EUROPEAN PARLIAMENT

Science and Technology Options Assessment

S T O A

URBAN TRANSPORT

Scoping Report

Phase I

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DIRECTORATE GENERAL FOR INTERNAL POLICIES
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SCIENCE AND TECHNOLOGY OPTIONS ASSESSMENT

URBAN TRANSPORT

Scoping Report

Phase I

Abstract

The scoping report gives a rough overview on the topics that will be addressed during the project. It gives a first impression of the most important developments and technologies that are currently evident in the transport sector. It further gives a first impression of today's political paradigms and expectations in the field of urban transport by looking at different official documents, such as transport development plans. It highlights the relevance of user habits and attitudes for the successful diffusion of sustainable innovations. All these aspects will be touched upon in the following phases in a much broader context.

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GENERAL INFORMATION

In a Draft Report on an action plan for urban mobility the European Parliament's Committee on Transport and Tourism states that the complexity and interdependence of travel systems and personal and collective modes of transport in urban areas makes a purely technical approach focussed on various modes of transport very limiting. The report emphasises the need for an integrated "urban travel systems" approach together with a "user-centred" approach taking the behaviour of the users adequately into account.

In line with these statements, this STOA project on urban transport is looking at technologies from an innovation-oriented angle. It provides an inventory of both existing and future technology options in urban transport as well as an overview of the scientific knowledge about their (potential) impacts on health and/or environment. Taking this as a basis, the project will also look at the socio-economic context in which these technologies are or will be implemented. It will analyse the knowledge about perceptions, motivations and the changeability of behavioural patterns of the actors, in particular users, which are relevant for the successful implementation of technological and organisational innovations in urban transport. The overall aim will be to highlight promising innovation pathways to a more sustainable urban transport system.

This report is Deliverable 1 of the project. It is the product of the scoping phase at the beginning of the project (phase I). In this initial phase the focus and design of the project was discussed with MEPs form the STOA panel and from the Transport Committee. Further, a first screening of relevant literature took place. The deliverable aims at giving an overview on the field of research and at sharpening the focus of the work in the following phases.

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1. BACKGROUND AND MOTIVATION

As a result of the expansion of the economy in modern societies over the past years and the improvements of general standards of living, there has been a substantial increase in the demand for transport of people and goods. An efficient transport system plays a key role for economic growth and social wealth in modern societies. Moreover, in the mean time it has become obvious that economic growth and the inherent growth in traffic volume have a trade-off relationship with the efficiency of the transport system. At the same time, the increased amount of traffic has led to a strong reduction of the quality of life because of the large environmental consequences including emissions of air pollutants and noise as well as reduced spaces for living and the segregation effects caused by the expanding transport infrastructure. So, paradoxically one of the basic pillars of today's quality of life at the same time reduces that quality. The driving force for the problems mentioned above is not only the growing amount of the general traffic volume, but especially the fast growing motorized traffic. Due to the increasing concentration of the population in cities and their suburbs and the connected process of urbanisation and urban sprawl, urban areas are suffering from the negative consequences of modern mobility patterns. 80% of the European citizens live in an urban environment. Therefore urban transport accounts for a significant part of total mobility and for an even greater proportion of its negative environmental and health effects.[1]

Urban transport is an issue that is related to a wide range of unsolved problems and challenges that needs to be tackled in order to guarantee a high level of quality of life in European cities and to make the transport system an even more efficient pillar of the European economies. More information is needed especially on the potentials of future or emerging technological developments and organisational innovations. For understanding and fully tapping these potentials, it is important to get a better understanding not only of technologies, but also of the relationship between technologies, concepts and their relationship with the different actors which are important for their successful development and implementation. [2]

A lot of progress has been made in the last years in European cities. For example, cleaner technologies have been introduced, cycling and walking have been promoted and the public transport has become more attractive in many urban areas. Still, the problems in European cities have not been solved. Urban mobility is of growing concern to citizens. Nine out of ten EU citizens believe that the traffic situation in their area still should be improved.[3] There are also gaps in knowledge that can be identified. For example the effect of measures and technologies in urban transport is sometimes difficult to predict.[4] This is underlined by many transport-related scenarios.[5]

A wide range of different technical options for transport are available especially in urban areas, such as busses, trams, cycling, walking, taxis, private cars or car-sharing systems. They all have specific requirements and implications for infrastructure. It can be observed that these requirements and implications are changing over time stimulated by technological progress in different areas.

[1] See CEC 2006

[2] See Halbritter et al. 2008.

[3] CEC 2009, 3)

[4] See Vieira et al. 2007

[5] See STOA 2008

For example it is obvious, that information and communication technologies (ICT) are gaining importance and having growing influence on the design of urban transport systems (public transport priority at intersections, public transport information, mobile phone ticketing, Car2Car communication is discussed, etc.).[6] Another central category of transport technologies are fuels and propulsion systems. For several reasons (climate change, peak oil) the need for alternatives to oil based propulsion in the next decades is being discussed.[7] So, the development of the urban transport systems strongly reflects the development of technological progress. The transport systems and their underlying technologies are changing and are changeable.[8]

Apart from the technological drivers, the development of the transport system is strongly driven by preferences, attitudes and paradigms of the various relevant actors, in particular users and transport planners, which makes transport a highly complex issue.[9] In a Draft Report on an action plan for urban mobility the European Parliament's Committee on Transport and Tourism states that the complexity and interdependence of travel systems and personal and collective modes of transport in urban areas makes a purely technical approach focussed on various modes of transport very limiting. The report emphasises the need for an integrated "urban travel systems" approach together with a "user-centred" approach taking the behaviour of the users adequately into account.[10]

Taking this complexity into account, the STOA project is looking at technologies from an innovation-oriented angle. This means looking at the entire urban transport system in its socio-economic context, taking the existing and the emerging technologies into account and considering - as far as possible - relevant stakeholders, their motivation, perceptions and behavioural patterns. The project will analyse the knowledge about perceptions, motivations and the changeability of behavioural patterns of the actors, in particular users, which are relevant for the successful implementation of technological and organisational innovations in urban transport. Technologies and innovations are needed to support a "transition" to sustainable urban transport system. However, technologies are a necessary but not a sufficient condition in this context.[11]

In a first step (Phase II), the project will provide an inventory of both existing and emerging technology options in urban transport as well as an overview on the scientific knowledge about their (potential) impacts on health and/or environment. A special focus will be put

- on the options to reduce motorised individual traffic;
- on options to strengthen public transport and other means of sustainable transport such as cycling and walking;
- on the existing knowledge on health effects of urban transport, especially regarding the effects on children under 15 years.

[6] See STOA 2009

[7] See STOA 2007

[8] See STOA 2008

[9] See Halbritter et al. 2008

[10] European Parliament 2009

[11] See CEC 2007

In order to provide for the required integrated perspective, the project will look at the visions, paradigms and expectations that are formulated in documents related to urban transport. Further, it will have to analyse the published knowledge on user acceptance and behaviour in relation to urban transport technologies and concepts. This will be supported by an empirical work conducted in phase IV. The overall aim will be to highlight promising innovation pathways to a more sustainable urban transport system.

