Creating a Sustainable Urban Transport – the Ecological Aspect

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Many European cities have initiated actions in the matter of creating sustainable transport systems that is useful for the society, economical and ecological, through utilization of modes of transport of better environmental performance. Many solutions promoting sustainable transport are being implemented such as electric vehicle rentals, separate infrastructure for collective transport, joint ticket systems, low emission zones or park&ride systems. The paper presents legal regulations and guidelines related to the principles and methods of creation of sustainable urban transport. In second part of paper, actions and measures facilitating the reduction of the impact of transport on the environment carried out by selected European cities are discussed.

Keywords: sustainable transport system; urban transport system.

1. INTRODUCTION

A growing world population leads to increasing urbanization. In Europe, the percentage of human population living in the cities is to grow from 72% in 2007 to 84 % in 2050 [12]. The growth of urban areas is a challenge for the urban transport system and results in an increased demand for transport services both individual and collective. The advancement of the transport sector unfortunately entails hazards such as increased noise and exhaust emissions. City traffic is responsible for 40 % of the emission of CO_2 and 70 % of the rest of the automotive pollutants [2]. These negative phenomena are augmented by the growing road congestion that, apart from environmental burdens, leads to economic losses. The response to these perils can be the creation of sustainable transport system. For urban transport, it means a system whose components are:

- useful for the society, through creating transport connections to the downtown areas and places of work,
- ecological, through utilization of modes of transport of better environmental performance (alternative powertrains, bicycle transport, collective transport) and creation of low emission zones in the city centres,
- economical, through creating effective and efficient transport system at a relatively low cost.

Recently, great stress has been put on the ecological aspects of transport. That is why, when designing a sustainable transport system we need to draw attention to the ecological aspects by promoting vehicles fitted with alternative powertrains or bicycles. In Poland, this type of solutions is still insufficiently popular, but in many EU member states we can see a significant progress in this matter.

2. THE POLICY OF SUSTAINABLE TRANSPORT

Sustainable development stands for an economic and social development that can be achieved by maintaining equilibrium in the impact of the individual human activities on the environment. The policy of sustainable transport includes such an assurance for the spatial functionality of urban areas that will guarantee a reduction of the needs for passenger transit and a reduction of the individual transport in favour of alternative (walking, cycling) or collective transport [8].

There are many legal regulations and guidelines related to the principles and methods of creation of sustainable urban transport in European cities. The most important of these legal acts are: White Paper [5], Green Paper [2] and the communication 'A sustainable future for transport' [1].

The recommendations of the EU and domestic legal acts are convergent and largely overlap. The Green paper contains generally formulated principles of transport policy that should lead to an improvement of the traffic flow in the cities and elimination of road congestion, reduction of the environment pollution, and increase in the transport safety and accessibility.

According to the guidelines of the White Paper, the European Union member states by 2050 should reduce the emissions by at least 60% as compared to 1990, which corresponds to a reduction of the emissions by approximately 70% compared to 2008 [5]. This is to be achieved through application of new technologies. The European Commission has indicated that the condition for the reduction of the emissions is gradual phasing out of 'conventionally-fuelled' vehicles from the urban environment and promoting collective transport, which should contribute to significant reduction of oil dependence, greenhouse gas emissions and local air and noise pollution. In particular, such actions are to be introduced as:

- development of appropriate fuelling/charging infrastructure for new types of vehicles,
- facilitating walking and cycling should become an integral part of urban infrastructure design and mobility,
- increasing the density and frequency of collective transport services, combined with minimum service obligations,
- encouraging the use of smaller, lighter and more specialized road passenger vehicles,
- introduction of alternative powertrains and fuels for large fleets of urban buses, taxis and delivery vans,
- encouraging the use of collective transport and gradual introduction of alternative propulsion through road pricing,
- use of Intelligent Transport Systems that contributes to real-time traffic management,
- use of low-emission urban trucks (electric, hydrogen and hybrid technologies) to reduce air emissions and noise, allowing a greater portion of freight transport within the urban areas to take place at night time (to ease the problem of road congestion during morning and afternoon peak hours).

The third of the above-mentioned papers – a communication titled 'A sustainable future for transport' indicates a necessity of propagation of ecological transport, and a reduction of the negative impact of urban transport on the environment in municipal transport. The indicated solutions were, *inter alia*, the need to support the development of joint local transport systems for city centres, suburbs and rural areas in the boundaries of the agglomerations, and integration of various transport systems using joint transport hubs. Attention was also drawn to the need of implementing intelligent transport pricing, differing depending on the ecological performance of a given mode of transport or the use of the infrastructure in the peak hours.

