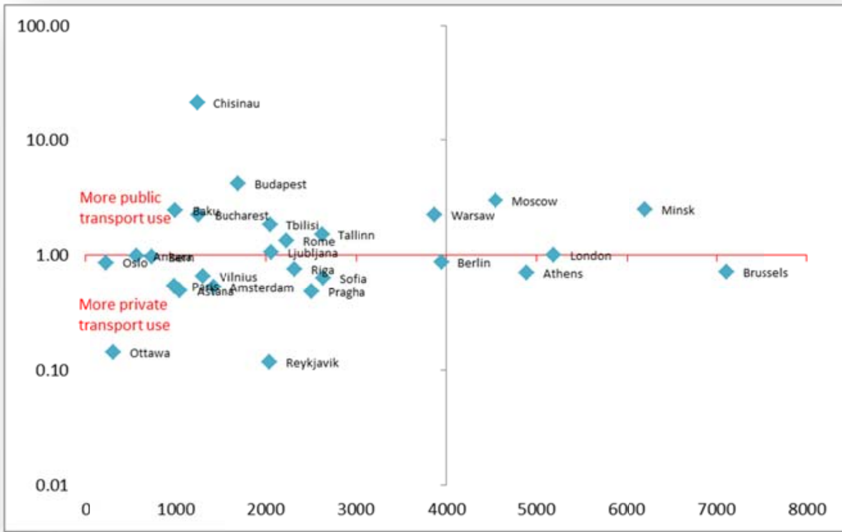
Source: ECE Transport Division

For the majority of the ECE capitals, the demand for motorized public and private transport is either equal or in favor of public transport (figure 2.10.). There are however also capitals (Ottawa and Reykjavik) where the private motorized transport dominates. At the same time, as the data show, there is no correlation confirming higher demand for public transport versus private motorized transport in the more populous and dense capitals.

Figure 2.10. Relation between rides with urban public and private motorized transport in 27 ECE capitals, as per size of capital area (1), size of the capital population (2) and capital density(3)



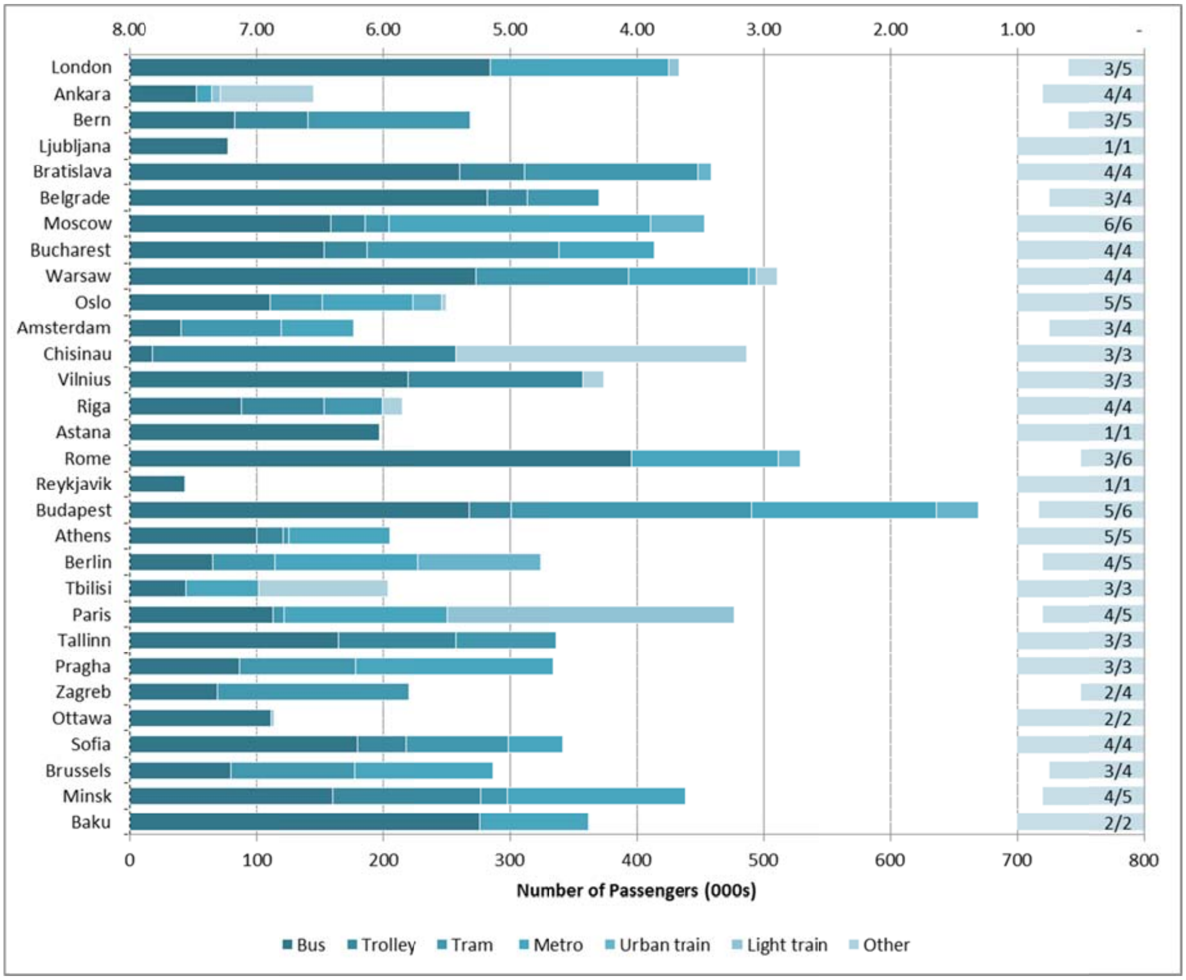




Source: ECE Transport Division

With regard to the demand for urban public transport in ECE capitals, it ranges from as few as some 50 trips per capital capita per annum (Reykjavik) to more than 650 trips (Budapest). In the first case, it means that an average citizen uses urban public transport once every week during a year, while in the second case the demand reaches almost 2 trips per day.

Figure 2.11. Demand for urban public transport, per mode of transport, in 30 ECE capitals, 2011



Source: ECE Transport Division

More than half of the capitals in the sample reach the use of the public transport at a level of nearly or above 1 trip per day during a year per average capital citizens (figure 2.11.). This result may be even better in reality since for several capitals data on passengers were not available for all the modes of public transport networks in operation. The result confirms a rather successful performance of the many urban public transport networks providers.

With regard to urban public transport modal split, the demand is mainly with the bus service accounting for 50 per cent of all the passenger trips (figure 2.12.). The bus is the most popular mode at the aggregated ECE level because this is the mode of public transport offered in each ECE capital under review and it has the highest network length of all the modes. There are, however, cases of capitals where other modes are more in demand e.g. metro (Berlin, Brussels, Moscow or Prague), tram (Amsterdam, Bern or Zagreb), light train (Paris) or other modes such as minibus service (Ankara or Tbilisi), measured in the actual number of passengers.

The demand for urban transport can vary over years for different reasons. Due to the fact, however, that urban population, and especially that in capital cities, is expected to grow, a public transport network losing demand might be an issue of concern, in particular, if the demand is at relatively low level compared to private motorized transport.

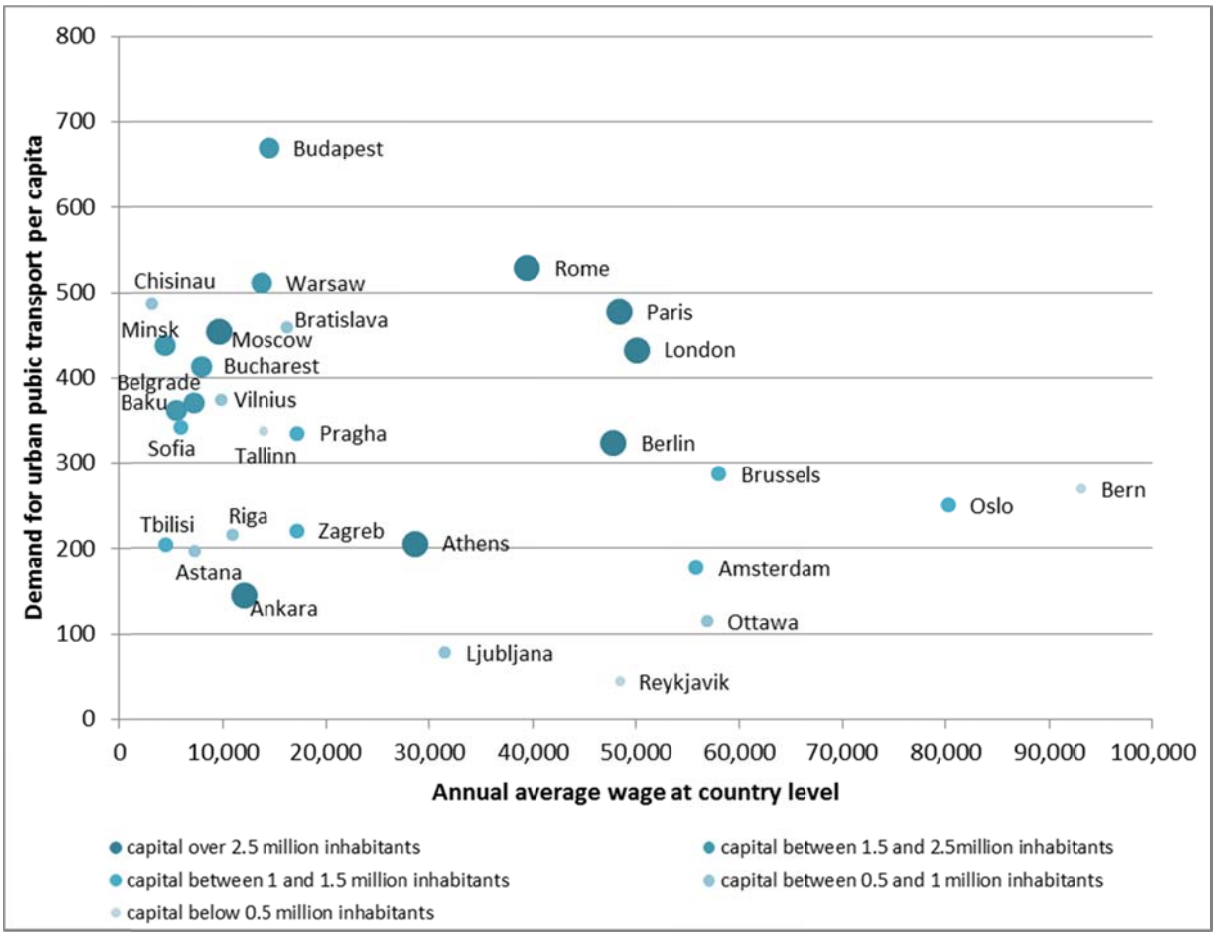
Figure 2.13. Changes in use of urban public transport modes between 2009 and 2011 in 26 ECE capitals

Source: ECE Transport Division

In the ECE capitals (figure 2.13), there are cases where public transport has been losing passengers in the sample period 2009-2011. While this is a too short period for drawing meaningful conclusions, the demand levels should be carefully watched, and the causes for declines identified. Actions should then follow to reverse the negative trends. From the three years observation, a continuous decline in demand for all public transport modes can be noticed in Athens, Prague, Rome and Zagreb from the ECE capitals that provided passenger data. At the same time, for Rome and Zagreb, such data have not been provided for all the transport modes (absence of sparklines on a green background indicating the transport service provision with the relevant mode).

Furthermore, cases, where certain modes gain while the other loose demand, should be also carefully watched. Such can be a controlled undertaking when e.g. a bus line capacity is replaced by tram or metro capacity, as part of an urban public transport infrastructure development. If however a public transport mode would lose demand to private motorized transport modes, such a change might be of concern and need to be tackled.

Figure 2.14. Demand for urban public transport in ECE capitals in relation to average annual wage at country level, 2011



Source: ECE Transport Division, For a number of ECE capital cities the demand level is higher in reality since the passenger volumes have not been reported for all the modes

Finally, interesting results are shown through a compilation of ECE capitals as per demand for urban public transport versus annual average wage at the country level and presenting the size of the population of the capitals (figure 2.14). This compilation discards the equation: ‘high income = low public transport use', as it shows that a relatively small capital city with a high level of income (Bern) can achieve higher demand for public transport use per capita than a much more populous capital where the population disposes of comparatively lower income (Ankara or Athens). It shows furthermore that capital cities of similar population and comparable income can vary substantially in the level of demand for urban public transport. The next sections analyze therefore the various features of public transport and its quality as well as the available infrastructure that may help to understand better the different levels of public transport demand in the various ECE capitals.

2.3. Urban public transport accessibility, comfort and urban traffic congestion

2.3.1. Urban public transport accessibility

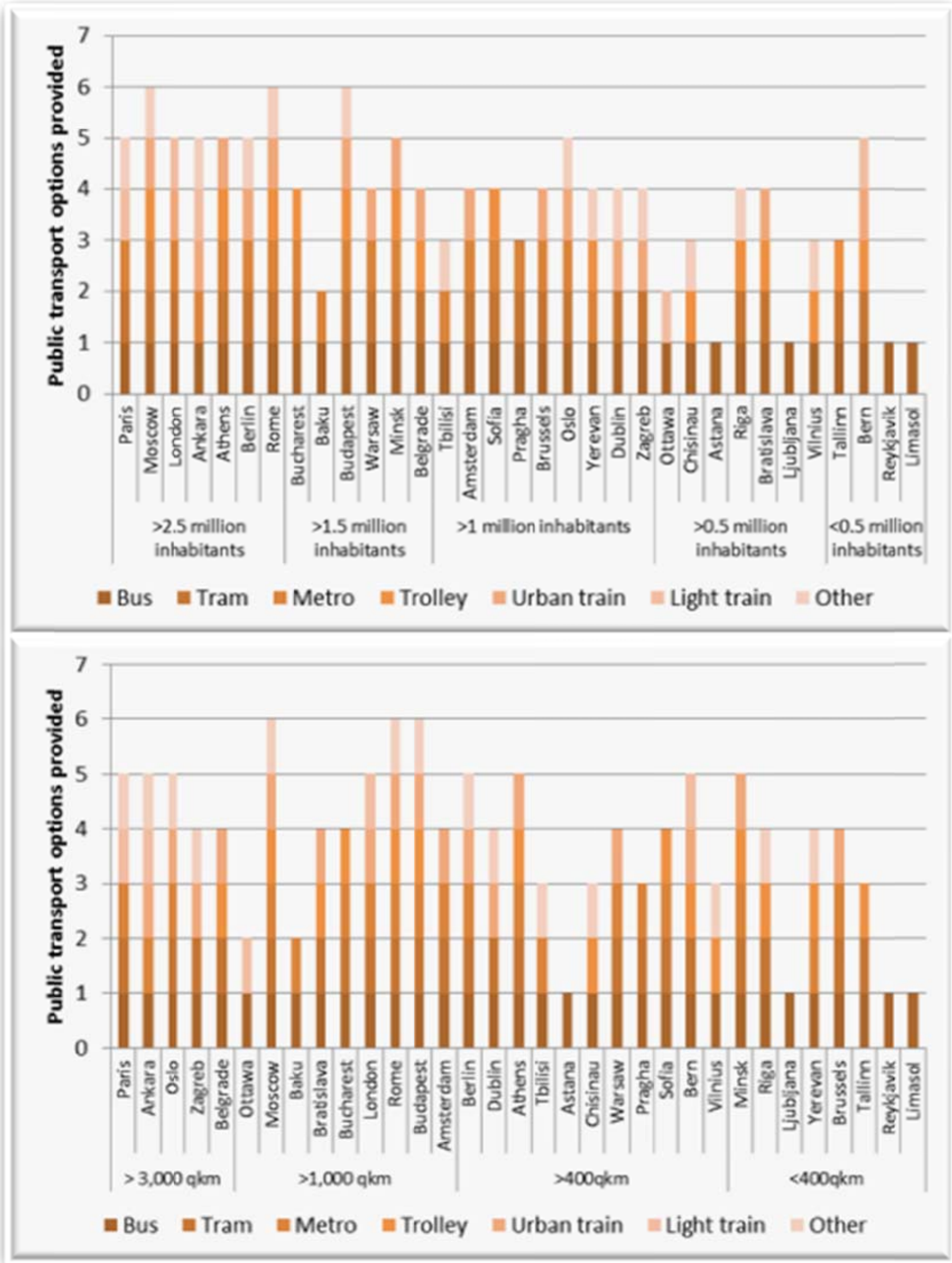
The demand for urban public transport service should be proportional to the accessibility it provides: better accessibility should translate into higher demand. The challenge is however that accessibility is not only about connecting the various A and B but also doing it with satisfactory ride times and at adequate frequency while offering sufficient places in the vehicles. Therefore, there is a need for a rather good public transport network design with preferably various mode options interconnected with each other.

To this end, public transport accessibility is assessed in terms of options and capacity offered by the network. The latter is then assessed with regard to the length of the public transport network, number of places both sitting and standing for passengers, number of stations in the network and circulation frequency. Also the speed, at which the various modes travel, is reviewed. There are no data unfortunately to assess the interconnectivity or reliability of the network.

With regard to the options, ECE capital cities offer from one to several options of public transport modes. The basic mode of transport, as already mentioned, is bus. The other major one can be trolley, tram, metro, light or urban train. There are also other modes, which usually carry far less passenger volumes compared to the major ones, apart from a few cases mentioned earlier.

With a few exceptions, the larger the capital city especially in terms of population but also the geographical size, the more urban public transport options it offers (figure 2.15.).

Figure 2.15. Number of urban public transport options in 33 ECE capitals, 2011



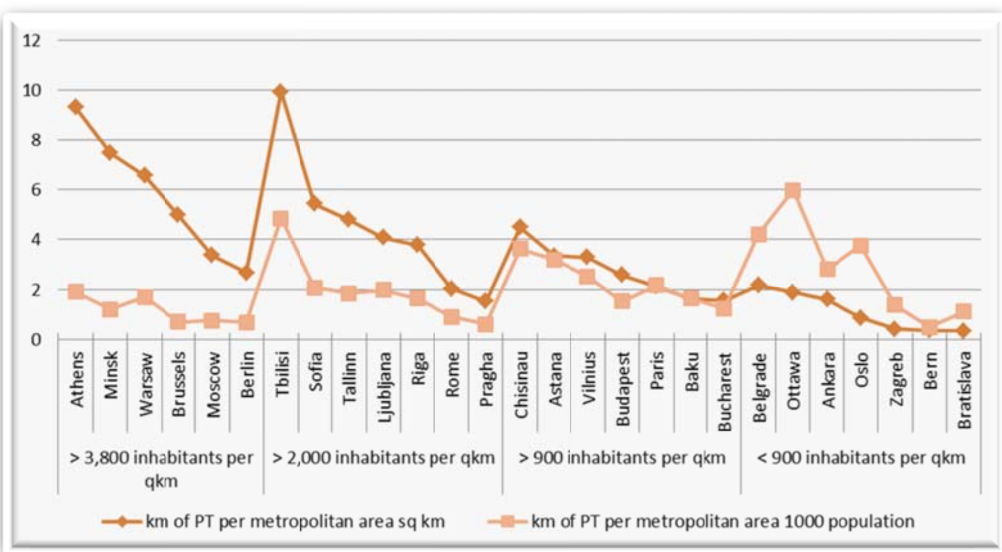
Source: ECE Transport Division

This relation is confirmed in the ECE region. The capital cities above 2.5 million inhabitants offer all at least five options of urban public transport modes. Those above 1.5 million inhabitants except for one capital (Baku) offer minimum four options. The difference in options provided is especially visible in cities below 1 million inhabitants. Certain capitals (Astana, Ljubljana) offer only bus service whereas others provide four (Bratislava, Riga) or even five (Bern) various public transport modes.

The compilation of the data shows that the availability of options may or may not be an element that impacts the passenger volumes carried with the public transport (figure 2.16.). In some cases (Baku with two options and Belgrade with four options) the results are very similar in relation to public transport demand per capita. In other (Ljubljana with one option and Riga with four options), the capital city with more options achieves higher public transport demand. Therefore, for a city where bus service is the only available option and the policy goal would be to increase the demand for public transport, the introduction of a second mode may be worth a relevant consideration, especially if peer cities offering more options do reach higher demand for public transport.

At the same time, as already mentioned, the issue is not just about the options offered but also the capacity that is provided with them.

Figure 2.17. Length of urban public transport network in relation to the size of the metropolitan area and its population, capitals grouped by their population density, 27 capitals, 2011



Source: ECE Transport Division

In terms of the length of the network, as well as with other elements assessed under public transport capacity, capital cities with higher population density achieve better scores if the length or other public transport capacity elements are measured per capital square kilometer while the more dispersed capitals score better per 1000 population. For the length, it is interesting to note that the capitals with the density between 900 to 1,600 inhabitants per square kilometer reach similar results for both measurements (figure 2.17.).

Another interesting observation is that in every density sample group there are relatively big differences between the various cities. For the highest density sample group, cities with high metro use (Berlin, Brussels, Moscow) have a relatively shorter network than cities with bus dominating in passenger volumes (Athens, Warsaw). This may provide the explanation why some cities (Berlin, Moscow) possessing relatively shorter public transport network achieve relatively higher public transport demand (figure 2.18.). The metro case is also visible in the second density sample (Prague versus Tbilisi). Furthermore, an interesting case is that of Tbilisi, which scores highest in terms of length per square kilometer and second highest per 1000 population. This phenomenon can be explained by the fact that highest volumes of passengers are carried with minibus service, which can have the most flexible network of all the public transport modes. Looking then at the example brought under the options analysis (Ljubljana versus Riga), both cities have relatively similar length of network per both measurements. Remembering that Riga achieves higher public transport demand, this can speak in favor of a more options-diversified public transport network.

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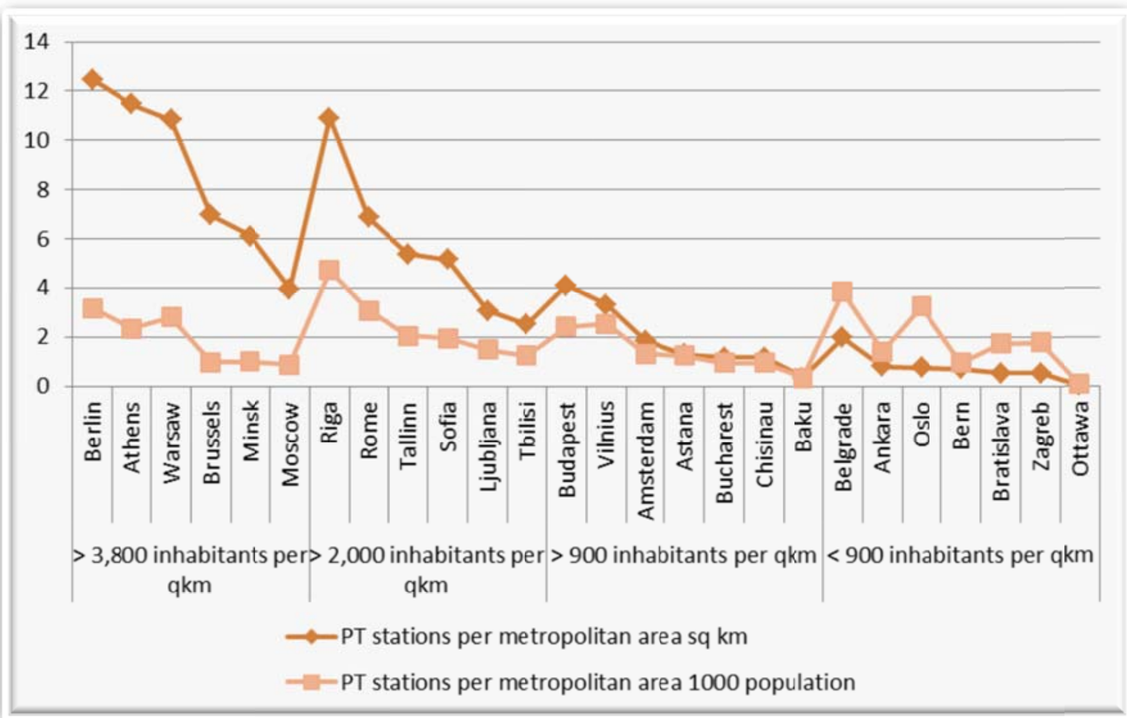
In terms of the number of stations of the urban public transport network (figure 2.19.), large differences between number of stations measured per square kilometer and per 1000 population can be detected in the capital cities with the population density above 2,500 inhabitants per square kilometer. The cities with the density between 900 and 1,300 inhabitants per square kilometer reach similar results for both measurements. At the same time, a relatively high network of public transport stations is not a guarantee for a higher demand. A right number of stations should be such that on one hand would allow the citizens to find a station in a vicinity of their work, living, shopping or recreation places and, on the other hand, would not delay the transfers due to too frequent stops of the public transport modes.

