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Commission for Territorial Cohesion Policy and EU Budget

COTER

The challenges for public transport in metropolitan regions

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It does not represent the official views of the European Committee of the Regions.

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Abbreviations

AI	Artificial Intelligence
ARI	Acute respiratory infection
BEUR	Billion Euro (French/German “Milliard(e)”)
CAM	Connected and Automated Mobility
CIL	Community Infrastructure Levies
CNG	Compressed Natural Gas
EC	European Commission
ETA	Estimated time of arrival
EV	Electric vehicle
FFPT	Free-fare public transport
FUA	Functional urban area
GDP	Gross Domestic Product
GHG	Greenhouse gas
GPP	Green Public Procurement
ILI	Influenza-like illnesses
IRU	International Road Transport Union
IT	Information technology
KPI	Key performance indicator
LNG	Liquefied natural gas
LOST	Local Option Sales Taxes
LPG	Liquefied Petroleum Gas
LRA	Local and Regional Authorities
MEUR	Million Euro
MIT	Motorised Individual Traffic
MLG	Multi-level Governance
MS	(European Union) Member State
PPE	Personal protective equipment
PSC	Public service contract
PSO	Public service obligations
PUT	Public Urban Transport
SERA	Single European railway area
SUMP	Sustainable Urban Mobility Planning
UITP	Union Internationale des Transports Publics (International Association of Public Transport)
ZET	Zero emission transport

Executive summary

The File Note focuses on public transport in metropolitan regions, one of the core competences of Local and Regional Authorities (LRAs). It starts with analysing the role of LRAs in green public transport and integrated urban planning. Then, specific urban planning aspects are considered: spatial planning needs for alternative fuels infrastructure, linkages with intermediate and rural areas and the use of public space for mobility. Funding of public urban transport (PUT) as well as social aspects of mobility complement the analysis.

Basic requirement for the effective governance of Functional Urban Areas (FUA) and development of Sustainable Urban Mobility Plans (SUMPs) are fair and concise agreements between the concerned LRAs and other institutions. Best practice for the governance of metropolitan public transport remains the Public Transport Association ("Verkehrsverbund") model with integrated transport planning, timetabling and ticketing, harmonised fares and revenue-sharing among the operators, common quality control and advertising.

Rail-bound modes will remain the backbone of municipal public transport in metropolitan areas, as this is the only means of transportation with sufficient capacity for mass transportation at viable environmental and external cost. They will be complemented by a bus feeder network. Options for the first/last mile include taxis, park/bike & ride facilities, car-sharing, ride-sharing and bike-sharing, as well as Mobility on Demand. In addition, active mobility like walking or cycling needs to be fostered in the cities.

For local co-financing of public transport, a variety of options exist, often combined with steering effects towards more environmentally friendly modes of transport. Exclusively revenue-financed PUT is usually not the best option. The reason is that the positive external effects of PUT outweigh the subsidies, which are necessary and motorised individual traffic (MIT) also receives subsidies, albeit hidden ones. Free PUT opens interesting possibilities for increasing the use, and enhancing social inclusion, but definitely needs more research on impacts.

Connected and automated mobility (CAM) based on battery-electricity or hydrogen-based propulsion systems might become an additional option partial alternative in the future; however, currently it is not clear which technology will prevail and if and when CAM will be rolled out to a wider use. IT will play a crucial role, be it for transportation system planning, asset and fleet monitoring and traffic control or for transport users.

All questions of mobility are currently overshadowed by the COVID-19 Event with potentially game-changing, though still largely unclear, consequences. A longer duration of the crisis will probably favour car use with its lower risk of contagion over PUT. In the wake of the crisis, resilience of transport systems might become an issue, favouring diversity of systems and IT-based monitoring.

1. Introduction

The present File Note focuses on public transport in metropolitan regions, one of the core competences of Local and Regional Authorities (LRAs). It highlights expected challenges and opportunities and aims to contribute to a planned opinion on the "challenges for public transport in metropolitan regions", to be drafted by Adam Struzik (PL/EPP).

Structure of File Note

First, the File Note deals with the policy context, focusing on the role of LRAs in green public transport and integrated urban planning (**Chapter 2**). Then, specific urban planning aspects are highlighted: how spatial planning needs to be adapted to the deployment of alternative fuels infrastructure, linkages with intermediate and rural areas as well as the use of public space for mobility (**Chapter 3**). **Chapter 4** deals with financing aspects of public urban transport (PUT). The social aspect is addressed in **Chapter 5**, analysing topics of service quality, social inclusion and free public transport. **Chapter 6** sums up the findings in a series of conclusions.

A common thread is the role of LRAs for urban mobility, especially in:

- Running municipal public transport operators,
- Contributing to the changes needed in the transport system towards green mobility,
- Designing and providing mobility as a service.

The impact of factors such as urbanisation, ageing population, accessibility requirements, new technological possibilities and customer communication on the provision of public transport by LRAs has been taken into consideration throughout the File Note.

Timing and Methodology

The Draft File Note was prepared between April 15 and May 12, 2020. The present final version was completed by May 28, 2020. The work was based on desk research. As main sources of information, EU legislation, studies and publications, commissioned by EC and other bodies, official statistics and published material on case studies were analysed and evaluated.

2. The policy context

The role of the local and national level in the provision of the right policy environment for multi-modal public passenger transport. How to reconcile policy objectives in light of the COVID-19 crisis?

2.1 Background – The challenge

The transport sector is the largest single emitter of GHG in the EU (24.6% in 2017 with a rising trend (EC 2019: 127)). Transport plays the central role for attaining the EU key climate and energy target for 2030 of 40% reduction in greenhouse gas (GHG) emissions as compared to 1990[1]. With 74% urban population, Europe is one of the most urbanised parts of the world[2]. There are more than 99 metropolitan regions with more than one million inhabitants in Europe (Cox 2013). These figures help pointing out the crucial role of urban transport for the EU climate strategy.

Rail is clearly the most environmentally friendly transport mode with the lowest external cost; it is also most efficient in terms of land use, capacity and safety. With a 2017 modal share of passenger transport of 8.3% (rail, tram and metro), rail transport only produced 0.5% of GHG emissions caused by transport, with a decreasing trend (EC 2019: 48 resp. 135). 40% of the electricity used by EU railways comes from low-carbon sources and 20% from renewables (CER 2018: 5).

In line with the subsidiarity principle, decisions on urban transport are taken by the regional and national levels, depending on the competencies in the respective Member State and usually executed at local level. Public urban transport is a paradigmatic example of multilevel governance (MLG). The legal background partly refers to the EU level, partly to the national level, partly to LRA level. Transport and spatial planning at city and regional level has to be integrated into national transport master plans that in turn have to take the relevant European legislative framework like the trans-European transport network (TEN-T) or clean vehicles into consideration. However, the main part of funding usually comes, directly or indirectly, from the national level, in some Member States strongly supported by EU funds and complemented by local income sources.

[1] https://ec.europa.eu/clima/policies/strategies/2030_en

[2] https://ec.europa.eu/knowledge4policy/foresight/topic/continuing-urbanisation/developments-and-forecasts-on-continuing-urbanisation_en

The main EU policy levers are:

- **Legislation**: pertinent provisions include the PSO Regulation[3] and Public Procurement Directive[4] as basis for public urban transport (PUT), TEN-T Regulation[5], Interoperability Directive[6] (standardisation of technical rail components, obligatory for main lines), SERA Directive[7] regulating the governance of main line rail, Clean Vehicles Directive[8], Alternative Fuels Infrastructure Directive[9]. The legislative initiatives of the EC have often been consolidated into packages. Four "Railway Packages" have been adopted since 2001[10], gradually establishing a Single European Railway Area. The three "Mobility Packages" proposed in 2017/18[11] are in major parts still under discussion; pending points are e.g. the revision of the Eurovignette Directive from the First Mobility Package in May 2017[12] and the revision of Regulation (EC) 1073/2009 on common rules for access to the international market for coach and bus services from the Second Mobility Package in November 2017[13].