2. CHALLENGES FOR URBAN TRANSPORT

Challenges in urban transport are well known since several decades. Most of them are mainly induced by mortised passengers and freight transport. They are regarded as being essential for the economic growth and a certain quality of live in urban areas. However, urban agglomerations in the EU face problems such as: poor air quality, traffic volumes and congestion, high levels of ambient noise, neglect of the built environment, high level of greenhouse gas emissions, social exclusion, urban sprawl and waste in space.[12]

Transport in general, and urban transport in particular are depending heavily on motorised individual transport. Passenger cars are responsible for 75% of passenger kilometres (pxkm) travelled in the EU. Car ownership per household is increasing (+ 38% in average between 1990 and 2004 for the EU 25, and between +14% and +167% per country)[13]. In urban areas there also is a high density in commercial facilities and infrastructures. As a consequence, not only passenger transport but also freight transport is significantly contributing to the problems mentioned above. Urban freight typically contributes to between 10% and 20% of urban road traffic (vehicle x kilometres) and between 20% and 25% of road space use in ruban areas (space used x hours).[14]

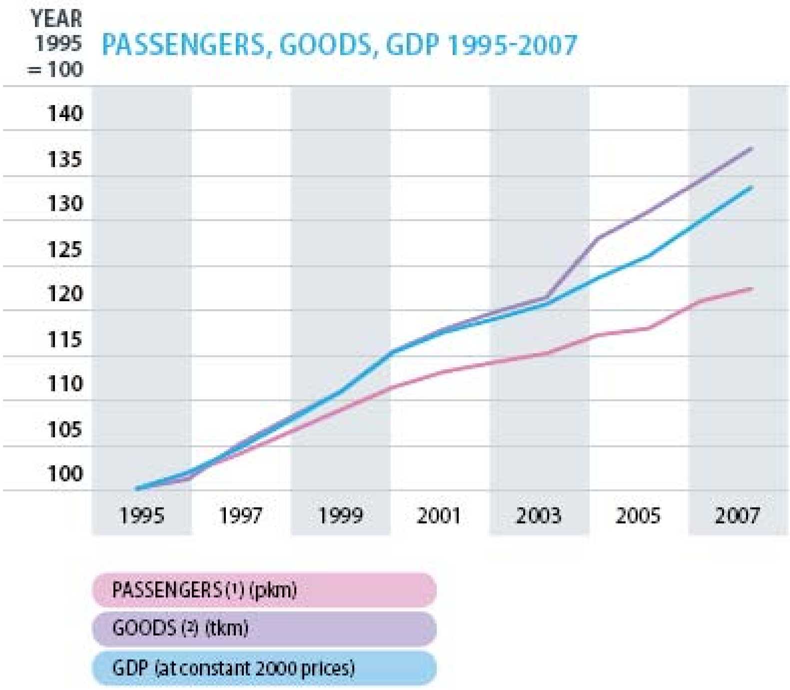

Figure 1: Total Transport Growth in EU-27
CEC 2009,P.96

[12] CEC 2007a

[13] CEC 2007a

[14] CEC 2007a

One major challenge is that congestion is reducing the functionality of the urban transport system and it increases the emission of pollutants and noise. In many cities, demand for motorised individual traffic is exceeding the capacities of the road network. Congestion takes often place on inner cities but also on urban ring roads where it affects the efficiency of the Trans-European Transport Networks (TEN-T). Every year, around 100 billion Euros, which is 1% of the EU's GDP, are lost to the European economy as a result of congestion.[15] In general, transport was characterised by intensive growth rates over the last year (see Figure 1) and is expected to further grow in future.

Another driver for increasing urban car traffic is the mutual relationship between urban sprawl and transport volume. In growing agglomerations, the distances to be travelled are increasing, leading to an increase in traffic. On the other hand, using a car enables for travelling longer distances and supports urban sprawl. The resulting distributed pattern of home, work and leisure facilities leads to an increase in transport demand.[16] In French conurbations, car traffic - measured in vehicle kilometres - from centre to the edge has increased by 83% whereas peripheral traffic has increased by 36% over a 10 year period.[17] The example illustrates that transport management and land use planning need an integrative perspective.[18]

Safety and security are also serious challenges. In 2005, 41 600 people were killed on the roads in the EU.[19] Two thirds of overall road accidents and one third of overall road deaths occur in agglomerations. In conurbations, powered two-wheelers, pedestrians and cyclists are frequently victims of road accidents where the 14-25 age group is most affected. Most accidents occur along arterial roads and at crossings due to poor road design, poor driving and excessive speed.[20]

Another serious problem caused by motorised transport are the emissions of pollutants and noise that do contribute to climate change and are a risk for human health and the environment. Since transport is responsible for about 20% of European GHG emissions it is discussed as a crucial factor in the climate change debate. CEC (2005) and other data sources illustrate that transport related GHG emissions will rise further in both, absolute and relative terms, if no trend-breaking policy is implemented.[21]

Whereas all challenges for urban transport will be considered in this STOA project, the health effects of air pollutions emitted by motorised transport should be of particular interest. There are problems induced by noise: It is suggested that around 20% of the Union's population suffer from noise levels that scientists and health experts consider to be unacceptable.[22] Concerning air quality, in recent decades a considerably reduction in air pollution can be observed in Western and Central Europe. Nevertheless, forecasts for the period up to 2010 assume that the majority of EU countries will not comply with the targets of the NEC (National Emission Ceilings) 2010 guideline for nitrogen oxide (NOx) emissions.

15 CEC 2007b

16 See CEC 2007b

17 CEV 2007a

18 See Viera et al. 2007; Banister 2008

19 CARE: Community database on road accidents.

20 CEC 2007a

21 see also STOA 2008

22 CEC 2007a, p.10

For example Germany will exceed the limits set for ammonia (NH3) emissions and will only be able to comply with the emission limits for non-methane volatile organic compounds (NMVOC) if all of the planned measures achieve their full effect and no additional emissions are caused by economic growth. Thus, ecosystems in Europe will continue to be damaged by acidification and eutrophication due in particular to nitrogen oxide (NOx) and ammonia (NH3). Human beings suffer from particle emissions and ozone. A reduction of life expectancy, a threat to the healthy development of children[23] and, by the year 2020, estimated yearly health costs of between 189 and 609 billion Euros are the consequences.

Whilst progress has been made regarding several air pollutants in Europe, one of the most striking problems are the emissions of particulate matter. According to the European Commission, Europeans live on average eight months less as a result of fine particle matter emitted into the air. The EEA[24] states that air pollution by fine particles represents the highest risk to public health in all regions, higher than that of other air pollutants. The estimated annual loss of life is significantly greater than that due to car accidents. The GEO 4 Report[25] shows that the main public health impact is caused by small airborne particles, their toxic constituents, such as heavy metals and polyaromatic hydrocarbons, as well as by tropospheric ozone. Over the last decades research interest has more centred on small particles and more exotic organic compounds that can be detected with new sophisticated analytical techniques.[26] But still, the role played by aerosols is not fully understood in particular with regard to how threshold values are defined. Their formation mechanisms, their biological potency, the dose-effect relationships, the effects when combined with other air pollutants, their acute and long-term effects as well as the basic conditions, which constitute special hazards, require further intensive research. Further there are still crucial gaps in knowledge in relation to the effects of particulate mass on human health, in particular on health of children.

[23] EEA 2007

[24] ibid

[25] GEO 4 2007

[26] Fenger 2009

3. TECHNOLOGIES AND CONCEPTS

There are basically three strategies that can be used to mitigate the various challenges mentioned above:[27]

1. Reducing transport volumes (avoidance, substitution or optimisation of trips by technologies, organisational or behavioural changes);
2. Reducing specific carbon intensity of the transport modes (cleaner fuels and propulsion technologies, improved transport flows);
3. Changing the modal split (inducing a shift of passengers and loads to more energy efficient modes of transport);

Translated into applied policy this could for instance mean: changing transport volumes could be achieved through demand management. Increasing the price of transport could have such an effect but also the concept of "cities of short distances". Improving specific carbon intensity could be realised through new propulsion technologies. A modal shift to more energy efficient transport modes requires measures that increase the competitiveness of these modes.