3. ECOLOGICAL MEANS OF TRANSPORT

While creating a sustainable transport system we need to promote the use of modes of transport of the lowest possible exhaust emissions and lowest possible fuel consumption per passenger or unit of carried load. In terms of urban transport, walking or cycling are the most environment-friendly. If motor vehicles are used, tramway, buses, subway, city trains, and suburban trains are of the lowest environmental impact. Collective transport (buses and tramways) generates lower emissions compared with individual transport (passenger vehicles fitted with combustion engines), yet for small passenger cars carrying more than two passengers, the unit emission may be lower than in collective transport. When analyzing the types of propulsion, the lowest emissions are generated by vehicles with electric and hybrid drives. The production of energy used by these vehicles results in the emission of CO_2, but even when this energy is manufactured entirely from coal, the total balance of the entire life cycle may be more advantageous than the emissions from vehicles fitted with combustion engines [3]. The average emission of CO_2 of a fleet of new vehicles sold in Europe remains on the level from 115 to 150 g/km, but vehicles used in the cities are several years old and they operate in conditions that facilitate higher exhaust emissions (slow motion, stop and start, congested urban traffic conditions, and frequent short journeys). According to the data of British Department of

Environment, Food and Rural Affairs, the average emission of CO_2 for passenger vehicles in 2012 was 198 g/km for gasoline engines (depending on the engine displacement from 162 to 297 g/km) and 183 g/km for diesel engines (depending on the engine displacement from 140 to 229 g/km). In comparison, in railway transport the level of emission was 60 g/km CO_2 per passenger, and city buses generated the emission of approximately 1104 g/km, which, assuming that it is used by 20 passengers on average, gives 55 g/km [4].

4. SOLUTIONS APPLIED IN ECOLOGICAL URBAN TRANSPORT

Many European cities implement a policy of sustainable development. We can observe this phenomenon in capitals and economically developed municipal regions of the Western and Northern Europe. We can distinguish two groups of measures facilitating the reduction of the impact of transport on the environment: technical and non-technical. The technical measures include cleaner burning combustion chamber designs or fitting

Table 1. Comparison of the equivalent emission of CO2 for transport by different modes of transport on the distance of 20 km [4].

Mode of transport		Equivalent CO_2 emission [kg] per passenger
Passenger car with petrol engine*	Small (<1,4l) Medium (1,4-2,0l) Large (>2,0l)	3.2 4.1 5.9
Passenger car with diesel engine *	Small (<1,7l) Medium (1,7-2,0l) Large (>2,0l)	2.8 3.5 4.6
Passenger car with hybrid engine *	Small (<1,4l petrol or 1,7l diesel) Medium (1,4/1,7l-2,0l) Large (>2,0l)	2.1 2.3 4.0
Passenger car with electric engine *		0
Bus**		1.1
Railways		1.1
Tram		0
Motorbike*		1.8

* One vehicle occupant
** 20 passengers

Despite lower unit emissions, the advantage of collective transport is the possibility of carrying a large number of passengers and the fact that collective transport vehicles (buses) occupy little space on the road, calculated per passenger. What is more, collective transport has its own independent infrastructure (subway) and it can move faster than passenger cars, thus avoiding the problem of congestion. Developing a separate infrastructure, however, is a costly undertaking. A downside of collective transport is also its limited flexibility – bus stops are located at designated places, regular timetables and preset routes, to which passengers must adapt [10].

abatement technologies, while the non-technical measures are limiting traffic on selected areas, promoting car-sharing, or promoting more environment-friendly vehicles (electric vehicles, collective transport, bicycles). Below will be discussed actions carried out by selected European cities using non-technical measures of reduction of the negative environmental impact of transport. It is noteworthy here, that only the replacement of fleet of conventional vehicles with hybrid vehicles and new bus connections do not require creating a new infrastructure in the city. Development of rail transport, bicycle transport and electric vehicle transport requires appropriate investments in infrastructure.

4.1. BICYCLE TRANSPORT

Bicycles are the most environment-friendly means of transport. Their operation does not generate any exhaust emissions and noise, and bikers usually maintain their physical fitness, which only contributes to their good health.

Properly planned municipal policy should promote bicycle transport and should lead to its increasing use by the citizens. Safe and mass use of bicycles requires a creation of a dedicated road infrastructure in large cities. Bikers using bike lanes do not generate road congestion and can travel more efficiently and safely.

