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Professional paper

Sustainable urban mobility – modern development and perspectives

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Abstract – **An analysis of the development of urban transport systems and mobility in major cities of Bulgaria is carried out on the basis of research done on plans for sustainable urban mobility in the country. The specific conditions in the country, studies of literary sources, policies and good practices are the perspectives for developing sustainable urban mobility in Bulgaria. An integrated mobility model has been developed that will be used in an average size town, with different modes of transport and means of active mobility. Results show the prospects for the development of integrated mobility.**

I. INTRODUCTION

Despite the measures taken, the speed of development and scale of urbanization makes it difficult for cities to develop efficient and sustainable transport systems, [1].

The need for sustainable urban mobility is receiving increasing attention in its three dimensions:

-economic (efficiency and effectiveness of the systems);

-social (access to all population groups, vision zero for road accidents);

-environmental (reducing the environmental footprint of transport to combat climate change and pollution).

Decarbonisation of the road transport system is a major challenge, especially in urban areas. Despite opportunities for public transport, bicycles and walking, private vehicles continue to dominate mobility modes in many cities, [2].

The search for new solutions related to the modern development of greening technologies for vehicles and intelligent transport systems, as well as new business ideas for reducing the use of private vehicles for driving, especially in cities, are relevant to the current development of transport systems. Insofar as each settlement has its own characteristics, the implementation of existing policies as well as the relevant solutions is not universal. Therefore, when applying specific innovative solutions, it is necessary to take into account the specific features of: the transport system, geographical location, area, transport freight flows, passenger flows, etc.

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II. MAIN EU DOCUMENTS AND INITIATIVES FOR PROMOTING SUSTAINABLE MOBILITY IN THE CITIES

Urban transport systems are an indelible part of the European transport system and therefore an indelible part of the common transport policy. It would be almost impossible for cohesion policy, as well as for other EU health and environmental policies, to achieve their objectives without integrating specific urban features, including urban mobility.

The development of the current EU policy on urban mobility has a long history: the challenges and opportunities for intervention in urban transport are discussed in a number of EU policy documents.

The EU's main documents in the field of promoting sustainable travel were published after 2006:

• 2007 – The European Commission presented the European Green Paper *Towards a New Culture for Urban Mobility*;

• 2009 - Action Plan for Urban Mobility (APUM) in 2009, [3] with 20 specific actions at EU level with a deadline by 2012.

• 2011 - White Paper *Roadmap to Achieving a Single European Transport Area - towards a competitive, resource efficient transport system* " by 2050;

• 2011, studies by APUM, CIVITAS, ITS Action Plan and *Smart Cities*;

• In 2013, EC published its Urban Mobility Package. The focus of this document is on energy efficiency in transport and climate change. It addresses the concept of Urban Mobility Plans (SUMPs);

• In 2013, DG MOVE launched the *European Urban Roadmap 2030 Study*.

Urban mobility is closely linked to other EU policies such as energy, climate change, air quality, economy, social justice and accessibility, innovation, IT deployment and smart cities.

In recent years, a number of scientific and applied research and demonstration projects have been funded in the field of urban mobility research in the European Union. Information on many of these projects, as well as best practices, can be found in the ELTIS European Web Portal on Urban Transport and Mobility, [4].

The CIVITAS initiative is designed to help cities in Europe to implement and test innovative and integrated strategies that address energy, transport and environmental goals, [5].

The Intelligent Energy Program for Europe is STEER. Activities funded by the program's transport sections promote more sustainable use of energy in transport (i.e. increased energy efficiency, new and renewable fuel sources and alternative vehicles).

Horizon Europe is the future EU Framework Program for Research and Innovation for the period 2021-2027. It is a

continuation of the Horizon 2020 Framework Program. The proposal for Horizon Europe includes three pillars: excellence in science; global challenges and competitiveness of European industry; an innovative Europe. The second pillar will support research addressing societal challenges and industrial technologies in areas such as digital technology, energy, mobility, food and natural resources. The second pillar also envisages the introduction of missions and partnerships for some research purposes, like zero carbon emissions.