[3] Regulation (EC) No 1370/2007 of the European Parliament and of the Council of 23 October 2007 on public passenger transport services by rail and by road.
[4] Directive 2014/25/EU of the European Parliament and of the Council of 26 February 2014 on procurement by entities operating in the water, energy, transport and postal services sectors.
[5] Regulation (EU) No 1315/2013 of the European Parliament and of the Council of 11 December 2013 on Union guidelines for the development of the trans-European transport network.
[6] Directive (EU) 2016/797 of the European Parliament and of the Council of 11 May 2016 on the interoperability of the rail system within the European Union.
[7] Directive 2012/34/EU of the European Parliament and of the Council of 21 November 2012 establishing a single European railway area.
[8] Directive 2009/33/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of clean road transport vehicles in support of low-emission mobility.
[9] Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure.
[10] https://ec.europa.eu/transport/modes/rail/packages_en
[11] A quick overview can be found under https://www.iru.org/where-we-work/europe/europe-overview/european-commission-mobility-package.
[12] Proposal for a Directive of the European Parliament and of the Council amending Directive 1999/62/EC on the charging of heavy goods vehicles for the use of certain infrastructures, COM/2017/0275 final - 2017/0114 (COD).
[13] Regulation (EC) No 1073/2009 of the European Parliament and of the Council of 21 October 2009 on common rules for access to the international market for coach and bus services, and amending Regulation (EC) No 561/2006 (recast).
Proposal for a Regulation of the European Parliament and of the Council amending Regulation (EC) No 1073/2009 on common rules for access to the international market for coach and bus services, COM/2017/0647 final - 2017/0288 (COD).

- **Strategic** initiatives like the recent Green Deal Communication[14] or the Declaration on Cycling as a climate friendly transport mode, adopted during an informal meeting of EU ministers for Transport in Luxembourg (10/2015).

- **Funding**: European Structural and Investment Funds, Connecting Europe Facility, Horizon Europe.

However, external trends strongly impact on transport sector governance. Digital media enable citizens to plan their own routes, leading to a loss of influence of central transport planning and traffic control systems. Impact and consequences of the "Black Swan" event in the form of the COVID-19 pandemic are currently unpredictable; however a severe recession has to be expected: The IMF output forecasts for 2020 are for the Euro area -7.5%, for the largest EU economies DE 7.0%, FR -7.2%, IT -9.1% (IMF 2020: ix)[15]. However, a major uncertainty remains: Will lockdown and restrictions caused by the COVID-19 Crisis lead to higher readiness to accept strong political intervention into personal freedom, supporting the transition to a greener economy? Or, if mass unemployment cannot be avoided, will a strong backlash push all environmental considerations aside for the years to come?

2.2 Reconciling policy objectives

In light of the recent events, this section focuses on two policy goals that have come up during the COVID-19 Crisis:

- Health issues of PUT;

- Resilience of municipal transport systems in case of component failures, supply failures, natural disasters, terrorist attacks.

[14] Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, The European Green Deal, COM(2019) 640 final.

[15] The EC Spring 2020 Economic Forecast, published shortly before the editorial deadline of the draft, shows similar figures: Euro area -7.7%, DE -6.5%; FR -8.2%; IT -9.5% (EC 2020:1).

2.2.1 Health

The Eltis[16] Topic Guide on health aspects of SUMPs lists five main health problems caused by road transport (Davis 2019: 41):

- Air, and noise emissions
- Physical inactivity
- Accidents
- Impact of traffic in public space on wellbeing
- Health inequalities

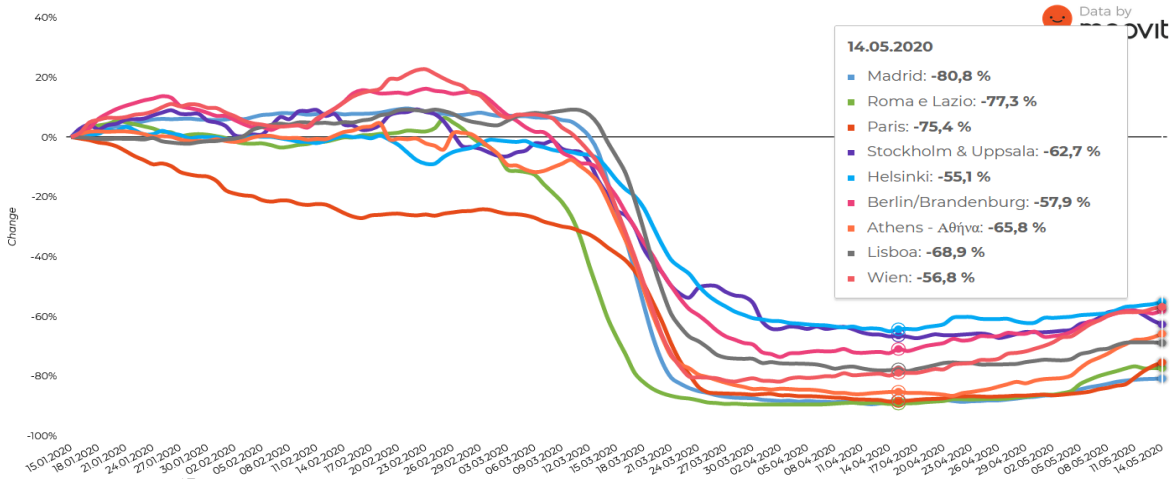
All these risks can be mitigated by a modal shift from MIT to PUT. The Topic Guide points out that health-related measures in urban transport tend to have a highly positive cost-benefit ratio as compared to expensive infrastructure measures. Measures should be developed in close cooperation with public health authorities (Davis 2019: 41). However, the Topic Guide does not mention a major transport-related health risk where individual transport, especially MIT, has a clear advantage over PUT, namely the risk of contagion.

Several studies in the past years have dealt with contagion risk in PUT. A 2011 case-control study used results gained during the influenza season 2008/2009. It found that tram or bus use within five days of symptoms onset was associated with an almost six times higher risk of consulting a general practitioner for acute respiratory infection (ARI), with occasional users being slightly more affected – probably due to them developing less antibodies as compared with regular users (Troko 2011). A 2011 model simulation based on data from the influenza pandemics of 1957/58 estimated that 4% of influenza transmissions in New York would happen in the subway (Cooley 2011). A 2018 study focused on the London underground and used Oyster Card data. It found a strong correlation between influenza-like illnesses (ILI) and the use of public transport "*Confined and crowded environments that people visit in their day-to-day life (such as town squares, business districts, transport hubs, etc) can act as hot-spots for spreading disease.*" (Goscé 2018).

During the current COVID-19 Pandemic, worldwide PUT ridership has been reduced by 70-90% (Rubiano 2020).

[16] Eltis, an Urban Mobility Observatory funded by the EC, publishes 'Topic Guides' as comprehensive planning recommendations for mobility-related topics (https://www.eltis.org/mobility-plans/topic-guides-and-practitioner-briefings).

Figure 1. Evolution of public transport ridership in select European capitals between January and mid-May 2020



Source: Moovit[17].

Jeffery Harris (Massachusetts Institute of Technology) recently published a study identifying the New York subway system as a main spreader of the COVID-19 pandemic (Harris 2020). Methodology and results were contested by several other transport experts (e.g. Furth 2020; Litman 2020). However, the simple fact remains that the exclusive use of a passenger car is by far the safest mode of travel during a pandemic crisis and a longer duration of the Crisis will favour car possession and MIT[18]. In this way, the COVID-19 Crisis poses a severe challenge for the environmentally friendly PUT in its competition with private car use.