Such cities as Amsterdam or Copenhagen invest in bicycle transportation. Amsterdam is commonly referred to as the 'bicycle city'– in the capital of Holland, there are more bicycles than citizens. It is estimated that 57% of the citizens use a bicycle as a means of transport within the city every day. It is possible because Amsterdam has approximately 400 km of dedicated bicycle lanes. Besides, the citizens of Amsterdam can also use roads common for bicycles and motor vehicles where the maximum speed limit is 30 km/h. That extends the total length of all the bicycle lanes to 900 km. Bikers can also use approximately 20 large bicycle parking areas. They are located in the centre of Amsterdam near transport hubs and city transit stops. The citizens can pay a service fee, which guarantees a parking spot [17].

In Copenhagen, bicycle transport is equally popular– almost 70% of the citizens use bicycles at least once a week. In the capital of Denmark, there is more than 400 km of bicycle lanes in the city centre area and in the direction to the suburbs, so that citizens living outside the city centre could get to school or work as well. For the city authorities this mode of transport is particularly important – out of 11 objectives related to the city development by 2015 as much as 3 are related to bicycle traffic [19]. The popularity of bicycles has led to a situation that even in large shopping malls, instead of large vehicle parking areas, smaller ones (for 3000 vehicles) are built with a much greater number of bike racks [9]. An interesting initiative is the possibility of planning a bike route using a special internet site [18]. The bicycle-related strategy for the city for 2011-2025 assumes modernization and extension of many existing bike lane systems as well as building new ones connecting the suburbs with the city centre [7]. Many of the newly planned bike lanes are to be separated from the motor vehicle traffic and surrounded with low emission zones. Copenhagen boasts a very high index of length of bicycle lanes per one citizen, which amounts to 0.8 m. For comparison, for Amsterdam it is 0.5 m, yet when we include the motor vehicle shared routes (speed limit of 30 km/h) this index grows to 1.1 per person.

An important element boosting the development of bicycle traffic are bicycle parking areas and bicycle rentals. City bikes, i.e. self-service bicycle rentals operate in many European cities including Copenhagen, Paris and Poland (Warsaw, Poznan). Paris launched city bike rentals under the name of Vélib in July 2007. Currently, in Paris and its adjacent municipalities there are 1700 bike stations offering over 23 thousand bicycles. In 2012, the annual service fee was paid by 225 thousand citizens and the daily rental rate is on the level of 110 up to 135 thousand rentals [14].

In Warsaw there are 267 bicycle parking areas but these are usually small areas with the capacity of 2.9 thousand [13]. Almost half of the available parking spots are located within the city centre. Bike + Ride (51 in Warsaw) is also a biker-friendly initiative. 21 are located near the subway stations and the rest at tramway end stops. The city also operates a city bike system under the name of Veturilo. The users can hire 2,600 bicycles at more than 173 locations in Warsaw [22]. Warsaw is one of over 60 cities worldwide using the system of self-service bicycle rentals run by the same operator. The Veturilo bike rentals operate, *inter alia*, in Germany, Austria, Switzerland, New Zealand and Latvia.

4.2. COLLECTIVE TRANSPORT

Collective transport is a key element of a sustainable urban transport system. The attractiveness of the urban transport depends on the following factors:

- price competitiveness,
- speed of transit,
- comprehensiveness and availability of connections,
- efficiency of the system measured with the adherence to the timetable and punctuality,
- travelling comfort.

The attractiveness of collective transport depends on proper planning of the routes, adaptation or construction of the infrastructure, selection of the means of collective transport, frequency of service and the system of ticket sale.

In Amsterdam, we can travel using a sizeable network of trams and buses. To the suburban zones we usually travel using the latter. The capital of Holland also has four subway lines and another one, connecting the north of the city with its south, under construction (eventually the subway line will service the Schiphol International Airport). Because of its maritime location, Amsterdam also offers ferry transport, which is an additional tourist attraction. The network of collective transport in Amsterdam is extensive and the stops of all modes of transport are integrated or are in close distance within one another [17]. The users of tramway, buses or subway must obtain a microchip card (OV-chipkaart). You can top up your microchip card at many points in the city or via the Internet. Additionally, the card entitles to a free admission to museums. More charges (of the transport operator) apply when travelling by ferry or train. New connections and adaptations for people with disabilities are planned [16].

