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ANALYSIS OF UKRAINE'S TRANSITION TO STIMULATING TARIFFS

Abstract

The prerequisites of public transport electrification and the need to reduce CO_2 emissions in the transport sector are investigated. It has been established that electricity is a universal energy source that can help diversify primary energy sources for transport and increase energy security. Positive socio-economic effects from the use of electricity in the transport sector are identified. The competitive advantages of using electric transport in the system of public transportation are determined. Global experience of electrification of passenger transportation is analyzed. An important driving force for the creation and development of the market was government support, which was carried out by adopting relevant legislative norms and implementing various initiatives at both the national and regional levels. The development of the legislative framework for the support of environmentally

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friendly modes of transport in the world economy markets is divided into stages. The current state of public electric transport in Ukraine is explored. The system of reform measures for the public electric transport in Ukraine is determined.

Key words:

Electric transport, public transport, energy consumption, electricity, transport, passenger transportation system, infrastructure.

JEL: R41, R42, R49.

Stable operation of public transport is one of the most important conditions for socio-economic development of any given country. In spite of the rapid development of motorization, it is public transport that should ensure full and timely satisfaction of the needs of all the population categories in travel (Pumbrasova, 2012). In recent years, the attention of researchers, state and city authorities, and the public (population) to electromobility for urban transport has been steadily increasing. That increase is provoked not only by the necessity to achieve sustainable urban development, but also by economic and social interests. Different approaches and business models for electromobility implementation in urban transport are applicable in different countries.

The objective of the article is to explore, analyse and evaluate the approaches and models for efficient implementation of EVs in urban transport from an economic, social and environmental point of view.

Prerequisites for electrification of public transport

The development of the global economy is accompanied by: an increase in energy consumption; limitation and exhaustion of fuel resources, primarily oil and natural gas; discrepancy between supply and demand of energy carriers; and increased competition on energy markets (Lishchynskyi, 2017). Energy consumption at the beginning of the 21st century in all regions of the world shows a

steady upward trend: it has increased by 11% over the past 10 years and amounts to about 11.8 billion tons annually. Aggravation of contradictions and new challenges in the world's energy industry is one of the prerequisites for increasing international tensions in the world energy markets (Lyzun, Komar, 2011). In order to ensure the energy security of the world and each country in particular, mutually beneficial integration is required, an agreed legal, regulatory and technical policy in the energy sector taking into account the current trends of the world economy development. Using renewable energy and increasing energy efficiency is a key objective for reducing greenhouse gas emissions. The EU aims to receive 20% of its energy from renewable sources by 2020, and the target for 2030 is set at 27%.

Since transport is one of the main sources of CO_2 emissions in the EU, the need to reduce emissions in this sector is inevitable. Thus, the European Commission has set a goal to reduce greenhouse gas emissions in the transport sector by about 20% by 2030, compared with emissions in 2008 and by 60% by 2050 compared to 1990 (European Comission. Directorate-General for Mobility and Transport, 2011). The European Commission recently reaffirmed this intention in the «European Strategy for Low-Emission Mobility» (2016), which expressed its hope that the CO_2 emissions of transport by 2050 should be «firmly headed to zero» (European Commission, 2016).

Electric mobility is expected to play a major role for achieving these goals for three reasons:

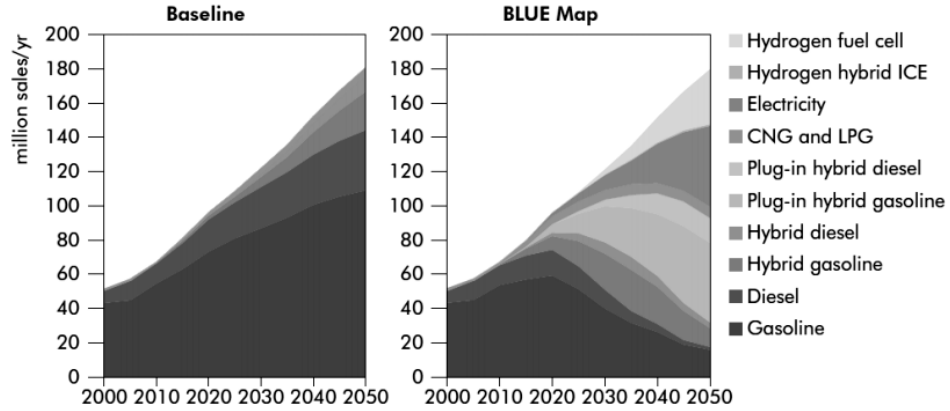
- electric powertrains are significantly more energy efficient than conventional ones,
- electricity can make direct use of energy from renewable sources available for transport,
- when connected to the power grid, batteries of electric vehicles could stabilize the grid and balance supply and demand facilitating the integration of renewable sources (European Commission. Report Electrification of Transport System, 2017).