Possible solutions not based on the use of private cars could lie in[19]:

- Fostering non-pollutant individual transport modes like walking or cycling (see example in the box below);
- Masks, partition walls and regular disinfecting and airing of taxis and shared cars;
- Steps toward social distancing in PUT: warning signs as reminders, obligatory masks to protect other passengers – close collaboration with health authorities, also for clarifying the responsibility for enforcement in order to avoid liability claims in case passengers do not cooperate;

[17] https://moovitapp.com/insights/en/Moovit_Insights_Public_Transit_Index-countries

[18] The severe and, from the current point of view, potentially catastrophic economic consequences might also call for increased car manufacturing and subsidised car sales in countries where the economy strongly relies on automotive industries as a measure to combat rising unemployment (e.g. a measure taken by DE and AT during the financial crisis in the last decade).

[19] Cf. UITP 2020.

- Provision of disinfectants at PUT stations, as it is already the case in Southeast Asian metro systems;

- Regular cleansing, disinfecting and, most important, airing of PUT rolling stock. The latter is, however, difficult with modern rolling stock where the windows cannot be opened and which rely on air conditioning that could further help spreading the disease. At least the filters would need regular cleaning at short intervals;

- More spacious stations and interiors of vehicles enabling social distancing; as a first step service intervals could be shortened in order to offset lost capacity from spatial restrictions within the vehicles;

- Financial support from LRAs or the state to compensate for reduced fare revenues; measures could include compensation of operating costs, but also tax exemptions, liquidity support, moratoria on debt repayment or interest-free loans – EU action might be required to ensure compatibility with the existing legal framework[20];

- Campaigns in order to restore trust, pointing out preventive sanitary measures taken by PUT operators, and eventually also reduced fares;

- Protection of PUT staff with personal protective equipment (PPE);

- UITP also mentions the possibility of measures to identify infected passengers, from thermal detection over data sharing with other authorities to tracking apps; the implementation of such measures raises questions of enforcement, funding of investment and data protection and would require close collaboration with other responsible authorities.

Box 1. Temporary cycling lanes in Milan as response to COVID-19 pandemia

In response to the COVID-19 Crisis, on 21.04.2020, the Municipality of **Milan (IT)** announced its "Strade Aperte" plan establishing temporary cycling lanes, widened pavements, 30 km/h speed limits and pedestrian and cyclist priority streets. In this way, it is hoped to curb private car use after easing the lockdown measures. Citizens were expected to avoid crowded PUT, since social distancing requirements will only allow metro trains to run on 30% capacity. Air pollution is a major concern of Milan residents and was considered (although not proven) as a reason for the high mortality from COVID-19 in the region[21].

[20] Mainly PSO Regulation (EC) 1370/2007 and Public Procurement Directive 2014/25/EU.

[21] https://www.theguardian.com/world/2020/apr/21/milan-seeks-to-prevent-post-crisis-return-of-traffic-pollution https://www.thelocal.it/20200421/milan-announces-major-expansion-of-cycle-paths-and-pedestrian-routes

2.2.2 Resilience

As the 2017 Expert Group Report on transport infrastructure points out, the basic challenge posed by resilience considerations in PUT systems is that the necessary redundancy in the systems will almost automatically require additional infrastructure and therewith increase GHG and carbon emissions. The Expert Group proposes the development of a common EU tool for the assessment of transport infrastructure vulnerability to disasters in order to determine best practice. In this way, LRAs that usually lack the relevant capacity could profit from joint research and predefined standards. Advanced IT-based traffic monitoring systems can at least help in detecting traffic disruptions at an early stage in order to quickly start remedial action (Dalton 2017: 23-26).

A solution to the challenge of resilience of transport systems lies in diversity. The transport system as a whole needs a mix of mass modes and individual modes, road-based and rail-based, human-powered (and maybe even animal-powered) as well as motorised modes. The latter ones also need diversity with a variety of propulsion systems – not only battery-electric but also hybrid, hydrogen, liquid gas and for some time to come realistically also gasoline/diesel/kerosene combustion – provided by large and small, private and public operators or by the citizens themselves.

2.3 Measures to promote investment into green public transport

The main focus of this section is on possible measures by LRAs to enable public transport operators to invest in green public transport. Green public transport encompasses transport by rail, tram, metro and electrical or hydrogen-powered buses. Human-powered transport like cycling or walking is also environmentally friendly.

It is evident that expanding urban and peri-urban light rail, tram and metro is a major long-term investment for metropolitan areas. Key factors to promote investment in these systems are a stable multi-annual financing framework and the clear political will to support the investment in the long run. Stable multi-annual frameworks usually mean agreements between several tiers of government, i.e. between national, regional and local levels on investment plans and subsidies to operation.

In contrast to rail-bound urban transport, bus transport offers a more flexible option for network expansion since initial investment cost is much lower (e.g. for

servicing suburban and peri-urban regions with lower population density and a need for more flexible timetables). Municipal buses currently run mostly on gasoline or diesel; therefore, electrification of buses would have a strong impact on urban environment, especially on air quality. The visibility of municipal electric buses could also help promote mobility with less emissions. (Mourey 2019: 29). Main levers to guide environmentally friendly investment decisions for urban transport are considerations of environmental aspects in key legal provisions:

- Procurement for purchase of vehicles – mainly relevant for urban bus services;
- Public Service Contracts (PSC) – mainly relevant for railway and regional bus services.

For transport in metropolitan areas different legal provisions apply and it is important to note that it is not yet mandatory in most EU countries to make environmental aspects a key criterion, neither in procurement nor in PSC.

Public procurement of goods and services represents 14% of EU GDP. Environmental criteria in public procurement could therefore contribute to an increase in the share of environmentally friendly vehicles and thus reduce emissions from transport (Mourey 2019: 38).

The BuyZET Handbook[22] lists six categories of municipal procurement in relation to transport (Clement 2019: 5):

- Vehicles: the municipal road fleet mainly comprises buses, but also passenger cars, lorries, utility vehicles;
- Transportation services;
- Other services with a transportation-related ecological footprint: cleaning, catering, plumbing, locksmith etc;
- Goods: purchase of products that need to be delivered;
- Construction;
- Non-transport relevant procurement.

[22] "BuyZET – Procurement of innovative solutions for zero emission urban delivery of goods and services" is a Horizon 2020-co-funded research project to develop innovative procurement plans for the participating cities. http://www.buyzet.eu/

Box 2. The BuyZET approach for LRA

The **BuyZET approach** for LRAs (Clement 2019: 24-30)

Step 1. Mapping of procurement transportation emissions.

Step 2. Prioritisation according to the criteria meaningfulness (i.e. size of the footprint), feasibility, visibility, snowball effect (encouraging suppliers to also serve other clients with zero emission vehicles.), political priorities (local political focus and/or sensitivities, e.g. in relation to certain economic sectors,), contract management planning (when contracts need to renewed or extended), budgetary significance.

Step 3. Market dialogue with suppliers in order to assess feasibility and effectiveness.
Step 4. Buyers groups together with other major public (e.g. universities, hospitals) and private sector buyers for increasing impact and reducing cost.

Step 5. Procurement plans based on the findings of the previous steps.

Next to procurement PSCs have the potential to be an essential driver towards the greening of public transport.

The EU legal background for public urban transport are the PSO Regulation (EC) 1370/2007[23] and the Public Procurement Directive 2014/25/EU[24].

According to Regulation (EC) 1370/2007, passenger bus and rail transport has to be carried out and subsidised via public service contracts (PSC) that the competent authorities[25] conclude with undertakings. PSCs are either publicly tendered out or, under certain conditions, directly awarded. They define public service obligations (PSO), compensation payments, exclusive rights granted and how costs and income from ticket sales are distributed.

[23] Regulation (EC) No 1370/2007 of the European Parliament and of the Council of 23 October 2007 on public passenger transport services by rail and by road.
[24] Directive 2014/25/EU on procurement by entities operating in the water, energy, transport and postal services sectors.
[25] "*any public authority or group of public authorities of a Member State or Member States which has the power to intervene in public passenger transport in a given geographical area or any body vested with such authority" (Regulation (EC) 1370/2007, Art. 1b)*).