In Copenhagen, similarly to Amsterdam, the citizens can travel with collective transport using a large bus network, fast suburban trains and subway. Within the bus system, there are three types of bus services: A-buses (operating mainly in the city centre area, each of the routes has many stops and the frequency of service is high), S-buses (are faster than A-buses because they stop at a lower number of stops and the service frequency is lower) and water buses (of service frequency of every 30 or 45 minutes, connecting the north of the city with the south). The latter are a tourist attraction [23]. A fast urban train - S-tog covers 7 routes and 85 stops. It enables travelling between the city centre and the suburbs with a high frequency. In 2002 subway was launched in Copenhagen. It now has 2 lines with 22 stations in the city centre. Similarly to Amsterdam, the stops of all modes of collective transport are interconnected or are very close to one another. If you want to travel by collective transport, you must have a valid ticket or obtain a card to purchase a 30-day or longer period tickets. Cardholders also have free admission to museums. Once a ticket (24 hour or 72 hour topped up in your card) is purchased, it can be used in all modes of transport available in Copenhagen without surcharge [19, 23].

A ticket purchasing system has also been introduced in Poland e.g. in Poznań a joint train and city transport ticket has been made available for people living in the adjacent municipalities. For some time now in Poznań Agglomeration there has been a single ticket system. The tickets can be purchased in the ticket machines on the stops and on recently introduced collective transport vehicles. The travellers can also purchase tickets via the Internet or smart phone applications such as moBILET or CallPay. 30-day tickets or tickets for a longer period can be purchased upon obtaining of a microchip card otherwise known as PEKA (Poznańska Elektroniczna Karta Aglomeracyjna - Poznań Agglomeration Electronic Card). From May 2014, payment for the actual travelled length will also be available (counted by the number of stops), not only for the time of travel as has been to date.

4.3. PARK&RIDE SYSTEM

Park&Ride systems facilitate the functioning of the urban transport. Car parks operating in this system are designed for travellers who wish to leave their vehicles near the city limits and continue travelling by collective transport.

Such car parks must be located near collective transport hubs – subway stations, tramway/bus route ends and suburban train stations. Large parking lots should mainly be built on the outskirts of the city. The Park&Ride system reduces the number of vehicles in the city centre.

There are three methods of operation of the Park&Ride system [11]. In the first scheme the driver pays for the parking but following a proper validation can use collective transport free of charge. The second method is that the driver must purchase a ticket for collective transport but the parking fee is not incurred. The third method is when the driver pays a reduced amount for parking and a reduced amount for collective transport.

There are 7 car parks within the Park&Ride system that are located at the outskirts of the city. Near the car parks, there are subway stations and tram/bus stops. The parking fee is 8 € per day and upon obtaining a microchip card as many as five people can use the collective transport without additional charge. Additionally, in 3 car parks there are electric vehicle charging stations and the drivers do not have to pay for the charging [17].

In Copenhagen, the drivers can use 9 Park&Ride locations. Half of them are located in the city centre and the rest is in the outskirts. Near these locations, there are subway stations, bus stops and fast suburban train stations. The driver, when parking the vehicle in these locations, must pay parking fee but gets a discount for a 24-hour ticket for collective transport (kids under 12 ride

free of charge). There is a possibility of a parking spot reservation via the Internet website.

In Warsaw, there are currently 13 Park&Ride locations offering 4100 parking spots. 7 of these locations are near the subway stations, two of them are near the fast suburban train stations and all of the locations are near bus and/or tram connections. Park & Ride allows the drivers to park free of charge if they present one of the following valid tickets for collective transport: day ticket, weekend ticket, 30-day ticket, 90-day ticket or any document entitling to a free ride using local collective transport. Otherwise, the driver must pay a one-off fee (100 PLN ≈ 25 €) upon departure [24].

4.4. ELECTRIC VEHICLES

In European cities, we can see a growing popularity of vehicles fitted with alternative sources of energy particularly electric power trains. Actions promoting electric vehicles include the creation of battery charging infrastructure, providing free or unlimited access to low emission zones within city centres, charge-free car parks or making the electric vehicle fleet available in city rentals.

Operation of electric vehicles in the city reduces noise levels and exhaust emissions. The use of electric vehicles however requires planning an appropriate infrastructure and making battery-charging stations generally available. Traditional charging stations should be located in the streets, on the Park&Ride lots where the vehicles are charged at night or are parked for a longer period. Quick charging stations should be located in the shopping malls and city parking areas where the vehicles are parked for a shorter period.