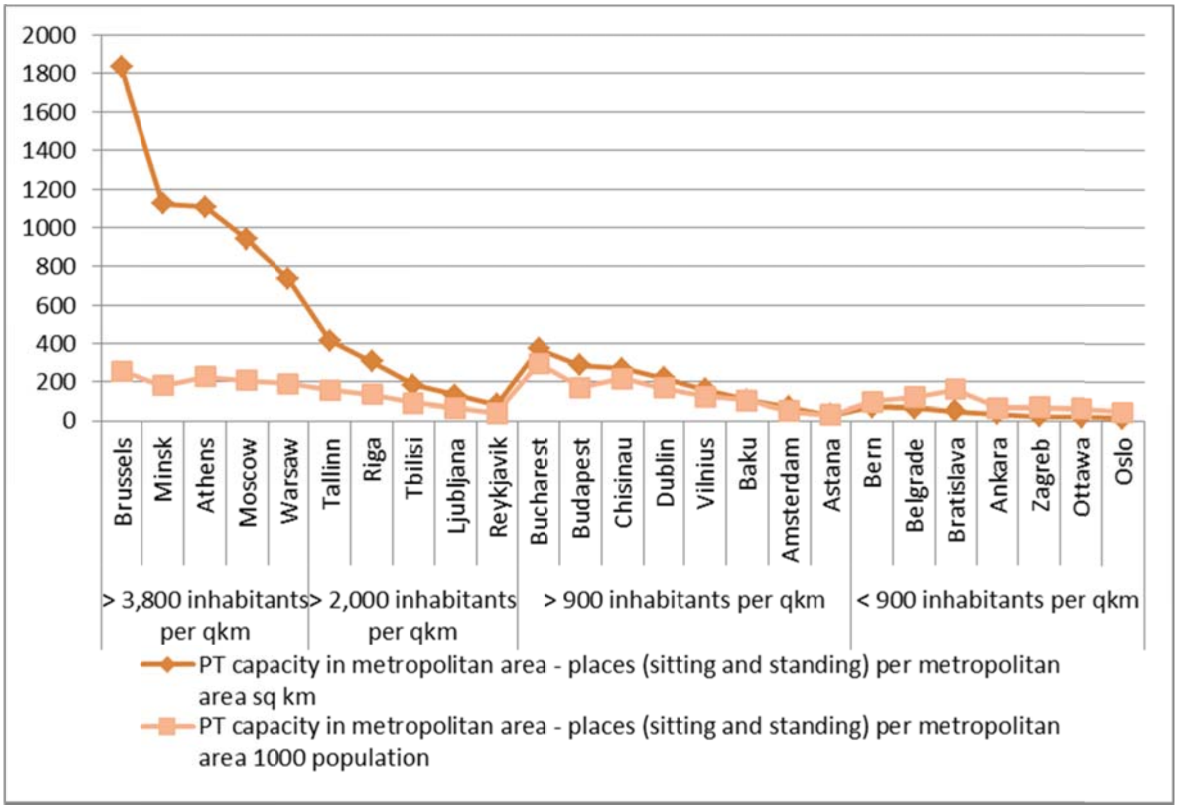
As far as total capacity of the network (population and size of Metropolitan area)is concerned, there are relatively large differences between the cities, in particular in the sample of the population densest cities (figure 2.20.). These are much more visible when measured per square kilometer compared to per 1000 population. The difference can be as much as 175 times (Brussels versus Oslo). In term of place capacity per 1000 population, the variation is more flat and is within the interval of 40 to almost 300 places per 1000 population, with the mean of some 130 and a median of 120 places. Hence, in the majority of cases the total capacity of the public transport network is calculated for at least 10 per cent of the metropolitan population.

Figure 2.19. Number of stations of urban public transport network in relation to the size of the metropolitan area and its population(capitals grouped by their population density) 2011



Source: ECE Transport Division

Figure 2.20. Place capacity of urban public transport network in relation to the size of the metropolitan area and its population(capitals grouped by their population density) 2011

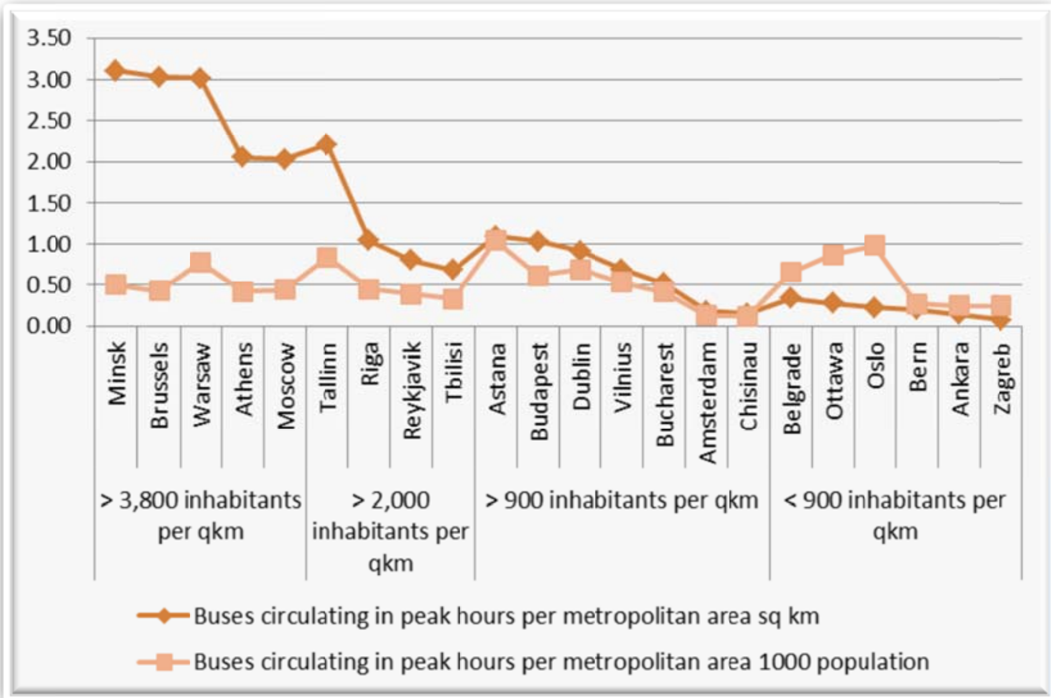


Source: ECE Transport Division

At the same time, as for the number of stations, high total capacity itself is not a guarantee for achieving higher demand for the public transport service.

The total place capacity is closely related to frequency of service during peak hours, hence providing an idea how much of the total place capacity is made available during the highest demand periods of the day. Looking at the bus service (figure 2.21.), on average there is one bus per square kilometer and half a bus for 1000 population. As in other cases, relatively large differences exist between cities. In general, cities that offer relatively high total place capacity have also a relatively high number of circulating buses during the peak hours. It should be noted, however, that cities where bus service is the only (Astana, Reykjavik) or a dominating public transport service (Belgrade, Oslo, Ottawa, Tallinn, Warsaw) score higher in this compilation.

Figure 2.21. Bus frequency, number of buses circulating in peak hours in relation to the size of the metropolitan area and its population (capitals grouped by their population density) 2011



Source: ECE Transport Division

When it comes to the speed with which public transport carries passengers, such should be at a satisfactory level for the passengers so that they would choose public transport modes rather than a private car.

The average speed varies largely between the various ECE capitals for the same type of mode they offer (figure 2.22.). In quite a number of capitals buses travel with an average speed below 20 km/h and in two cases (Bucharest and Ljubljana) even below 15 km/h, which is rather slow. Such a low average speed may keep car drivers attached to their cars, as they are usually able to achieve similar average speeds driving their cars even in congested cities.

Trams achieve yet a lower speed than buses. There are only two cases (Athens and Dublin) where trams travel with higher average speed than 20km/h. At the same time, there are several cases with average speed falling below 15 km/h (Belgrade, Bucharest, Moscow, Sofia and Zagreb).

Metro is the fastest public transport mode, and in majority of ECE capital cities offering this service, it travels with an average speed of over 30 km/h. There are however two cases (Brussels and Rome) where metro does not reach this average speed level.

A low average speed of public transport modes, (Bucharest, Ljubljana) may be a cause for decreasing the demand for public transport (figure 2.13.).

2.3.2. Urban public transport comfort

Whether or not a person becomes a user of public transport can depend on comfort that it provides. Comfort can be assessed with proxies in terms of average age of transport vehicles, availability of intelligent transport system (ITS) for passenger information and of the number of options for purchasing tickets.

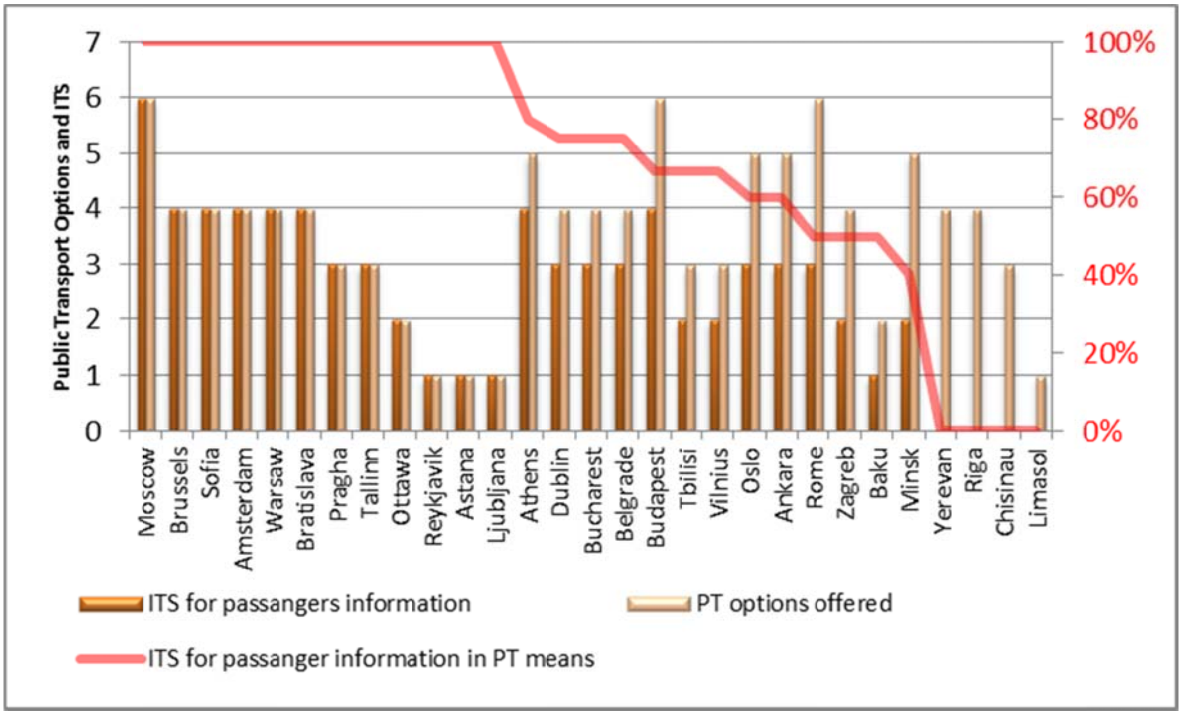
For the first indicator – age of buses – it can be applied in this context assuming that more recent vehicles are equipped with technology and systems that increase the passenger comfort, among them such as air condition, low-floor vehicle, etc.

In most of the capital cities that provided data, the bus fleet is relatively young with 80 per cent of cases having a fleet with average age around or below 10 years and nearly 50 per cent below the average age of 6 years (figure 2.23.). Since in this period a low-floor, air-conditioned bus became a standard product, it is expected that, such buses carry passengers for the majority of trips in nearly all the capitals.

For all the cities with the youngest fleet, except for one case (Bucharest) the passenger number had an increasing trend (figure 2.13.), though such had been also for cities with an older fleet (Astana, Vilnius). Hence, while the data available do not allow to establish any correlation between the increasing age of the fleet and a decreasing demand for service, the aging fleet should be taken into account in cases of a persisting decrease in passenger demand, which often may be more visible on particular lines rather than for the whole bus network.

In terms of ITS availability for passenger information, in the majority of the capital cities such system is provided for all or almost all public transport modes (figure 2.24.). There have been only four cities that reported absence of ITS for passenger information at all (Chisinau, Nicosia, Riga and Yerevan). Taking as an example Riga that does not provide ITS with any of its four public transport mode options, and comparing to its peer capital cities in the Baltic states (Tallinn and Vilnius), where ITS is provided with either three of three (Tallinn) or two of three (Vilnius) public transport mode options, ITS may have a positive impact on increasing the demand (figure 2.25.). This correlation could be even better proven if a positive change in demand would be shown in a city before and after ITS launching, which may be available in a number of cities.

Figure 2.24. Availability of ITS for passenger information in urban public transport options in 29 ECE capitals, 2011



Source: ECE

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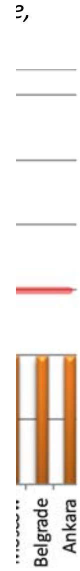
Furthermore, it is expected that the impact may potentially be the higher the more advanced the information system for passenger is, i.e. real time information provided in the vehicles only, or both in the vehicles and at the stations or stops. Data are however not available in this regard to present any correlation.

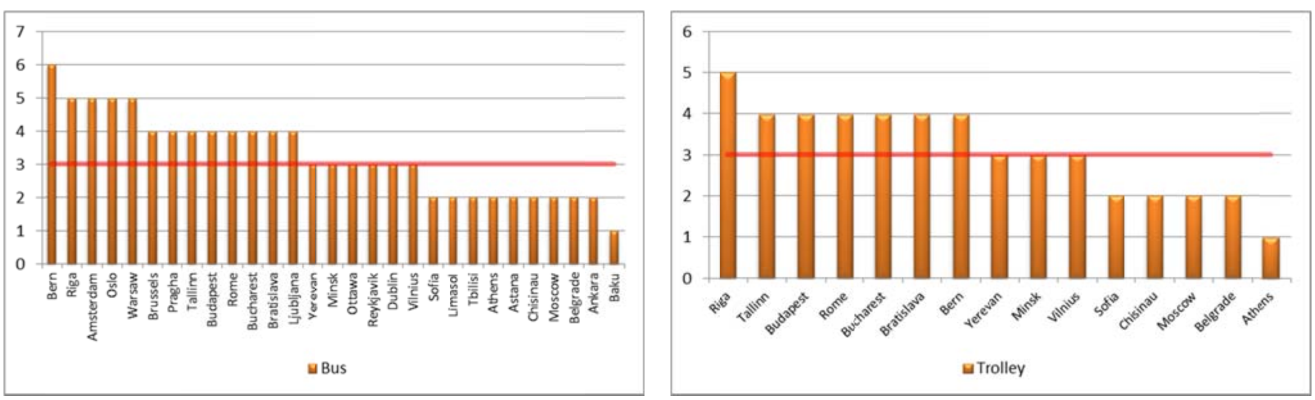
The comfort can be also evaluated in terms of the number of opportunities for ticket purchase, where limited accessibility or inconvenient options for ticket purchase may reduce the number of users of the public transport.

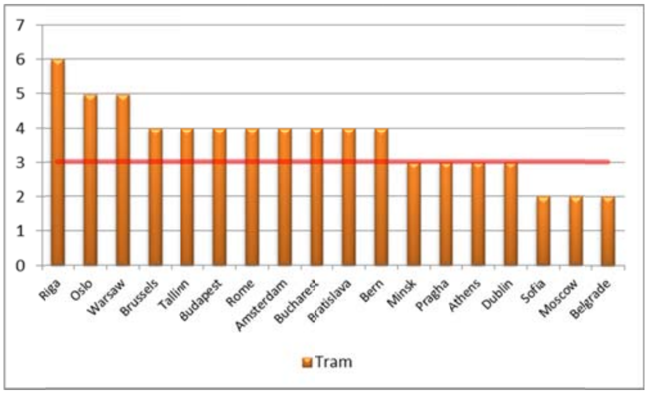
The majority of ECE capital cities, for whom data are available, offers minimum three or more options for ticket purchase on average for all the transport modes (figure 2.26.), which suggests an easy accessibility of tickets to passengers.

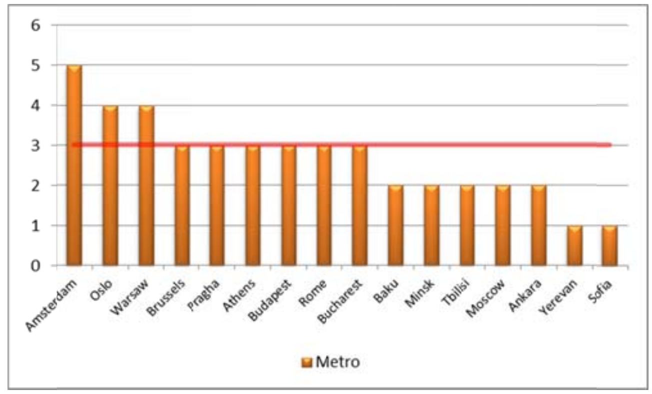


The availability of options does not differ substantially between the various public transport modes (figure 2.27.). Usually, for the main modes like bus, trolley, tram and metro, the difference can be about the ticket purchase with the driver, which for certain modes (metro) would not make much sense. On the other hand while providing ticket machines at the metro stations is among one of the most favorite options, it is less popular for bus, whose network has many more stops. In the bus network case, provided that ticket machines should be available at the majority of stops, such solution might be quite expensive for launching, in particular in comparison with more modern ways like through website and mobile services, already available in a few capital cities.

Figure 2.27. Availability of options for urban public transport ticket purchase, for bus, trolley, tram or metro tickets, 2011







Source: ECE

While the availability of options for ticket purchase may have an impact on the level of demand for public transport, such is not so visible among the cities in the sample. The only case can be that of Sofia and Bucharest, which can be considered peer cities. They have the same number of public transport options and although Sofia has relatively a little bit more accessible public transport network in terms of length and stations, it is Bucharest that achieves higher relative demand while offering on average more ticket purchase options. The compilation of several capital cities shows, at the same time, that the more rich cities offer more ticket purchase options (figure 2.28.), among them ticket purchase through internet.

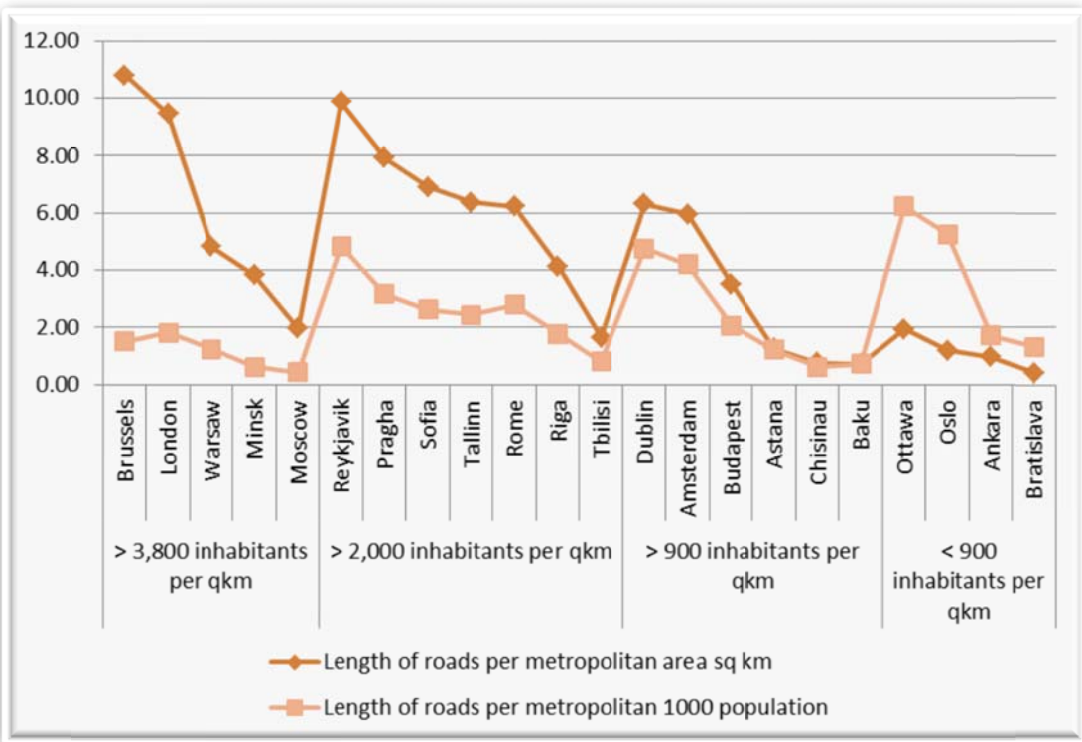
2.3.2. Urban traffic congestion

The demand for urban public transport service can be inversely proportional to the car friendliness of the metropolitan area of a city. The more car friendly a city, the more difficult it can be for the public transport to compete with that motorized private mode of transport. On the other hand, if in the cities the available road capacities have been reached making the cities prone to traffic congestion, such a situation can provide opportunities for the urban public transport to attract more passengers. This however can only be achieved, if the urban public transport is not itself highly impacted by the traffic congestions.

To start with, it is interesting to assess the road capacity provided in the ECE capital cities in terms of length of roads per square kilometer of the metropolitan surface area and per 1000 population. Again, like in the case of public transport capacity, it is more meaningful to provide a compilation presenting cities grouped per population density.

The ECE capital cities vary largely with regard to the road capacity they offer. It can span from some 11 kilometer (Brussels) to less than half a kilometer (Bratislava) per one square kilometer of the metropolitan surface area or 6 kilometer (Ottawa) to again less the half a kilometer (Moscow) per 1000 population (figure 2.29.). Two cities (Ottawa and Reykjavik) that score highest within their population density groups for both measurements are those, whose urban transportation is dominated by private motorized transport (figure 2.10.).

Figure 2.29. Length of metropolitan roads in relation to the size of the metropolitan area and its population, capitals grouped by their population density, 22 capitals, 2011



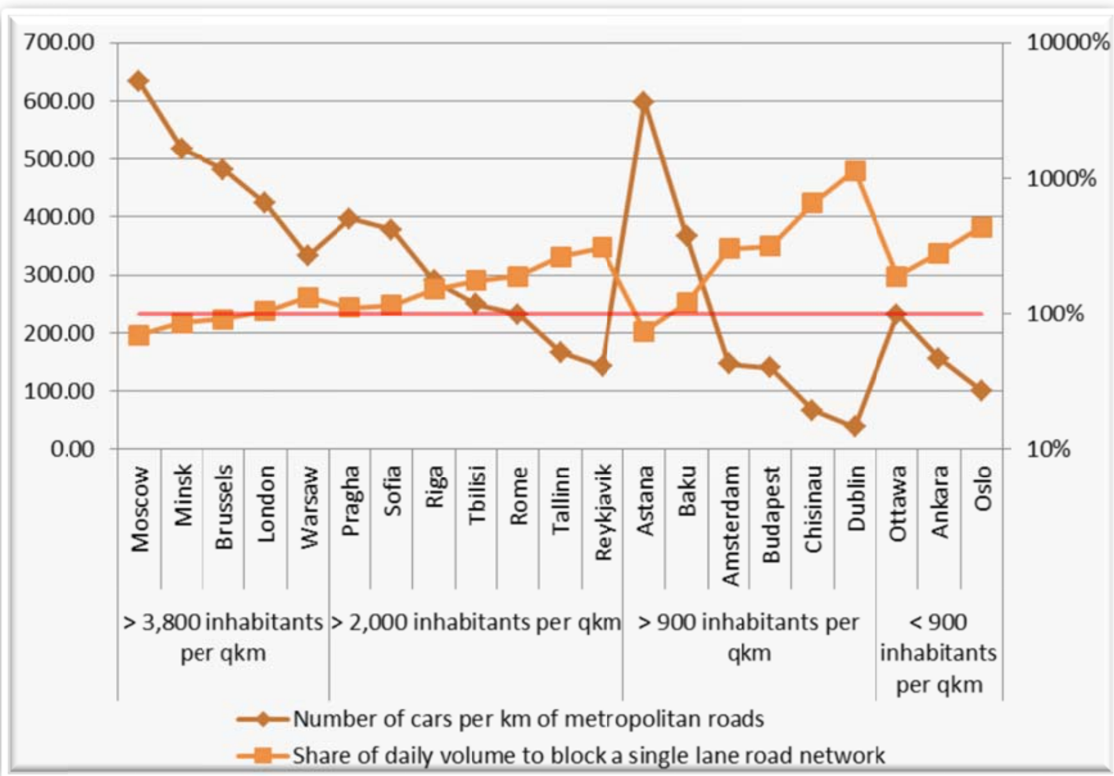
Source: ECE

For other high scoring cities, their public to mortised private transport ratio has also been in favor of the second mode (Brussels, Oslo, Prague). On the other hand, those cities whose score is relatively moderate for the road capacity (Budapest, Chisinau, Minsk, Moscow, Tbilisi, Warsaw) have the ratio in favor of the urban public transport.