These three strategies are supported by innovative technologies, concepts or policies. Since transport in urban areas is organised in different modes, such as cycling, walking, motorised individual traffic or public transport, and transport demand is influenced by many different factors, there is a huge variety in technologies and concepts for improving the sustainability of the system.

In general, innovations are needed for enabling sustainable development. As it is stipulated by many authors, a focus on so called "incremental" innovations along established paths is not enough for achieving such a development[28]. For reaching demanding goals such as a significant reduction in GHG emission and a mitigation of climate change, "radical" changes are needed. It is not always easy to differentiate between a radical and an incremental innovation. However, for many subsystems of the transport sector new technologies are being discussed or are already emerging, that surely could be categorised as radical innovation. These technologies would mean a significant change for the transport system or the corresponding subsystem and they would go along with positive impacts and quality of life and the environment. In the following, a first overview is given on such technologies and organisational innovations. The selection of technologies and concepts as well as the assessment of their effects has to be further elaborated during the project.

[27] see STOA 2008; Dalkmann et al. 2007

[28] Nill and Kemp 2009

3.1. Fuels and propulsion systems

The key -element of motorised road vehicles is the internal combustion engine (ICE), which usually burns oil-based fossil fuels. It was developed and improved step by step, pushed by the dynamics and pressure of hard international competition during a time span of more than hundred years. Over this long period, heavy improvements have been made in terms of emissions and efficiency. Air quality in European cities improved remarkably, also due to new technologies such as cleaner burning processes in engines, catalytic converters or soot filters. In parallel, it was possible to improve the quality of oil-based fuels (unleaded and sulphur-free gazoline). It looks as if the conventional propulsion systems will be further improved. Important triggers are fuel prices, CO2 regulations (130 CO2/ km) and the EURO Norms.

Whereas it might be contested to what extent these improvement of conventional ICE's should be regarded as incremental or radical, it seems to be much clearer that the introduction of a new fuel-propulsion system would be a radical innovation with the potential to change the emission patterns and efficiency of motorised road transport. In the last decades, alternative fuels and propulsion technologies have been high on the agenda, on the one hand because of new technological developments (technology push). On the other hand, from a demand-pull perspective, the discussion was motivated by the prognosticated phase-out of oil; the potential impacts of climate change as well as by companies heading for competitive advantages on global markets. It should be noted that about half of all road transport fuel is combusted in urban areas. Some 98% of the transport related energy market depends on oil. Further, the European dependency on energy imports is rising. It is estimated that in the next 20 to 30 years, 70% of the Union's requirements will be met by imports, some from regions threatened by insecurity.[29] According to the NGO Transport and Environment[30] in summer 2008 the costs of oil imports in the EU exceeded €1bn per day.

A wide range of non oil-based options for road and air transport has been developed in the last decades, and some technologies are already commercialised. Five technological mainstreams are discussed, mainly in relation to passenger transport[31]:

1. Battery Electric Vehicles
2. Hybrids
3. Hydrogen and fuel cells
4. Biofuels
5. Natural Gas and LPG

All of these technologies have their advantages and disadvantages and it is currently difficult to predict which technologies will emerge as the front-runners for Europe.

[29] CEC 2007a

[30] T&E 2009

[31] JRC 2006; STOA 2007

In the mid to long term, many experts see a strong market penetration of battery electric vehicles[32]. Because of the limited range of batteries (100-150 km) this technology is in particular interesting for urban areas. 50% of all car trips in the EU are less than 5km, 30% are less than 3km.[33] Most of the car manufactures have announced ambitious goals regarding commercialisation of battery electric vehicles. For the moment it is not clear, under which conditions BEV's will be able to compete with conventional technologies. There is not that much knowledge on acceptability on the user side. For example, it would be of particular interest to see if the younger generation is more flexible in adapting their mobility patterns to new framework conditions. There are indicators that the car does not have the same symbolic value as before among young people in the city areas.[34] The driving licence rates among young people between 18 and 24 years decreased both in Norway and in Sweden. The same trend has appeared in big cities in Finland and also in the UK[35]. It is planned that the STOA Project on urban transport will have a closer look at these issues. One option for doing this would be to focus the empirical research in phase IV of this project on the perceptions and attitudes of young adults.

Hydrogen combined with fuel cells is also seen as a promising technology by many experts. This technology allows for travelling ranges around 400 km and only needs a comparatively short time for refilling. Also in this case, crucial technological problems remain unsolved, amongst them for instance questions concerning the performance of fuel cells and from where large amounts of "clean" hydrogen may be taken. Recently, the only affordable way of large-scale hydrogen production is via steam-reformation from natural gas. Hydrogen production from renewable sources (wind, photovoltaic, solarthermal, water) via electrolyses is often regarded as a kind of silver bullet since it enables close to zero emissions of greenhouse gases (GHG). Further, surplus energy from fluctuating sources (wind and photovoltaic) could be "stored" in form of hydrogen during off-peak hours. But it is not clear if, at which time, and in which regions the production of hydrogen from renewable sources will be feasible at larger scales and at reasonable costs.

Hybrid technology is currently also high on the agenda and extends its market shares. It offers a possibility to save energy and emissions by using established technologies and infrastructures. The potential of hybrid systems can be best tapped in urban areas because the driving cycle is characterised by many stop and go situation. As "hybridisation" implies an "electrification" of the drive train technology, it thus supports a more dominant role of the electric engine in general. Whatever fuel and propulsion technology will be dominant in 20-30 years, it seems to be highly likely that hybrid technology will be part of the propulsion system, at least in cars. It is conceivable that battery powered vehicles will be equipped with a range extender that allows travelling longer distances. The range extender could be a small conventional ICE that is producing electrical power. Fuel cells powered by hydrogen could also be regarded as a range extender since they produce electrical power as well.

[32] see for example acatech 2010

[33] CEC 2007a

[34]See for example: http://magazine.web.de/de/themen/auto/verkehr-service/10184876-Auto-fuer-Jugendliche-kein-Statussymbol.html

[35] see Ruud, Nordbakke 2005

Biofuels are another option to reduce the CO_2 emission from transport and to extend the feedstock for fuels. Admixtures of biofuels to conventional fuels are widespread. One of the main advantages is that the established infrastructure and, apart from minor changes, the conventional propulsion technologies (ICE) can be used. Biofuels can be derived from a wide range of biomass. So-called first generation fuels, mainly biodiesel and bioethanol, are the only renewable transport fuel option that is commercially deployed toady on a broader scale. Second generation biofuels are produced by chemical synthesis, in most cases from synthesis gas which is then treated in a so-called "biomass-to-liquid" process (BTL). A decisive benefit of BTL is the opportunity to define the properties of such "designer fuels" by setting the synthesis parameters; engine and fuel can be very well adjusted to each other. For second generation biofuels the whole plant or other forms of biomass can be used to produce fuel, in contrast to the production of "first generation" biofuels where only parts of the plants (oil, sugar, starch) are used. Biogas as well has the potential to contribute to climate and energy security. Blends with natural gas are imaginable. In general, the usage of biomass as an energy carrier is discussed highly controversial. In particular imports of biomass might go at the expense of both food production and ecologically sensitive areas.

Natural gas technology (CNG)[36] is feasible in the transport sector and has the potential to bring at least mid term improvements in terms of energy security, pollutants and GHG emissions. Autogas (LPG) is a relatively uncomplicated technology. It offers some environmental benefits at relatively low costs. Still, both CNG and LPG are fossil fuels.