The International Energy Agency recently derived from the two-degree target some general market development scenarios for vehicles based on alternative fuels and new propulsion systems worldwide (fig. 1).

Under the assumption of a reasonable 2030 mix of passenger car propulsion technologies (20% EV, 40% HEV, 10% FCEV, and 30% conventional), an overall 70% reduction of CO_2 emissions from passenger cars can be expected (European Commission. Report Electrification of Transport System, 2017).

Fig. 1

Global annual market shares (millions) of various alternative propulsion technologies in a baseline scenario (left) and the BLUE map scenario derived from the two-degree target of climate protection the International Energy Agency (IEA, 2010)



Electricity is a universal energy source that can help diversify primary energy sources for transport, which will increase the security of energy supply. This not only raises the energy efficiency of vehicles, but also diversifies energy sources for transport, and is particularly important in an unstable political situation and price volatility conditions in many oil and gas exporters. The European transport system currently faces growing problems, including air pollution and climate change. In this context, vehicle electrification is a promising area with significant potential for reducing air pollution associated with transport, greenhouse gases and noise emissions. Moreover, the use of electricity in the transport sector has positive socio-economic effects: the EU spends around EUR 1 billion a day on the import of hydrocarbon fuels for transport and on covering the associated increase in environmental costs (European Commission, 2018).

Concerning the use of electric transport in the system of public transportation, it is necessary to distinguish competitive advantages, such as:

- environmental friendliness;
- the possibility of avoiding traffic jams through correct planning of tram lines, when the rails are laid either in parallel to the highway or in the areas of the city where there is no car traffic;

- low cost of operation. At high cost of rolling stock of electric vehicles, its service life is two to three times higher, which reduces the proportion of depreciation in current expenses. However, the main reason for low operating costs is that electric transport operates on the relatively cheap electricity.

Global experience in the electrification of passenger transportation

In many countries, the market of ecological modes of transport, including electric transport, began to develop several decades ago. An important driving force for the creation and development of the market was government support. The authorities carried it out by adopting relevant legislative norms and implementing various initiatives at both national and regional levels.

Thus, nowadays in many countries there is a complex system of state support for the development of environmentally friendly modes of transport. Such measures can be directed both to stimulate the market demand for new modes of transport, and to restrict the use of traditional modes of transport, often characterized by emissions of harmful substances into the atmosphere. The development of a legislative framework to support markets for environmentally friendly modes of transport in most countries can be divided into two stages (Fig. 2).

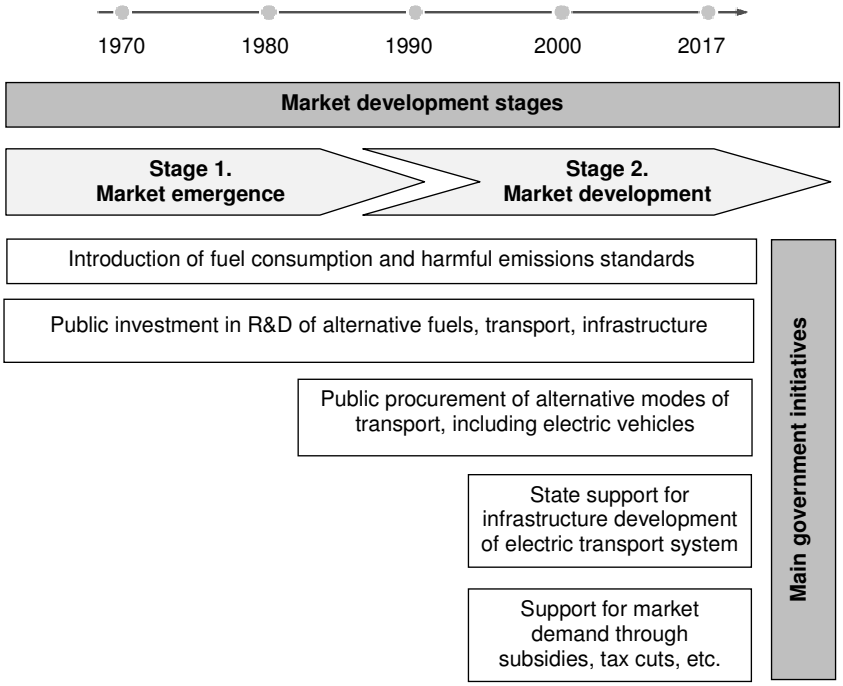
The first stage (1970–80s) includes the introduction of measures that indirectly affect the development of the market for alternative modes of transport. Among them are the establishment of standards for emissions of harmful substances and fuel consumption for manufacturers and sellers of vehicles. Somewhat later, the United States introduced a system of sales points that companies received for the production of cars with low fuel consumption, thus, manufacturers of more economical cars could receive additional revenue from sales points. In addition, a number of countries (such as the United States, Norway) invested in and provided grants for research in the field of transport, working on alternative energy sources, and the development of the infrastructure needed for this.