In terms of use of road capacity, the average daily number of cars in the traffic is so large that for some of the cities (Astana, Brussels, Minsk, Moscow), if all the cars were on road at the same time they would completely block the city roads if they were of a single lane. This is when assuming that an average length dimension of the car of 4,5m and hence 440 cars covering one kilometer of one lane road counted both directions (figure 2.30).

The compilation further shows that many cities with the exception of a few (Ankara, Amsterdam, Budapest, Chisinau, Dublin, Oslo, Ottawa, Reykjavik and Tallinn) are relatively prone to traffic congestions. Furthermore, since roads and demand for roads is not evenly distributed on the territory of the city, also these capitals mentioned above can be prone to traffic congestion in their centers or along the main traffic corridors.

Figure 2.30. Average daily number of cars on metropolitan roads, capitals grouped by their population density, 21 capitals, 2011



Source: ECE

itals
, 2011

If urban roads are congested, this may well impact the speed of the public transport buses if they do not travel on dedicated lanes. Such impacts are visible for a number of ECE capital cities (figure 2.31.). In a few cases (Ankara, Chisinau, Oslo, Ottawa, Reykjavik) the speed decreases during the peak hours by a few km/h from a relatively high level. There are however also cases where the speed further declines from already a relatively low level (Brussels, Ljubljana, Moscow).

The average speed of buses is, in numerous cases, inversely proportional to the number of cars per kilometer of metropolitan roads (figure 2.32.). The average level of bus speed is higher for capital cities with relatively lower number of cars in traffic with a clear exception in one case (Astana), which has a rather large number of cars in a daily traffic per kilometer of available roads, while the bus travels there at highest speed of all capitals.

The low speed of on-ground public transport (figure 2.22.) in quite a number of ECE capitals and its further decrease during peak hours indicates that public transport is affected by traffic congestions. In such a case, it may face difficulties in competing with cars for urban transfers.

There seems therefore to be a potential for a number of cities in increasing the demand for public transport while decreasing the number of cars in the traffic by taking measures such as marking dedicated lanes for public transport modes and enforcing it. The separated dedicated lanes should allow the on-ground public transport modes to move even if the roads are blocked by the traffic caused by private motorized transport modes.

2.4. Urban transport and road safety

When it comes to road safety and urban mobility and transport, it is important to understand how close or maybe far the countries and cities are from achieving the goal of zero road fatalities and injuries. It is important to further understand how urban public transport helps, or the lack of it hinders achieving this objective.

There is unfortunately still quite a number of fatalities and many more injuries from road transport in ECE urban areas when looking at absolute numbers. At the same time, it is interesting to see that when it comes to the fatalities they constitute for the majority of countries from 30% to 40% of all road fatalities. For injuries, however, their ratio is more negative for urban transport, which takes a share of between 55% and 65% of all transport injuries for the majority of countries (figure 2.33 and figure 2.34.).

In order to better understand how far away the particular countries are from achieving the zero fatalities and injuries objective, it is more important to look at relative numbers, such as injuries and fatalities per e.g. 100,000 population.

The urban transport fatalities for all but one country (Romania) are around or below 5 persons per 100,000 urban inhabitants. The injuries are below 300 persons per 100,000 urban inhabitants for the majority of countries (figure 2.35). There are clearly some better performing countries and they should be the benchmark on how to further improve working toward the “zero objective”.

Urban public transport is unfortunately not free from fatalities and injuries either, although there are capital cities, which have reported zero public transport fatalities and or injuries (figure 2.36.).

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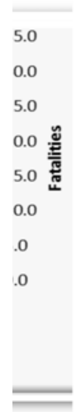
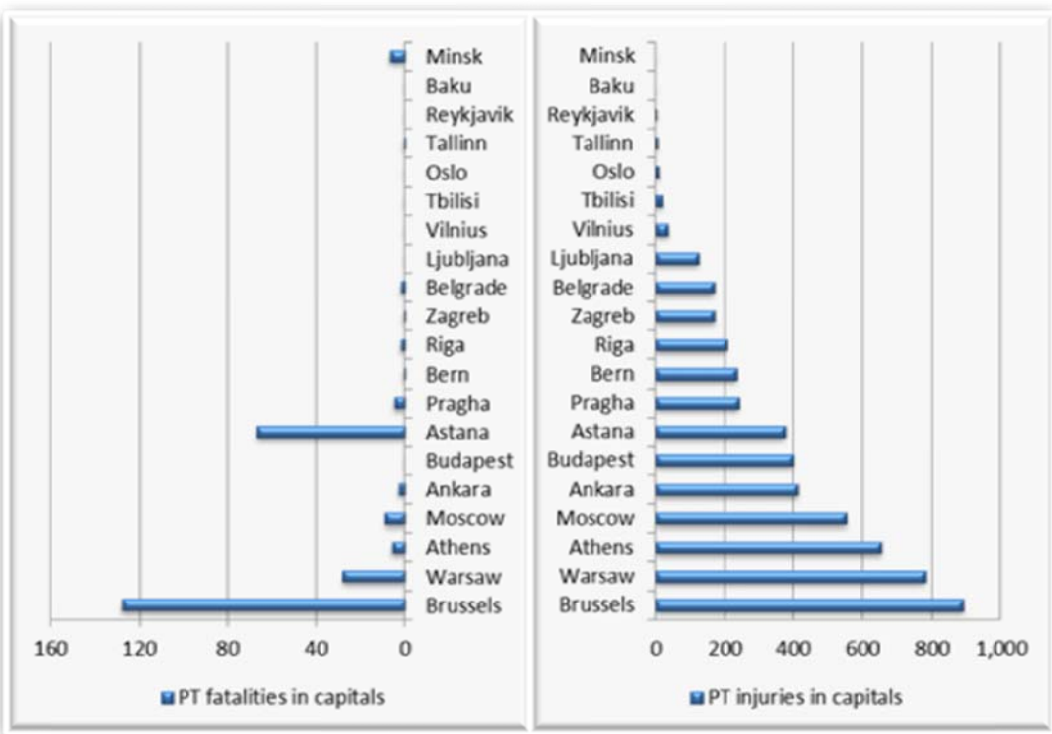


At the same time, there are capital cities at the other side of the scale that report quite large absolute numbers of both fatalities and injuries, whether on board or at the stations of public transport. They are counted for all modes, i.e. also for such as metro and light or urban train, for which not all accidents may fall under the category of road accidents e.g. injury at the metro station.

Figure 2.36. Urban public transport fatalities and injuries in ECE capitals, 20 capitals, 2011



Source: ECE

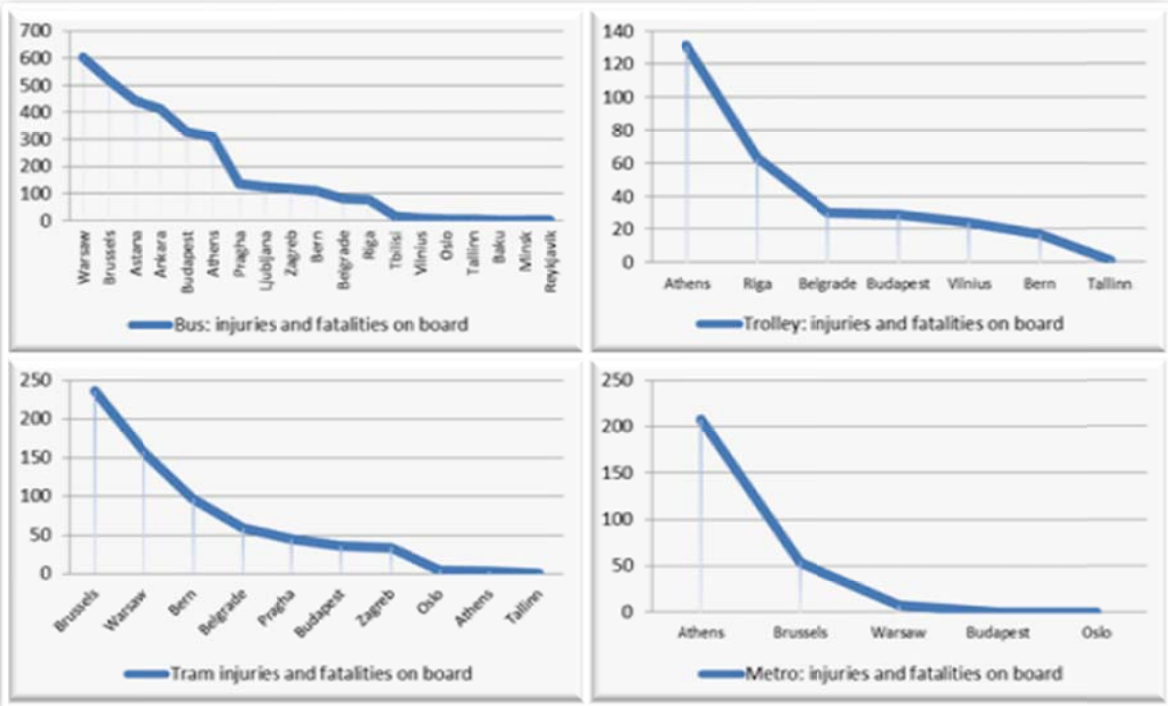
While some cities have clearly space for improvement and should follow the practice of the best performer cities in public transport safety, i.e. those which achieve the "zero objective", it is fair to provide a more relative picture of the safety situation by showing the fatalities and injuries per 100,000 capital inhabitants (figure 2.37.).

When it comes to urban public transport fatalities, except for two capital cities (Astana and Brussels), they are around or below 1 case per 100,000 capital inhabitants. The injuries are below 30 cases per 100,000 capital inhabitants for the majority of capital cities in the sample. This is clearly not a bad result, which suggests that safety is not an issue that would discourage passengers from using public transport in any of the ECE capitals that provided data.

Comparing the numbers between road fatalities and injuries in urban areas and public transport fatalities and injuries in capitals, both per 100,000 of respectively the urban or the capital population, it is visible that for the majority of cities public transport accidents are a small fraction of all the road accidents. The numbers confirm the assumption that public transport is a safe means of mobility.

Furthermore, looking at the absolute numbers of injuries and fatalities on board per main transport modes, the most cases are with buses followed by trams for the majority of cities that provided data (figure 2.38.). This result is not surprising since bus networks providea more extended service and carriy most of the passengers in many of the cities.

Figure 2.38. Injuries and fatalities per urban public transport mode for ECE capitals, 2011

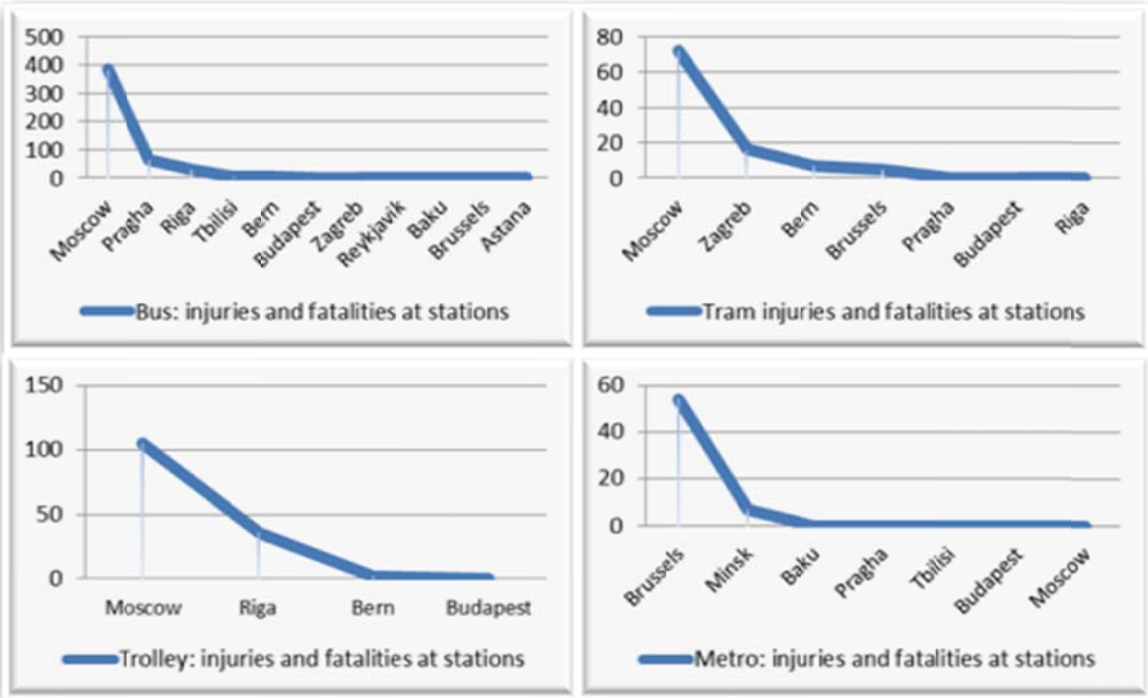


Source: ECE

The injuries at the stations are not that common for any of the main public transport modes. There are, however, a few exceptions (Moscow, Prague for bus, Riga for trolley), at least for the sample group of cities that provided data (Figure 2.39.).

Finally, since there are no data for all road injuries and fatalities for the capital cities available, it is unfortunately not possible to verify a likely correlation that cities with ratio of public to private motorized transport in favor of the first one should in general have less road accidents. At the same time, the main point from this analysis is that urban public transport is overall safe in all of the ECE capitals that provided data in this context. Consequently increasing the role of public transport in urban mobility can have a positive externality, i.e. it helps improving urban road safety.

Figure 2.39. Injuries and fatalities at the urban public transport stations per mode, 2011



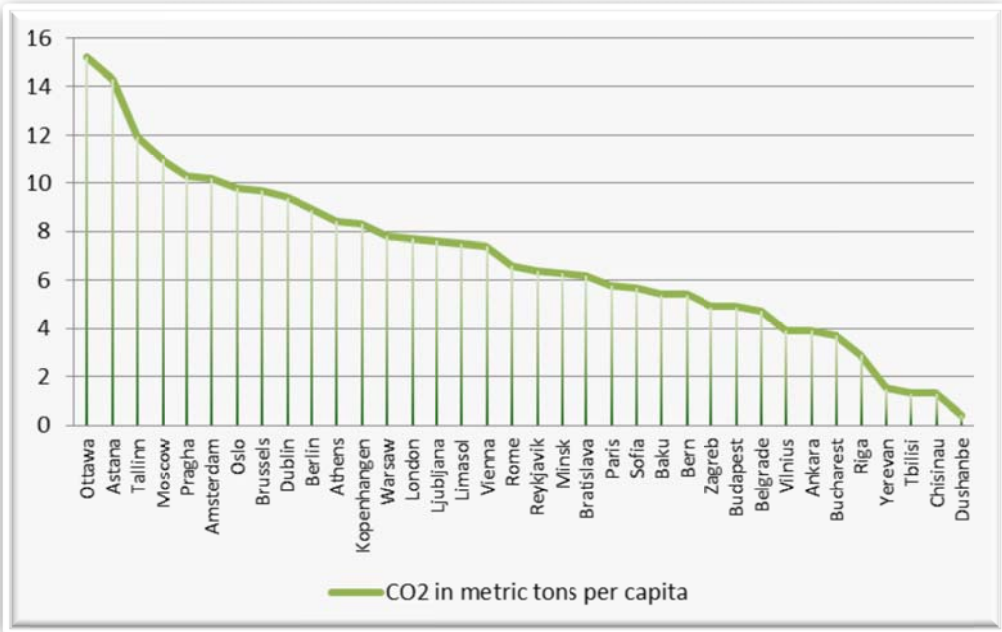
Source: ECE

2.5. Urban transport and environmental pollution including climate change

Transport, due to large dependence on internal combustion engine vehicles and due to gases they emit, is among the main sectors that contribute to climate change and cause significant environmental impacts, in particular air pollution. In this context, it is important to see the level of emissions causing climate change and pollutants concentration in ambient air in the ECE capital cities and compare them vis-à-vis their urban transport situation. It would also be important to understand whether public transport helps in combating climate change and improving air quality.

The ECE capital cities reach very different values in emissions of greenhouse gases in metric tons per capita. These emissions caused at the city level spanned in 2009 from 15 metric tons (Ottawa) to less than half a metric ton per capita (Dushanbe) (figure 2.40.). At the minimal side of the scale there are mainly the capital cities from Eastern Europe, Caucasus and Central Asia. At the opposite side, there are cities from all the sub-regions.

Figure 2.40. Emissions of CO_2 per capita in ECE capitals, 36 capitals, 2009



Source: UNSTATS

The share of urban transport in the CO_2 emission level per capita can be different between the ECE capital cities. Not knowing these shares makes it difficult to establish any correlations between the emission levels and use of public versus private motorized modes of transport. The general emission level per capita for a city that has a minimal use of public transport (Reykjavik) can be lower or much lower compared to cities with a relatively high usage of public transport (Warsaw, Moscow). Cities of similar size and similar geographical locations (Riga, Tallinn and Vilnius) can also vary substantively in terms of emission levels (figure 2.41.)[34]. The main sources of energy generation for electricity and

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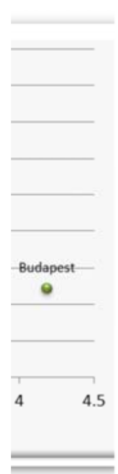


[34] This figure is indicative only, assuming that both values are not changing substantially from year to year (CO_2 emissions are of 2009, while the ratio is based on 2011 data)

ECE

heating purposes may explain these differences.

When it comes to the concentration of air pollutants in the atmospheric air, the majority of ECE capital cities have decreased the concentrations of sulfur dioxide (SO_2) and of nitrogen oxides (NO_x) in atmospheric air below the levels recommended by the World Health Organization (WHO). These are mainly the capitals of the EU member States, while the capitals of the countries with economies in transition do face challenges in combatting the high concentration of these two pollutants (figure 2.42.). As for the CO_2 emissions, the values are also at city level and not for urban transportation only.

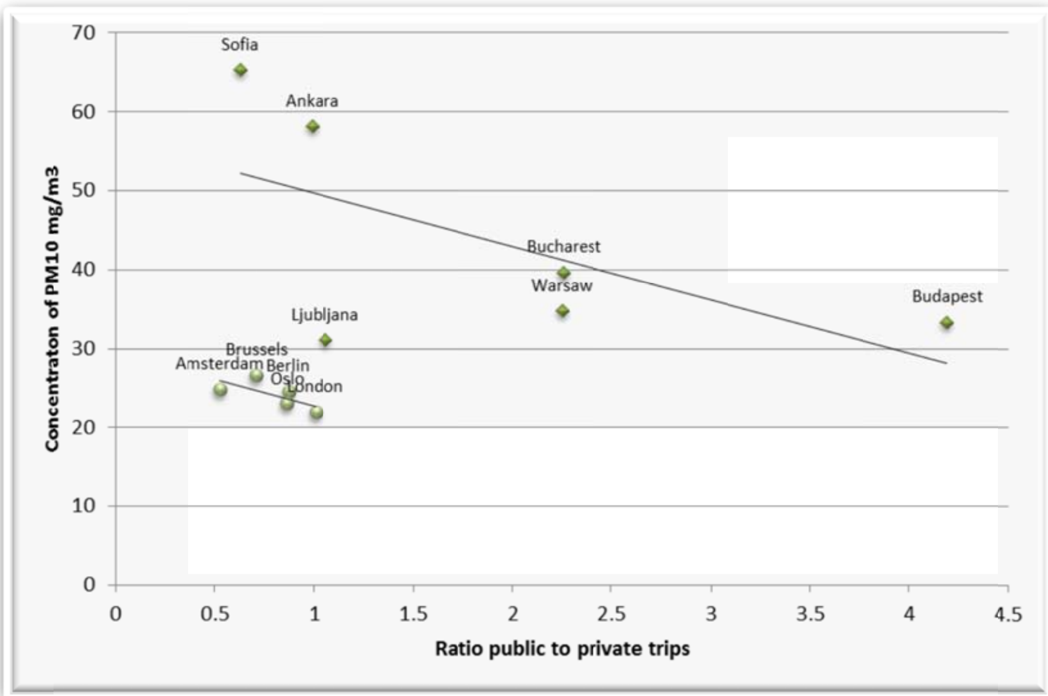
Regarding the concentrations of particulate matter (PM_{10} and $PM_{2.5}$), nearly all capital cities are above or well above the concentration levels as recommended by WHO (figure 2.43.). Therefore, further measures to limit the concentration of particulate matter would need to be applied throughout the sectors where solid and liquid fuels are combusted, in particular in the energy, industry and transport sectors. For the transport sector this would imply the need for further improvement of the modal split in favour of public transport, but also to increase

$PM_{2.5}$ - in

the share of environmental friendly vehicles in the vehicle fleet .

In general, the capitals of Western European countries have been able to limit their concentrations to higher degree than those from Central of South-Eastern Europe (figure 2.44.). If the explanation was to be found in the transport sector only, such could be the availability of lower-age transport vehicles - such equipped with more fuel efficient engines - in Western European capitals compared to vehicles used in the other capitals. Furthermore, cities with more public transport trips should normally achieve lower pollutant concentrations compared with cities where private trips are dominating.

Figure 2.44. Concentration of PM_{10} versus ratio of public to private trips, 2011



Source: ECE and EEA

While the necessary data is unavailable to provide a more conclusive analysis for urban transportation, the promotion of more fuel efficient technologies for transport vehicles, as well as the replacement of private motorized trips by public transport ones or by walking and cycling would clearly help cities to decrease their climate change and environmental footprint.

When it comes to climate change and urban transport, it is not only crucial to work on climate change prevention but also adaptation. This work is about ensuring that the transport infrastructure is resistant to extreme weather events and its effects (e.g. localized flooding, very high or low temperatures, extreme snow falls etc.) caused by climate change. The resistance of public transport infrastructure to extreme weather events is crucial to provide for high reliability of the network, without which it could not be considered as a good quality one.

The transport infrastructure resistance could be measured by the number of extreme weather events and related effects leading to closure of roads for urban transport in general or stopping any of the public transport service. Unfortunately such data are not available to analyze the degree to which the infrastructure is adapted to climate change.

Another proxy indicator could measure the infrastructure investments related to climate change adaptation. However, due to the absence of data, it is not possible to provide empirical evidence with regard to the resistance of the urban transport system to climate change.

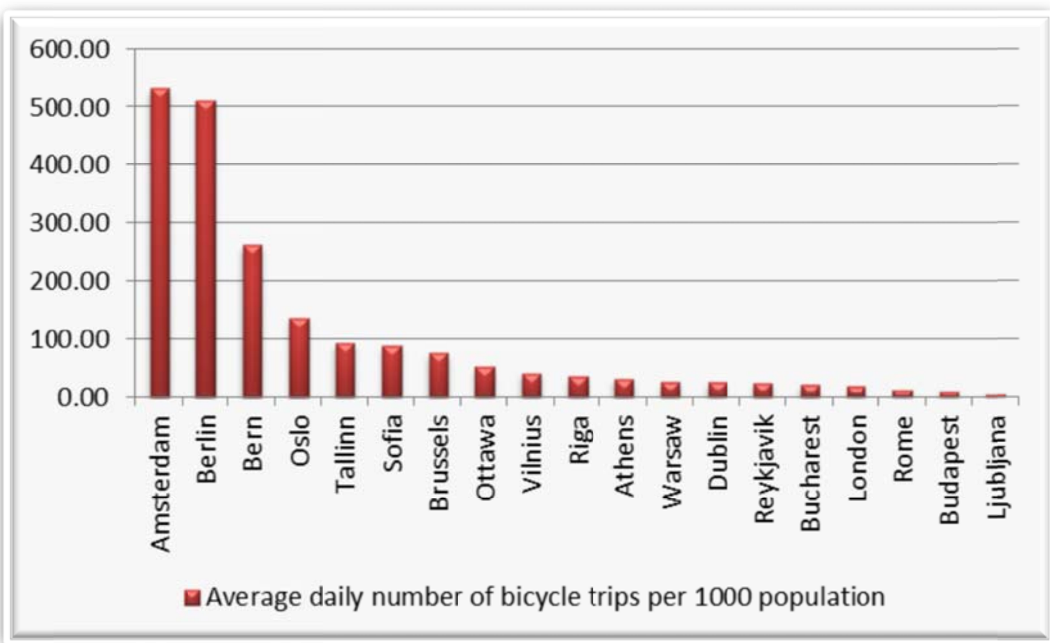
2.6. Cycling and walking in capital cities

Cities can ensure a more sustainable transport system if they provide the necessary infrastructure and promote cycling and walking as a type of the non-motorized transport, in particular for shorter trips. In connection with urban public transport, however, cycling and walking can also be promoted for the longer trips.