If tendering procedures relating to PSCs include conditions requiring the greening of transport, it is important to take account of provisions concerning avoidance of discrimination and fair competition[26].

Art. 5a of Regulation (EC) 1370/2007 allows the introduction of vehicle pools for rail rolling stock to ensure non-discriminatory access to suitable rolling stock for tenderers. According to the Commission Guidelines on State aid for railway undertakings[27], subsidised rail rolling stock may only be used for urban, suburban or regional transport in a certain region and must be part of a coherent regional development strategy[28]. The vehicle pools mentioned in Regulation (EC) 1370/2007 are explicitly restricted to rail rolling stock. It is worthwhile considering an extension to hydrogen or electric buses in order to provide a possibility to foster environmentally friendly vehicles without distorting competition.

Public transport by tram or metro is not regulated by Regulation (EC) 1370/2007 but by Directive 2014/25/EU[29]. Above a certain threshold these services must have a contractual basis. If the public authority issues a call for tender, it may not discriminate among the applicants[30]. It is possible to include quality, social and environmental criteria into tenders (Art. 82). Tender assessments based on a life-cycle cost approach may include external costs into the assessment if they can be monetarised (Art. 83).

The Clean Vehicles Directive[31] applies in cases of contracts under both Regulation (EC) 1370/2007 and Directive 2014/25/EU. It defines MS-specific procurement targets for the share of clean buses[32] (half of them actually zero-emission buses). In this respect it is worth noting that since 2010, the European Commission has been collecting good practice examples of GPP (Green Public Procurement)[33].

[26] I.e. conditions for green public transport have to be the same for all competitors.
[27] Communication from the Commission - Community guidelines on State aid for railway undertakings.
[28] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=LEGISSUM:tr0004&from=EN
[29] Directive 2014/25/EU on procurement by entities operating in the water, energy, transport and postal services sectors.
[30] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=LEGISSUM:240602_2&from=EN.
[31] Directive 2009/33/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of clean road transport vehicles in support of low-emission mobility.
[32] I.e. buses fulfilling certain defined emission targets.
[33] European Commission, GPP Good Practice https://ec.europa.eu/environment/gpp/case_group_en.htm

Box 3. EU-supported procurement of electric buses in Ostrów Wielkopolski (PL)

The Municipal Transportation Company of **Ostrów Wielkopolski (PL)**[34] has been implementing a project on replacing its old buses with more environmentally friendly vehicles. Besides six Euro 6 diesel buses, six further zero emission electric low-floor city buses, together with a battery charging system and equipped with braking energy recuperation, were procured in June 2019 and will be in operation from August 2020 onwards. Annual mileage of 70,000 km as well as an operating range of 130 km had to be guaranteed by the manufacturer. The electric buses are estimated to reduce average CO_2 emissions per bus by 76.6 tonnes; in this way, the city will save ca. 460 tonnes of CO_2 p.a. The project was co-financed from the European Regional Development Fund (ERDF) under the Wielkopolska Regional Operational Programme for 2014-2020.

2.4 Integrated urban planning

Integrated urban planning refers to a range of approaches which mainly focus on the following aspects:

- Introduction of more comprehensive models for urban planning;
- Consideration of agglomeration areas from a functional perspective (see below) in order to plan and run all kinds of public utilities more efficiently (public transport, water and waste management, etc.);
- Development of government and governance models to tackle the rising number of planning issues, as well as the recurring challenges of vertical coordination (in the sense of MLG) and horizontal coordination (for cross-sector issues such as urban energy management or waste management).

In the context of urban transport planning it is important to understand two key approaches:

- Functional Urban Areas (FUA);
- Sustainable Urban Mobility Plans (SUMP).

[34] Miejski Zakład Komunikacji S.A. - MZK

The concept of **Functional Urban Areas** (FUA)[35] is important since it relates to more efficient models for urban governance. A FUA includes a city together with its commuting zone (Dijkstra 2019: 5). The concept dates back to the 1980s when, for instance, first cities in DE started to establish associations with surrounding communities in order to provide more efficient solutions for many types of public utilities. Other countries have introduced similar approaches aiming at more efficient governance of metropolitan areas.[36] Evidently, public transport and interconnections between regional and city transport have been one of the major issues in that respect.

Sustainable Urban Mobility Planning (SUMP) is a European urban transport planning concept. It was defined in an Annex of the EC's Urban Mobility Package of 2013[37]. *"A Sustainable Urban Mobility Plan is a strategic plan designed to satisfy the mobility needs of people and businesses in cities and their surroundings for a better quality of life. It builds on existing planning practices and takes due consideration of integration, participation, and evaluation principles."* (Rupprecht 2019: 9). There are two key requirements for setting up a SUMP (Rupprecht 2019, 11-12):

- Cooperation across institutional boundaries:
  - in transport policy *per se* and with other policies like land use and spatial planning, social services, health, energy, education, enforcement and policing,
  - involvement of different government levels: district, municipality, agglomeration, region and state,
  - with other public and private institutions as providers of public transport.
- Involvement of citizens and stakeholders: participatory planning to determine the mobility needs of
  - Residents and visitors,
  - Institutions and companies.

[35] A statistical concept has been developed by OECD and EC in order to achieve a harmonised definition of a city's area of influence, enabling international comparisons. OECD, Functional urban areas by country. https://www.oecd.org/cfe/regional-policy/functionalurbanareasbycountry.htm

[36] E.g. FR in its adminsitrative reform in 2014 when the statute of metropolises had been set in order to improve adminstration and governance of major conurbations.

[37] Together towards competitive and resource-efficient urban mobility - Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and The Committee of the Regions, COM(2013) 913 final, 17.12.2013.

The main challenges in achieving effective SUMP in metropolitan areas are (Rupprecht 2019: 25):

- The large number of administrative entities encompassed by FUAs (e.g. 55 in Bologna, 18 in Lisbon);

- The lack of vertical cooperation between municipal, regional and national governments; different government levels have to be included, the district and municipality levels, where the measures usually are implemented, but also regional and national levels, which are competent for ports, main line railways or motorways;

- The lack of horizontal cooperation between policies of government departments, sectoral departments and agencies responsible for transport, land-use and spatial planning, economic development, social affairs, environment, health and energy;

- Diversity of political views between the administrative entities requiring ways to find a consensus based on a harmonisation of interests and leading to an agreement between the parties involved.

These challenges result in unfavourable conditions due to:

- Unclear competencies,
- Insufficient awareness and commitment of decision-makers,
- Absence of coordinated and sustained funding.

The last one is obviously a key impediment to integrated urban planning approaches and thus also for sustainable mobility as one of the key pillars of it. Long-term investment plans for public urban transport require stable institutional and financial cooperation frameworks. And such frameworks should be based on longer-term agreements between different tiers of the governments in order to:[38]

- secure the funding for financing gaps in operation as well as for investment;

- underpin a stable regulatory framework for sustained cooperation between key institutional partners (such as transport operators, urban planning departments, authorities in charge of land-use and zoning plans in surrounding municipalities etc.).

[38] See (Chinellato 2019: 10-17).

Next to having these proper institutional key mechanisms in place, it is important that approaches to integrated urban planning duly consider participatory approaches. Citizens' participation can help to identify e.g. efficient solutions for 'First/last mile questions' in transport networks (e.g. attractive solutions for pedestrians and cyclists) or for new schedules during periods of low demand (night time, summer time etc.). Also, communication has become crucial in raising the degree of acceptance for restrictive planning measures. Visions, strategies and measures have to be communicated to the public via means of communication fitting the different interests involved (Chinellato 2019: 36).

3. The urban planning aspect

Access restrictions and use of public space for mobility / linkages with intermediate and rural areas.