Many of the concepts above are also useful for public transport. Hybrid systems and fuel cells buses are an option for busses in urban areas. An (re-) electrification of busses in form of a trolley system is as well discussed as a solution for a cleaner public transport system. These technologies will also be part of the analyses in phase II of the project.

3.2. ICT as an enabling technology in urban transport

The sector of information and communication technologies have become of utmost importance for the future design of transport systems. ICT is a crucial enabling technology in nearly all areas of daily life and it also affects urban transport under many aspects.[37] A comprehensive analysis is given, for example, in Kompfner and Reinhardt (2008). In this report, seven types of ICT application in the transport sector are identified, that seem to have the greatest potential for environmental benefit: eco-driving support, eco-traffic management, eco-information and guidance, eco-demand and access management, eco-mobility services, eco-freight and logistics management, eco-monitoring and modelling. Most of these applications are still at an early stage of development and only few are deployed at a larger scale. These approaches have to be considered in the Urban Transport projects, some of them are touched upon in this chapter.

A better organisation and management of the transport system is supposed to lead to improved traffic flows, less congestion, more efficiency through better load factors and the use of less energy consuming modes of transport.[38] The relevant IT applications are usually subsumed under the terms "Telematics" or "Intelligent Transport Systems" (ITS). These concepts are related to control and guidance, road pricing, parking, assistance, freight and fleet control and management.[39]

[36] Compressed Natural Gas

[37] See STOA 2009

[38] see EC 2001, EC 2006a; Hummels 2006

[39] see Erdmann et al. 2004

Most congestion charging systems are based on ICT technologies (for example London and Stockholm, see chapter 3.3). ICT based road pricing systems could support a push to the rail sector. Furthermore, ICT is a necessary tool for the organisation of efficient car-sharing systems (see chapter 3.3). Advanced car-sharing vehicles are equipped with on-board computers that are a central element in an efficient and comfortable booking system.

Concerning motorised individual transport, ICT applications focus on a better organisation of transport through information and communication via the steering of traffic flows and optimised use of infrastructure capacities.[40] The underlying idea is that real-time information that is available for the individuals via navigation systems, internet or mobile phone helps to avoid congestion and to improve traffic flows. Real-time information about full or free parking facilities can help to reduce travel time and, thus, emissions. In the future, vehicle-to-vehicle communication might be enabled, where cars inform each other about driving conditions and contribute to the optimised organisation of the whole system. Regarding trucking, an increased efficiency per tonne kilometre could be achieved by an optimised logistic system. This is mainly an issue for long distance transport but could also have an effect in urban areas. More flexibility in logistic chains will be enabled by RFID (Radio Frequency Identification) technologies. A technically supported "Supply Chain Management" could improve the system. Potential rebound-effects have to be taken into account since increasing capacities might lead to an increase in demand, for example when less congestion on roads attracts additional car trips.

Another key element of urban transport strategies in general is to increase the competitiveness of public transport. This can be realised with better information, improved quality of information and more comfortable access to tickets. Concrete measures are real-time information, online ticketing or electronic tickets (on mobile phones) which are being tested in several European cities and metropolitan areas. An improved and comfortable access to information at any time is crucial also in order to foster intermodal transport chains (combinations of different modes of transport, for example rail, bus and taxi).

The applications mentioned so far are either targeted on an increased efficiency or on modal shift, mainly to public transport and freight rail. But ICT is also seen as a means to avoid trips and, thus, to reduce traffic volume. Key words are tele-working or tele-commuting, video-conferences, tele-shopping or tele-learning.[41] In the meantime, the use of ICT for a "virtualisation" or "dematerialisation" of work-routines has become an everyday task in several sectors. Teleworkig reduces commuting (see WWF 2008). Dematerialisation is related to the idea that not goods but information is travelling; further it is related to a concrete substitution of material goods by ICT products. Examples are the use of e-mail and the reading of e-books instead of using letters or reading books.[42] Furthermore, tele-shopping is supposed to become more popular. Goods are ordered via Internet and delivered by a special service. However, for most of these forms of virtual mobility it is not clear that they always have a significant effect on travel volumes, in particular in urban areas. Again, rebound effects are possible. Teleworking, for example, might lead to longer distances for commuting and/or to urban sprawl. This is surely an issue that should be tackled in more detail in the urban transport project.

[40] See Rothengatter 2008

[41] ETNO 2005

[42] Erdmann et al. 2004

3.3. Managing motorised individual and freight transport

There are quite a lot of approaches for managing motorised individual and freight transport in urban areas and beyond. ICT in general plays a crucial role for most of these concepts. Therefore, an overview on this approaches was given in the chapter on ICT as an enabling technology (see above, 3.2), such as improving traffic flow, avoiding congestions or enabling better load factors for freight transport.

Other concepts are related to a restriction of car transport in urban areas. This often goes along with a prioritisation of cleaner propulsion technologies. Restrictions on circulation in urban areas through access limitations in the form of environmental zones, city tolls, congestion charging have rapidly spread throughout Europe over the last years. An increasing number of cities is establishing "green zones" to reduce pollutant and noise emissions.[43] Prominent examples are the congestion charging schemes implemented in London and Stockholm and the low emission zones implemented in several German Cities:

In London, in the inner City a Congestion Charging Zone (CCZ) was introduced. A fee is charged for cars and trucks travelling into this zone. The main intention of this charge is to reduce congestion. The earnings should be used for improving urban transport in London. The system is controlled with cameras that are able to record license plates of the vehicles. Exemptions are made for buses, minibuses (of a certain size), taxis, ambulances, fire engines and police vehicles, motorcycles, "alternative fuel vehicles". Residents of the zone are eligible for a 90% reduction.[44] In Stockholm, a similar system was implemented as a tax on a permanent basis in 2007 after a seven month trial period. The tax aims at reducing congestions. At the same time, the environmental situation in the area should be improved. Also in this case, earnings should be used for new road constructions in and around Stockholm. The effect of both the London and the Stockholm scheme is discussed controversially and will be part of the analyses in phase II of the project.

Low Emission Zones as they are implemented in Germany are organised in a different way. Basis is the ordinance on marking of vehicles with low emissions which allows cities and municipalities to classify passenger cars and trucks into four emissions classes. The vehicles get a sticker showing their classification. The intention is to improve air quality in inner cities by reducing particulate matter and other air pollutants. Vehicles with particularly high emissions, such as EURO 1 diesel engines not fitted with a particle filter or Otto engine vehicles without a catalytic converter, will not get a sticker when the regulation takes effect; that is, they may not drive through the environmental zone.[45]

Another form of managing car traffic are new concepts related to ownership of cars. Car-Sharing is a model of car rental where people rent cars for short periods of time, often by the hour. They are attractive to customers who make only occasional use of a vehicle, as well as others who would like to have occasional access to a vehicle of a different type than they use day-to-day. In Germany, the number of Car-Sharing users has been growing continuously over the last two decades. In 2010 nearly 160.000 people were users of the system in Germany.[46] Car Sharing could be an interesting niche market for alternative fuels and propulsion technologies, since it is possible to choose between different types of vehicles according to the purpose or distance of the journey.