III. SUSTAINABLE URBAN MOBILITY PLANNING IN BULGARIA

In 2013, the European commission published its Urban mobility package. The focus of this document is the energy efficiency of transport and the climate changes. The concept of Urban Mobility Plans (SUMP) is included in this package, [6].

In Bulgaria, the transport schemes in cities are regulated by the Road transport Act. The municipalities are responsible for the policy and decision-making, related to spatial and urban planning and development of municipal territory.

The concept for sustainable urban mobility is still new in Bulgaria and the development of SUMP is not required by law, [7]. In the national programme of reforms in Bulgaria 2011-2015, the development and implementation of sustainable urban mobility plans (SUMP) was planned for 35 municipalities by the end of 2015, which has not been achieved. The developing and implementation of SUMP is the initiative of individual municipalities. The developing of the concept is a transition from the traditional planning of migration of people to the cities, oriented predominantly towards developing the infrastructure and planning of sustainable urban mobility, directed to meeting the needs of different groups of people.

The three main elements, which differentiate the approach to sustainable urban mobility (SUMP) are outlined:

- *Inclusion of all possible means of travelling in populated places*. These are: Quality and energy- efficient public transport, favourable conditions for pedestrian and bicycle traffic; gradual abandonment of the use of private vehicles;
- *Evaluation of consumer-related results*. Include target indicators: percentage of sustainable movements; reducing greenhouse gas, energy use, etc.;
- *Taking into account the needs of different population groups*. Active involvement in the discussion and decision-making of stakeholders and the general public.

The inclusion of all possible means of transport in the settlement implies the provision of high quality services by urban passenger transport, provision of conditions for walking and cycling, but above all the search for solutions.

The assessment of consumer-oriented results is linked to the evaluation of environmental and social problems, [8].

The overview of municipalities showed that by mid-2019, 11 Bulgarian cities are working on SUMP (Sofia, Varna, Montana, Veliko Turnovo, Kavarna, Stara Zagora, Kurdjali, Ruse, Burgas, Pleven and Gabrovo). The plan status is at different stages of implementation.

The plan for the capital Sofia is for the interval 2019-2035, with a vision for sustainable urban mobility. „Sofia is developing sustainable urban mobility which is protecting the environment and human health; oriented towards the people, not towards the automobiles, efficient and innovative; safe and secure; integrated and accessible to all. It contributes to transforming the capital into a green, attractive, smart, safe and accessible city“, [9].

Goals:

- reducing the negative impact of transport on people's health and on the environment (green city);
- increasing the attractiveness of the urban environment and ensuring better quality of life (attractive city);
- implementing transport innovations and strengthening the local mobility and economy (smart city);
- improving the safety and security of all participants (safe city);
- integrated transport system, accessible for all (accessible city).

The distribution of travels on the territory of Sofia by 2017 is as follows: personal automobiles 30,7; walking 29,7%; urban public transport 37,4; bicycles 1,8; others 0,4.

The target indicators: 20% - private car travels, 80% - sustainable transport (walking, bicycle, urban public transport); in other words, private transport should be reduced by over 130 000 travels (population is maintained at 1,242 million people). The plan for Ruse has been developed for the period 2016-2026 with the following vision: „Achieving high degree of mobility in urban zones and suburbs in conditions of travelling with maximum accessibility, security, safety, and guaranteed environmental protection, to the interest of the local community and as foundation for stimulating internal integrity and sustainable development for the whole region“, [10].

Priority goals:

- increasing the efficiency and attractiveness of the public transport system;
- improving the quality of mobility and creating conditions for alterantive types of travel;
- integrating the concept for sustainable mobility in the civic culture of Ruse.

According tho the detailed study carried out in connection with developing a project *Integrated urban transport system of Ruse*, the distribution of travels on the territory of the city is as follows: walking - 43,5%; automobile-driver-28%; public transport-20,1% (the ratio of bus rides and trolleybus rides is 59,4 to 40,6%, respectively); bicycles 2,4%; taxi 2,3%; automobile-passenger 2,1%; company transport (mini-bus) 1,1%; motorbike 0,5.

The share of travels by car (automobile-driver-28%, automobile-passenger 2,1%, taxi 2,3%) is 32,4% in total of all travels, which is almost 50% more than travelling with public transport.