Amsterdam is a city with a very well developed infrastructure for electric vehicles. It has more than 550 public charging stations, mainly in the centre of the city. The city authorities have set a goal of having 10000 electric vehicles on the roads and 1500 charging stations by 2015. By 2040, Amsterdam is to be a city exclusively for electric vehicles [17]. An incentive to purchase an electric vehicle (including the charging stations) is the subsidies for private persons and business entities.

Electric vehicles are also promoted by the city of Berlin within the project called 'e-mobility Berlin' launched in 2008 [21]. The car manufacturer, Daimler, is responsible for the delivery of 100 Mercedes-Benz and Smart electric vehicles and providing them with maintenance and repair. The RWE energy group deals with the development, installation and operation of the charging infrastructure that is to eventually reach 500 charging stations (houses, places of work, public car parks and shopping malls), energy supply and management, and control of the system. The payment system is designed in the form of data exchange between a special vehicle communication system and an intelligent charging point. Currently there are already 260 charging stations in Berlin.

Copenhagen also invests in electric vehicles. There are 500 parking spots for the citizens where they can charge their electric vehicles. They are located mainly in the city centre but construction of more car parks with charging stations is in the pipeline so that people living in the outskirts also have access to public charging stations. The city authorities also promote this means of transport by celebrating the Electric Vehicle Day [19].

In the Paris agglomeration, in 2011 project AutoLib was launched (shared use of electric vehicles) [15]. Initially, within the AutoLib system 250 vehicles and 250 charging stations were available. Today there are 2000 vehicles and 103,000 users. The average daily rental rate amounts to 10,000. The target number of the charging stations is to reach 1,150, 1,100 of which will be located in Paris. The target number of vehicles in the Autolib system is to reach 3000 electric vehicles. From the beginning of its operation until 2013 AutoLib vehicles covered a total distance of 26 million km. At the end of 2013 the same operator launched a similar rental system in two other French cities - Lyon and Bordeaux.

The cost of rental of electric vehicles is calculated per minute of use and the price depends on the length of rental. The lowest rental prices are with the annual prepaid system (costs EUR 120) and the highest is daily rental but then the prepaid system does not apply in this case.

A competitive system operates in Nice where it offers 180 electric vehicles distributed over 60 charging stations. Additionally, all charging stations that belong to the rental system allow charging private vehicles as well. An analogical system of car-sharing also operates in Amsterdam where the Car2Go EV car rental operates 200 electric vehicles.

Electric taxicabs operate in the streets increasingly. Such taxicabs are available in Amsterdam and will soon be available in Paris (200 units in 2014) and Oslo (1,000 units by the end of 2015).

4.5. COLLECTIVE TRANSPORT FLEET

One of the ways to reduce the on-road exhaust emissions is the introduction of environment friendly collective transport fleets (buses in particular). Many cities prefer electric vehicles together with other environment friendly solutions (compressed natural gas-CNG, biogas fuelled vehicles). This boosts the market of ecological vehicles, which additionally spurs the supply of such means of transport.

For example, there are no longer any conventional diesel buses running in Madrid with 31% of the municipal vehicle fleet running on CNG and 68% on biodiesel [6]. Buses running in London must be at least Euro IV compliant and on strategic routes hybrid drives are used. In Copenhagen, the city authorities plan that by 2015 85% of public fleet will be fitted with electric drives.

4.6. LOW EMISSION ZONES

Low emission zones are zones were additional fees are applied for vehicles that are not fitted with modern power trains or fail to comply with the latest Euro standard. The least ecologically friendly vehicles are barred from entering on these areas. This leads to a reduction of noise or exhaust emissions in a given part of the city, which translates into better life quality of the society and a reduction of the morbidity rate.

Many European cities have introduced low emission zones (LEZ) determining the standards that vehicles must meet in order to be allowed into the city. The entrance requirements and standards vary, depending on the country and city. In some cities they are applicable to all vehicles (Berlin, Milan) and in others (Holland and Sweden) they apply only to light duty and heavy-duty trucks [20].

In Berlin LEZ was introduced in January 2008. Initially, depending on the emission level that the vehicle complied with (passenger cars, buses, coaches, LDVs and HGVs) the driver had to purchase a relevant sticker to be granted access to the zone. Since January 2010, only Euro 4/IV or 3/III+ DPF compliant vehicles have been allowed in the LEZ zone. A low emission zone for all vehicles has been operative in Milan since 2012. It is accessible by at least Euro 1 vehicles, and diesel vehicles must be Euro 3 compliant to access the zone. In London a zone of Greater London has been operative since February 2008 and focuses on diesel-engine lorries over 3.5 tons, buses, coaches, large vans and minibuses. A daily charge of GBP 100-200 = EUR 120-250 applies for each day the non-compliant vehicle is driven within the zone [20].