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[43] http://ec.europa.eu/transport/urban/urban_mobility/urban_mobility_actions/urban_mobility_actions_en.htm

[44] http://www.bbc.co.uk/london/content/articles/2006/10/30/congestioncharge_feature.shtml

[45] http://www.umweltbundesamt.de/uba-info-presse-e/2007/pe07-010.htm

[46] http://www.carsharing.de/

Battery electric vehicles could be used for trips in urban areas. For longer trips a car with range extender or a conventional ICE might be chosen. Pilot projects illustrate that car manufactures are getting interested in similar systems. In the car2go project Daimler has located 200 "Smart" cars in the German city of Ulm on a Rent-A-Car basis.[47]

Figure 2: Electric vehicles charging at the "Better Place" visitor centre in Pi-Glilot, Israel
Source: Wikipedia (Bardak)[48]

The company "Better Place" aims at supporting the market penetration of Battery Electric Vehicles and, thus, reducing the global dependency on fossil resources.[49] In the so called "Project Better Place" the company first focuses on the countries Israel and Denmark, where a dense network of stations for reloading electric cars will be installed (see figure 2). In addition, battery switch stations should offer the possibility to change empty batteries against full ones. Thus, the user does not have to wait for several hours until his battery is recharged. Denmark and Israel have enacted policies, which create a tax differential between zero-emission vehicles and traditional cars to accelerate the transition to electric cars. It is planned that the required electricity is produced form renewable sources. The underlying marketing model is adopted from the mobile phone sector: initial costs of electric vehicles are subsidized by the ongoing per-distance revenue contract just as mobile handset purchases are subsidized by per-minute mobile service contracts.

Other important organisational measures that have to be dealt with in the project are City logistic schemes for urban freight transport. In addition, it will be discussed how a more integrated view on passenger and freight transport might be realised.

[47] https://www.car2go.com/portal/ulm/page/home.faces

[48] http://en.wikipedia.org/wiki/File:BetterPlaceEVsCharging.JPG

[49] www.betterplace.com

3.4. Promoting public transport, cycling and walking

There is a wide range of measures to increase the competitiveness of public transport, cycling and walking. A promotion of these environmental friendly modes is supposed to attract more users and to induce a modal shift. Measures targeted at public transport often make use of advanced technologies, such as Handy Ticketing or real time information as was mentioned in the ICT related chapter (3.2). There are many examples for European cities where such a shift has been induced effectively in the last decades. The European Commission has supported a broad range of initiatives aiming at promoting public transport, cycling and walking.[50] However, in spite of these successful examples, the challenges mentioned in chapter 2 of this report remain. In this context it is important to note, that 50% of car trips are less than 5km, 30% are less than 3km[51]. Looking at these figures it becomes obvious that there still is a huge potential in particular for cycling. A modal shift in urban areas still seems to be a promising approach.

In order to better tap the potential of cycling and walking, a better integration of these modes in urban mobility policies is needed. More attention should be paid on related concepts and a corresponding infrastructure. The European Commissions Green Paper on Urban Mobility stipulates that initiatives in cities, companies and schools can promote cycling and walking, for example through traffic games, road safety assessments or educational packages. Further, training programmes help children and young people to become familiar with cycling; experienced cyclists travel safer. Stakeholders have proposed that bigger cities could consider appointing a policy officer specifically for walking and cycling.[52] For some cities (Stuttgart) the developments in the E-bike sector are a promising approach to increase the attractiveness of cycling. However, for walking and cycling mostly non-technical concepts or established low-tech approaches have to be implemented. A conventional but effective measure is the implementation of cycle lanes. But especially in many Eastern and south European areas there is a lack in infrastructure dedicated to cyclists. Regarding walking a pedestrian network is of utmost importance. It must allow to cross streets save and fast.

Concerning information about non-motorised transport, recent research proves that a much more pro-active approach is needed.[53] It is crucial, that information is taken to the consumer, rather than assuming that they will find it themselves. According to Banister (2008), individualised marketing is a good example of a dialogue-based technique for promoting the use of public transport, cycling and walking as alternatives to the car. In European and Australian Cities, where such an approach has been applied, a reduction in car use of around 10% has been proved and it seems that theses behavioural changes are maintained over time.

[50] See for example www.civitas.com

[51] CEC 2007a

[52] CEC 2007b

[53] see Brög 2009

3.5. Out of the box: new technologies and concepts

A wide range of options can be found in literature that deals with rather new and sometimes more visionary approaches. In this scoping report, only a few of these technological and organisational approaches can be described. In phase two of the project, a more detailed analysis of this field will be given. The approaches will have to be discussed in terms of feasibility and their potential contribution to sustainable urban transport.

Some of these approaches are targeted on making more extensive use of the "third dimension". Most of these options are enlarging the capacities of the transport system, which means that rebound effects in terms of inducing additional traffic have to be taken into account:

- For example, large tunnel system might reduce the traffic on the surface and provide for new capacities in the underground. One concept is called "Cargo Cap". It is discussed for freight transport in congested urban areas on the local and long-distance traffic sector up to 150 km.[54] Underlying idea is that unmanned caps are running in an extensive underground transportation pipe network. It is assumed that because of underground transportation pipes CargoCap is working independent, unaffected and uninfluenced by other transports modes and traffic jams. Even if a rather low transport speed is assumed, this could lead to a significant decrease of transport time in comparison to lorries in congested urban areas. Further, there are no local emissions of pollutants and noise.
- Another notion is to go into the air above the congested areas with personal air vehicles (PAV) such as small Helicopters. Advantages are that flying vehicles can make the journey at higher speed. Unlike cars or current public transportation systems, the idea is that PAV's might not require large-scale facilities such as roads, rails, stations or airports, which are expensive to set-up and maintain.[55]

Other ideas to be considered in the project are the following:

- Concepts for simplified intermodal transport: for example the separation between road and rail could be dissolved (road trains, cars using overhead lines).
- Radical ICT concepts leading to driverless vehicles. Autonomous systems in vehicles could become interesting in the context of an ageing population.
- New business models or new 'post-ownership' vehicle initiatives; new ideas for sharing or renting elements of the transport systems.

[54] See http://www.cargocap.com/

[55] NASA 2007

4. PARADIGMS, VISIONS AND BEHAVIOURAL CHANGES

It was the main tasks of chapter 3 to give an overview on the broad field of technical and organisational innovations that are already established, initially implemented as a pilot or just emerging. A lot of approaches are being discussed that are expected to have promising potentials for mitigating the challenges mentioned in Chapter 2 and for supporting the development to sustainable urban transport systems in Europe. But experiences prove that quite a lot of barriers and resistance have to be overcome for tapping these potentials. So, it is crucial to have a broader view on promising innovation strategies. Technologies and innovative concepts are a necessary but not sufficient requirement for sustainable urban transport systems. Transport is deeply embedded in the socio-technical systems, thus, a broad range of factors needs to be taken into account to get a better understanding of barriers and success factors for technical and organisational innovations.[56] Values and norms are of importance, in many cases habits and behavioural patterns are affected by innovations, for example a shift from car use to public transport or cycling means a considerable behavioural change. "The sustainable mobility paradigm goes beyond the actual measures and attempts to understand the reasons behind effective implementation."[57]

It is discussed and illustrated by many examples[58] that paradigms and visions have the power to shape the design and development of technological and organisational innovations. Dosi et al. (1982 and 1988) discuss a "meta-paradigm" as a "dominant technological style whose 'common sense' and rules of thumb affect the entire economy."[59] Accordingly, it is important to understand innovations and technological developments in context of paradigms, or guiding principles, that exerts large influence on the design and development of a socio-technological system, in our case the transport system.

In a similar way, expectations that are shared among a group of actors in a certain domain have been shown to be of considerable impact on the development of technologies. For example, studies with an evolutionary economics background argue that due to positive expectations "niches" are emerging where new technologies can be developed in a sort of protected space.[60] This is where an early learning between users and developers can take place. This gives the opportunities for new socio-technical formation to first stabilise, than spread out and bring about a regime change or a transition to a more sustainable (transport) system.[61]. So, on all levels of the innovation process visions and expectations play a "performative role"[62].