In this context, it is important to view how successful the ECE capitals are in promoting non-motorized transport and in providing the necessary infrastructure for it.

A good indicator of success in promoting cycling is an average daily number of bicycle trips per 1000 population. The data show that for the majority of ECE capitals less than one person of 10 would make on average a trip by a bicycle (figure 2.45.). At the same time, there are cities that are clear champions in bicycle use with one of two (Amsterdam, Berlin) or one of four persons on average using bicycles (Bern).

Figure 2.45. Bicycle use in ECE capitals per 1000 population, 19 capitals, 2011

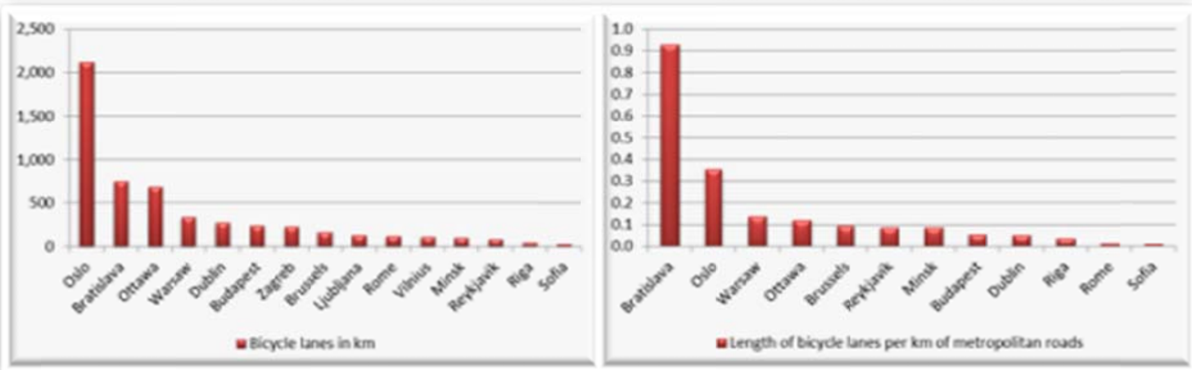


Source: ECE

When it comes to the infrastructure for cycling, i.e. availability of cycling lanes, it is unfortunate that data are provided for just a limited number of ECE capital cities and that data are not provided for the cities with highest bicycle use per 1000 population.

For cities having provided data, the longest network of bicycle lanes is in Oslo followed by Bratislava, Ottawa and Warsaw. The same cities have not only the longest network in absolute numbers but also when measuring the bicycle lanes per length of metropolitan roads (figure 2.46.).

Figure 2.46. Length of bicycle lanes in ECE capitals, 2011

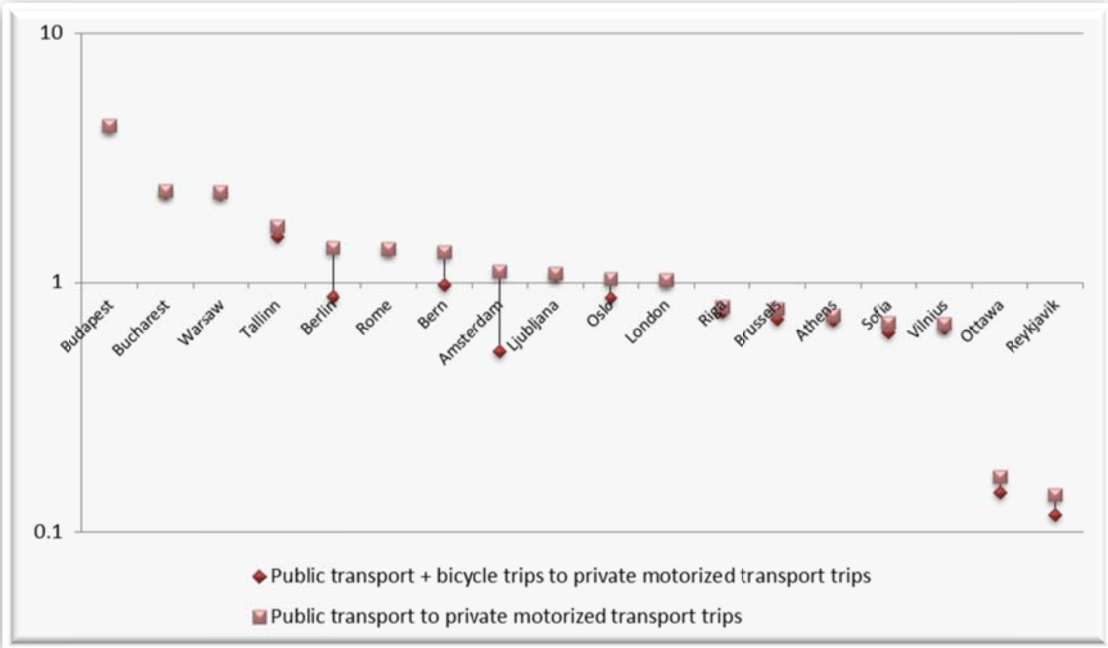


Source: ECE

For the infrastructure, it is not only its length that is important but also its quality. The information however on the quality of bicycle lanes is not available. It is unknown, whether the bicycle lanes are separated from motorized transport infrastructure and pedestrians sidewalks to prevent collisions with motorized transport or pedestrians. It is also unknown, whether walking and cycling infrastructure at intersections with roads is given priority: short waiting time for crossing, convenient on-ground passages for cyclists and pedestrians. It would be expected that cities with clearly separated infrastructure that provides more safety and convenience for cyclists and pedestrians, should be more successful in achieving higher demand for both cycling and walking.

When it comes to the use of bicycles in combination with public transport for longer trips, assessment could be based on availability of bicycle parking infrastructure and its occupancy at main public transport stations. Such data are however absent.

Figure 2.47. Changes in relation between rides with urban public transport to private motorized transport by rides with bicycle in 18 ECE capitals,



Source: ECE

Finally, it is interesting to verify how the use of bicycles impacts the ratio of public transport to private trips. If the bicycle trips are added to public transport trips, there are several cities (Amsterdam, Berlin, Bern and Oslo), for which motorized private transportation is not prevailing anymore for urban mobility (figure 2.47.). There are several other cities for which the ratio: public transport trips and bicycle trips to private motorized transport trips visibly improves (Ottawa, Reykjavik and Tallinn).

The cycling and walking, although the second type of the non-motorized transport has not been analyzed, take an important share in urban transport system, at least in a number of ECE capitals. For others, the potential needs to be still discovered.

2.7. Urban transport and financing

2.7.1. Affordability of public transport

The public transport fare price among other elements determines the demand for public transport. In theory, the lower the price the higher demand it should attract for public transport. This however would hold only if the same quality of service was provided. A low price for a poor service can attract less demand that a good service for a higher price. To this end, the situation in the ECE capital cities needs to be seen in view of the price and demand, where the price is also assessed versus income.

The demand for public transport can further depend on the fares for using private motorized transport versus public transport. Such could be analyzed as monthly costs of a private vehicle use (gasoline, parking and other e.g. congestions or toll expenditures) versus the costs of a public transport monthly ticket. It could be further reviewed for a single ride between suburban area to city center in view of the single ride fare versus costs of parking, gasoline and others. Since, however, the parking fares are not provided (congestion and toll fees in urban areas are not that common in ECE capital cities), such analysis cannot be done.

As far as the affordability of public transport is concerned, the cities with highest fares of single bus, trolley or tram tickets[35], which are mainly capitals of the Western European countries, do still provide relatively affordable bus, trolley or tram service (figure 2.48.) compared to some other capital cities. There are vast differences between the cities in the number of single tickets that can be purchased with the average monthly wage at the country level. It can span from as few as some

[35] There are no differences in prices for public transport service provided by bus, tram or trolley. Only metro service has in a number of capitals a different fare.

400 tickets (Bucharest) to more than 2,000 tickets (Amsterdam, Ankara, Brussels, Dublin or Ljubljana).

There is very similar situation with the monthly tickets for bus, trolley or tram (figure 2.49.). Despite high absolute fare levels in a number of capitals, their service is still relatively affordable (Oslo, London) as compared with other cities with low monthly fares (Chisinau, Sofia).

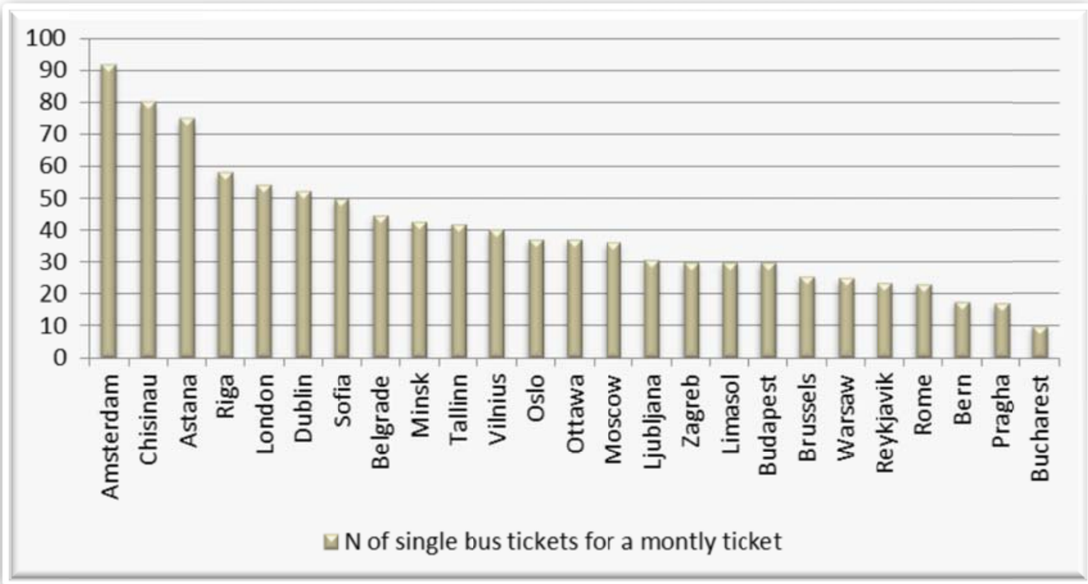
The capital inhabitants may need to spend from as little as around one percent of their monthly wage for the monthly ticket (Bern, Brussels and Ljubljana) to as much as six percent or more (Belgrade, Chisinau, Sofia).

ey tickets

Furthermore, the capital cities adopted different approaches to monthly versus single tickets (figure 2.50.). There are cities that have a pricing policy clearly favoring monthly tickets (Bern, Bucharest, Prague or Rome), where a relative low number of single tickets (10-20) equals the price of a monthly one. There is a second group of cities (Belgrade, Minsk, Tallinn or Vilnius) that set prices at a level not favoring any of the fares: some 40 single tickets for one monthly one. There is finally a group of cities (Amsterdam, Astana, Chisinau) where monthly tickets will be in the interests of inhabitants using bus, tram or trolley on average between 2 and 3 times every day in a month or almost 4 times every working day of a month.

In general, the approach of providing relatively more affordable monthly tickets can be seen as such that is more focused on regular commuters. The opposite approach encourages more the irregular public transport users to also use this type of transport.

Figure 2.50. Relation between bus single and monthly fares in ECE capitals, 2011



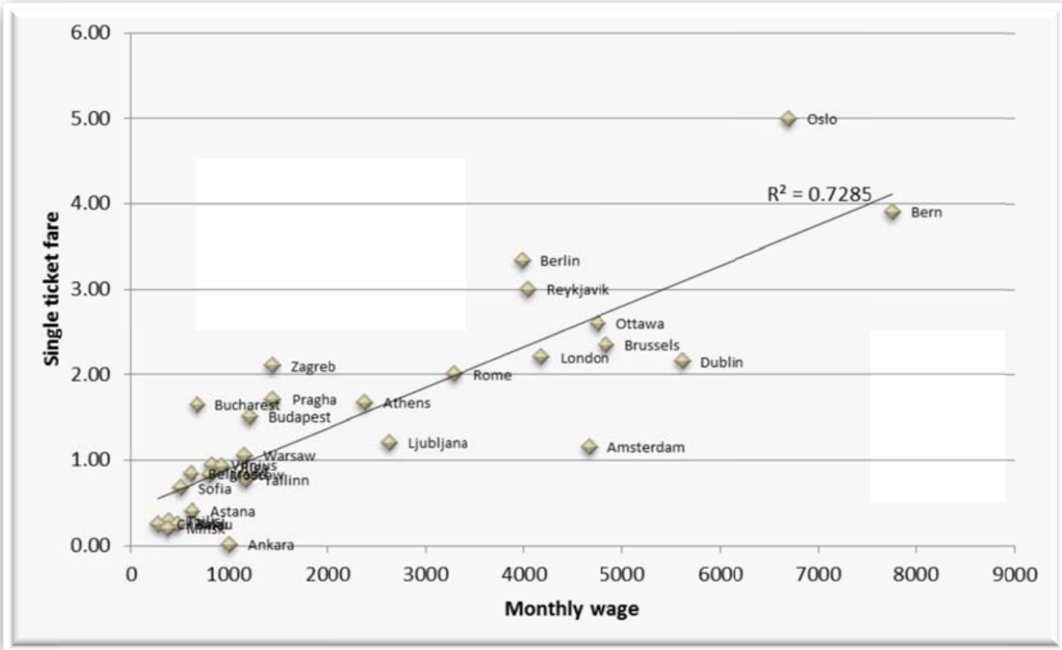
Source: ECE

Both approaches may be a good choice depending on specific circumstances. If a large number of transfers is done by cycling and walking (Amsterdam), relatively inexpensive single ticket offers a good alternative to a car ride in case the bicycle cannot be used. On the other hand, a relatively inexpensive monthly ticket seems to be the right strategy to discourage driving for regular commuting to work.

While cities may adapt various strategies to single versus monthly ticket pricing, it can be interesting to find out if the capital cities offer comparatively too high or too low public transport fares if analyzing the fares to monthly wages.

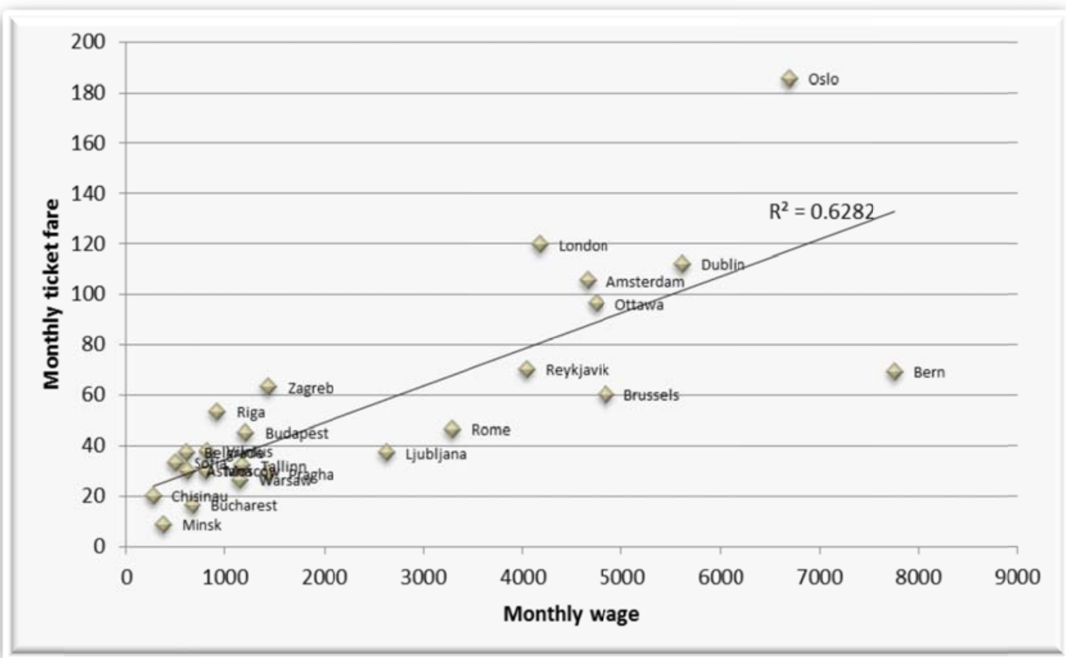
A compilation of ECE capital cities per ratio single or monthly fare to average wage shows capitals for which the prices stand out (figures 2.51. and 2.52.). There are capital cities (Oslo, Zagreb) whose ratio: fare to wage for both single and monthly tickets are well above the ratios of other capitals. There are such capitals for which this ratio is well below the other capitals for both fares (Ljubljana, Minsk, Tallinn). There are also such, whose ratio for one of the fares is well above whereas for the other one is well below the other capitals (Amsterdam, Bucharest). Finally there are capitals which ratio for both fares seems to be just right (Ottawa, Sofia, Vilnius). This compilation would be however more accurate if the wages in the capitals were considered.

Figure 2.51. Relation between bus single ticket fare and monthly wage at the country level in ECE capitals, 2011



Source: ECE

Figure 2.52. Relation between bus monthly ticket fare and monthly wage at the country level in ECE capitals, 2011

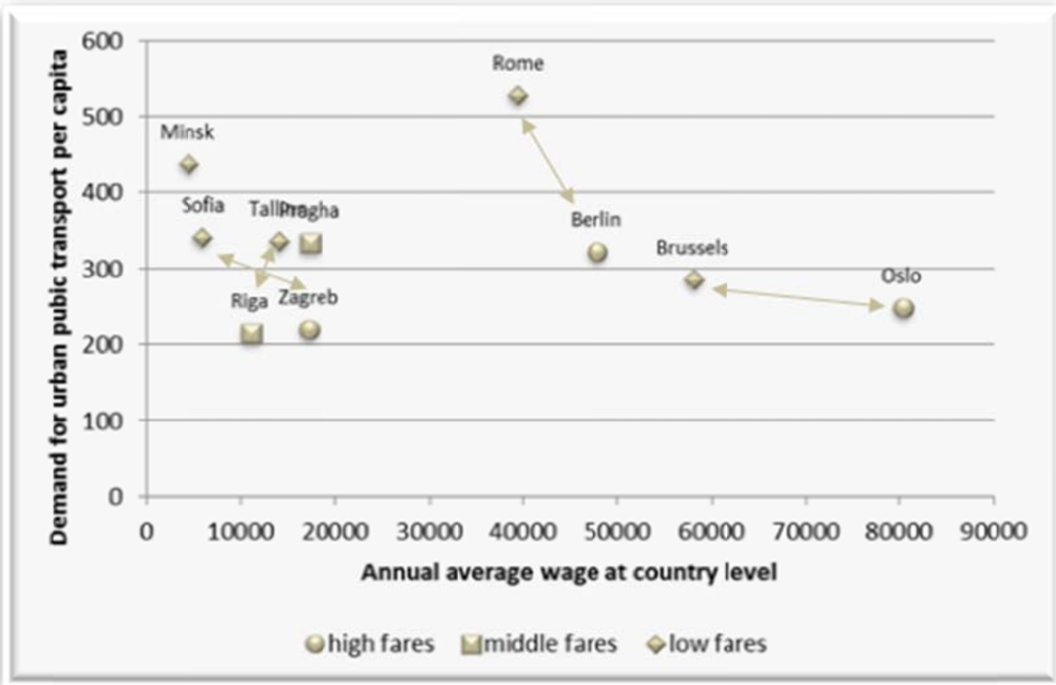


Source: ECE

When it comes to metro fares, in the case of a few capitals (Amsterdam, Bucharest, Moscow or London) they are slightly higher than for the bus, tram and trolley fare. At the same time, the findings and relations between single and monthly fares do not differ from those provided for bus, tram and trolley fare.

The capitals that offer comparatively lower fares (ratio fare to wage), should normally be able to achieve higher demand for public transport if other public transport features are relatively comparable. A number of cases of similar capitals prove the price-demand principle (figure 2.53.).

Figure 2.53. Relation between bus monthly ticket fare and monthly wage at the country level in ECE capitals, 2011



Source: ECE

Looking at two capital cities with high average wage (Brussels and Oslo), they seem to have a public transport of similar quality, with little differences for the various quality elements sometimes in favor of one or the other city. The main differences between them seem to be in terms of congestions and public transport fare prices. Brussels has more cars per km of metropolitan roads and relatively less expensive public transport fares. Both these elements may speak in favor of attracting more demand to public transport.

For the second couple of cities belonging to a group of the larger metropolis (Berlin and Rome), they seems to mainly differ based on the data that were made available in terms of public transport fares charged and use of bicycles with Berlin charging relatively more for a single public transport fare though having many more bicycles on the roads. As a possible consequence demand for public transport is higher in Rome.

For another couple of capitals belonging to a group of smaller-medium size capitals (Riga and Tallinn), both seem to offer similar quality of public transport with exception of ITS in favor of Tallinn as mentioned already in this report under comfort-ITS example. The other differences are relatively more congested roads, less bicycle use and relatively higher fares in Riga versus Tallinn. While the congestion should speak in favor of Riga in attracting demand for public transport, the already mentioned ITS and the cheaper fares seem to attract more users to public transport in Tallinn even despite more popularity of cycling for transfers.

Finally, while the availability of data does not allow to review many parameters for the fourth couple of capitals (Sofia, Zagreb), Sofia having a more accessible public transport network at a cheaper fare and providing ITS for passenger information for all mods is able to achieve higher demand for public transport. The combination of better accessibility at a lower fare may be crucial in this context.

The fare level is clearly an important element to impact the demand for public transport. It has to be however considered in connection with the profitability of the public transport provider as well as the inhabitants' purchasing power.

In first case, if the charged fares are far below the level to ensure the break-even point for the business, the demand may decline in medium to longer term due to inability for continuous restoring of the vehicles fleet and infrastructure, which inevitably would result in deterioration of service. This will happen unless the local governments are able to take over the investment costs.

In the second case, if public transport fares are too expensive relatively to the income of the city inhabitants, the demand will stay rather limited too. Provided that the operation is above break-even point, it would give space for fare cut. In an opposite situation – below break-even – the costs of operation need to be reviewed with the objective of finding savings to decrease the level of break-even point.

2.7.2. Public transport profitability

A provider optimizing the cost of operations has better chances to achieve profit. Among main elements of costs that can be assessed are, inter alia, such related to employees' salaries, holding of depots and garages, fuel costs, etc..

To this end, the optimization can be assessed through a number of indicators such as: number of customers (public transport passengers) per employee, number of employees (of whom drivers) per vehicle stock, employees' distribution between administration, technicians and drivers, use of available vehicle stock, age of buses, etc.

When it comes to passenger volumes per employee indicator, there are quite some differences noticeable between the ECE capitals, despite a limited number of cities that provided data. For the bus service the difference is 5-6 times more passengers per employee, for the tram service some five times and for the metro service 5-9 times (figure 2.54.). Certain cities (Riga, Tbilisi) achieve relatively low indicator value for bus and tram service (Riga) and for bus and metro service (Tbilisi). There are capitals with mixed values (Belgrade, Bucharest and Sofia) and high value (Rome).

The relative low number of passengers per employee can suggest that the employee level may be too high for the service rendered.

Therefore it is interesting to review the number of employees versus the use of the fleet. Such has been done for bus and tram service, since for the metro service only two cities provided the necessary data.

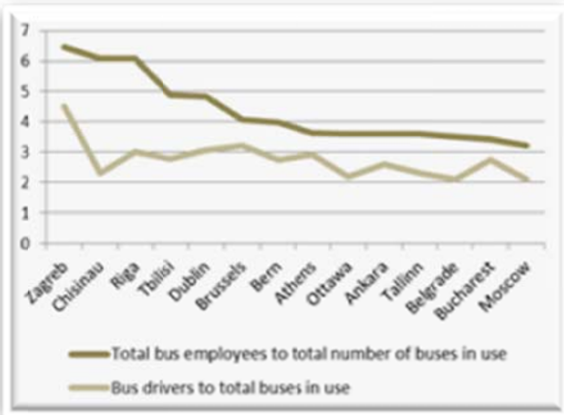
For the bus service, the majority of the cities have some four employees per vehicle in use during peak hours of whom 2-3 are drivers (figure 2.55.). There are however also cities that reach a value of 6 employees per vehicle of whom 30% (Chisinau) to 70% are drivers (Zagreb).

For the tram service, there are on average more employees hired per vehicle in use. However, while for certain cities the increase is rather moderate (Brussels, Bucharest, Moscow, Tallinn) for some others (Athens, Riga) the high increase might be inexplicable in terms of operation needs (figure 2.56.).

The capital cities that have relatively high number of employees per vehicle operated during peak hours are exactly those with low value of number of passengers per one employee: Riga for bus and tram, Athens for tram, Chisinau and Zagreb for bus.