3.1 Alternative fuelling infrastructure

In order to reduce the ecological footprint of mobility, various types of alternative fuels are currently under consideration, mainly LNG[39], LPG[40], CNG[41], hydrogen and battery-based electric propulsion. It is not yet clear which technology will prevail. All these different technologies require different fuelling infrastructures. This section deals with the challenge of how to integrate them into a city without cramping narrow space like pedestrian routes or creating double or triple infrastructure. The main EU legal basis is Directive 2014/94/EU on the deployment of alternative fuels infrastructure.

From the point of view of urban planning, there are two basic types of alternative fuelling infrastructure: electric charging infrastructure, and infrastructure for refuelling liquid gases resp. hydrogen.

The main electric charging infrastructure targets are:

- Municipal fleet, especially buses;
- Private vehicles, especially passenger cars.

Charging options for municipal electric buses are (Mourey 2019: 30):

- Overnight charging at depot,
- Fast charging at stops,
- On-route charging (when the bus is run as a trolleybus on a part of the line),
- Using existing electric infrastructure as shown in the example below.

[39] Liquefied Natural Gas.
[40] Liquefied Petroleum Gas.
[41] Compressed Natural Gas.

Box 4. Example for Electric infrastructure in Oberhausen (DE)

An example is the Horizon-2020-cofunded research project "ELIPTIC - Electrification of public transport in cities "[42] that focuses on the optimisation of existing electric infrastructure and rolling stock. One of use cases is **Oberhausen (DE)**, where the existing tramway catenary is used for fast charging electric buses (Mourey 2019: 30).

Electric charging stations for private cars comprise (Mourey 2019: 33-34)

- Private spaces like overnight charging in residential buildings or charging during the day on company parking areas: EVs are mostly bought by people that have such personal charging facilities at their disposal. They provide an important policy lever for LRAs via building codes, advice and subsidies. Directive (EU) 2018/844 on the energy performance of buildings, Art 8, requires a minimum number of charging points in new or renovated buildings.

- Semi-public spaces, e.g. customer car parking.

- Public space, either open (on street) or closed (e.g. municipal parking garages). Public chargers are only used for 5% of charging processes; however, their visibility may play a certain role in promoting EVs. There is an important opportunity for regulatory influence of cities: policy levers are planning frameworks like parking regulations, building/zoning codes, land use/development plans; evidently, public chargers should not narrow space for pedestrians and cyclists as the key means of 'green' transportation.

Box 5. Example for a demand-based system in Amsterdam

An example for a demand-based system can be found in **Amsterdam (NL)**. EV users without private charging stations can ask the municipality to permit the installation of a public charging point nearby (Mourey 2019: 34).

The Joint Research Centre has developed a methodology for planning an electric charging network (Gkatzoflias 2016). However, future requirements will depend on technical developments of battery charging capacity, charging duration and frequency.

[42] https://www.eliptic-project.eu/

Concerning other alternative fuels (liquid gases and hydrogen), the best option will be using existing infrastructure (fuelling stations) that also meet safety requirements. It is important to note that the electrification of individual means of transport poses new safety risks. The considerable fire hazard of electric vehicles (EV) needs to be taken into consideration and standards for thermal management of batteries[43] will become an increasingly important issue the more electric vehicles populate the public urban road space. Fire hazard concerns all types of EV, i.e. e-cars, e-bikes[44] and e-scooters.

3.2 Interlinkage of urban and surrounding rural areas

The challenge is the integration of the linkages with intermediate[45] and rural areas within the functional area of the metropolis into urban planning in order to promote a modal shift. The SUMP Guidelines for metropolitan regions include both, the city core and the commuter flows. In an integrated planning that would not be possible with individual municipal SUMPs in a larger FUA (Chinellato 2019: 16).

Best practice remains the German "Verkehrsverbund" (Public Transport Association) model as introduced in the 1960s. It is similar to '*integrated public passenger transport services*' according to Art. 2 (m) of Regulation (EC) No 1370/2007 on public passenger transport services by rail and by road: "*interconnected transport services within a determined geographical area with a single information service, ticketing scheme and timetable*".

[43] Thermal management of batteries is important in order to prevent so-called thermal runaway, a dangerous reaction associated with lithium-ion batteries.
[44] According to the Austrian automobile club ÖAMTC charging e-bike accumulators in private apartments would require a one-meter distance from all inflammable objects around (including furniture); this however reduces the practical value of e-bikes in cities where many people live in small flats, however where they would be most useful as an alternative means of transportation.
[45] Intermediate regions - regions that are neither rural nor urban and which are composed of small and medium-sized towns (cf. www.oecd.org)

Box 6. Hamburg Public Transport Association

The **Hamburg Public Transport Association** (Hamburger Verkehrsverbund GmbH, HVV) was established in 1965 as the first "Verkehrsverbund" worldwide.

Today it is organised as a Limited Liability Company according to German Law ("GmbH") with three Federal States and seven Administrative Districts as shareholders. HVV organises public transport by bus, ferry, tram, metro, light rail and main line rail in the Hamburg FUA as provided by some 25 different operators[46].

Services of HVV are (HVV 2016: 16-17.).

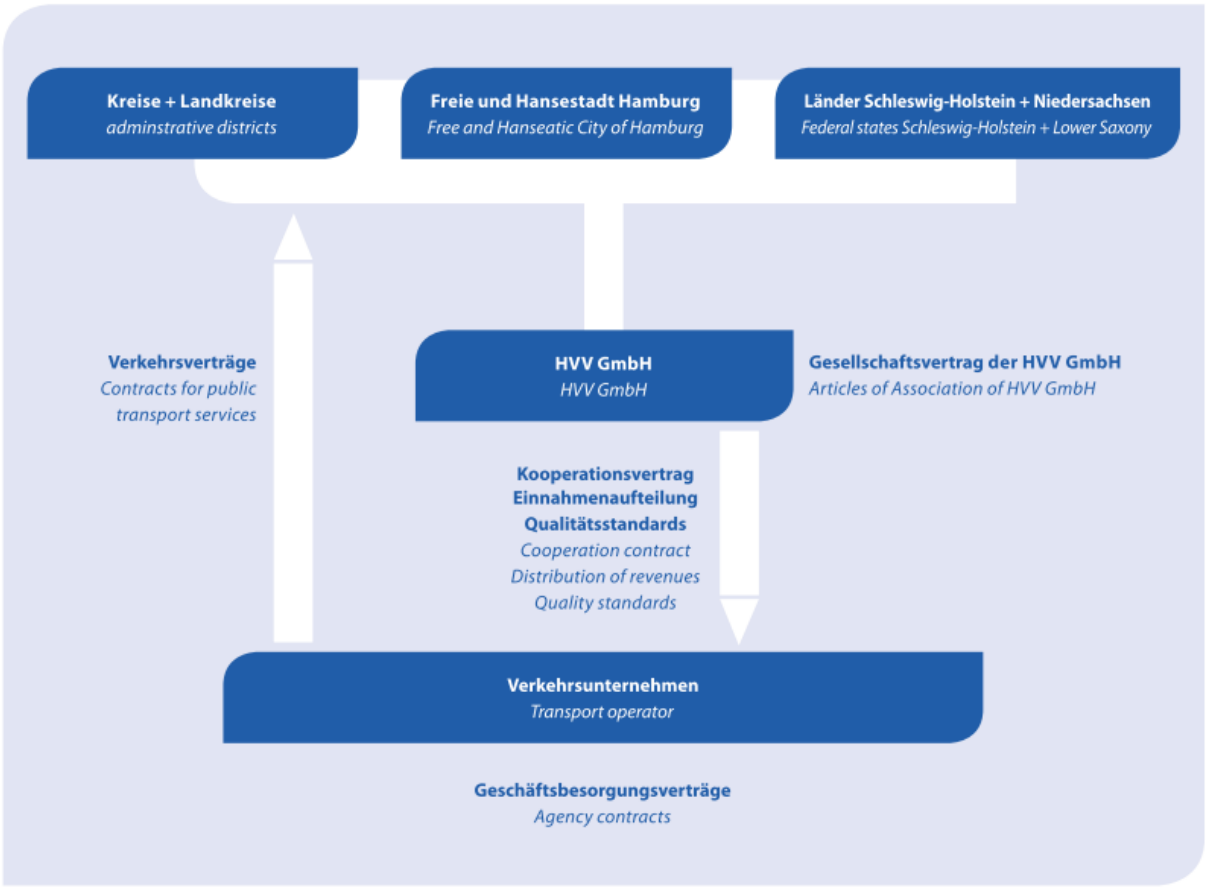
- Basis for service planning are the regional public transport plans of the administrative districts and federal states.
- Integrated timetabling.
- Tendering procedures for PSCs on behalf of the Public Transport Authorities.
- Unified ticketing and fare system based on fare stages and rings, sales via various channels.
- Common corporate identity and marketing; information management.
- Joint quality standards set out in the cooperation contract (especially punctuality, cleanliness and security), quality assessment base on regular customer satisfaction surveys, financial incentives for overfulfilment.