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[56] Halbritter et al. 2008

[57] Banister, 2008, p. 79

[58] For example the paradigm or "Leitbild" of the car-friendly city, which was dominating city panning strategies after World War two (see Halbritter 2008, p. 61).

[59] In the project, it will be also important to be aware of the concept of „rules embedded in artefacts", for example, as Rip and Kemp (1998, quoted in Geels 2004) put it: "A technological regime is the rule-set or grammar embedded in a complex of engineering practices, production process technologies, product characteristics, skills and procedures, ways of handling relevant artefacts and persons, ways of defining problems; all of them embedded in institutions and infrastructures."

[60] Warnke, Heimeriks 2008

[61] Kemp 1994

[62] Warnke, Heimeriks 2008, p. 79

Expectations, visions, paradigms or "Leitbilder" are of normative character. They entail social values which are relevant for the success or failure of innovations. Priorities are set according to social values. There is nothing intrinsic to technologies that makes one more sustainable than another. The difference lies not in the technology itself but rather in the contingencies of socio-technical circumstances and the play of institutional interests that favour one technology over another.[63] This means that norms and values have to be taken into account. These values are built up over time as a result of societal discourses in different arenas - and they do change.

Expectations, visions and paradigms are influencing both transport behaviour and transport as well as the related innovations. Moreover, they influence the design and development of technological and organisational innovations. Further more, consumer behaviour has a mutual relationship with innovations and with the paradigms they are developed in. This complex situation is illustrated in the following figure 3. However, it is in general not well understood how exactly these relationships are working and if there are any underlying patterns that allow for a certain degree in generalisation.

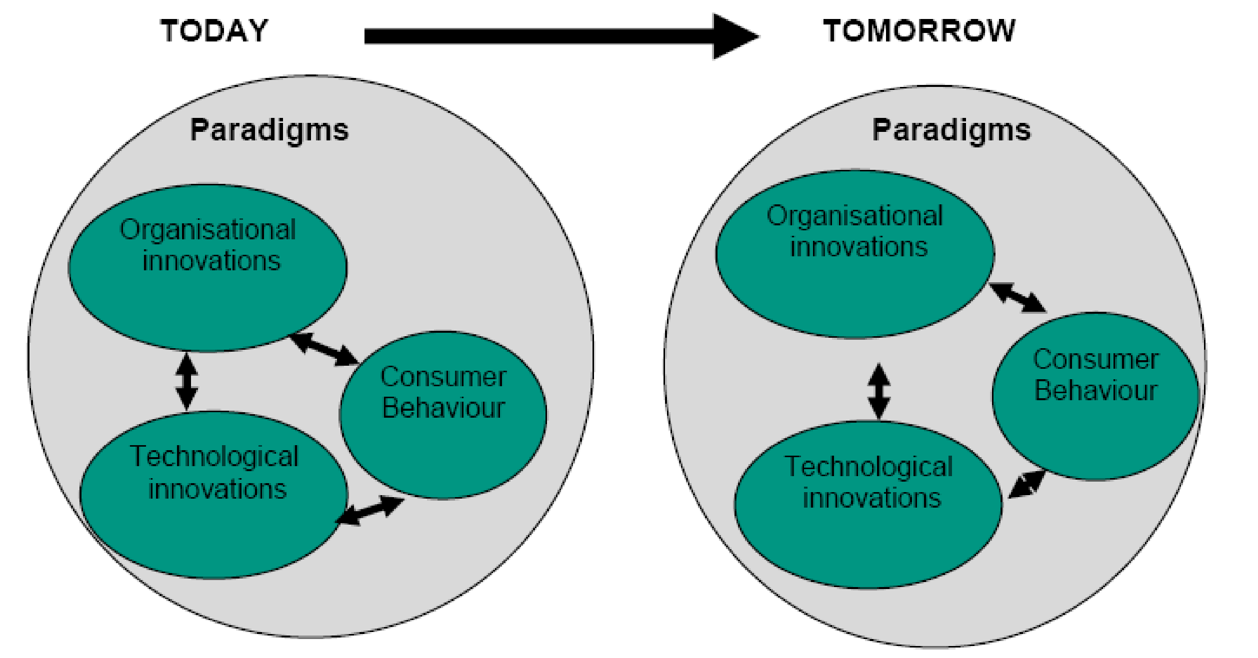

Figure 3: Co-evolution of innovations, user behaviour and paradigms

[63] Brown et al. 2000, p. 11

It can be observed that not only technologies and behavioural pattern are changing over time, but also the goals, visions or paradigms for urban transport which has considerable implications for technological developments and organisational innovation. For example, in the 1960s and partly also in the 1970s, the leading paradigm for urban transport was to create a city that was optimised for motorised individual transport, with broad roads and parking spaces. Public transport was considered as being old fashioned and in many cities tramway lines were removed during this period. Already in the 1970s there were calls for integrated transport solutions, whereas in the 1980s deregulation and liberalisation of access to the markets became important issues[64]. In the meantime, the paradigm of "sustainable transport" has become a well established key-concept[65].

On basis of the arguments raised in this chapter, the STOA Project will have to analyse the visions, paradigms and expectation as they are described in various urban development concepts or transport development plans. Further, there are several documents on EU level that illustrate how sustainable urban transport is expected to be achieved. On the other hand, the knowledge on user perceptions and attitudes will be analysed for better understanding the acceptability of technologies and the conditions of behavioural changes. An initial overview on these two aspects is given in the following two chapters:

4.1. Urban transport related visions and expectations in official documents

The paradigm of sustainability is a key element of most visions and expectations that are formulated in official documents from European institutions and urban authorities. In this scoping report it is only possible to mention a few examples. A more profound comparative analysis will follow in Phase II of the project.

In general, the paradigm or vision of sustainable urban transport is putting a strong emphasis on an attractive public transport system and, thus, on technologies supporting such a task. For example the Commission's 2001 White Paper states at the very beginning that "a modern transport system must be sustainable from an economic and social as well as an environmental viewpoint"[66]. It emphasises decoupling of economic growth from transport growth by shifting the balance of transport modes, elimination of bottlenecks and by placing users at the heart of transport policy. Integration and model shift are key concepts in the White Paper, whereas the 2006 Mid-Term Review of the White Paper slightly shifts the focus by introducing the concept of co-modality. The underlying idea is that all modes must become more environmental friendly, safe and energy efficient[67]. The green paper "towards a new culture for urban mobility" emphasises the importance of a common view or vision on urban transport which is shared by most of the relevant stakeholders.[68]

[64] See Viegas 2003

[65] See Banister 2008

[66] CEC 2001; already in the 1992 Transport White Paper term "sustainable transport" was in the title (CEC 1992)

[67] CEC 2006

[68] CEC 2007b

The commission's action plan on urban mobility states that responsibilities for urban mobility policies lie primarily within the local, regional and national level. Still, cooperation and coordination between these levels is important.[69] It aims at setting out a coherent framework for EU initiatives targeted towards sustainable urban transport while respecting the principle of subsidiary. The plan argues that long term integrated policies are very much needed in complex environments such as transport, and that the local, regional, and national level should adopt such policies. Expecting considerable changes in the coming years the plan argues: "Urban areas are becoming laboratories for technological and organisational innovation, changing patterns of mobility and new funding solutions". The plan strongly promotes integrated polices. Following the strategy on the Urban Environment[70], the Commission intents to support local authorities in developing sustainable urban mobility plans, covering freight and passenger transport in urban and peri-urban areas. Further, the document emphasises the importance of passenger rights as well as the provision of travel information. Action on EU level should help to strengthen markets for clean vehicles technologies and alternative fuels. Research and demonstration activities should be an important topic, including research on the internalisation of external costs. The Commission envisages offering assistance on ITS applications for urban mobility to complement the ITS Action Plan.[71] All the measures mentioned in the document are targeted on the sustainability of urban transport systems.