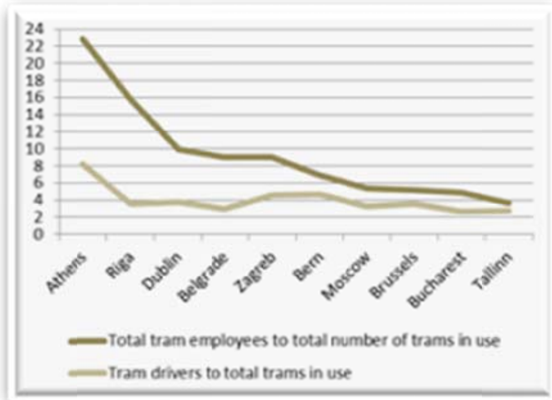
Certain capital cities have a relatively high number of employees hired for administrative functions or repairs and maintenance. For bus service, for two cities (Chisinau and Riga) every second person is hired for other purpose then driving while the average is 2 drivers per three employees (figure 2.57.). For tram service, for three cities (Athens, Dublin and Riga) only one per three employees is driving, while the average is 1 driver per two employees (figure 2.58.).

Figure 2.55. Number of total bus employees and bus drivers to bus fleet in operation during peak hours, 2011



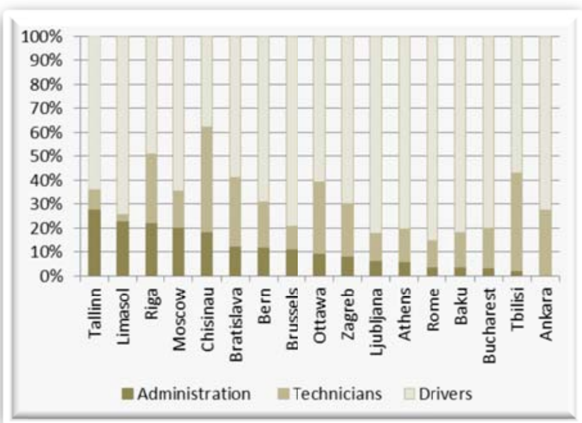
Source: ECE

Figure 2.56. Number of total tram employees and tram drivers to tram fleet in operation during peak hours, 2011



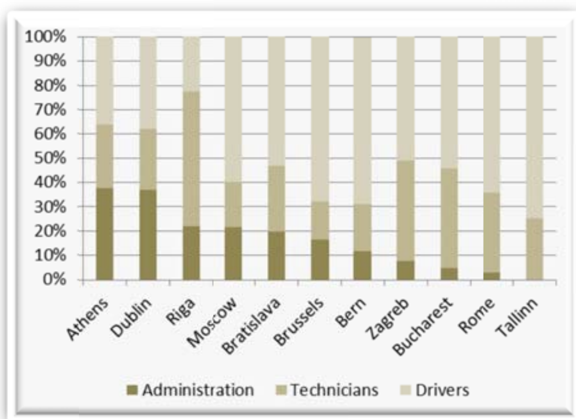
Source: ECE

Figure 2.57. Employees' distribution between administration, technicians and drivers for bus service, 2011



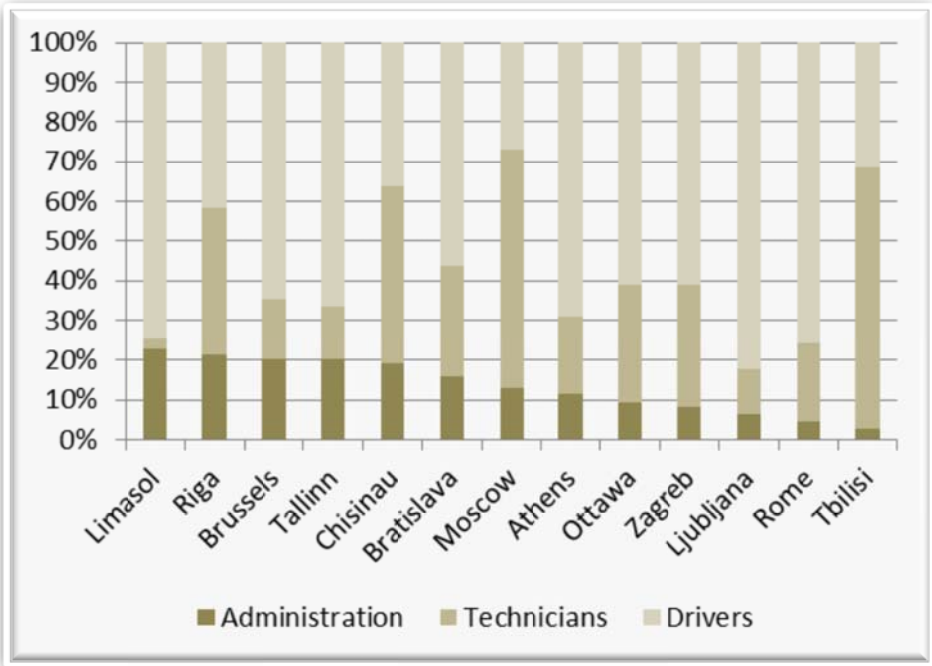
Source: ECE

Figure 2.58. Employees' distribution between administration, technicians and drivers for tram service, 2011



Source: ECE

Figure 2.59. Employees' distribution between administration, technicians and drivers, aggregated for bus, trolley, tram and metro services, 2011



Source: ECE

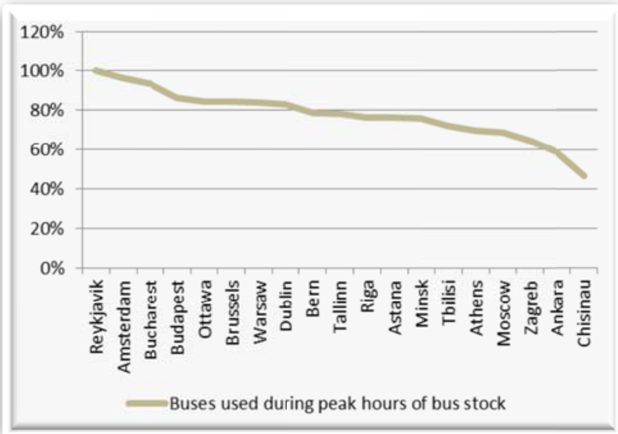
Looking at the aggregated figures for bus, tram, trolley and metro service, it is noticeable that a relatively high number of employees are hired as technicians in a number of cities (figure 2.59.). For two capitals (Moscow and Tbilisi) the numbers are made by technicians hired in metro service who account for almost 90% of all metro employees. While the sample of cities that provided data is quite limited to draw more data-proven conclusions, the technicians' number seems to be too high in both cities.

Another interesting cost area to review is that one related to vehicle fleet in possession versus the fleet in use. The fleet that is not operated does not generate any income while it generates costs as minimum depot or maintenance costs. To this end, public transport providers should be interested in possessing a fleet of which the large majority is in daily operation and minimum fleet is kept as reserve for cases of breakdowns, etc.

There are however quite a number of ECE capital cities, from those that provided data, where the reserve fleet or the unused fleet is relatively large. For bus service (figure 2.60.), there are cities (Ankara, Chisinau), who operate less than 60% of their bus fleet. The average, at the same time, is 80% of the bus fleet in operation, with several cities operating more than 90% of their buses during peak hours (Amsterdam, Bucharest and Reykjavik).

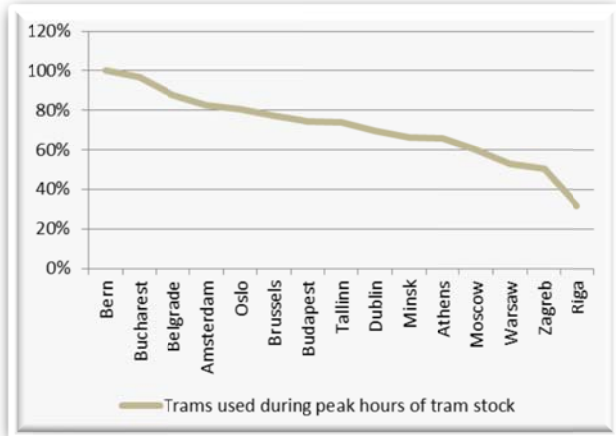
For tram service (figure 2.61.), four cities have 60% or less of their tram fleet in operation (Moscow, Riga, Warsaw and Zagreb). The average figure is 70% with two cities (Bern and Bucharest) using their fleet fully during peak hours.

Figure 2.60. Use of the available bus fleet, 2011



Source: ECE

Figure 2.61. Use of the available tram fleet, 2011



Source: ECE

Finally for metro service (figure 2.62.), there are majority of cities that use their fleet at a level of 80% or more. There are however two capitals (Baku and Tbilisi) who use only less than 20% of it, which is quite an unusual situation.

When it comes to the age of fleet, as presented in the section 2.3.2 urban public transport comfort – figure 2.22. – nearly 50% of buses are below the average age of 6 years, hence the buses should be equipped with more fuel-efficient engines. For cities operating older buses, they should evaluate the impact of the cost savings on fuels versus increased leasing costs for new buses.

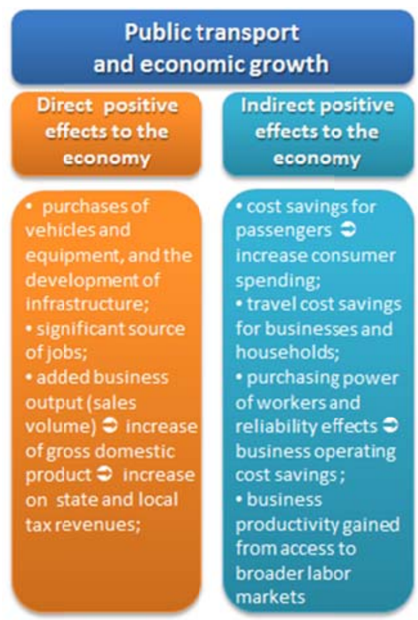
All in all, it seems that for a number of capital cities there is a good potential to optimize their urban public transport costs and as a consequence decrease the fare level, e.g. Riga and Zagreb.

2.7.3. Financing urban public transport and Economic growth

Public transport should be available for all citizens. Accessibility for all neighbourhoods to public transport is an essential factor social inclusion. Therefore, more investments are needed to improve accessibility. Investment in public transportation expands service and improves mobility, and, if sustained over time, can potentially affect the economy by providing:

- travel and vehicle ownership cost savings for public transportation passengers and those switching from automobiles, leading to shifts in consumer spending;
- reduced traffic congestion for those traveling by automobile and truck, leading to further direct travel cost savings for businesses and households;
- business operating cost savings associated with reduced congestion on wages and reliability effects;
- business productivity gained from access to broader labour markets with more diverse skills, enabled by reduced traffic congestion and expanded transit service areas; and
- additional regional business growth enabled by indirect impacts on supplies and induced impacts on spending of worker wages. At a national level, cost savings and other productivity impacts can affect competitiveness in international markets.

Figure 2.63. Economic growth through investments in public transport



Source: UNECE

Furthermore, capital investment in public transport (including purchases of vehicles and equipment, and the development of infrastructure and supporting facilities) is a significant source of jobs. In the United States an analysis[36] indicates that, per billion dollars of spending on public transport capital, nearly 24,000 jobs are supported for a year. Public transport operations (i.e., management, operations and maintenance of vehicles and facilities) are additional source of jobs. The same analysis indicates that over 41,000 jobs are supported for a year, for each billion dollars of annual spending on public transportation operations. Other economic impacts are associated with the job impacts. Corresponding to the 36,000 jobs is approximately $3.6 billion of added business output (sales volume), which provides $1.8 billion of GDP (gross domestic product, or “value added”) -- including $1.6 billion of worker income and $0.2 billion of corporate income. This additional economic activity generates nearly $500 million in federal, state and local tax revenues.

The sources of funding for public sector investments may include transfers from central government, local borrowing, local taxation, and service charging. Public expenditures on urban transport in

[36] Economic impact of public transportation investment, American public transportation investment, 2009

capital cities may be fully financed by the central government. More generally, and almost exclusively in noncapital cities, the main responsibility for financing will rest with the regional or municipal government with some degree of participatory funding from the central government. Local borrowing may be secured against general municipal revenues or occasionally against toll revenue. Some municipalities are at least as creditworthy as their national governments and may be able to issue bonds of their own.

Where public transport service is franchised to the private sector, the financing of vehicles and their supporting infrastructure normally become the responsibility of the franchisee. The main difficulty in this context is that unless the contracts are well defined, and of reasonable duration, it may be difficult for a private operator to finance the necessary vehicles.

Public-Private-Partnerships (PPP) financing schemes could be a financing solution for urban transport projects. However, as the Asian Development Bank (ADB) finds there are major gaps that can be reduced only through robust and persistent efforts:

- the legal, regulatory, and institutional frameworks within which private sector participation via PPPs is enabled and the authorization, treatment, and use of debt is allowed to operate;
- local variables (e.g., the size, tax base, accounting and debt management) which, in their current form, severely limit local governments' ability to tap financial markets;
- enabling arrangements (credit enhancement mechanisms, credit rating systems) that enhance the borrowing and repayment capacities of local governments;
- technical and managerial capacity of cities to become financially credible and accountable.

Figure 2.64. Pricing and Financing Urban Transport

Source: World Bank, UNECE

Targeted subsidies present a solution to the dilemma of affordable prices and financial sustainability. With increasing pressures for cities to achieve both the design and implementation of targeted subsidy schemes is not only possible, but an affordable and smart way to use city resources. The World Bank based on two recent supported analyses in Buenos Aires and Bogotá identified several key aspects of implementation which are the basis of the five-step framework presented in Box 1.6.

The European Union on the other hand has been promoting Public Service Obligation contracts and through this recognising that imposing low tariffs, extended networks and frequency can bleed operator if these costs are not recovered. In other words the demand for services by the Government that the operator otherwise would not meet if it is left to its financial considerations, are in need of compensation.

2.7.3.1 World Bank

World Bank has been increasingly involved in urban transport projects. Within the WB funding, the share of urban transport related investments rose from 10% ($893 million) in FY 2011 to 19% in FY 2013 ($1billion), with four new urban transport projects approved. A capacity building program for Leaders in Urban Transport Planning has been developed to create awareness amongst leaders about the need to plan for urban transport in a comprehensive and holistic manner rather than through construction of high cost facilities alone. The program seeks to create an understanding of the need to combine supply side measures with demand side measures and also the need for integrating urban transport planning with several dimensions such as land use, environment, social, energy and other issues. In FY 2013 the program trained 250 participants from 20 countries.

Table 2.1. World Bank's projects in ECE region

Project Title	Country	Project ID	Commitment amount	Status	Approval Date
Second Regional Development Project	Georgia	P130421	30.0	Active	November 6, 2012
Regional Development Project	Georgia	P126033	60.0	Active	March 20, 2012
AF - BISHKEK &OSH URBAN	Kyrgyz Republic	P122811	15.8	Active	January 12, 2012
Regional and Municipal Infrastructure Development Project	Georgia	P110126	40.0	Active	October 2, 2008
Bishkek and Osh Urban Infrastructure Project	Kyrgyz Republic	P104994	12.0	Active	March 18, 2008
Second East-West Highway Improvement	Georgia	P094044	35.0	Closed	December 18, 2007
Istanbul Municipal Infrastructure Project	Turkey	P100383	322.15	Closed	June 28, 2007

MUNICIPAL SERVICES PROJECT	Romania	P088252	131.7	Closed	July 13, 2006
National Urban Transport Improvement Project	Russian Federation	P133201	119.0	Pipeline	
Second Regional and Municipal Infrastructure Development Project	Georgia	P147521	45.0	Pipeline	

Source: World Bank

World Bank has invested or is planning to invest in five projects in **Georgia**. One project is on the pipeline, one is closed and three projects are ongoing. The total budget of the projects – approved and forecasted – is 210 US$ millions. The development objective of the ***Second Regional Development Project*** for Georgia is to improve infrastructure services and institutional capacity to support increased contribution of tourism in the local economy of the Imereti region. There are two components to the project. The first component is infrastructure investments in urban regeneration of Tskaltubo and tourism circuits' development. The activities will help improve livability and hospitality in a culturally-informed manner, enhance attractiveness for visitors, revitalize the urban nucleus, and attract increased volume of private sector investments around the medical and spa tourism cluster. The second component is institutional development. The objective of the ***Regional Development Project*** for Georgia is to improve infrastructure services and institutional capacity to support the development of tourism-based economy and cultural heritage circuits in the Kakheti region. There are two components to the project, the first component being Infrastructure Investment. The second component is the institutional development. The objective of the Additional Financing for ***Regional and Municipal Infrastructure Development Project*** (RMIDP-AF) is to improve the efficiency and reliability of selected municipal infrastructure and service; and assist in restoring infrastructure, services and improving housing conditions of conflict-affected people in Georgia. This will include: 1) rehabilitating additional municipal infrastructure throughout the country; and 2) preparing strategic development plans for a selected number of cities in support of municipal and regional development program of Georgia.

In addition, the Bank has invested in two projects in **Kyrgyz Republic**. The total budget of the projects is 27.8 US$ millions. The objective of the ***Additional Financing (AF) for the Bishkek and Osh Urban Infrastructure Project*** (BOUIP) is to improve the living conditions in selected semi-informal settlements (novostroiki) in Bishkek and Osh, the two largest cities of the Kyrgyz Republic, by increasing the availability of basic infrastructure to the residents of these areas. It will also help continue the successful municipal and social infrastructure investments supported by the World Bank to the country's twenty-three small towns under the Small Towns Investment Capacity Building Project (STICBP).

In **Turkey** the Bank invested in one project. The project introduced changes in the Turkey ***Istanbul Municipal Infrastructure*** and accompanying amendments to the project's legal documents. The restructuring serves to align the project with the evolving priorities of the Istanbul Metropolitan Municipality. The restructuring : (a) expanded the scope of improvements in solid waste management and rehabilitation and clean-up of creeks; (b) removed retrofitting and construction of buildings, fire stations and emergency housing associated with urban transformation.

The ***Municipal Services Project*** aims to assist **Romania** to meet European Union environmental directives in the water and wastewater sector, thereby improving the quality and coverage of water and wastewater services. The project will have three components: a) Component 1, urban services in Bucharest municipality, which will include provision of urban services - water, sewerage, drainage, and road surfacing - in priority neighborhoods; b) Component 2, urban services in Arad municipality, which will include provision of urban services - sewerage, drainage, and road surfacing - in priority neighborhoods.; and c) Component 3, consulting services to prepare for water and wastewater projects in 11 counties.

Finally, the ***National Urban Transport Improvement*** Project in **Russian Federation** has two components: Component 1: Development of a National Framework for Improvement of Urban Transport Systems (estimated $5 million IBRD Loan, $5 million Borrower funds and $1.1 million GEF Grant). This component will support development of a national framework for urban transport, which would provide an enabling environment for municipalities to improve the condition and quality of their urban transport systems and to develop the institutional and technical capacity. To that end, this component would support the following activities: (i) Refinement and adoption of a national strategy for urban transport improvements; (ii) Introduction of high-priority legal reforms; (iii) Creation of a Federal Urban Transport Center; (iv) Development and delivery of an urban transport learning program for policy-makers and practitioners in all Russian cities by the Federal Urban Transport Center; and (v) Development and dissemination of toolkits by the Federal Urban Transport Center. Component 2: Pilot Program for Urban Transport Improvements (estimated $100 million IBRD loan, $100 million Borrower funds and $5.5 million GEF Grant). This component will support urban transport pilot projects in three cities, with co-financing by participating cities (the amount to be determined). Candidate areas for pilot projects would include (i) improvement of traffic management systems, potentially including advanced technologies of intelligent transportation systems (ITS), (ii) improvement of public transport infrastructure, vehicles and services, (iii) development and implementation of a city-wide parking plan, (iv) improvement of road traffic safety and non-motorized transport, and (v) implementation of various TDM measures. Pilot projects will be selected by municipal administrations, based on their long-term transport strategy Public Disclosure Copy and investment programs.

2.7.3.2. European Investment Bank

The EIB has supported a wide range of projects in urban public transport sector. Total of 41 loans approved: €4.2 billion ($5.4 billion) of investment; 45% of lending to public transport, of which 33% to urban transport and 12% to rail. A key area of intervention is increasing the capacity of public transport networks through the construction or rehabilitation of infrastructure such as metro and tramway lines and rapid transit bus systems and the acquisition of rolling stock for all transport modes (suburban rail and metro services, trams, trolleybuses and buses). In recent years, projects have also been developed with the help of ELENA, a joint Commission-EIB initiative that helps local authorities prepare energy efficiency projects, including urban public transport schemes. Investments in specific equipment to improve the quality of public transport, such as electronic ticketing, traffic management and communication systems, are also supported by the Bank.

Over the last five years the EIB has helped part-finance:

a. 32 metro networks
b. 4 urban rail projects
c. 48 tramways
d. 48 rail projects
e. 27 high-speed rail projects.

During 2012 EIB approved a number of urban transport projects, including one large metro extension (Dnepropetrovsk in Ukraine) and one new metro line (Warsaw in Poland). In addition, the EIB invested in various smaller tramway schemes, in particular in Poland. These extensions of lines and new lines provide more capacity, safety and efficiency, and encourage modal shift from cars and buses.

Table 2.2. EIB projects in ECE region

Date of entry	Title	Country	Sector	Status
16/12/2013	BERLIN INTERURBAN RAILWAY NETWORK "RING"	Germany	Transport	Under appraisal
Contract for provision of transport services including the procurement, testing and licensing as well as operation and maintenance of new rolling stock to be used on the Berlin "Ring S-Bahn" rail network with an approximate total transport service provided of 9.4m train-km.				
13/11/2013	MARSEILLE TRANSPORT URBAIN II	France	Transport	Approved
Le projet a pour objectif de financer plusieurs composantes du programme d'investissements en transports publics de la Communauté Urbaine de Marseille (MPM) pour la période 2013-2016. L'opération permettra d'améliorer la qualité de service de l'ensemble des modes du réseau de transport public de l'établissement Public de Coopération Intercommunale (EPCI).				
06/11/2013	CITY BY-PASS ZWETTL	Austria	Transport	Approved
Design, construction, financing, operation and maintenance of a by-pass road around the city of Zwettl, district capital in the State of Lower Austria, within a PPP Availability Scheme. The project will enhance the road and transport network of the city, alleviating its growing traffic by redirecting HGV and substantially reducing the related levels of congestion, emissions and noise. This will also lead to an improved quality of life for the inhabitants.				
14/10/2013	SOFIA METRO PHASE III (FWL 20060411)	Bulgaria	Transport	Under appraisal
The project is a major allocation under the structured programme loan "Bulgaria EU Funds Co-Financing 2007-13" (20060411) and concerns the 3rd phase of Sofia's metro extension. The works to be co-financed hereunder comprise the extension of the current metro line 1 from Tsarigradsko schosse to (i) Sofia International Airport through the residential area Drushba (lot 1) and to (ii) Sofia's largest residential area Mladost and its business park (lot 2).				
08/10/2013	CZESTOCHOWA URBAN	Poland	Transport	Signed

	INFRASTRUCTURE II		Industry	

The project focuses on financing small and medium-scale investment schemes, mainly in the fields of urban renewal, transport, health and education in Czestochowa. The project will contribute to the implementation of a sustainable development strategy of the City of Czestochowa, and in particular, to the improvement of the urban infrastructure such as the internal road network and public transport as well as public buildings (schools, public housing, social care centres, and cultural amenities).

28/08/2013	BRATISLAVA URBAN TRANSPORT	Slovakia	Transport	Under appraisal

The project concerns the financing of different investment schemes in the City of Bratislava within its framework development plan, mainly in the field of public transport. Most of these schemes are expected to be complemented by EU grant support from the Structural Funds. The project includes a new tramway line linking the city centre with the most densely populated residential area, PetrÅ¾alka. It will upgrade the old bridge of Starý Most over the Danube for use by trams, pedestrians and cyclists. The upgraded bridge will be in line with Danube Convention and will increase traffic capacity on the river. The project will also include upgrade of tram tracks, trolley bus lines, new rolling stock of trams and trolley buses, and a new depot for rolling-stock.

01/07/2013	URBAN TRANSPORT MAINZELBAHN	Germany	Transport	Signed

Extension of a tram line by 9.2 km from Mainz Central Station to Mainz Lerchenberg and acquisition of additional trams. The project will increase the efficiency and quality of public transport services in Mainz and thereby support sustainable transport solutions in line with EU objectives.

28/06/2013	NAHVERKEHR GRAZ	Austria	Transport	Signed

Upgrade and extension of tram infrastructure, rolling stock and buses. The selected investments will improve the quality and service level of the sustainable transport modes, in particular buses and tram.