Funding is provided in the following ways (HVV 2016: 13):

- Fare revenues are largely pooled by HVV and shared among all the operators according to actual demand, only a small amount remains with the actual operator;
- Statutory financial compensation for subsidised transport of schoolchildren and people with special needs;
- Deficits are reimbursed either by the owners of the operators, on the basis of PSCs or via subsidies.

[46] Hamburger Verkehrsverbund. https://www.hvv.de/de/ueber-uns/der-hvv/uebersicht

Figure 2. Contractual setup of the Hamburg Public Transport Association



Source: Hamburger Verkehrsverbund (HVV 2016: 10).

This example shows that the integration of city, metropolitan and regional transport is less of a technical issue and more a question of governance. The development of efficient and effective governance models depends mostly on the management models applied by the transport operators as well as the intergovernmental funding/subsidy schemes for public transport. The development of new services requires adequate planning tools (such as for modelling of transport flows) and solid funding arrangements.

3.3 Public space and universal access

Public space requirements per person for individual transport are considerable and much higher than for Public Urban Transport (PUT) (Randelhoff 2014): at 30 km/h one person requires 65.2 m^2 for passenger car transport and 41 m^2 for

cycling as opposed to 8.6 m^2 for bus and 5.5 m^2 for tram/light rail (PUT calculated with only 20% seat capacity utilisation!). Walking at 4 km/h requires appr. 0.95 m^2 per person. Taking such figures into consideration, efficient use of scarce public space in metropolitan areas would call for access restrictions on individual transport modes, especially private cars.

Since the appropriate types of measures and examples of implemented measures are known, the present section focuses on issues of political feasibility and acceptance by population. Road access restrictions are a widely discussed policy to reduce motorised individual traffic (MIT) and foster PUT and active forms of mobility like cycling or walking. They are, however, not without subjective and objective risks. Parking fees can be unpopular and citizens' reactions to parking restrictions can be fierce. Parking restrictions (usually in conjunction with other factors like high rents) can drive citizens, especially young families, into suburbs leading to empty city centres and MIT commuting. The COVID-19 Crisis highlighted the risk of contagion in PUT. If movement restrictions and periodic lockdowns continue for the years to come, they will probably strongly favour MIT in private cars, which are safer from a personal health safety point of view.

According to the SUMP Guidelines, one major challenge for achieving political commitment lies in the fact that the benefits of the measures take longer than an electoral cycle to become visible. Therefore, it is advisable to include small-scale measures with high visibility into the SUMP that help generating public support in the short term, e.g. temporary street closures for spare time activities or temporary cycle paths separated by flowerpots (Rupprecht 2019: 32).

Box 7. A new pedestrian Zone in Ljubljana (SI)

An example cited by the SUMP Guidelines is from **Ljubljana (SI)**, where on the occasion of the European Mobility Week 2013, Slovenska Street in the centre was closed for all motorised traffic during a four-month period as a step towards introducing a new pedestrian zone. CO_2 levels dropped by 70% for several months. The related improvement of air quality and noise level led to positive feedback from the public. Based on this, by September 2015 the street had been permanently transformed into a pedestrian zone with new urban furniture and green space that is only accessible by PUT, cyclists and pedestrians (Rupprecht 2019: 158).

4. The financial aspect

Who pays for the greening of transport?

4.1 Revenues from public transport

In practically all European cities, PUT is subsidised, however at a widely varying level (e.g. Hanover 15%, 50% Stockholm, 68% Den Haag) (Cats 2017). Should public transport be financed through fare revenue only and if so at the cost of possible reduction in services?

Box 8. Covering costs of PUT through real estate revenues in Hongkong and Melbourne

An interesting example is **Hongkong (CN)** where real estate revenues from properties upgraded by proximity to PUT stations cover the cost of PUT, bearing in mind that, in a system where private real estate ownership is not possible, ticket sales alone would only cover 20 % of costs. However, when MTR Hongkong took over the public transport in **Melbourne (AU)**, privatisation did not lead to the expected reduction of subsidies to zero but to an increase of subsidies by 60 % combined with very low user ratings of service quality (Knoflacher 2020: 25-27).

There are several arguments against public transport being exclusively financed from revenue. PUT is subject to marked network effects: potentially profitable metro/tram/rail main lines need the bus feeder services with low frequency in the suburbs or rural areas in order to provide area coverage.

Observations show that well-functioning Northern European metropoles usually have highly subsidised, dense, well-used rail-based PUT networks, i.e. there seem to be strong positive macroeconomic effects associated with such networks. Three of the four highest placed cities in Mercer's 2019 quality of living city ranking, Vienna, Zurich and Munich (Mercer 2020), are Central European metropolitan areas with dense PUT networks and high PUT modal share.

Box 9. PUT and quality of life

1. **Vienna (AT)**: PUT cost coverage 50-60%[47]; PUT modal share 2019: 38%[48].
2. **Zurich (CH)**: PUT cost coverage ca. 50%, varying between 30% and 100% according to line[49]; PUT modal share 2019: 41%[50].
3. **Munich (DE)**: claims 100% cost coverage of PUT operations through revenues as only German metropole (Schlesiger 2013); however, network expansion still needs to be publicly financed[51]; PUT modal share 2019: 24%[52].

These three examples also show a clear correlation between the degree of PUT subsidisation and modal share in three very similar cities. PUT modal share of Vienna and Zurich is among the highest in the world (for comparison: Singapore 44%[53]).

The high external cost of Motorised Individual Traffic has to be taken into consideration in a macroeconomic cost-benefit analysis: private cars are *de facto* highly subsidised. Based on a model developed by the University of Kassel (DE), external cost per trip leg in Munich are EUR 0.36 for passenger cars, EUR 0.11 for cycling (mainly accident costs), EUR 0.04 for PUT and EUR 0.03 for walking (Schürmann). Subsidies are a major area of LRA involvement and a lever in integrated planning and efforts for greener and socially equitable mobility.

In the past years, ideas have come up that that CAM-based MIT (Connected and automated mobility-based motorised individual traffic) will make mass PUT obsolete in the long run. This is, however, difficult to imagine given the sheer capacity of a metro or tram system and the mobility requirements in a densely populated metropole. Tramways are able to transport more than 6,000 passengers/hr per direction (Guerrieri 2019), metros more than 30,000 (ERRAC: 4). Under ideal conditions (80-100 km/h, regular driving) that are rare in European metropoles, road capacity is 1,500 to 2,500 vehicles per lane per hour (Pfnier 2015). Urban all-purpose roads are able to carry between 750 (narrow, busy high street, 50 km/h) and 2,000 vehicles (wide, mainly through-traffic route

[47] https://wien1x1.at/site/wie-finanziert-sich-der-oeffentliche-verkehr-in-wien/, https://www.diepresse.com/4707043/stadt-zahlt-500-mio-euro-pro-jahr-fur-wiener-linien.
[48] https://www.wienerlinien.at/eportal3/ep/contentView.do/pageTypeId/66528/programId/67199/contentTypeId/1001/channelId/-47395/contentId/68061
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[53] https://www2.deloitte.com/content/dam/insights/us/articles/4331_Deloitte-City-Mobility-Index/city-mobility-index_SINGAPORE_FINAL.pdf

with limited access, 65-100 km/h) per lane per hour under ideal conditions (TfL: 2-3). With a realistic average of 1.5 persons per car (Bundestag 2018) this amounts to ca. 1,100-3,000 persons per hour per lane. Even in case of three lanes in each direction this is still only a fraction of the capacity of a metro system.