Sustainable transport also plays a central role in the METREX[72] network of European agglomeration. In a vision for the year 2050 the METREX sees a need for [73]:

- electric and hydrogen based road transport;
- high-speed rail transport;
- a concentration on price mechanism to favour low carbon transport and to establish high quality urban environmental standards;
- pioneering the infrastructure required for electric cars and hydrogen buses;
- for urban areas becoming, once more, mixed use, higher density and public transport related.

As mentioned above, there are good reasons for claiming and developing a common vision for sustainable urban transport in Europe. However, looking at the variety in socio-economic and geographical characteristic of European cities, it is clear that there is no one-size-fits-all approach for a successful transition to a sustainable urban transport system. It is not possible to fully cover this variety in this STOA project. Therefore, it makes sense to focus on 5-10 examples that will be selected for a more thorough comparative analysis of the visions and exceptions published by these agglomerations. The selection should include agglomeration with different socio-economic characteristics and from different geographical areas. Some of the following examples will be used:

[69] CEC 2009a

[70] CEC 2005

[71] CEC 2008

[72] METREX, the Network of European Metropolitan Regions and Areas, provides a platform for the exchange of knowledge, expertise and experience on metropolitan affairs, and joint action on issues of common interest. The Network has members from some 50 metropolitan regions and areas and partners in many others.

[73] http://www.eurometrex.org/ENT1/EN/Activities/activities.asp

Barcelona (E): In Barcelona the Regional Government of Catalonia, after approving the National Mobility Directives issued from the Mobility Law of 2003, entrusted the Transport Authority (ATM) as Regional Mobility Authority with the new task of drawing the Urban Mobility Plan (PDM) including targets for reducing pollution. The PDM was approved in September 2008.[74]

Birmingham (UK): The City of Birmingham has pusblished a Strategy on Intelligent Transport Systems in 2007. It is expected that the implementation of ITS technology together with appropriate investments in infrastructure will provide benefits in terms of reduced accidents and congestion and that ITS will help in protecting the environment by improving the efficiency of existing transport infrastructure and helping to reduce traffic growth. Improvements for public transport are explicitly expected[75].

Budapest (H): Budapest won the 2008 European Mobility Week Award. The Hungarian capital was judged by an independent panel of experts to have done the most to raise public awareness of air pollution from traffic and promote cleaner alternatives. The city introduced and promoted several permanent measures to demonstrate its commitment to sustainable transport, such as expanding the downtown pedestrian area, increasing parking fees in the city centre, improving metro and tram infrastructure and services, and introducing new bicycle lanes and 'park and ride' facilities.[76]

Bucharest (RO): The local public transport operator in Bucharest, Romania, modernised its fleet by replacing polluting buses with new energy efficient trams and trolley buses. Bucharest is also investing in the modernisation of its tram, trolley bus and metro networks.[77]

Copenhagen (DK) municipal plan 2001: Main elements of the Municipal Plan of Copenhagen show a comprehensive and horizontal strategy for the 12 coming years, combining urban development, transport and environment related requirements with the view to ensure 'sustainable urban and transport pattern'.

Freiburg im Breisgau (D): Freiburg reversed its transport patterns over a 15 year period in favour of non-car modes. On basis of a combination of restrictions on car use, mainly in the form of a pedestrian and traffic calmed central and inner area, the provision of facilities for bicyclists and pedestrians, a good public transport system, and a compact land use pattern, growth in car use has been stopped.[78]

Graz (A): Measures having to deal with behaviour and how to influence people to change habits are an important part of the transport strategy of Graz, beside large scale introduction of biodiesel vehicles, improving public transport and managing traffic flows.[79]

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[74] EMTA 2009

[75] (Birmingham City Council 2007)

[76] http://europa.eu/rapid/pressReleasesAction.do?reference=IP/09/306&format=HTML&aged=0&language=EN&guiLanguage=en

[77] http://civitas-initiative.org/docs1/GreenPaperUrbanMobilityleaflet.pdf

[78] CEC 2007c

[79] http://www.trendsetter-europe.org/index.php?ID=482

Karlsruhe (D): The existing tram system in Karslruhe was modernised and extended by making use of German Rail tracks. The project also included the introduction of exclusive right of way (today 80%) for trams at most crossings and the use of vehicles able to handle the 750 Volts DC tram environment as well as the German rail 15.000 Volts AC system. Today the Karlsruhe light rail rolls on a network of 400 km and stretches far out into the region even.Its success is demonstrated by the high level of patronage and is mainly due to its convenience – no interchange between outer and inner parts of the line, central tram station – and the existence of a regional master plan that provided a favourable framework for the development of the solution. The regional master plan is an important success factor as it created a final system layout, allocated the roles of different modes in the overall scheme and identified the consequences for urban planning. Applications of this solution can now be found in other cities.[80]

Lille (F): In 2000 Lille Metropole had adopted ambitious policies for the ten next years, including the Urban Mobility Plan, the Local Safety Plan and the purchase of 100 new biogas buses, with the target of a 100 per cent clean public transport service.[81]

Merseyside / Liverpool (GB): In the Local Transport Plan For Merseyside 2006 – 2011 it is stated: "Our vision for transport on Merseyside is: 'a fully integrated safe transport network for Merseyside which supports economic and social regeneration and ensures good access for all, and which is operated to the highest standards to protect the environment and ensure quality of life'. Our long term strategy is to support the continuing economic development of Merseyside by managing for growth in travel demand to ensure the efficient movement of goods and people."[82]

Prag (CZ): A new traffic policy is based on the preference for public transport, development of traffic infrastructure and regulation of car traffic, particularly in the centre of the town. Prague focuses on shift in modal split from private car transport towards public means of transport with emphasis on improving public bus service transport (using new and alternative approaches) to the same high level service as other means of transport (underground, tramways) in the City. At the time, the City aims at a reduction of heavy transport (over 6 tonnes) in certain areas of the City.[83]

Stockholm: Congestion charging

Zürich (CH): The city has successfully promoted the use of public transport, cycling and walking, while controlling traffic and parking. Zurich transport strategy is based on principles such as making public transport faster, and keeping it attractive; road traffic and public transport management by means of a dynamic control system; effective management, planning and supervision of parking, on- and off-street; good living conditions, through traffic calming in residential areas with City-wide 30km/h speed –limits; good conditions for walking and cycling; soft policies for a sustainable mobility management such as a 'Zurich mobil' package for new residentspublic awareness and education, new offers in the mobility behaviour etc.[84]

[80] CEC 2007c

[81] http://www.trendsetter-europe.org/index.php?ID=4622

[82] Merseyside 2006

[83] http://www.trendsetter-europe.org/index.php?ID=540

[84] CEC 2007c

4.2. About user acceptance and behaviour

In most cases, the visions and expectations mentioned above promote technological or organisational innovations that, in principle, already exist, but are not implemented on a broader scale. Many of these innovations are mentioned in chapter 3 of this scoping report. These technologies often go along with, or are targeted at changes in habits or behaviour of the users. For example, the introduction of realtime information and handy ticketing in public transport aims at attracting new passengers that used to take the car for specific trips; the introduction of battery electric vehicles, which is promoted by many experts, would probably mean changes in terms of better planning of trips in accordance with reduced range and longer times for recharging. The market penetration of the car-sharing scheme goes along with a reduced importance of the emotional aspects of owing a car (status symbol) and with rather pragmatic attitudes to mobility. Video conferences might become more established if people are getting familiar with the specific situation this form of communication brings with it.[85]

It was illustrated above and is known from other fields that user perceptions and attitudes are playing a crucial role for the acceptance and success of technical and organisational innovations. Understanding user perceptions and motivation is a highly complicated issue. There are considerable gaps in knowledge. Banister (2008, p.79) emphasise that acceptability is an essential (yet often neglected) element of sustainable mobility. The scale of change required to promote a more effective strategy on sustainable mobility means that a deeper understanding of acceptability is needed. Behavioural change must be seen as part of the solution.