The main reasons for the adoption of relevant legislation at the first stage were:

- high level of air pollution in certain industrial regions;
- rising oil prices and, as a result, a significant increase in the total cost of owning traditional modes of transport;
- increasing dependence of developed countries on import of energy resources.

Fig. 2

State support of the market for alternative modes of transport, including electric transport, in developed countries



Note: created on the basis of (State Role in Electric Transport Development, 2018).

Thus, the emergence of more environmentally friendly and economical (for users) technologies for traditional modes of transport and the creation of new modes of transport working on alternative fuels, such as biofuels or electricity were the results of the first stage.

During the second stage (beginning in the 2000s), the main reasons for state support became the need to increase the competitiveness of domestic automakers on the global market and the desire to develop new technologies in the field of environmentally friendly modes of transport.

It is worth noting that the indirect cause for the intense development of electric transport was the need to reduce carbon dioxide emissions into the atmosphere. However, to date there is no evidence of direct impact of carbon diox-

ide emissions on climate change. Other reasons for the emergence of electric vehicles in some countries, in particular in Norway, were the development of renewable energy sources and the need to create additional markets. Consequently, during the second stage, in light of rigid standards on emissions of harmful substances and requirements for the cost-effectiveness of fuel consumption by cars, states began to introduce incentive measures for producers and users of electric transport.

Shenzhen (China), with the population of 12 million people, has become a striking example of public transport electrification. On October 12, 2017, this city became the first in the world with exclusively electric public transport. The city added 16,359 electric battery buses to the previously functioning subway and trams. The programme of public transport electrification has been in implementation for 7 years (World Top Position with 100% Electric Public Transport, 2017). The next stage of modernization will see a full transition to electricity in all taxis by 2020, as well as in utility and construction equipment.

Development of public electric transport in Ukraine

Electric transport is important for the passenger transport system in Ukraine and provides 50% of all passenger traffic, as shown in Table 1.

All represented modes of electric transport belong to the system of public transportation. The analysis of transport indicators for 2005-2016 shows that the share of electric transport has increased from 48% in 2005 to 50% in 2016. However, it should be noted that the share of electric transport in passenger traffic in 2000 was 60%.

As of the beginning of 2017, there are 53 enterprises operating in Ukraine that provide public transport services. They operate 2646 tramcars, 3736 trolleybuses, 1927 km of tramlines (177 routes); 4412 km of trolley lines (405 routes). Every year, more than 2 billion passengers use public electric transport services (in particular, trams and trolleybuses). At the moment, 95% of tramcars and 67% of trolley buses have passed the normative term of operation and require replacement or need urgent overhaul. The normative term of exploitation for a tram is 15 years, while the same for a trolleybus is 10 years. Now 1193 units of tramcars have been in service for over 30 years, 1979 trolleybuses – for more than 20 years (Ministry of Infrastructure of Ukraine, 2018). In particular, the average age of vehicles in Lviv is 10.5 years old, in Ternopil – 31, and in Vinnytsia – 44 years old (trams). One third of public transport consists of electric vehicles, except for Lutsk, where 100% of vehicles are electric, and Vinnytsia, where their share is 60% (European Investment Bank. System of E-ticket in Ukraine, 2017).