4.2 Creation of local funding sources

If PUT remains dependent on public subsidies, how can LRAs contribute to the funding of public transport through the creation of local funding sources? Increased value of real estate by PUT connections[54], benefits for companies profiting from increased access to work force as well as compensation for the additional cost generated by traffic from newly developed residential or business areas can serve as basis for local revenue sources.

Box 10. Creation of local funding sources in Seattle, Switzerland and Île-de-France

"Versement Transport" in **Île-de-France (FR)**, introduced in 1971, is a tax for all employers with more than 11 employees, calculated as percentage of the wages paid. It is used to co-finance PUT operations in the region (42% in 2017) (Werland 2019 : 18;Knoflacher 2020 : 22).

The **Swiss LSVA** (Leistungsabhängige Schwerverkehrsabgabe; redevance poids lourds liée aux prestations - RPLP) is a road toll system for heavy-duty vehicles covering all types of roads that were introduced in 2001. The system is based on the calculation of external cost and its major part is used for funding large Alpine-crossing rail tunnel projects (ARE 2015).

Seattle (US) introduced a "Local Improvement District" tax on real estate owners to fund South Lake Union Streetcar in Seattle. The tax was agreed beforehand with local businesses and real estate owners and contributed USD 25 m to the total project cost of USD 56.4 m[55].

The Eltis Topic Guide on SUMP financing and funding provides a detailed list of potential local funding sources (Werland 2019: 14-22).

[54] For Ottawa (CA), a decrease of real estate value of CAD 12-49 per meter of distance from the next PUT station has been calculated (Knoflacher 2020: 26).
[55] https://www.fhwa.dot.gov/ipd/project_profiles/wa_slu_streetcar.aspx

Table 1. Local funding sources

Source	Description	Remarks
Project-related income	Fares or other revenue sources, e.g. lease of advertising space in vehicles or stations, fares, but also real estate income like rents or leaseholds, shop sales	Available at operations stage (i.e. at earlier stages, additional financing arrangements are necessary); can cover part of the operations cost.
Pricing of individual car use	Direct charge for the use of infrastructure such as parking or road space: differentiated road charging for peak/off-peak hours, congestion charges, environmental charging, parking fees	User-pays or polluter-pays principle to recover external cost; impact transport demand.
Road pricing, congestion charges	Originally, charge on the use of specific infrastructure, e.g. motorway, bridge or tunnel, often in the framework of a concession agreement with a private operator; recently extended to city areas and road networks based on zone pricing or distance and time-based charging systems	Strong impact on reducing the volume of traffic and encouraging modal shift.
Cross-payments, ring-fenced taxes/fees like heavy goods vehicles charging schemes	Mostly at national level; however, municipal roads could also be included, with revenue sharing.	See above the Swiss LSVA as example.
Parking management	Usually targeting visitor parking. Adequate provisions for residents (e.g. reasonably priced annual permits in combination with a reduced parking pressure) increase citizen acceptance.	Important lever for reducing individual car use and encouraging modal shift. Availability of cheap parking space may render PUT investment ineffective.
Employers‘ contributions	Dedicated taxes on public and private employers for expanding, maintaining resp. operating PUT.	See above the French “Versement Transport” as example.
Value capture instruments	Wide array of instruments to capture at least a part of the additional value generated by PUT investment from key beneficiaries, e.g. property owners, land developers.	▪ Stamp duty land tax (UK, since 2003) ▪ Mobility taxes ▪ Voluntary capture, based on an agreement between developers LRA concerning a voluntary contribution

Source	Description	Remarks
		▪ Development Charges, Planning Obligations, Community Infrastructure Levies (CIL) ▪ See above the example from Seattle (US).
Local Option Sales Taxes (LOST)	Based on a referendum, LRAs in US levy a surcharge on sales taxes for a limited period of time, earmarked for funding transport projects.	Assessment of compatibility with MS law is required.
City bonds	Municipal or city bonds with fixed annual interest rate and time frame for repayment, to finance transport infrastructure or services. Green city bonds committed to use of the capital for environmentally sustainable mobility projects, e.g. procurement of e-buses or tramway extension.	Debt instruments to unlock investment capital for expenditures yielding immediately capital for the issuer while repayments can be extended over a time period of approx. 20-30 years.
Public-private partnerships (PPP)	Private partners are repaid either by contractual repayments or entitled to user charges / fares under a long-term concession arrangement, handing over the asset to the public authority after expiration of the concession contract.	Means of leveraging of private funds for upfront funding of capital-intensive infrastructure projects with most of the costs incurred during the construction phase and revenue generation only after commissioning.

Source: Werland 2019.

Low-emission mobility could receive dedicated support via measures like purchase subsidies, registration tax benefits, ownership tax benefits, company tax benefits, VAT and other financial benefits or local incentives for electric vehicles. In this way, electric resp. low-emission vehicles could be exempted from congestion charges or parking restriction systems; at least as long as the share of these vehicles is low and the business case is negative for private owners as compared to conventional vehicles (Mourey 2019: 37).

It should not be forgotten that LRA-owned rail projects generate revenues to the infrastructure manager via the infrastructure charges stipulated in Directive 2012/34/EU establishing a single European railway area. These fees are intended to cover "*the cost that is directly incurred as a result of operating the train service"* (Art. 31.3) and may not be zero. In this way, LRAs have the possibility to recover at least part of the cost of managing LRA-owned main line rail infrastructure.

5. The social aspect

A socially inclusive and high quality public transport system for all

5.1 Measures to improve service and ensure accessibility

The quality benchmark for PUT services is the private car providing seamless, sheltered and comfortable door-to-door transport. There is a wide array of aspects to be taken into consideration. These include governance aspects (integrated planning), commercial aspects (ticketing), technical aspects (rolling stock, stations, IT) and psychological aspects (safety including health issues, security, image/status).

Measures to improve customer service of PUT include:

- Inclusion of quality criteria into PSCs based on measurable key performance indicators (KPIs). In the case of public transport associations, quality criteria are usually part of the service contracts. Public transport associations, operators or LRAs should carry out regular customer satisfaction surveys and "mystery riding" to monitor quality.

- IT-based journey planning, traffic monitoring and travel information: Big Data, Intelligent Transport Systems, Mobility on Demand, ETA based on real-time data can all contribute to pinpointed planning of PUT in order to mimic the versatility of MIT.

- Crucial is 'first/last mile transport' as a complement of mass PUT for trunk lines (rail/tram/metro). Park & ride or bike & ride facilities are an obvious option for rural areas. Mobility on Demand could provide service for the 'first/last mile' while also potentially increasing vehicle utilisation. Important are additional ordering possibilities that do not depend on smartphone use (e.g. via accessing drivers or station/security personnel) in order to keep the system accessible for older persons.

- Integrated ticketing systems between modes and operators according to the "Verkehrsverbund" (public transport association) model: could eventually include taxis, Mobility on Demand, ride-sharing, car-sharing and bike-sharing; ticketing based on prepaid smart cards, credit cards, bank cards or smartphone apps.

There is no one-size-fits-all solution. Solutions combining measures such as those mentioned above will depend on various factors. Moreover, the service level offered will depend on the economic means of the municipalities and other public authorities, the alternatives available and the expectations/requirements of the customers.