Habits and routines that might be shaped by the use of existing technologies play a significant role for the acceptance of new developments. Kemp (1994, 1032) points out, that consumer preferences and habits are influenced by the adoption and use of past technologies. Accordingly, technological change and socioeconomic trends co-evolve and interact. Mechanism of habituation and endogenous taste formation play a role. Kemp argues (1994, 1032): "The fact that people are sued to having a car with a certain mileage and speed may obscure the development of a car with totally different characteristics (for instance, an electric vehicle with a relatively low speed and range and long loading time)". It might be, that new ideas about social behaviour and different values are needed for new technologies to be adopted and used.

Apart from these general and broad views related to the socio-technical context of innovation in urban transport, there is quite a lot of research on the effectiveness of specific technologies or measures on transport behaviour and modal split. For example, several studies illustrate the importance of easily accessible information for the willingness to use public transport. Brög et al. (2009) show, on solid empirical basis, that a lack of information and motivation and incorrect perceptions of the alternatives to the car were significant barriers to modal shift. For example research showed that in German cities in 1990, 81% of all trips were made by modes other than public transport (PT), and 19% by PT modes.[86] Nearly a quarter of all trips (24%) used another mode because there were constraints to using PT. If these constraints are related to car usage for business reasons or to carry a heavy load, these trips are likely to have limited potential for change.

[85] Of course, there also innovative technologies that do not directly affect user behaviour, such as the implementation of biodiesel or soot filtes,

[86] VDV and Socialdata, 1993

A further 32% of trips would have required system improvements, such as the provision of an adequate bus connection or improved service frequencies, before a switch could be made. However, for the remaining 25% of trips there were only subjective reasons preventing PT use. For these trips, a voluntary behaviour change approach (using so-called ‘soft’ measures) appeared to be a solution to achieve modal shift without the need for ‘hard’ measures such as system improvements, pricing or changes in land use policy (ibd.).

Many studies focus on the effect of different strategies for transport pricing.[87] For example, the effects of congestion charging are investigated quite intensively. Amongst the most prominent examples are London and Stockholm. A general problem of road pricing measures is the lack of public and political acceptance. Jakobsson et al. (2000) assume that acceptance of road pricing (increased travel costs) by private car users is determined by their perceptions of how fair the increase is and how much it infringes on freedom.

Findings of a study by Souche (2010) highlight the importance of user costs of trips and of urban density. According to this study, urban car travel increases when the average user cost of a car and the urban density fall. Theses results are interesting because they support the need for an integrated view on transport and space, which leads to considerations of the optimum size and structure of cities.[88] The importance of the relationship between land use and transport for a sustainable urban development is emphasised by other authors.[89] Furthermore, this illustrates that behaviour has to be understood in context of the specific urban structure.

As Anable (2005) highlights, it is becoming increasingly recognised that rational, instrumental arguments are insufficient to explain why measure to restrict car use generate strong emotions and negative reactions. Increasingly, psychological factors including perceptions, identity, social norms and habits are being used o understand travel modal choice. In consequence, there is no sense in addressing the “average consumer”. Different people must be addressed in different ways. In studies of consumer behaviour and marketing it is standard practice, to distinguish homogeneous groups of consumers who can be targeted in the same manner because they have similar needs and preferences.[90]

The brief overview on findings and research issues from the fields of consumer behaviour and acceptance in transport supports the view that there are no one-size-fits all solutions. However, there are still many open questions in relation to transport behaviour and acceptance of measures of various societal groups. The STOA project on Ubran Transport will analyse the knowledge in this field in phase II. On this basis, an analytical framework will be designed in Phase III of the project, to address specific questions on basis of empirical tools (Phase IV).

[87] see Steg, Schuitema 2007

[88] see also Venables 2007

[89] see Banister 2005; Hall and Pain 2006

[90] Anable 2005

5. IMPLICATIONS FOR THE PROJECT PLAN

The discussions with MEP's and the description in the chapters above illustrate that no changes to the original project plan are required regarding contents and focuses. The scoping report highlights a broad range of interesting areas for a more detailed analysis in Phases II, III and IV of the project.

What should be changed according to the discussions in the scoping phase is that the parliamentary event (could be a workshop) should take place in 2010, but either in Phase II or in Phase III of the project. In the original project plan this event was scheduled for phase II.

Phase 2: Description of technologies, challenges and paradigms in urban transport

Start: 15 April 2010

A.) Description of perceived problems of recent urban transport systems. The aim is to provide a description of existing technologies in urban transport and their impacts with particular focus on

- Health: physical and psychological health effects, in particular on children;
- Demand for transport and modal split;
- Congestion / transport flow.

B.) Description of changing paradigms and visions of future urban transport systems. Aim is to get a better understanding of different paradigms and visions in relation to urban transport and their changes and changeability over time. This includes looking at the historical development of transport paradigms. Further, different visions about future urban transport systems – as published by Metropolitan Areas, local authorities and other stakeholders (for example METREX[91]) - will be compared in relation to their goals, to their degree of concreteness and to the preferred technologies and policies mentioned to reach these goals. Special focus will be put on the perceived role of sustainable transport.

Deliverable 2: Interim report on technologies, challenges and paradigms in urban transport (31 October 2010, by the latest)

Phase 3: Barriers and success factors for innovation pathways to sustainable urban transport

Start: 1 November 2010

In relation to the paradigm of sustainable transport (phase 2), there will be elaboration on how this paradigm is materialising. The WP includes the following research activities: Analysing which technology options and organisational innovations are discussed to enable a transition to sustainable urban transport. Elaborating which framework condition seems to be needed for successful development and implementation of technology options and organisational innovations. Analysing what kind of user behaviour is anticipated in relation to the discussed technologies. On basis of the work done so far, an analytical framework for the empirical work in phase 4 will be developed.

[91] /www.eurometrex.org

Deliverable 3: Interim report: barriers and success factors for innovation pathways (31 March 2011 by the latest)

No one size fits all solution. There is a need to look at the specific situation of the various agglomerations. Regarding limited resources, it is important to have a closer look at 5 – 10 selected urban areas. The example mentioned in chapter 3 should be considered when deciding on the selection. The transferability of these cases should be discussed together with the questions if there are patterns or archetypes of cities that are particularly suitable for certain measures.

Phase 4: User perceptions on technological developments and paradigms

Start: 1 April 2011

In this phase perceptions and attitudes of different user groups in relation to selected innovation strategies (phase 3) will be investigated with help of qualitative social science research methods (focus groups, citizens' interviews). Basis will be the analytical framework developed in phase 3. Aim of this phase is to validate and enrich the anticipated user behaviour as it is described for the innovation pathways in phase 3. Design and scope of this tool will be further discussed in the consultation phase.

Deliverable 4: Report on empirical findings (30 September 2011, by the latest)

Phase 5: Conclusions and final report

Start: 1 October 2011

On basis of results of the previous phases conclusions will be drawn an integrated in a final report. It will include discussion on how the potential of technology options and innovation can be better exploited. Promising innovation strategies to a more sustainable urban transport system will be highlighted.

Deliverable 5: Final report (31 December 2011, by the latest)

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