Table 1

**Distribution of passenger traffic by mode of transport in Ukraine, %
(State Statistics Service of Ukraine, electronic resource)**

Modes of transport	2000	2005	2010	2011	2012	2013	2014	2015	2016
Transport	100	100	100	100	100	100	100	100	100
Railway*	6	5	6	6	6	6	7	8	8
Maritime (sea)	0	0	0	0	0	0	0	0	0
Maritime (river)	0	0	0	0	0	0	0	0	0
Air**	0	0	0	0	0	0	0	0	0
Road (buses)	33	47	55	52	51	51	49	43	42
Trolleybuses	33	23	18	19	20	20	19	21	22
Trams	18	14	10	12	12	11	13	14	14
Metro	10	11	11	11	11	12	12	14	14

Notes: * according to PJSC «Ukrzaliznytsia», since 2010 – including the transportation of passengers by city electric train; ** since 2003 – according to the State Aviation Service of Ukraine; *** including the volume of road passenger transport (buses), made by individuals and legal entities of small business.

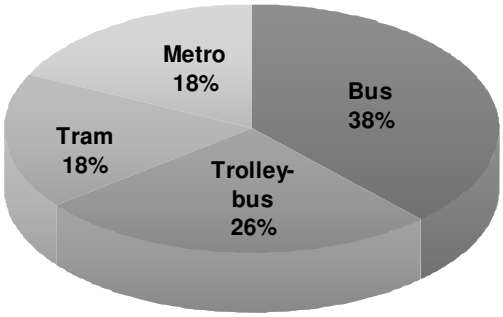
It should be noted that in 2016 in Ukraine, the total number of passengers on public electric transport amounted to 2243 million passengers (in 2015 this figure amounted to 2520 million passengers), which is 61.94% of all intra-urban traffic. Figure 3 shows the structure of public transport in Ukraine in 2016 (State Statistics Service of Ukraine, electronic resource).

Figure 3 shows that in 2016 trolleybuses had the largest share (26%) in the volume of transportation by public electric transport. It should be noted, that in the structure of public transportation modes, metro was the leader, with a volume of 698 million passengers, in 2016. However, it is characterized by territorial limitations (such mode of transport is available only in Kyiv, Kharkiv and Dnipro) and high cost of construction and maintenance.

Ternopil also has large experience of involving electric vehicles in public transport. Particularly trolleybus lines are functioning in the city since 1975. Currently there are 11 trolleybus lines, which are of big social importance (the lines are of community ownership and provide free of charge services for socially unsecured person). Besides, more than 30 electric train-routes are connecting Ternopil and nearest cities and towns. Moreover, the city community is planning to increase involvement of electric vehicles in its infrastructure. Currently all police cars are equipped with hybrid engines (most of the cars are received in the frame of Kyoto protocol from Japan as the compensation for non-polluting atmosphere.)

Fig. 3

The structure of passenger transportation by public transport in Ukraine in 2016, % (State Statistics Service of Ukraine, electronic resource)



The global trends in passenger transportation make it is advisable to create a system of measures for reforming the public electric transport of Ukraine:

- renewal of electric vehicles through the use of financial leasing system;
- introduction of an automated control system for the fare fees;
- introduction of targeted subsidy system for privileged categories of passengers;
- setting economically justified tariffs for public electrical transport services (Dobrova, Osypova, 2017);
- introduction of automated dispatching systems.

Conclusions

The system of passenger transportation is undergoing enormous changes based on electrification. The most important factors influencing the transformation of public transport in the global economy are:

- need to accelerate efforts to combat climate change and air pollution (especially in urban areas);
- strengthening norms of regulation of CO_2 emissions and pollutants established in most countries, along with the desire to reduce depend-

ence on exhaustive fuel resources whilst increasing the use of renewable energy sources;

- global economic environment with competing American, Asian and European industries vying for leadership in the field of electric motors technology;
- state incentives for using electric vehicles and infrastructure development;
- encouragement to use of electrified 2-3-wheelers (e.g. bicycles and scooters) for internal urban mobility.

Thus, the transport sector of Ukraine meets only the basic needs of the population and the national economy in traffic volume, but not in its quality. The current state of its development and material provision does not fully meet the requirements of the European orientation of Ukraine and the integration of its national transport system into the pan-European transport network. Establishing conditions for the development of electric transport is not only a Ukrainian, but also a pan-European objective that encompasses the continuity of public transportation, environmental and climate protection, alternative energy and health care policy.

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