Motor vehicles are barred from city centres increasingly and in areas where traffic is allowed speed limits of up to 30km/h are applied. In Amsterdam and Copenhagen city centre traffic area is limited to bicycles and collective transport exclusively.

Fig. 1. Low emission zone in Berlin [6].

5. GUIDELINES FOR THE CREATION OF A SUSTAINABLE URBAN TRANSPORT SYSTEM

The introduction of a sustainable transport system is based on promoting collective transport or, alternatively, combining individual transport with collective transport into a single system in which the individual transport is more of a 'delivery tool' to the public network hubs. The share of collective transport in the total passenger carriage should be increased and in the individual transport ecology should be promoted.

Solutions that are used to encourage the citizens to use collective transport are as follows:

- all means of collective transport are privileged on all roads (priority in the intersections, separate bus lanes),
- separate infrastructure for collective transport (separation of the tram tracks from the road, subway, bus lanes)
- integration of the collective with the individual transport through Park&Ride systems and bicycle parking areas,
- integration of various types of collective transport – trams, buses, subway, railway (building underground passages that join the

individual modes, combined railway and bus stations)
- creating new connections that increase the availability of collective transport,
- providing facilities for the elderly and people with disabilities (low floor fleet, elevation of the bus stops fitting the bus doors),
- exchange of the collective transport fleet to low emission vehicles,
- introduction of a joint ticket system for all collective transport carriers within a single agglomeration,
- effective information systems in compliance with Intelligent Transport Systems (fitting electronic information boards on bus stops informing on the actual time of bus arrival.)

Citizens should also be encouraged to purchase vehicles fitted with moderns power trains such as: hybrid, electric or hydrogen vehicles. Such actions should be subsidized by the state (purchase and development of the charging and refuelling infrastructure for these vehicles). Cities can ban vehicles that fail to comply with ecological requirements from certain city zones.

Negative impact of individual transport on the environment, the traffic and air pollution can also be reduced by promoting solutions such as car sharing and car-pooling. The concept of car sharing is based on creating car rentals (municipality-owned or private) that hire vehicles fitted with environmentally friendly power trains. The underlying idea is to help people who cannot or do not want to purchase their own vehicles. For a fee, they can use a generally available vehicle when needed (going shopping or on an out of city tour). The rental is hourly or daily.

Car-pooling is based on joint rides of people going in the same direction (travelling to work or weekend students' homecoming). This reduces traffic congestion and demand for parking space in the city.

Additionally, a reduction of the exhaust emissions is possible through an improvement of traffic organization, increasing traffic smoothness and fitting electronic information boards on the roads providing information on the traffic conditions or available parking space in a given area.

An important action is also the modernization of road infrastructure in order to eliminate heavy haulage from the city centres and increase road throughput and traffic smoothness. This can be achieved by building bypasses of city agglomerations. It reduces the number of vehicles in the city, which translates into a reduction of the noise level, exhaust emissions and traffic congestion as well as the travelling time for the citizens and passers.

Another area is the promotion of bicycle and pedestrian transport. The development of bicycle transport entails a construction of a safe and dedicated infrastructure of bicycle lanes and city bike rentals.

The municipal authorities should promote innovative solutions and ideas that encourage ecological transport by:
- day without a car – on a given day/week, passengers travel free of charge on a means of collective transport if they carry a valid vehicle registration with them,
- school educational activities and speeches prepared by specialists in ecological transport to instil proper behaviour patterns in youth to be used in adult life.

Informational activities and campaigns raising awareness may play a significant role in the shaping of the behaviour of future customers and facilitate choices related to sustainable transport related mobility.

6. CONCLUSIONS

The creation of an ecological transport system is not a simple task because of the costs and the time of implementation. Practically, every European city has initiated actions in this matter that have recently intensified. In Poland, this process is still in its infancy. We can still see insufficient interest from the city authorities related to the creation of a sustainable transport system. The citizens should have the possibility to use ecological means of transport (bicycle lanes), electric vehicle charging infrastructure or low emission collective transport. Many solutions promoting sustainable transport are being implemented, such as electric vehicle rentals, separate infrastructure or joint ticket systems. Some other, such as intelligent pricing systems are still in the pipeline.

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