27/05/2013	NICE TRANSPORT URBAIN II	France	Transport	Under appraisal

Construction de la ligne de tramway Ouest-Est permettant de relier l'aéroport et le centre administratif au port, 11,3 km (dont 3,2 km en tunnel), en desservant tout l'hypercentre, avec 20 stations, matériel roulant, parcs relais. Améliorer les conditions de la mobilité dans le périmètre de la métropole avec un impact positif sur la qualité de vie, la compétitivité économique et l'environnement.

27/05/2013	LILLE METROPOLE MODERNISATION DU METRO	France	Transport	Signed

Le projet consiste en un programme d'évolution et de modernisation du métro, destiné à résoudre l'ensemble des problèmes actuels pour les trente prochaines années. Le doublement des rames et des quais permettront d'accueillir l'évolution du trafic prévue.

14/05/2013	EE PUBLIC TRANSPORT BARCELONA	Spain	Transport Energy	Under appraisal

Framework loan to finance small to medium-size schemes included in the promoter's investment programme to improve the energy efficiency and operation of the existing public transport network. The proposed loan will contribute to capitalising on the existing ELENA (European Local ENergy Assistance) facility in place with Transports de Barcelona, which is dedicated to the Electrobus project (the first large scale program in Europe to retrofit existing diesel and GNC buses into hybrids), improving the leverage effect of EU resources on EIB's

lending for climate action.				
03/05/2013	TRAMWAY DE LIEGE PPP	Belgium	Transport	Approved
The project consists of the construction of the first phase of the first tramway line of Liège. It will be 11.4 km long with 21 stations, and includes the construction of a new depot as well as the acquisition of 19 trams.				
14/02/2013	SZCZECIN TRAMWAY INFRAST (FL2012-0399)	Poland	Transport	Under appraisal
The project consists of modernisation of 13 km of tram tracks and catenaries, construction of additional tram track and modernisation and extension of an existing tram depot (Pogodno) in the city of Szczecin, in the north west of Poland. The project is part of the Integrated Plan for Public Transport Development for 2007-2015, adopted by the Szczecin City Council on 25 January 2010.				
06/03/2012	DNIPROPETROVSK METRO COMPLETION	Ukraine	Transport S	Signed
The project consist of extending the existing metro line in Dnipropetrovsk by 4.0 kilometres and adding 3 stations. This would bring the metro service to the city centre to serve areas of high urban density and activity.				
30/07/2010	Odessa Public Transport	Ukraine	Transport	Under appraisal
The project consists of (i) the reconstruction of approximately 14 km of tracks on the tram line that runs between the historic city centre of Odessa and its major satellite residential district; (ii) the purchase of 16 articulated, semi-low floor trams and (iii) the modernisation of the tram depot.				

Azerbaijan plans to open new subway stations in the capital Baku in 2014 to tackle the transport problems of the big city. The decision was made after growing traffic jams turned into an urban challenge for Azerbaijan's government and Baku population. Baku Metro put pressure on the government to adopt a 20-year-old program for developing the metro stations across the capital. The 46-year old Baku Metro operates 23 stations in two lines – Red and Green with the total length of 34.6 kilometers. Under the new program, the number of subway lines is planned to increase from two to five , its length up to 119 kilometers and the number of stations up to 76 by 2030.

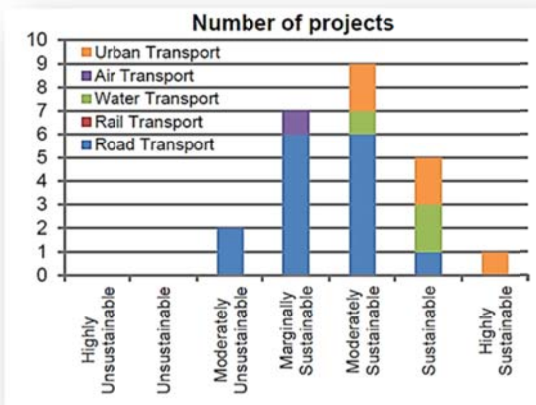
In order to improve rail passenger service quality and efficiency in Riga and outside the capital city, Latvian Railway (LDz) plans to modernize 16 railway stations, in the framework of the project Rail passenger infrastructure upgrade/passenger information & CCTV system installation – monitoring & contract management. This will ensure sustainable operation of the railway Riga urban and suburban public transport system and, at the same time, reduce environmental pollution. This project also received the support of the Latvian government, being declared of national interest.

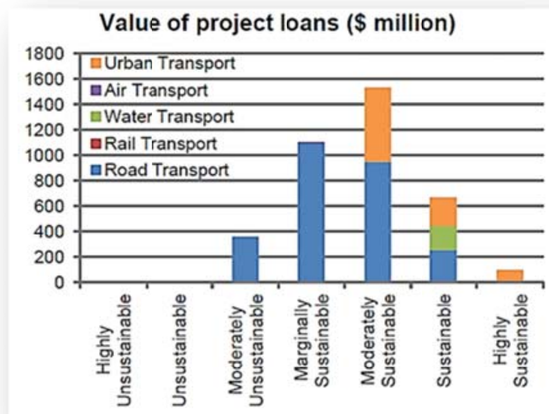
In early 2014, Kyiv metro received the eight five-car trainsets, ordered in 2013. The subway cars comply with the technical requirements for fire safety and environmental requirements established by Ukrainian legislation. .

2.7.3.3. Asian Development Bank.

ADB's transport sector support is changing to meet the new challenges facing the Bank's developing member countries. Guided by its Sustainable Transport Initiative Operational Plan (STI-OP), ADB's work in 2012 included three new projects for Buss Rapid Transit (BRT) and two for metros. In 2012, total of 26 loans/grants and 45 technical assistance projects were approved, totaling $3.9 billion in investments, and serving 23 countries. More than 20% of lending was for urban transport, up from a low 2% (between 2000 and 2009). Implementing sustainable urban transport: The Lanzhou Sustainable Urban Transport project (approved in 2009) is ADB's first BRT project. It has been supporting the development of a BRT corridor which opened in December 2012 and now carries more than 280,000 persons per day. Lessons from Lanzhou are being used to develop BRT systems in other Asian cities including Astana, Davao, Dhaka, Jinagxi Ji'an, Ulaanbaatar, and Yichang.

Figure 2.65. Number and Value of ADB projects in Transport



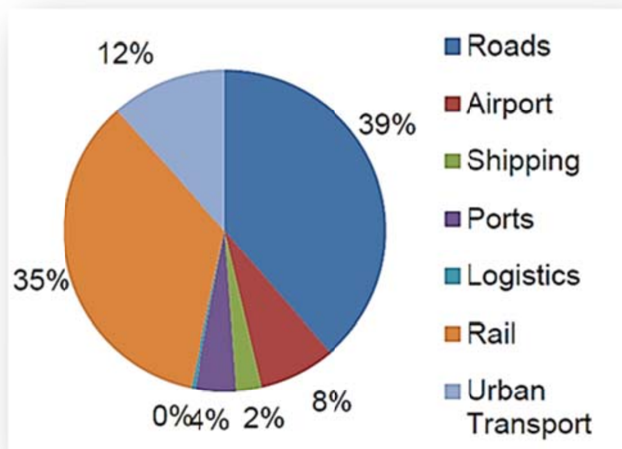


Source: ADB

2.7.3.4. European Bank for Reconstruction and Development

European Bank for Reconstruction and Development (EBRD) supports the development of efficient, reliable and secure transport systems in its countries of operations which embody market principles, balance economic, environmental and social needs and are responsive to the needs of industry and the individual. Spanning all key subsectors – aviation, ports, railways, roads, shipping, urban transport and logistics – over the past five years EBRD has more than doubled its annual investments. In urban transport, the largest of the six operations signed in 2012 was the Dnepropetrovsk Metro extension project, co-financed with EIB, which will see Line 1 of the metro completed, with parallel institutional and commercial strengthening of the metro company. EBRD is also providing financing for new low-floor trolleybuses in the City of Balti, Moldova and alongside the EIB, agreed a second phase of financing to the Yerevan Metro Company. Finally, EBRD financed an important BRT project in Burgas, Bulgaria, as a complement to EU financing.

Figure 2.66. EBRD's modal distribution of 2012 transport approvals



Source:EBRD

2.7.3.5. Additional sources for funding public transport

There are examples of ECE capital cities that use additional sources for financing the urban transport projects: such as employer tax, tolls, public-private partnerships or the instruments to capture the increase in land value due to public transport investments.

Table 2.3. Additional source for financing public transport projects, examples from ECE capitals

Capital city	Additional source for financing	Project
Berlin	Grants from private sector	Construction of stations of S-Bahn (stations servicing newly contracted housing complexes)
Copenhagen	Land sales along metro line Real estate taxes	Ørestad-Copenhagen metro line
Dublin	Betterment levy scheme Selling of real estate development rights	Luas cross city: the extension of the light rail network
London	Congestion charge	General investment in transport services beyond the contribution to the operation
	Commercial sponsorship	Barclays Cycle Hire Emirates air line
	Business rate supplement as tax increment Selling of real estate development rights of surplus land and on top of new stations Community infrastructure levy	London Crossrail
Madrid	Public-private partnership: concession for the construction and operation of infrastructures	Light-rail lines n Sanchinarro, Pozuelo de Alarcón and Boadilla del Monte, the metro extension to the new terminal 4 at the airport
	Betterment levy as capture of increase in land value	Parla tramway or the extension of metro line 1 to a new residential area called PAU de Vallecas
	Grants from private sector	Construction of metro station Ronda de la Comunicación (the station provides the access to the grant providing enterprise facilities)
Oslo	Car toll	Public transport investments

Paris	Employer tax "versement transport"	General investment into public transport
	Re-allocation of office tax	Grand Paris project involving construction of four new automatic metro lines around Paris and expansion of two existing lines of Paris Metro, with the aim of providing direct connectivity between suburban districts without having to travel through the city center, while also linking important transport hubs in the city
	Commercial sponsorship	Velib public bicycle
Warsaw	Commercial sponsorship	Installation and maintenance of new bus stops sheds

Chapter 3: Profiles of capital cities

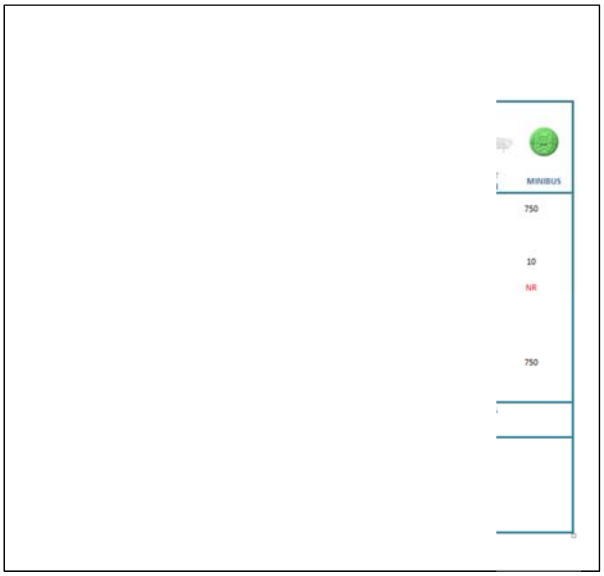
3.1. Introduction

The profiles for the selected ECE capital cities have been created to provide information at glance on the city's urban transport system.

The profile has seven sections:

Section 1: Provides the name of the country and the capital city and its Seal.

Section 2: Specifies the data on the capital city's size, population and population density. It further provides the period for tourist visits and their number as well as the number of available parking facilities.



Section 3: Illustrates through colored or faded images the existing options for modes of urban public transport. The coloured images indicate the modes of public transport in operation.

Section 4: Specifies the length in kilometers of the lines provided with the various public transport modes. It further specifies the length of the cycling lanes.

Section 5: Provides the information about the distribution of passengers among the modes of public transport illustrated through a pie chart.

Section 6: Details the costs in United States dollars of single or one hour and monthly tickets for the bus service.

Section 7: Informs about actions taken to further improve the quality of urban public transport and of non-motorized transport or other actions aimed at making the urban transport system more sustainable.

Where applicable, it is specified whether data were not made available by indicating "NR" to be understood as "not reported".

Armenia Yerevan

Size: 227 km^2

Population: 1.122 million

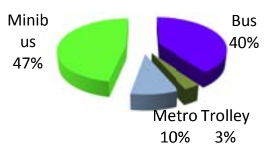
Density: 4,942 inhabitants/km2

Tourist Season: July - October

Number of Tourists: NR

Number of Parking: 60

Distribution of passengers among modes of public transport:



Existing means of Public Transport in Yerevan:

BUS | TRAM | METRO | TROLLEY | URBAN TRAIN | LIGHT TRAIN | MINIBUS

Mode				
Bus	Lines in km	1,324	Number of stations	750
Tram	Lines in km		Number of stations	
Metro	Lines in km	12,1	Number of stations	10
Trolley	Lines in km	NR	Number of stations	NR
Urban train	Lines in km		Number of stations	
Light train	Lines in km		Number of stations	
Minibus	Lines in km	1,200	Number of stations	750
Bicycle	Lanes in km	NR		

Cost of single / one hour ticket	$0.25
Cost of monthly ticket	NR

Actions taken to improve the quality of urban public transport and of non-motorized transport:

- Purchase of new buses and increase of bus frequency of service (implemented)
- Repair of the trolley infrastructure and construction of new segments of reticular net (implemented)

Austria Vienna

Size: 415 km^2

Population: 1.757 million

Density: 4,237 inhabitants /km2

Tourist Season: NR

Number of Tourists: 8 million

Number of Parking: NR

Distribution of passengers among modes of public transport:

NR

Existing means of Public Transport in Vienna :

BUS | TRAM | METRO | TROLLEY | URBAN TRAIN | LIGHT TRAIN | MINIBUS

(Bus)	Lines in km	NR	Number of stations	NR
(Tram)	Lines in km	NR	Number of stations	NR
(Metro)	Lines in km	NR	Number of stations	NR
(Trolley)	Lines in km		Number of stations	
(Urban train)	Lines in km	NR	Number of stations	NR
(Light train)	Lines in km	NR	Number of stations	NR
(Minibus)	Lines in km		Number of stations	
(Bicycle)	Lanes in km	NR		

Cost of single / one hour ticket	$2.6
Cost of monthly ticket	NR

Actions taken to improve the quality of urban public transport and of non-motorized transport:

NR

Azerbaijan Baku

Size: 2,130 km^2	
Population: 2.122 million	
Density: 996 inhabitants/ km^2	
Tourist Season: May - September	
Number of Tourists: some 1.5 million	
Number of Parking: NR	

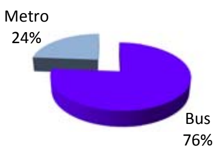
Existing means of Public Transport in Baku:

BUS | TRAM | METRO | TROLLEY | URBAN TRAIN | LIGHT TRAIN | MINIBUS

Mode				
Bus	Lines in km	3,452	Number of stations	664
Tram	Lines in km		Number of stations	
Metro	Lines in km	35	Number of stations	23
Trolley	Lines in km		Number of stations	
Urban train	Lines in km		Number of stations	
Light train	Lines in km		Number of stations	
Minibus	Lines in km		Number of stations	
Bicycle	Lanes in km	NR		

Cost of single / one hour ticket	$0.25
Cost of monthly ticket	NR

Distribution of passengers among modes of public transport:



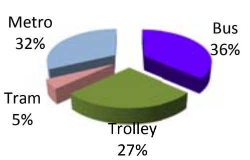
Actions taken to improve the quality of urban public transport and of non-motorized transport:

- Construction of more stations for the underground (planned)
- Reconstruction of the existing underground stations with the objective to increase customer service (planned)
- Improve the reliability of schedules (planned)
- Increase of the average travelling speed by construction of dedicated public transport lanes (planned)

Belarus **Minsk**

Size: 306 km^2
Population: 1.900 million
Density: 6,209 inhabitants/km2
Tourist Season: whole year
Number of Tourists: 100 thousand
Number of Parking: 98

Distribution of passengers among modes of public transport:



Note: no passenger data for urban train

Existing means of Public Transport in Minsk:

BUS | TRAM | METRO | TROLLEY | URBAN TRAIN | LIGHT TRAIN | MINIBUS

	Lines in km	2,150	Number of stations	1,750
	Lines in km	90	Number of stations	80
	Lines in km	35	Number of stations	28
	Lines in km	600	Number of stations	NR
	Lines in km	40	Number of stations	10
	Lines in km		Number of stations	
	Lines in km		Number of stations	
	Lanes in km	100		

Cost of single / one hour ticket	$0.2
Cost of monthly ticket	$8.5

Actions taken to improve the quality of urban public transport and of non-motorized transport:

- Extension of the existing metro lines: line 1 to 20.8 km and line 2 to 20.3 km (ongoing)
- Construction of new metro lines: lines 3 and 4 (planned)
- Improvements to tram infrastructure (implemented)
- Redesign of trolley network to be used in micro districts to transfer passenger to metro stations (ongoing)
- Implementation of ITS: automated control system with navigation (planned)
- Implementation of ITS for ticket control (non-contact cards, electronic punch)

Belgium **Brussels**

Size: 162 km^2

Population: 1.152 million

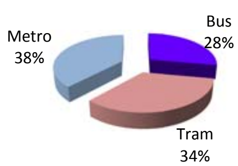
Density: 7,111 inhabitants/km2

Tourist Season: April – September

Number of Tourists: 2.7 million

Number of Parking: 57

Distribution of passengers among modes of public transport:



Note: no passenger data for urban train

Existing means of Public Transport in Brussels:

BUS | TRAM | METRO | TROLLEY | URBAN TRAIN | LIGHT TRAIN | MINIBUS

Mode				
Bus	Lines in km	542	Number of stations	778
Tram	Lines in km	211	Number of stations	290
Metro	Lines in km	56	Number of stations	59
Trolley	Lines in km		Number of stations	
Urban train	Lines in km	520	Number of stations	NR
Light train	Lines in km		Number of stations	
Minibus	Lines in km		Number of stations	
Bicycle	Lanes in km	163		

Cost of single / one hour ticket	$2.35
Cost of monthly ticket	$60.2

Actions taken to improve the quality of urban public transport and of non-motorized transport:

- Launch of the public bike sharing system (implemented)
- Improvements to the public transport service: introduction of vehicles with larger capacity, increase of service frequency, improvements at stations, giving priority to public transport at intersections (ongoing)

Other:

- Launch of the car share system (ongoing)

Bulgaria Sofia

Size: 492 km^2

Population: 1.296 million

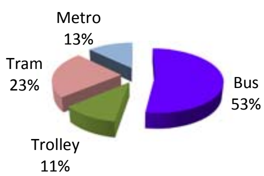
Density: 2,635 inhabitants/km2

Tourist Season: May - October

Number of Tourists: 250 thousand

Number of Parking: NR

Distribution of passengers among modes of public transport:



Existing means of Public Transport in Sofia:

BUS · TRAM · METRO · TROLLEY · URBAN TRAIN · LIGHT TRAIN · MINIBUS

Mode				
Bus	Lines in km	2,347	Number of stations	2,510
Tram	Lines in km	294	Number of stations	NR
Metro	Lines in km	31	Number of stations	27
Trolley	Lines in km	187	Number of stations	NR
Urban train	Lines in km		Number of stations	
Light train	Lines in km		Number of stations	
Minibus	Lines in km		Number of stations	
Bicycle	Lanes in km	30		

Cost of single / one hour ticket	$0.67
Cost of monthly ticket	$33.3

Actions taken to improve the quality of urban public transport and of non-motorized transport:

- Increase of economic efficiency of trolley service (ongoing)

Canada **Ottawa**

Size: 2.976 km^2

Population: 0.935 million

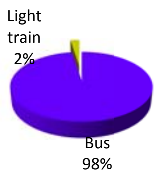
Density: 314 inhabitants/km2

Tourist Season: whole year

Number of Tourists: 7.3 million

Number of Parking: NR

Distribution of passengers among modes of public transport:



Existing means of Public Transport in Ottawa:

BUS | TRAM | METRO | TROLLEY | URBAN TRAIN | LIGHT TRAIN | MINIBUS

Mode				
Bus	Lines in km	5,584	Number of stations	57
Tram	Lines in km		Number of stations	
Metro	Lines in km		Number of stations	
Trolley	Lines in km		Number of stations	
Urban train	Lines in km		Number of stations	
Light train	Lines in km	8	Number of stations	5
Minibus	Lines in km		Number of stations	
Bicycle	Lanes in km	688		

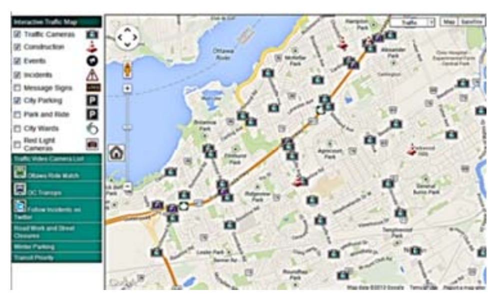
Cost of single / one hour ticket	$2.60
Cost of monthly ticket	$96.25

Actions taken to improve the quality of urban public transport and of non-motorized transport:

- Launch of a cycling online map (implemented)
- Development of a multi-year accessibility plan (ongoing)

Other:

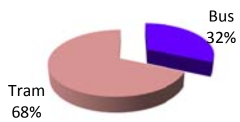
- Launch of an online map providing information for construction locations, traffic incidents, real-time traffic flow



Croatia Zagreb

Size: 3,719
Population: 1.108 million
Density: 298 inhabitants/km2
Tourist Season: May - September
Number of Tourists: 767 thousand
Number of Parking: NR

Distribution of passengers among modes of public transport:



Note: no passenger data for urban train

Existing means of Public Transport in Zagreb:

BUS TRAM METRO TROLLEY URBAN TRAIN LIGHT TRAIN MINIBUS

	Lines in km	1,351	Number of stations	1.688
	Lines in km	152	Number of stations	257
	Lines in km		Number of stations	
	Lines in km		Number of stations	
	Lines in km	58	Number of stations	17
	Lines in km		Number of stations	
	Lines in km		Number of stations	
	Lanes in km	229		

Cost of single / one hour ticket	$2.1
Cost of monthly ticket	$63.0

Actions taken to improve the quality of urban public transport and of non-motorized transport:

- Launch of a public bike sharing system (implemented)

nextbike

Cyprus

Nicosia

Size: 111 km^2	
Population: 0.310 million	
Density: 2,800 inhabitants/km^2	
Tourist Season: January - December	
Number of Tourists: NR	
Number of Parking: NR	

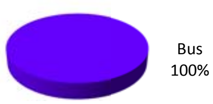
Existing means of Public Transport in Nicosia:

BUS | TRAM | METRO | TROLLEY | URBAN TRAIN | LIGHT TRAIN | MINIBUS

Mode				
Bus	Lines in km	NR	Number of stations	884
Tram	Lines in km		Number of stations	
Metro	Lines in km		Number of stations	
Trolley	Lines in km		Number of stations	
Urban train	Lines in km		Number of stations	
Light train	Lines in km		Number of stations	
Minibus	Lines in km		Number of stations	
Bicycle	Lanes in km	NR		

Cost of single / one hour ticket	\$1.39
Cost of monthly ticket	\$41.72

Distribution of passengers among modes of public transport:



Actions taken to improve the quality of urban public transport and of non-motorized transport:

- Increase of frequency of bus service (ongoing)
- Introduction of fleet management system (planned)
- Introduction of ticketing machines (planned)

Czech Republic **Prague**

Size: 496 km²

Population: 1.241 million

Density: 2,503 inhabitants/km²

Tourist Season: April – September

Number of Tourists: 7.0 million

Number of Parking: NR

Distribution of passengers among modes of public transport:

Existing means of Public Transport in Prague:

BUS | TRAM | METRO | TROLLEY | URBAN TRAIN | LIGHT TRAIN | MINIBUS

Mode				
Bus	Lines in km	695	Number of stations	NR
Tram	Lines in km	NR	Number of stations	NR
Metro	Lines in km	59	Number of stations	NR
Trolley	Lines in km		Number of stations	
Urban train	Lines in km		Number of stations	
Light train	Lines in km		Number of stations	
Minibus	Lines in km		Number of stations	
Bicycle	Lanes in km	NR		

Cost of single / one hour ticket	$1.7
Cost of monthly ticket	$28.8

Actions taken to improve the quality of urban public transport and of non-motorized transport:

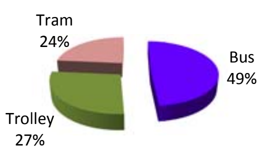
- Launch of Prague Integrated Transport System: Prague Public Transport Company operating bus, tram, metro and funicular with the Czech Railways, with use of single ticket for all modes of the integrated system (implemented)
- Extension of P+R zones (implemented)

Estonia

Tallinn

Size: 159.1 km^2
Population: 0.416 million
Density: 2,619 inhabitants/km^2
Tourist Season: May-September
Number of Tourists: 781 thousand
Number of Parking: NR

Distribution of passengers among modes of public transport:



Existing means of Public Transport in Tallinn:

BUS | TRAM | METRO | TROLLEY | URBAN TRAIN | LIGHT TRAIN | MINIBUS

Mode				
Bus	Lines in km	730	Number of stations	855
Tram	Lines in km	33	Number of stations	NR
Metro	Lines in km		Number of stations	
Trolley	Lines in km	730	Number of stations	855
Urban train	Lines in km		Number of stations	
Light train	Lines in km		Number of stations	
Minibus	Lines in km		Number of stations	
Bicycle	Lanes in km	NR		

Cost of single / one hour ticket	$0.76
Cost of monthly ticket	$31.99

Actions taken to improve the quality of urban public transport and of non-motorized transport:

- Launch of free public transport for city residents (implemented)
- Designation of dedicated lanes for public transport (implemented)
- Implementation of ITS (implemented)
- Purchase of new fleet (implemented)

France Paris

Size: 12,012 km²	
Population: 11.867 million	
Density: 988 inhabitants/km2	
Tourist Season: NR	
Number of Tourists: NR	
Number of Parking: NR	

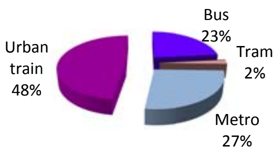
Existing means of Public Transport in Paris:

BUS | TRAM | METRO | TROLLEY | URBAN TRAIN | LIGHT TRAIN | MINIBUS

Mode				
Bus	Lines in km	24,661	Number of stations	NR
Tram	Lines in km	65	Number of stations	NR
Metro	Lines in km	219	Number of stations	NR
Trolley	Lines in km		Number of stations	
Urban train	Lines in km	NR	Number of stations	NR
Light train	Lines in km	601	Number of stations	NR
Minibus	Lines in km		Number of stations	
Bicycle	Lanes in km			

Cost of single / one hour ticket	NR
Cost of monthly ticket	NR

Distribution of passengers among modes of public transport:



Note: no passenger data for light train

Actions taken to improve the quality of urban public transport and of non-motorized transport:

- Opening of the public transport services to competition (planned)

Georgia **Tbilisi**

Size: 726 km^2	
Population: 1,485 million	
Density: 2,046 inhabitants/km^2	
Tourist Season: NR	
Number of Tourists: NR	
Number of Parking: NR	

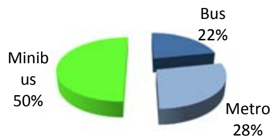
Existing means of Public Transport in Tbilisi:

BUS | TRAM | METRO | TROLLEY | URBAN TRAIN | LIGHT TRAIN | MINIBUS

Mode				
Bus	Lines in km	2,185	Number of stations	1,803
Tram	Lines in km		Number of stations	
Metro	Lines in km	27	Number of stations	22
Trolley	Lines in km		Number of stations	
Urban train	Lines in km		Number of stations	
Light train	Lines in km		Number of stations	
Minibus	Lines in km	5,000	Number of stations	NR
Bicycle	Lanes in km	NR		

Cost of single / one hour ticket	$0.29
Cost of monthly ticket	NR

Distribution of passengers among modes of public transport:



Actions taken to improve the quality of urban public transport and of non-motorized transport:

- Implementation of the differentiated types of fares to make the public transport system more accessible to the poor (implemented)

Germany **Berlin**

Size: 892 km^2

Population: 3.517 million

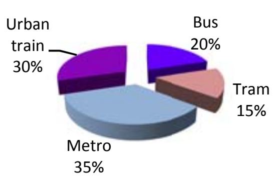
Density: 3,944 inhabitants/km^2

Tourist Season: NR

Number of Tourists: NR

Number of Parking: NR

Distribution of passengers among modes of public transport:



Note: no passenger data for metronetz

Existing means of Public Transport in Athens:

BUS | TRAM | METRO | TROLLEY | URBAN TRAIN | LIGHT TRAIN | METRONETZ

Mode				
Bus	Lines in km	1626	Number of stations	10,000
Tram	Lines in km	431	Number of stations	789
Metro	Lines in km	152	Number of stations	170
Trolley	Lines in km		Number of stations	
Urban train	Lines in km	332	Number of stations	166
Light train	Lines in km		Number of stations	
Metronetz	Lines in km	NR	Number of stations	NR
Bicycle	Lanes in km	NR		

Cost of single / one hour ticket	$3.3
Cost of monthly ticket	NR

Actions taken to improve the quality of urban public transport and of non-motorized transport:

NR

Greece **Athens**

Size: 730 km^2	
Population: 3.577 million	
Density: 4,900 inhabitants/km^2	
Tourist Season: June-September	
Number of Tourists: NR	
Number of Parking: NR	

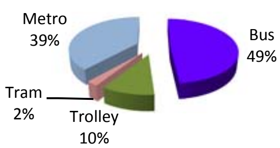
Existing means of Public Transport in Athens:

BUS | TRAM | METRO | TROLLEY | URBAN TRAIN | LIGHT TRAIN | MINIBUS

Mode				
Bus	Lines in km	6,610	Number of stations	8,268
Tram	Lines in km	24	Number of stations	48
Metro	Lines in km	148	Number of stations	54
Trolley	Lines in km		Number of stations	
Urban train	Lines in km	52	Number of stations	11
Light train	Lines in km		Number of stations	
Minibus	Lines in km		Number of stations	
Bicycle	Lanes in km	NR		

Cost of single / one hour ticket	$1.7
Cost of monthly ticket	NR

Distribution of passengers among modes of public transport:



Note: no passenger data for urban train

Actions taken to improve the quality of urban public transport and of non-motorized transport:

- Designation of dedicated lanes for bus network (implemented)
- Reorganization of the bus and trolley service to better serve the extended metro network (implemented)

Hungary

Budapest

Size: 1,226 km^2

Population: 2.079 million

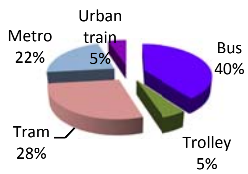
Density: 1,696 inhabitants/km2

Tourist Season: May – October

Number of Tourists: 3.8 million

Number of Parking: NR

Distribution of passengers among modes of public transport:



Note: no passenger data for river boat

Existing means of Public Transport in Budapest:

Bus	Lines in km	2,697	Number of stations	4,099
Tram	Lines in km	251	Number of stations	677
Metro	Lines in km	32	Number of stations	83
Trolley	Lines in km		Number of stations	
Urban train	Lines in km	146	Number of stations	139
Light train	Lines in km		Number of stations	
River boat	Lines in km	38	Number of stations	16
Bicycle	Lanes in km	240		

Cost of single / one hour ticket	$1.50
Cost of monthly ticket	$45.0

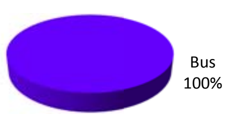
Actions taken to improve the quality of urban public transport and of non-motorized transport:

- Extension of night bus service to 37 lines (implemented)
- Free travel for seniors (over 65 years old) (implemented)

Iceland Reykjavik

Size: 100 km2	
Population: 0.204 million	
Density: 204 inhabitants/km2	
Tourist Season: May-September	
Number of Tourists: 370 thousand	
Number of Parking: NR	

Distribution of passengers among modes of public transport:



Existing means of Public Transport in Reykjavik:

BUS TRAM METRO TROLLEY URBAN TRAIN LIGHT TRAIN MINIBUS

Mode				
Bus	Lines in km	NR	Number of stations	NR
Tram	Lines in km		Number of stations	
Metro	Lines in km		Number of stations	
Trolley	Lines in km		Number of stations	
Urban train	Lines in km		Number of stations	
Light train	Lines in km		Number of stations	
Minibus	Lines in km		Number of stations	
Bicycle	Lanes in km	85		

Cost of single / one hour ticket	$3.0
Cost of monthly ticket	$70.0

Actions taken to improve the quality of urban public transport and of non-motorized transport:

- Construction of new bicycle lanes (ongoing)
- Bicycle counter and speed measure system on certain bicycle lanes (implemented)

Ireland Dublin

Size: 840 km2
Population: 1.111 million
Density: 1,322 inhabitants/km2
Tourist Season: June-August
Number of Tourists: 1.3 million
Number of Parking: NR

Distribution of passengers among modes of public transport:

NR

Existing means of Public Transport in Dublin:

Mode				
Bus	Lines in km	NR	Number of stations	NR
Tram	Lines in km	37	Number of stations	54
Metro	Lines in km		Number of stations	
Trolley	Lines in km		Number of stations	
Urban train	Lines in km	53	Number of stations	31
Light train	Lines in km		Number of stations	
Minibus	Lines in km		Number of stations	
Bicycle	Lanes in km	275		

Cost of single / one hour ticket	$2.15
Cost of monthly ticket	$112.0

Actions taken to improve the quality of urban public transport and of non-motorized transport:

- Launch of National Transport Authority's National Journey Planner Application and website for planning personal door to door journeys using public transport and or walking and cycling (implemented)
- Launch of integrated ticketing system – National Transport Authority's Leap Card – that allows using a single smart card to pay for the public transport within and around Dublin (implemented)
- Launch of ITS for passenger information (bus service) with signs at the majority of stops and on the website or per SMS in real time (implemented and ongoing for other modes)

Italy **Rome**

Size: 1,285 km^2

Population: 2.864 million

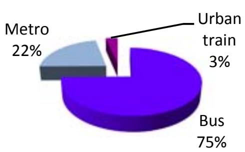
Density: 2,229 inhabitants/ km^2

Tourist Season: July-October

Number of Tourists: 4.8 million

Number of Parking: NR

Distribution of passengers among modes of public transport:



Note: no passenger data for tram and trolley

Existing means of Public Transport in Rome:

BUS | TRAM | METRO | TROLLEY | URBAN TRAIN | LIGHT TRAIN | MINIBUS

Mode				
Bus	Lines in km	2,300	Number of stations	8,500
Tram	Lines in km	76	Number of stations	126
Metro	Lines in km	80	Number of stations	53
Trolley	Lines in km	NR	Number of stations	NR
Urban train	Lines in km	348	Number of stations	147
Light train	Lines in km		Number of stations	
Minibus	Lines in km		Number of stations	
Bicycle	Lanes in km	120		

Cost of single / one hour ticket	$2.0
Cost of monthly ticket	$46.5

Actions taken to improve the quality of urban public transport and of non-motorized transport:

- Launch of ITS: (1) Automatic Vehicle Monitoring: 450 high level on-board systems including TV video surveillance, passenger counters, on-board announcements, TV movie and advertisement screens, 7 depot systems, WiFi and 3G data communication as well as (2) bus lanes monitoring (implemented)

Other:

- Launch of ITS for car traffic: Video Surveillance Cameras, Traffic flows measurement stations, Variable Message Signs (VMS), Urban Travel Times (UTT), Monitoring of red light violation, Speed Monitoring System (SICVe) (implemented)
- Extension of a recharging network for electric vehicles to the whole Municipality (implemented)
- Launch of Limited Access Zone Electronic gates for private car vehicles: “Muoversi a Roma” (web site specialised for smartphone access): infos about Traffic restrictions in ZTL's (implemented)

Kazakhstan Astana

Size: 710 km^2	
Population: 0.743 million	
Density: 1,046 $inhabitants/km^2$	
Tourist Season: June - August	
Number of Tourists: 10 thousand	
Number of Parking: NR	

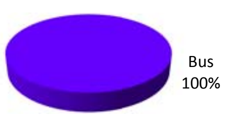
Existing means of Public Transport in Astana:

BUS | TRAM | METRO | TROLLEY | URBAN TRAIN | LIGHT TRAIN | MINIBUS

Mode				
Bus	Lines in km	2,372	Number of stations	920
Tram	Lines in km		Number of stations	
Metro	Lines in km		Number of stations	
Trolley	Lines in km		Number of stations	
Urban train	Lines in km		Number of stations	
Light train	Lines in km		Number of stations	
Minibus	Lines in km		Number of stations	
Bicycle	Lanes in km			

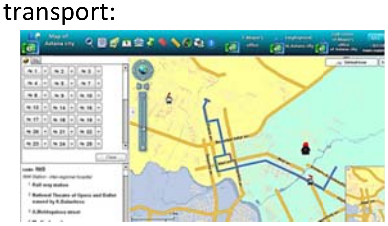
Cost of single / one hour ticket	$0.4
Cost of monthly ticket	$30.0

Distribution of passengers among modes of public transport:



Actions taken to improve the quality of urban public transport and of non-motorized transport:

- Launch of a website providing real-time information on the bus service (location and speed of all buses) (implemented)



Latvia **Riga**

Size: 304 km^2	
Population: 0.703 million	
Density: 2,314 inhabitants/km^2	
Tourist Season: May -September	
Number of Tourists: 900 thousand	
Number of Parking: NR	

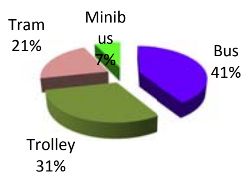
Existing means of Public Transport in Riga:

BUS | TRAM | METRO | TROLLEY | URBAN TRAIN | LIGHT TRAIN | MINIBUS

Mode				
Bus	Lines in km	1,060	Number of stations	1,633
Tram	Lines in km	91	Number of stations	227
Metro	Lines in km		Number of stations	
Trolley	Lines in km	NR	Number of stations	NR
Urban train	Lines in km		Number of stations	
Light train	Lines in km		Number of stations	
Minibus	Lines in km	NR	Number of stations	1,454
Bicycle	Lanes in km	45		

Cost of single / one hour ticket	$0.92
Cost of monthly ticket	$53.39

Distribution of passengers among modes of public transport:



Actions taken to improve the quality of urban public transport and of non-motorized transport:

- Launch of electronic validation of tickets with a module registering every trip taken by the public transport modes (implemented)

Lithuania Vilnius

Size: 402 km^2

Population: 0.523 million

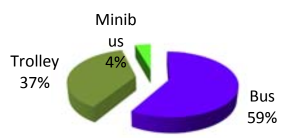
Density: 1,301 inhabitants/km^2

Tourist Season: April-September

Number of Tourists: 500 thousand

Number of Parking: NR

Distribution of passengers among modes of public transport:



Existing means of Public Transport in Vilnius:

BUS, TRAM, METRO, TROLLEY, URBAN TRAIN, LIGHT TRAIN, MINIBUS

Mode				
Bus	Lines in km	846	Number of stations	1,272
Tram	Lines in km		Number of stations	
Metro	Lines in km		Number of stations	
Trolley	Lines in km	259	Number of stations	NR
Urban train	Lines in km		Number of stations	
Light train	Lines in km		Number of stations	
Minibus	Lines in km	473	Number of stations	58
Bicycle	Lanes in km	113		

Cost of single / one hour ticket	$0.94
Cost of monthly ticket	$37.88

Actions taken to improve the quality of urban public transport and of non-motorized transport:

- Launch of a public bike sharing system (implemented)
- Extension of the public bike sharing system network (ongoing)

Moldova Chisinau

Size: 635 km^2

Population: 0.786 million

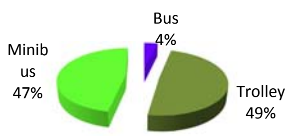
Density: 1,238 inhabitants/km2

Tourist Season: October-January

Number of Tourists: NR

Number of Parking: 12

Distribution of passengers among modes of public transport:



Existing means of Public Transport in Chisinau:

BUS | TRAM | METRO | TROLLEY | URBAN TRAIN | LIGHT TRAIN | MINIBUS

Mode				
Bus	Lines in km	786	Number of stations	539
Tram	Lines in km		Number of stations	
Metro	Lines in km		Number of stations	
Trolley	Lines in km	NR	Number of stations	NR
Urban train	Lines in km		Number of stations	
Light train	Lines in km		Number of stations	
Minibus	Lines in km	2065	Number of stations	200
Bicycle	Lanes in km			

Cost of single / one hour ticket	$0.25
Cost of monthly ticket	$20.0

Actions taken to improve the quality of urban public transport and of non-motorized transport:

- Purchase of new trolley (ongoing)

Netherlands Amsterdam

Size: 1003 km^2
Population: 1.424 million
Density: 1,420 inhabitants/km^2
Tourist Season: April - September
Number of Tourists: 6.0 million
Number of Parking: NR

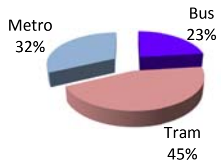
Existing means of Public Transport in Amsterdam:

BUS | TRAM | METRO | TROLLEY | URBAN TRAIN | LIGHT TRAIN | MINIBUS

Mode				
Bus	Lines in km	NR	Number of stations	1,300
Tram	Lines in km	NR	Number of stations	490
Metro	Lines in km	81	Number of stations	52
Trolley	Lines in km		Number of stations	
Urban train	Lines in km	NR	Number of stations	22
Light train	Lines in km		Number of stations	
Minibus	Lines in km		Number of stations	
Bicycle	Lanes in km	NR		

Cost of single / one hour ticket	\$1.15
Cost of monthly ticket	\$105.33

Distribution of passengers among modes of public transport:



Note: no passenger data for urban train

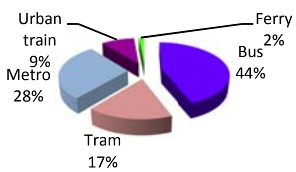
Actions taken to improve the quality of urban public transport and of non-motorized transport:

NR

Norway Oslo

Size: 5,005km^2
Population: 1.145 million
Density: 229 inhabitants/km^2
Tourist Season: May - August
Number of Tourists: 3.5 million
Number of Parking: 115

Distribution of passengers among modes of public transport:



Existing means of Public Transport in Oslo:

BUS | TRAM | METRO | TROLLEY | URBAN TRAIN | LIGHT TRAIN | FERRY BOAT

Mode				
Bus	Lines in km	2,050	Number of stations	3,500
Tram	Lines in km	41	Number of stations	94
Metro	Lines in km	80	Number of stations	94
Trolley	Lines in km		Number of stations	
Urban train	Lines in km	NR	Number of stations	NR
Light train	Lines in km		Number of stations	
Ferry boat	Lines in km	2,125	Number of stations	15
Bicycle	Lanes in km	2,125		

Cost of single / one hour ticket	$4,99
Cost of monthly ticket	$185.45

Actions taken to improve the quality of urban public transport and of non-motorized transport:

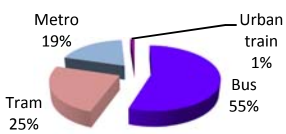
- Launch of mobile application for public transport tickets with pay-as-you-go credit function (implemented)

Poland

Warsaw

Size: 517 km2	
Population: 2.000 million	
Density: 3,868 inhabitants/km^2	
Tourist Season: NR	
Number of Tourists: 13 million	
Number of Parking: 54	

Distribution of passengers among modes of public transport:



Existing means of Public Transport in Warsaw:

BUS | TRAM | METRO | TROLLEY | URBAN TRAIN | LIGHT TRAIN | MINIBUS

Mode				
Bus	Lines in km	3,077	Number of stations	4,965
Tram	Lines in km	248	Number of stations	571
Metro	Lines in km	23	Number of stations	21
Trolley	Lines in km		Number of stations	
Urban train	Lines in km	147	Number of stations	46
Light train	Lines in km		Number of stations	
Minibus	Lines in km		Number of stations	
Bicycle	Lanes in km	340		

Cost of single / one hour ticket	$1.05
Cost of monthly ticket	$26.34

Actions taken to improve the quality of urban public transport and of non-motorized transport:

- Launch of a public bike sharing system (implemented)

Romania

Bucharest

Size: 1,811 km^2

Population: 2,272 million

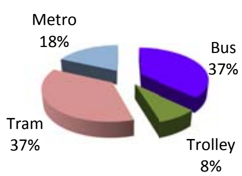
Density: 1255 inhabitants/km^2

Tourist Season: March - November

Number of Tourists: 1.0 million

Number of Parking: NR

Distribution of passengers among modes of public transport:



Existing means of Public Transport in Bucharest:

BUS | TRAM | METRO | TROLLEY | URBAN TRAIN | LIGHT TRAIN | MINIBUS

Mode				
Bus	Lines in km	2,282	Number of stations	1,482
Tram	Lines in km	484	Number of stations	586
Metro	Lines in km	69	Number of stations	51
Trolley	Lines in km	NR	Number of stations	NR
Urban train	Lines in km		Number of stations	
Light train	Lines in km		Number of stations	
Minibus	Lines in km		Number of stations	
Bicycle	Lanes in km			

Cost of single / one hour ticket	$1,64
Cost of monthly ticket	$16.40

Actions taken to improve the quality of urban public transport and of non-motorized transport:

- Launch of an integrated electronic/contactless ticketing system (implemented)

Russia Federation

Moscow

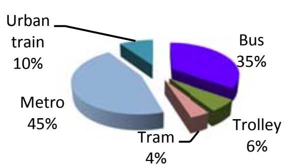
Size: 2,550 km^2	Existing means of Public Transport in Moscow:
Population: 11,600 million	
Density: 4,549 inhabitants/km^2	
Tourist Season: whole year	
Number of Tourists: 4.5 million	
Number of Parking: 14	

BUS **TRAM** **METRO** **TROLLEY** **URBAN TRAIN** **LIGHT TRAIN** **MONORAIL**

	Lines in km	7,816	Number of stations	8,947
	Lines in km	379	Number of stations	862
	Lines in km	309	Number of stations	186
	Lines in km	NR	Number of stations	NR
	Lines in km	1772	Number of stations	89
	Lines in km		Number of stations	
	Lines in km	5	Number of stations	6
	Lanes in km	NR		

	Cost of single / one hour ticket	$0.83
	Cost of monthly ticket	$30.0

Distribution of passengers among modes of public transport:



Note: no passenger data for monorail

Actions taken to improve the quality of urban public transport and of non-motorized transport:

- Construction of 15 new dedicated bus lanes (implemented)
- Renewal of rolling stock (ongoing)
- Construction of express tramway lines (ongoing)
- Optimization of operation costs (ongoing)

Serbia

Belgrade

Size: 3,223 km^2

Population: 1.659 million

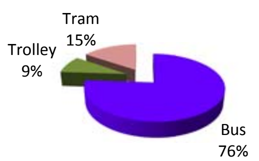
Density: 515 inhabitants/km^2

Tourist Season: NR

Number of Tourists: NR

Number of Parking: NR

Distribution of passengers among modes of public transport:



Note: no passenger data for urban train

Existing means of Public Transport in Belgrade:

BUS | TRAM | METRO | TROLLEY | URBAN TRAIN | LIGHT TRAIN | MINIBUS

Mode				
Bus	Lines in km	6,850	Number of stations	5,869
Tram	Lines in km	122	Number of stations	477
Metro	Lines in km		Number of stations	
Trolley	Lines in km	58	Number of stations	252
Urban train	Lines in km	20	Number of stations	9
Light train	Lines in km		Number of stations	
Minibus	Lines in km		Number of stations	
Bicycle	Lanes in km	NR		

Cost of single / one hour ticket	$0,84
Cost of monthly ticket	$37.4

Actions taken to improve the quality of urban public transport and of non-motorized transport:

- Launch of an integrated electronic/contactless ticketing system (implemented)
- Launch of ITS for operation (use of GPS and GPRS for automatic vehicle location) (implemented)
- Launch of ITS for passenger information on board, at stops, through internet and SMS (implemented)

Slovakia

Bratislava

Size: 2,000km^2

Population: 0.611 million

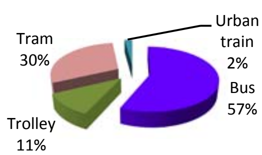
Density: 306 inhabitants/km^2

Tourist Season: May-September

Number of Tourists: 780 thousand

Number of Parking: 20

Distribution of passengers among modes of public transport:



Existing means of Public Transport in Bratislava:

BUS | TRAM | METRO | TROLLEY | URBAN TRAIN | LIGHT TRAIN | MINIBUS

Mode				
Bus	Lines in km	602	Number of stations	876
Tram	Lines in km	39	Number of stations	152
Metro	Lines in km		Number of stations	
Trolley	Lines in km	46	Number of stations	70
Urban train	Lines in km	196	Number of stations	33
Light train	Lines in km		Number of stations	
Minibus	Lines in km		Number of stations	
Bicycle	Lanes in km	750		

Cost of single / one hour ticket	NR
Cost of monthly ticket	NR

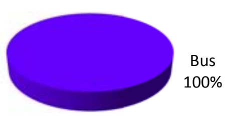
Actions taken to improve the quality of urban public transport and of non-motorized transport:

- Launch of tourist city card for free of charge public transport use (implemented)

Slovenia **Ljubljana**

Size: 260 km^2
Population: 0.536 million
Density: 2,063 inhabitants/km^2
Tourist Season: May -September
Number of Tourists: 267 thousand
Number of Parking: NR

Distribution of passengers among modes of public transport:



Existing means of Public Transport in Ljubljana:

BUS | TRAM | METRO | TROLLEY | URBAN TRAIN | LIGHT TRAIN | MINIBUS

Mode				
Bus	Lines in km	1,058	Number of stations	798
Tram	Lines in km		Number of stations	
Metro	Lines in km		Number of stations	
Trolley	Lines in km		Number of stations	
Urban train	Lines in km		Number of stations	
Light train	Lines in km		Number of stations	
Minibus	Lines in km		Number of stations	
Bicycle	Lanes in km	127		

Cost of single / one hour ticket	$1.20
Cost of monthly ticket	$37.0

Actions taken to improve the quality of urban public transport and of non-motorized transport:

- Launch of a cash-free payment for bus travel “Urbana Smart Card” (implemented)
- Launch of public bicycle sharing system “Bicike(LJ)”(implemented)
- Launch of mobile payment for bus ticket “Moneta”(implemented)
- Launch of two free-of-charge 5 person electric vehicles for old town rides on pedestrian zones “Cavalier”(implemented)
- Launch of ITS for passenger information (implemented)

Switzerland **Bern**

Size: 483 km^2	
Population: 0.355 million	
Density: 737 inhabitants/km^2	
Tourist Season: July - September	
Number of Tourists: NR	
Number of Parking: 13	

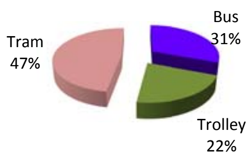
Existing means of Public Transport in Bern:

BUS | TRAM | METRO | TROLLEY | URBAN TRAIN | LIGHT TRAIN | MINIBUS

Mode				
Bus	Lines in km	130	Number of stations	261
Tram	Lines in km	40	Number of stations	71
Metro	Lines in km		Number of stations	
Trolley	Lines in km	NR	Number of stations	NR
Urban train	Lines in km	NR	Number of stations	NR
Light train	Lines in km	NR	Number of stations	NR
Minibus	Lines in km		Number of stations	
Bicycle	Lanes in km	NR		

Cost of single / one hour ticket	$3.9
Cost of monthly ticket	$69.0

Distribution of passengers among modes of public transport:



Note: no passenger data for urban and light trains

Actions taken to improve the quality of urban public transport and of non-motorized transport:

- Launch of priority crossing system for public transport at intersections (implemented)
- Extension of public transport lines (ongoing)
- Improvement of the visual appearance and safe and secure access for public transport stops (ongoing)
- Launch of a system to ensure vehicle cleaning during operation "TEAM CLEAN"(implemented)
- Launch of stations with supervised bicycle stands

Turkey

Ankara

Size: 8,621 km^2	
Population: 4.890 million	
Density: 567 inhabitants/km^2	
Tourist Season: NR	
Number of Tourists: NR	
Number of Parking: 101	

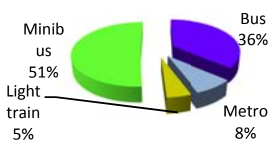
Existing means of Public Transport in Ankara:

BUS, TRAM, METRO, TROLLEY, URBAN TRAIN, LIGHT TRAIN, MINIBUS

	Lines in km	13,705	Number of stations	6,838
	Lines in km		Number of stations	
	Lines in km	15	Number of stations	12
	Lines in km		Number of stations	
	Lines in km	NR	Number of stations	NR
	Lines in km	9	Number of stations	11
	Lines in km	NR	Number of stations	NR
	Lanes in km	NR		

Cost of single / one hour ticket	$0.014
Cost of monthly ticket	NR

Distribution of passengers among modes of public transport:



Note: no passenger data for urban train

Actions taken to improve the quality of urban public transport and of non-motorized transport:

NR

United Kingdom

London

Size: 1,579 km2
Population: 8.200 million
Density: 5,193 inhabitants/km2
Tourist Season: NR
Number of Tourists: NR
Number of Parking: NR

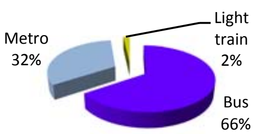
Existing means of Public Transport in London:

BUS	TRAM	METRO	TROLLEY	URBAN TRAIN	LIGHT TRAIN	MINIBUS

Mode				
Bus	Lines in km	NR	Number of stations	NR
Tram	Lines in km	NR	Number of stations	NR
Metro	Lines in km	NR	Number of stations	NR
Trolley	Lines in km		Number of stations	
Urban train	Lines in km	NR	Number of stations	NR
Light train	Lines in km	NR	Number of stations	NR
Minibus	Lines in km		Number of stations	
Bicycle	Lanes in km	NR		

Cost of single / one hour ticket	$2.20
Cost of monthly ticket	$119.5

Distribution of passengers among modes of public transport:



Note: no passenger data for tram and urban train

Actions taken to improve the quality of urban public transport and of non-motorized transport:

NR

Chapter 4: Conclusions and recommendations

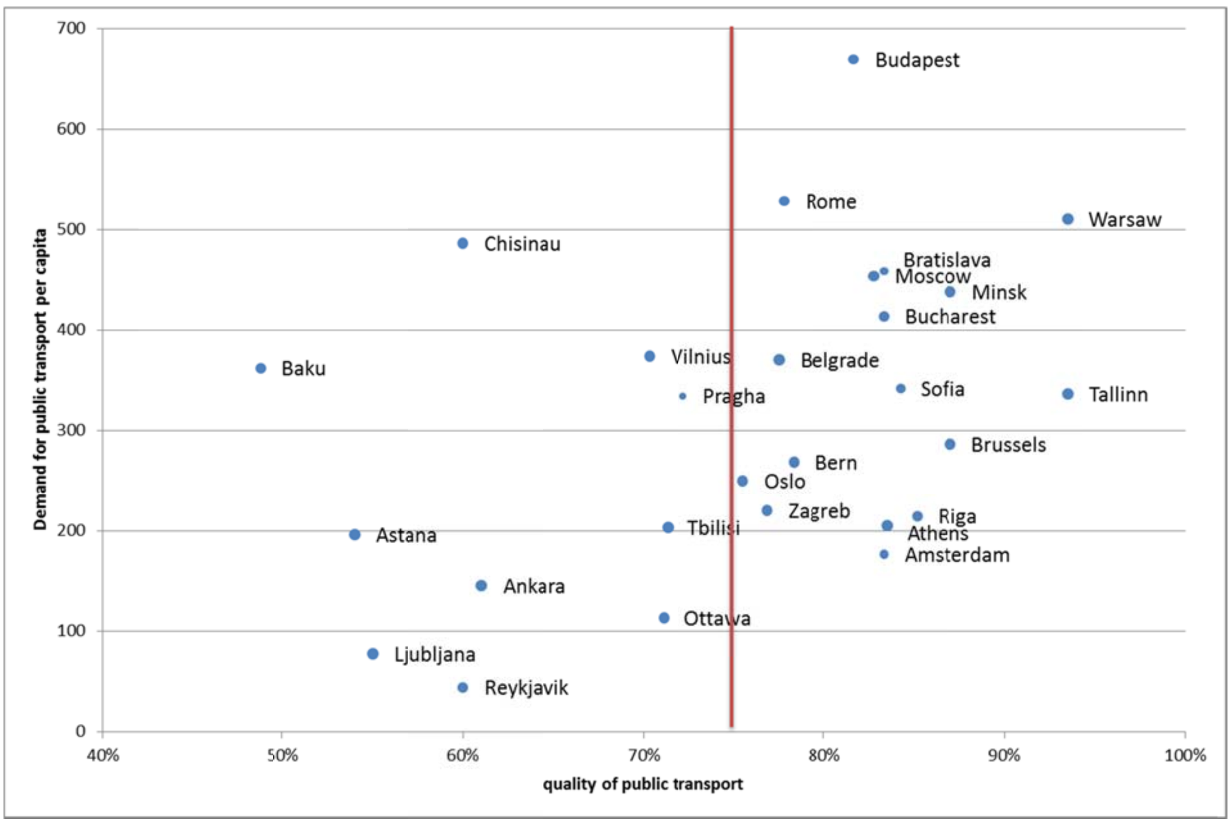
4.1. Conclusions

Urban mobility within urban areas of many ECE capital cities is ensured through a mix of individual car use, public transport, cycling and walking. While ECE capital cities have a traditional for public transport services, individual car use has been growing and distorting the modal split in many. As a consequence externalities related to congestions, pollution and traffic accidents remain a major concern.

As there is always a room for improvement, the analysis provided in this paper tries to draw the attention to issues that may or should be considered for making urban transport systems and mobility more efficient and sustainable.

There are quite many ECE capitals that offer a relatively good quality of public transport in terms of its accessibility, comfort and safety (figure 4.1.) as based on the data made available and assuming that a score of above 75 per cent suggests a good quality of public transport provided.

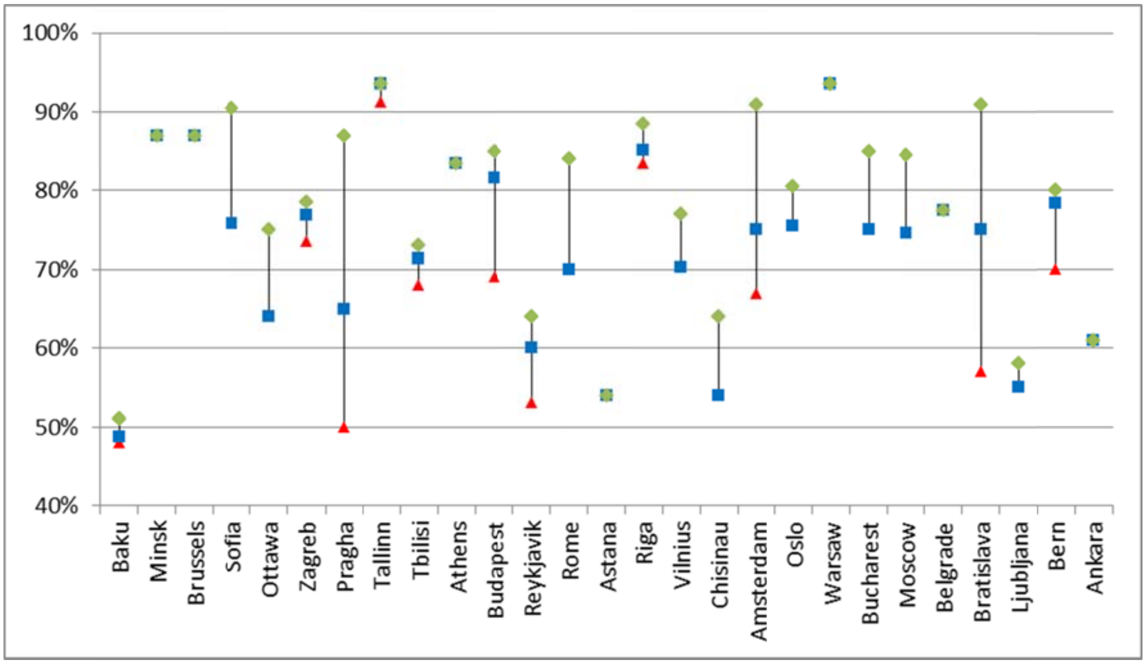
Figure 4.1. Quality of urban public transport in ECE capitals



Source: ECE

In a number of cases, however, due to incomplete data, the quality can vary substantially in plus or in minus from that presented, especially for a few capital cities, in particular Amsterdam, Bratislava or Prague. Assuming a best case scenario – the missing data would show positive results – only seven capitals would fall below a line of a mark of 75 per cent. In the opposite case there would be 16 capitals below that mark (figure 4.2.).

Figure 4.2. Possible deviation in quality of public transport in ECE capitals, 2011



Source: ECE

While the quality of public transport in the majority of cases is relatively good, weak points of the systems exist everywhere. When they are addressed, significant further improvement of public transport services can be achieved. All this seems to be feasible with just a little effort.

A number of ECE capital cities stand out in minus with regard to the public transport options provided if regarded vis-à-vis cities of similar population or metropolitan area size. Among them are Astana, Baku, Ljubljana, Ottawa, Prague and Tbilisi (ref. to figure 2.15.).

When it comes to accessibility of public transport: length of the network, number of stations, places (sitting and standing) capacity, frequency and speed, certain capitals offer comparatively less accessible network. Among them are, especially, Baku, Bern, Bucharest, Moscow, Tbilisi, Zagreb (ref. to figures 2.17., 2.19., 2.20., 2.21.). With the exception of Baku, all these cities and a few more: Athens, Belgrade, Brussels, Rome and Sofia provide public transport transfers at comparatively low speed (ref. to figure 2.22.).

With regard to comfort offered by public transport and assessed based on indicators such as: bus average age, availability of ITS, options for ticket purchase and vulnerability to traffic congestion (expressed as decrease of bus speed during peak hours), a few capitals seem to offer relatively modest comfort: Ankara, Baku, Belgrade and Chisinau (ref. to figures: 2.23., 2.24., 2.26. and 2.31.). There are a few more capitals that provide public transfers with relatively old bus fleet: Astana, Budapest, Yerevan and Vilnius. Some other capital cities do not offer ITS for passenger information with any or the majority of the public transport modes available: Minsk, Riga and Yerevan.

Regarding safety of public network, even if it is relatively safe everywhere, certain capitals, among them: Ankara, Astana, Athens, Brussels, Budapest and Warsaw had a number of injuries and fatalities well above other capitals (ref to figure 2.38.).

The quality of public transport service and the demand for it can be also regarded in the context of fares set for the service. Certain capitals may benefit from decreasing the fares to attract more passengers to a good quality service provided. Some others may think of increasing the fares to invest into the quality improvements.

Two capitals: Oslo and Zagreb, which provide relatively high quality public transport service, though achieve relatively low demand, offer the service at high price comparatively to citizens' income (ref. to figures: 2.51. and 2.52.). Four capital cities: Ankara, Astana, Chisinau[37], Ljubljana and Tbilisi, whose public transport is of moderate quality but at relatively low price compared to income, also achieve only modest passenger volumes. In the first case, the decrease of the fare price may attract more passengers. In the second case, the increase in fare, hopefully allowing for raising investments into improving the quality of service, may not affect the demand volume, while the improving quality service in a medium term may attract new passengers.

The change of the fare should be regarded in the context of service profitability. While the cost-recovery has not been reviewed in this project, in the number of capitals the providers offer the services with comparatively many more employees than the others thus less efficient: Athens, Chisinau, Riga and Zagreb (ref. to figures: 2.55. and 2.56.). In a number of capitals the employees hired for administration and fleet and infrastructure maintenance account for a great share of all employees: Chisinau, Moscow, Riga and Tbilisi (ref. figure 2.59.).

The cost-recovery can be further linked with the efficiency of fleet use. In a number of capitals, however, the fleet is not that efficiently used, with often more than 40 per cent of the fleet staying in depots: Ankara, Baku, Chisinau, Riga, Tbilisi and Zagreb (ref. figures: 2.60., 2.61. and 2.62.).

Furthermore, a good quality public transport at a competitive fare may be attracting moderate volumes of passengers, if the road capacity can accommodate well the private cars i.e. travel at relatively high speeds while enough parking capacity is provided and no extra fees are charged. In a number of capital cities this seems to be the case: Amsterdam, Ankara, Dublin, Oslo, Reykjavik and Tallinn (ref. to figure 2.30.).

At the same time, for some cities, the roads may be less congested due to high use of bicycles for city transfers, especially for shorter trips, e.g. in Amsterdam and Oslo (ref. to figure 2.47.).

4.2. Recommendations

The ECE capitals may consider the following recommendations when looking for ways to further increase the sustainability of their urban transport system.

Quality and safety of public transport:

[37] Chisinau achieves relatively high demand for its public transport service, however, nearly half of it is generated by the private mini buses service

1. Public transport should preferably offer more than one option of service, while the offered options should be well interconnected with each other.

The introduction of additional mode of public transport might help in attracting new passengers to using the public transport service, in particular when a mode offering high capacity and transferring at relatively high speed is placed along a frequently used commuting corridor.

2. Public transport should offer the adequate accessibility.

The length of the network, number of stations, frequency of operation and place capacity should be designed in a way that allows for a satisfactory ride time door-to-door or nearly, while the journey is comfortable, i.e.:

- The stations will be easily reachable, including by bicycle or car in suburbs or by walking, i.e. also offering as part of the station's infrastructure an adequate parking capacity
- The ride time will be perceived as quick: i.e. no long stops at the stations or at traffic lights.
- Enough sitting or standing capacity allowing for a comfort zone for every passenger.

3. Public transport should offer transfer at speed above 20kmh for bus, trolley and tram service and above 30kmh for metro and urban train service.

The speeds below the recommended levels may not allow public transport to compete with travel by car. To this end, on-ground modes should use dedicated lanes on congested roads and be given priority at roads intersections.

4. Public transport should offer adequate comfort, including clean, low-floor and air-conditioned vehicles, real-time information displayed for passengers in vehicles and at the stations and various passenger-friendly options of ticket purchase, including e.g. s purchase through mobile services and internet.

Comfortable public transport system with easily accessible vehicles is an attractive option for every group of potential customers, whether with physical limitations or a parent with pram. The availability of real-time information, clean and heated / air-conditioned vehicles may help to attract passengers that otherwise would prefer taxi service. The easy-access to tickets will make the use of the public transport overall more satisfactory, especially if no time is lost unnecessarily in queues to kiosks or ticket machines.

5. Public transport should be safe limiting the risk of injuries or fatalities as well as of theft or harassment to nearly zero.

Safety can increase by providing public transport service with vehicles equipped with the latest safety technology, while its infrastructure should be separated from the other motorized vehicles through availability of public transport dedicated lanes, in particular on the most used roads. Safety inside of the vehicles should be increased by introduction of ITS.

Traffic congestions and pollution:

6. Road capacity for private motorized transport should be decreased in city centres, which can be easily accessible by the public transport. Instead the existing road capacity should be dedicated to on-ground public transport modes, bicycles and widened pedestrian zones.

The decreased road capacity for private motorized vehicles and good accessibility with public transport would discourage the use of private cars for transfers to city centres.

7. It can make a difference when congestion fees are introduced on the high traffic corridors to city centres while park-and-ride infrastructure is made available in the suburbs to allow for easy intermodal connection.

The undercharged roads create a heavy demand for road space that otherwise would be distributed differently. Therefore, while access possibilities should be ensured also by private motorized transport, it should be charged for transfers at the cost it creates, including air pollution. At the same time, park-and-ride infrastructure should allow for easy intermodal travel car-public transport from suburbs or metropolitan vicinities to the centre.

Cycling and walking

8. Cycling and walking should be encouraged through availability of adequate and safe infrastructure, especially for short trips.

Cycling and walking gives the very much needed physical activity to citizens. Therefore it helps to improve citizens' health directly. Furthermore, by replacing or limiting the car travel it also contributes to decreasing air pollution from transport, hence affects the citizens health also indirectly.

To attract citizens to cycling and walking, the infrastructure should be separated from the motorized transport infrastructure and safe intersections provided. It should also be convenient and hence prioritize walking and cycling at road intersections: shorter waiting times, on-ground passages.

9. Cycling and walking should be encourage in connection with public transport for longer trips

Safe and convenient pedestrians and cycling roads should provide easy connections to public transport stations. For the cyclist, the stations should provide adequate parking infrastructure for bicycles.

Affordability of urban transfers

10. Fares for public transport use should be set at the level taking into account the profitability of the operation and the average income of the population.

The public transport should be offered at the fare level that would allow an average citizen to use the service so that the right to urban transfers and mobility and accessibility to markets is not limited to him or her. At the same time, however, in order to keep public transport providing a high quality of service, fares should be calculated at the level to ensure as much cost-recovery as possible. In turn, , the costs should be properly managed. Also additional sources of income should be sought: advertising revenue or license fee from business activities at the main stations. It is essential that public transport gets financial support even to their operating costs through compensation for public transport services or even through subsidies. For investment into infrastructure the additional source s of income can be the supplementary property tax or betterment levy, etc.

Table 4.1.Scores on quality of public transport

Name of the country	Name of the capital city	PT modes options[a]	PT accessibility					PT comfort				PT safety
			PT length[b]	PT stations[b]	Capacity (sitting and standing places) [b]	Operation frequency (bus service) [b]	Travel speed (bus and tram service)[a]	Bus average age[a]	Availability of ITS for passenger information[a]	Availability of options for ticket purchase[b]	Decrease of travel speed during peak hours[a]	Injuries in PT modes[b]
Armenia	Yerevan	1	n.a.	n.a.	n.a.	n.a.	n.a.	0	0	1	n.a.	n.a.
Azerbaijan	Baku	0	0.5	0.5	0.5	n.a.	1	1	0	0.5	0.5	1
Belarus	Minsk	1	1	1	1	1	0.5	1	0	1	1	1
Belgium	Brussels	1	1	1	1	1	0.5	1	1	1	0.5	0.5
Bulgaria	Sofia	1	1	1	n.a.	n.a.	0.25	n.a.	1	0.5	1	n.a.
Canada	Ottawa	0.5	1	0.5	0.5	1	1	1	1	1	0	n.a.
Croatia	Zagreb	1	0.5	0.5	0.5	0.5	0.25	1	0.5	n.a.	1	1
Cyprus	Nicosia	0	n.a.	n.a.	n.a.	n.a.	n.a.	0.5	0	0.5	n.a.	n.a.
Czech Republic	Pragha	0.5	0.5	n.a.	n.a.	n.a.	n.a.	n.a.	1	1	n.a.	1
Estonia	Tallinn	1	1	1	1	1	0.75	0.5	1	1	1	1
France	Paris	1	1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Georgia	Tbilisi	0.5	1	0.5	0.5	0.5	0.5	1	0.5	n.a.	1	1

Name of the country	Name of the capital city	PT modes options[a]	PT accessibility					PT comfort				PT safety
			PT length[b]	PT stations[b]	Capacity (sitting and standing places) [b]	Operation frequency (bus service) [b]	Travel speed (bus and tram service)[a]	Bus average age[a]	Availability of ITS for passenger information[a]	Availability of options for ticket purchase[b]	Decrease of travel speed during peak hours[a]	Injuries in PT modes[b]
Germany	Berlin	1	0.5	1	n.a.	n.a.	0.5	n.a.	n.a.	n.a.	n.a.	n.a.
Greece	Athens	1	1	1	1	1	0.75	0.5	1	0.5	1	0.5
Hungary	Budapest	1	1	1	1	1	n.a.	0	1	1	n.a.	0.5
Iceland	Reykjavik	0	n.a.	n.a.	0.5	0.5	1	0.5	1	1	0.5	1
Ireland	Dublin	1	n.a.	n.a.	1	1	1	1	1	1	n.a.	n.a.
Italy	Rome	1	0.5	1	n.a.	n.a.	0.5	0.5	0.5	1	1	n.a.
Kazakhstan	Astana	0	1	0.5	0.5	1	1	0	1	0.5	1	0.5
Latvia	Riga	1	1	1	1	1	0.75	n.a.	0	1	1	1
Lithuania	Vilnius	1	1	1	0.5	1	1	0	0.5	n.a.	0.5	1
Moldova	Chisinau	1	1	0.5	1	0.5	1	0.5	0	0.5	0	n.a.
Netherlands	Amsterdam	1	n.a.	0.5	0.5	0.5	n.a.	1	1	1	n.a.	n.a.
Norway	Oslo	1	1	1	0.5	1	0.75	n.a.	0.5	1	0	1
Poland	Warsaw	1	1	1	1	1	0.75	1	1	1	1	0.5
Romania	Bucharest	1	0.5	0.5	1	0.5	0	1	1	1	1	n.a.

Name of the country	Name of the capital city	PT modes options[a]	PT accessibility					PT comfort				PT safety
			PT length[b]	PT stations[b]	Capacity (sitting and standing places) [b]	Operation frequency (bus service) [b]	Travel speed (bus and tram service)[a]	Bus average age[a]	Availability of ITS for passenger information[a]	Availability of options for ticket purchase[b]	Decrease of travel speed during peak hours[a]	Injuries in PT modes[b]
Russian Federation	Moscow	1	0.5	0.5	1	1	0.25	1	1	0.5	1	n.a.
Serbia	Belgrade	1	1	1	0.5	1	0.25	0.5	1	0.5	0.5	1
Slovakia	Bratislava	1	0.5	0.5	0.5	n.a.	n.a.	n.a.	1	1	n.a.	n.a.
Slovenia	Ljubljana	0	1	0.5	0.5	n.a.	0	0.5	1	1	0.5	1
Switzerland	Bern	1	0.5	0.5	0.5	0.5	0.5	1	n.a.	1	0.5	1
Turkey	Ankara	1	1	0.5	0.5	0.5	1	0.5	0.5	0.5	0	0.5
United Kingdom	London	1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

[a] *evaluation span 0 to 1 where 0.5 or 0 are given respectively for performance slightly below or below other peer cities,*

[b] *evaluation span 0.5 to 1 where 0.5 or is given for performance slightly below other peer cities,*