5.2 Free public transport

The concept of free-fare public transport (FFPT) services has been in the public debate for decades, yet there is only limited data on the effects of a full-fledged FFPT. However, there are a few examples which provide evidence on the **consequences of FFPT** and allow a discussion on positive macroeconomic effects as well as on whether FFPT leads to a higher modal share of PUT.

Free public transport in Tallinn

Public transport in Tallinn has been free for registered residents since 2013, hence Tallinn is the first capital in the EU and with ca. 445,000 inhabitants[56] the largest city in the world so far to provide free public transport to its citizens. Overall, the case of Tallinn provides a unique opportunity to analyse the impacts of FFPT[57].

As a consequence of the implementation of FFPT, the number of registered Tallinners increased significantly. This was, indeed, the aim of the LRA, since stimulating the registration of inhabitants as residents of Tallinn would increase the municipal income tax – which in turn should cover the lost ticket revenues. It was estimated that each registered resident contributes approximately EUR1,000 in annual municipal tax. Hence, if more than 12,000 non-registered Tallinn inhabitants were to register themselves in order to benefit from the new policy, then the increased municipal tax collection could compensate for the lost ticket revenues. *"There's no doubt that we not only cover the costs, but also come out with a surplus"*, Allan Alaküla, Head of Tallinn European Union Office and official spokesperson for the project, told Pop-Up City (Schröter 2018).

Almost a year after the introduction of FFPT, **public transport usage** – which was already at a high level – **increased by 14 %** from 55% to 63%. The increase was especially high among age groups 15–19 and 60–74, people with a very low income (up to EUR 300 net/month) and people who are out of employment and education, who are the most sensitive to price. However, there is mixed evidence

[56] https://worldpopulationreview.com/world-cities/tallinn-population/
[57] Main sources for the Talinn case study were Cats 2017 and https://www.tallinn.ee/eng/freepublictransport/About-free-public-transport-in-Tallinn

AS TO whether FFPT improved mobility and accessibility of low-income and unemployed residents, since it rather had a trip generation effect and there is no indication that employment opportunities improved as a result of this policy.

As opposed to this, the share of public transport trips performed by very high-income group (above EUR 1,000/month net) decreased substantially, possibly due to image and crowding issues.

To sum up, the introduction of FFPT in Tallinn led to an increased public transport usage, an improvement of mobility for low-income residents as well as a significant increase in the satisfaction with public transport. However, the modal shift from car to public transport was accompanied by a shift from walking to public transport and an increase in car traffic[58]. FFPT therefore led to a **trip generation rather than substitution effect**.

Long-term effects of free public transport remain to be assessed, since Tallinn might not be able rely on increasing tax revenues by attracting new residents alone in the future[59].

Free public transport in Luxemburg and feed-back from the Brussels region

On 1 March 2020, **Luxembourg** made its public transport free of charge. The strategy is to reduce traffic congestions in a country with the highest share of cars per person. "*We anticipate that mobility needs will increase by 20% by 2025. We should be able to cope with this increase by continuously expanding public transport.*"[60] Compared to other European countries, Luxembourg has an insufficient public transport system and in order to raise the share of passengers, it needs more incentives (Ortega 2020). The loss of revenue has been taken into account in the national budget and, like all other services, will be financed by taxes.

A survey among commuters in the **Brussels** Capital Region has shown that 9% of the respondents would use public transport instead of their car if it would be free of charge. However, more important would be the quality of the transport

[58] "*The increase in the market share of public transport stems from a decrease of 10 % in the number of car trips and a staggering decrease of 40 % in the number of trips for which walking was the main model of travel.*" (Cats 2017).

[59] Allan Alaküla emphasisest the longevity of the project to The Guardian and says they have also been able to funnel money back to improve their networks. However, "*before the scheme started, 6,000 new residents registered annually. And while the numbers shot up to about 10,000 new registrations in the immediate years after the scheme launched, early figures Alakula has seen suggest that only 3,000 to 4,000 have registered in 2016 so far.*" https://www.theguardian.com/cities/2016/oct/11/tallinn-experiment-estonia-public-transport-free-cities

[60] https://www.mobilitegratuite.lu/en/faq/

connections. 22% would change to public transport if connections, speed and mobility would be improved. Besides, an issue mentioned in the survey is the use of company cars. Those who have a company car are significant less willing to use public transport (De Witte 2008).

Various factors need to be taken into consideration. **Improving service efficiency** as well as **disincentives for car usage** such as congestion pricing, parking fees and fuel prices might have a greater effect on modal shift than reducing public transport fares. However, high public transport costs can become barriers in the labour market. As an effect of FFPT, **enhancing social inclusion** by providing access to work for lower income and minority groups may be just as important.

6. Conclusions

Rail-bound modes will remain the backbone of municipal public transport in metropolitan areas, as this is the only means of transportation with sufficient capacity for mass transportation at viable environmental and external cost. Efficient rail-bound trunk networks will be complemented by a bus feeder network. Options for the first/last mile include taxis, park & ride and bike & ride facilities, car-sharing, ride-sharing and bike-sharing as well as Mobility on Demand.

Integrated urban planning is an important tool to foster green urban transport – a major lever towards smart and sustainable metropolitan areas. Key for the effective governance of Functional Urban Areas (FUA) and development of Sustainable Urban Mobility Plans (SUMPs) are fair and concise agreements between the concerned LRAs and institutions on:

- Urban planning and infrastructure management (land use, zoning, major public infrastructure) for FUA;
- Planning and funding of public transport systems allowing for long-term investment in trunk networks on safe grounds as the core element of SUMPs.

As an element of micro-management, which is largely in the hands of LRAs, active mobility like walking or cycling needs to be fostered in the cities.
Best practice for the governance of metropolitan public transport remains the Public Transport Association ("Verkehrsverbund") model with integrated transport planning, timetabling and ticketing, harmonised fares and revenue-sharing among the operators, common quality control and advertising. Given the number of LRAs and operators involved, such governance models have to be considered as prime examples for effective and efficient MLG.[61]

IT will play a crucial and ever-increasing role, be it for transportation system planning, asset and fleet monitoring and traffic control based on AI, Big Data, advanced sensor systems, or for transport users concerning journey planning, real-time travel information, ticketing and Mobility on Demand.

Connected and automated mobility (CAM) based on battery-electric or hydrogen-based propulsion systems might become a partial alternative in the future; however, at the moment it is not clear which technology will prevail and when CAM will actually turn into a mass phenomenon. Also, the ecological footprint

[61] Structures of Transport Associations in federal countries often mirror the structure of planning and management associations in FUAs.

of the systems may be higher than expected at present, if proper life-cycle analysis is applied. It is highly improbable that CAM will replace mass transportation modes like metro or light rail in metropolitan areas since it will not be able to meet passenger volumes during peak times.

Exclusively revenue-financed PUT is usually not the best option since the positive external effects of PUT outweigh the subsidies it requires while MIT receives hidden subsidies, too. For local co-financing of public transport, a variety of options exist, often combined with steering effects towards environmentally friendlier modes of transport. Free PUT is an option that should be taken into consideration; future studies will bring empirical evidence based on experiences from the first cities to introduce it.

At the moment, all questions of transportation are overshadowed by the COVID-19 event with potentially game-changing, though still largely unclear, consequences. A longer duration of the crisis will probably favour MIT over PUT for several reasons: the lower risk of contagion, more home office work and higher unemployment resulting in less commuter traffic, as well as awkwardness of using masks and social distancing in mass transportation vehicles.

The resilience of transport systems will become an important topic in the wake of the Corona Crisis. It will be important to strike a balance between efficiency and minimising ecological footprint on the one hand side and redundant infrastructure as buffer for external shocks on the other hand. Diversity of systems will increase the resilience of the overall system as will IT-based real-time monitoring systems.

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