The target indicators according to SUMP by 2026 are: increasing walking to approximately 50%, public transport usage to 24%, cycling to 2,5% and reducing travels by car to 21,5%. The remaining 2% are to be distributed among the other categories of the modal split.

IV. PERSPECTIVES FOR DEVELOPMENT OF SUSTAINABLE URBAN MOBILITY IN BULGARIA AND MODEL OF INTEGRATED URBAN MOBILITY INTHE CONDITIONS OF RUSE

To date, three potential avenues for the future of urban transport systems have been identified in literature and transport practice. The first is related to the development of: vehicle greening technologies; intelligent transport systems and transport infrastructure. The other two are related to changing business models and developing: cars sharing, [11, 12] carpooling and integrated mobility (Mobility as a Service-MaaS), [13, 14].

These three paths should not be considered separately. Servicing (expanding the range of services and offering complex solutions) of transport on shared and integrated mobility routes can create incentives for even faster technological renewal of transport fleets, [15].

The application of all three options in Bulgaria is realistic, as is their service. By assessing the characteristics of settlements, transport flows and transport schemes, the application can be implemented in two stages:

First stage - provision of conditions for integrated mobility, including multimodal one, for commuters from other settlements by: parking in the outskirts of the city, where the incoming traffic flows; provision of public transport from the parking lots; offering carsharing from parking to the city centre and integrating into MaaS, [16].

Second stage - introduction of the possibility of using the carsharing system throughout the city, by constructing the necessary car parks, taking into account the characteristics of the passenger traffic and introducing a MaaS system for integrated travel management, [17].

Assessment of the occupancy of seven major intersections in the city of Ruse, arranged by intensity, shows a significant proportion of passenger vehicles (an average of 69.31%), followed by vans (14.63%), bus / trolley bus (11.39%), truck (3.51%), bicycle and motorcycle (1.16%), (Fig. 1).

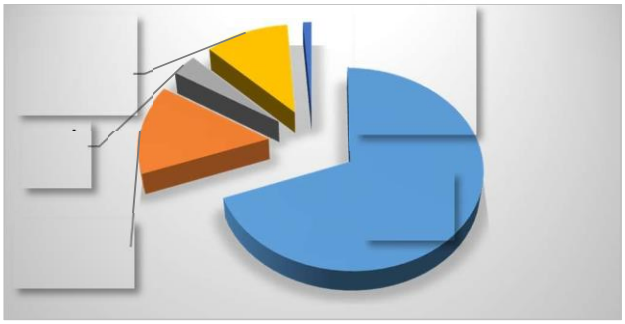

Fig. 1. Average value in percentage of vehicle types at the seven busiest intersections in the city of Ruse

Finding solutions to reduce the use of cars in the city is an important task.

Along with the development and improvement of public passenger transport services, other options are also being sought, especially for reducing the movement of passenger vehicles throughout the city.

Building a MaaS integrated carpooling system can produce good results. Studies of traffic flows show that it could be organized in two stages:

- Stage One: providing a journey for passengers coming from the three main inbound entries with vehicles to the city center. First entry is form Sofia, Svilengrad and Plovdiv; second from Buharest and Silistra; third from Varna;

- Second stage: introduction of a system covering the whole urban territory.

The first stage relates to the inbound traffic flows connected with the algorithm shown in Fig. 2.

A statistical survey to determine the number of passengers traveling by car for the purpose of visiting the city of Ruse, including daily, weekly and seasonal irregularities, can be conducted by collecting information from direct observation or using registering devices. The construction of three parking lots for traffic flow 1,2 and 3 at the outskirts of the city includes the preliminary determination of their capacity and the intended location of carsharing vehicles; construction of a central parking lot that collects the three rays of carsharing vehicles; inclusion in the route scheme of urban passenger transport for all three parking lots, associated with adjustments to the scheme; provision of a fleet of vehicles for the application of the carsharing system with the capacity to serve the required number of passengers in four locations: flows 1,2 and 3 at the outskirts of the city and in the city centre (where the main destinations are located). The construction of an information MaaS system is related to its estimated expansion in the second stage of construction. In order for the MaaS system to be effective, it is necessary to involve all transport operators in building the integrated system from the urban passenger transport subsystem, the carsharing subsystem and the Ruse MaaS System. Monitoring and correcting is a prerequisite for success. The adoption of each new system, as a rule, requires a certain amount of time, the introduction of incentives and a strong information campaign, which could speed up the processes.

The second stage of the system construction is related to designating the areas of origin and final destinations of the traffic flows in the city, as well as the construction of stations for carsharing vehicles and electrical cars.

V. CONCLUSION

Regular Urban transport systems are an integral part of the European transport system and, therefore, an integral part of the EU's common transport policy. There are a number of documents defining the policy for the development of urban transport systems, including decarbonisation and reduction of harmful emissions from road transport, as well as a number of initiatives and programs. However, their application requires taking into account the specificity of the locality concerned.

Developing the Sustainable Urban Mobility Planning SUMP is a transition from traditional urban relocation planning, oriented predominantly to infrastructure development, to sustainable urban mobility planning that addresses the needs of different groups of people. Despite the EC recommendations as of October 2019, only 11 Bulgarian cities are working on SUMP. The plans are at a different stage in their development. The traffic survey at seven major intersections in the city of Rousse shows a significant proportion of passenger vehicles (average 69.31%), followed by light commercial vehicles (14.63%), bus / trolley bus (11.39%), truck (3, 51%), bicycle and motorcycle (1.16%). This shows the serious imbalance in which passenger vehicles overwhelm and burden the traffic, creating serious conditions for traffic congestion.

Building a MaaS system in Ruse for integrated shared travel

can produce good results. Studies of traffic flows show that its construction can be done in two stages; the first stage: providing transfer for passengers from the three main inbound passenger vehicle traffic flows to the city center; the second stage with the introduction of a system covering the entire city territory.

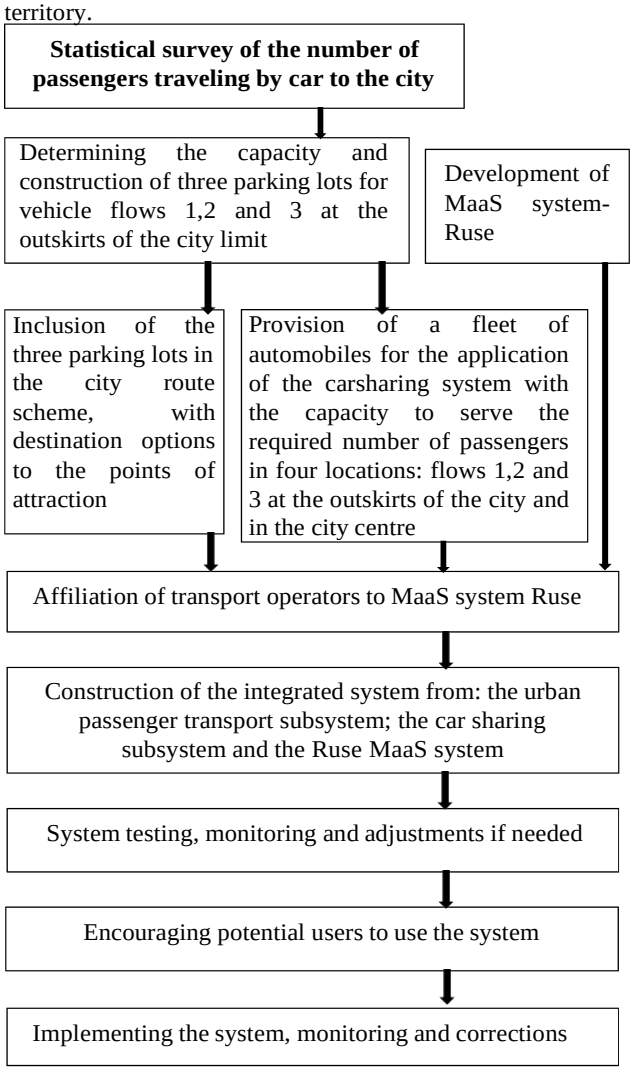

Fig. 2. The algorithm for the main stages of work for the provision of travels from the main three incoming passenger vehicle traffic flows to the central part of the city of Ruse

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