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THE METHOD OF MARKETING MONITORING OF BUSES ACCORDING TO INDICATORS OF TRANSPORT ENERGY EFFICIENCY

МЕТОДИКА МАРКЕТИНГОВОГО МОНІТОРИНГУ АВТОБУСІВ ЗА ПОКАЗНИКАМИ ТРАНСПОРТНОЇ ЕНЕРГЕТИЧНОЇ ЕФЕКТИВНОСТІ

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Abstract. *The main direction of energy efficiency in the transport system is the comprehensive improvement of transport equipment and technology. There is a need for an element-by-element parametric analysis of the bus design. A feature of the choice of rolling stock is the compliance of this choice with the concept of economy energy and resources. The development of the world market of motor vehicles is characterized by an increase in the variety of types and types of bus designs. Leading automotive companies offer dozens of designs for individual orders buses.*

Key words: *bus, bus transportation, energy efficiency, integrated approach, renewal of the bus fleet, operating conditions.*

Introduction

The existing bus market for passenger transportation is characterized by a large number of vehicles of various sizes, models (within the same segment), and different structural and technical parameters of the same category and class of buses [1].

Bearing this in mind, carriers that provide road transport services to the population to meet their social needs are faced with the task of choosing buses that, in their turn, will provide not only a high level of comfort but also an increase in the level of technical and technological competitiveness of future transport offers and transport energy efficiency.

The research purpose

The purpose of the proposed methodology is to assess the existing segment of buses on the vehicle market by transport energy efficiency indicators and predict their suitability for future operating conditions.

Presentation of the main research material

The methods and criteria that are usually used in assessing and selecting buses can only solve the problems of socio-ethical marketing, and market relations. In some cases, they partially consider technical, operational, and other indicators that do not reveal the issue of energy efficiency, since their disadvantage is that they are based on cost-effective calculation schemes for passenger transportation [2].

In this regard, there is a need for an element-by-element parametric analysis of the bus design and an assessment of the complex impact of the given design parameters on energy efficiency of bus transportation.

Energy efficiency of bus transport is characterized by three physical factors of adaptive discrete transport operation (average speed of complex adaptive discrete bus traffic; energy and fuel consumption of transport operation at different phases of traffic; run structure of the traffic operation, which consists of a set of phases of steady and unsteady traffic of bus transport) [3]. At the same time, a parametric analysis of energy efficiency of the structural-parametric organization of the bus design, which consists of four devices (BECD – bus energy-converting device; DCWBP - device for carrying the weight of bus passengers; BBD – bus braking device; BSD – bus steering device) and 14 functional and constructive modules (CM 1.1 – energy source (engine); CM 1.2 – energy transformation (gearbox, main gear); CM 1.3 – energy distribution (differentials between wheels, between axles and power take-off device); CM 1.4 – wheel traction module (pair of drive wheels); CM 2.1 – body; CM 2.2 – frame; CM 2.3 – suspension; CM 2.4 – running modules; CM 3.1 – brake pedal and brake drive; CM 3.2 – brake mechanisms; CM 3.3 – brake wheels (axles); CM 4.1 – steering wheel and steering mechanism; CM 4.2 – steering drive (steering trapeze and steering rods); CM 4.3 – steering wheels (front)) can be used to solve various problems [3]: a) marketing monitoring of buses; b) operational analysis of the suitability of the structural and parametric organization of the bus design for a specific route.

During the marketing monitoring of buses (Fig. 1), the vehicle operation is considered as a complex scientific and technical product. Therefore, accounting for the regularities of the influence of various factors on energy efficiency of buses is important for consumer-oriented selection and renewal of the bus fleet. The assessment of the bus technical parameter to save energy in the transport process is carried out using energy efficiency indicators $П_e$ (in the test operation) [4].

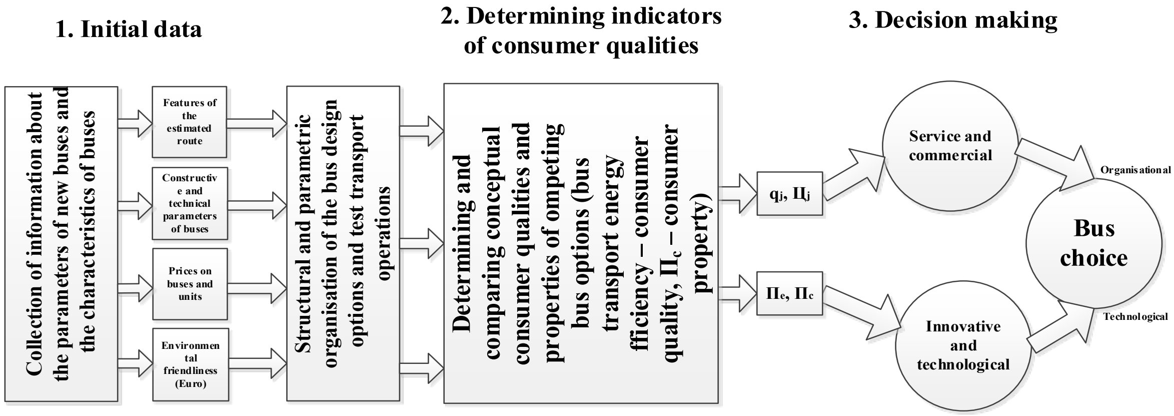


Figure 1 – The process of monitoring the bus market of the given segment by transport energy efficiency

Authoring

The transport energy efficiency indicator is the ratio of the transport energy release of this bus in the test operation ρ to the transport energy release of the reference bus in the reference operation ρ_{eT} [5]:

$$П_e = \frac{\rho}{\rho_{ет}} = \frac{K_v \cdot \gamma_{ст}}{K_e \cdot (\eta_q + \gamma_{ст})} \rightarrow \max, \quad (1)$$

where K_v is the bus speed coefficient in the test operation (the ratio of the average bus speed in the test cycle to the reference bus speed); $\gamma_{ст}$ – the coefficient of static use of the bus passenger capacity; K_e - the energy coefficient of the bus run in the test operation (the ratio of fuel consumption of this bus in the test operation to fuel consumption of the reference bus, which moves at a constant reference speed); η_q – the coefficient of the equipped mass of the bus.

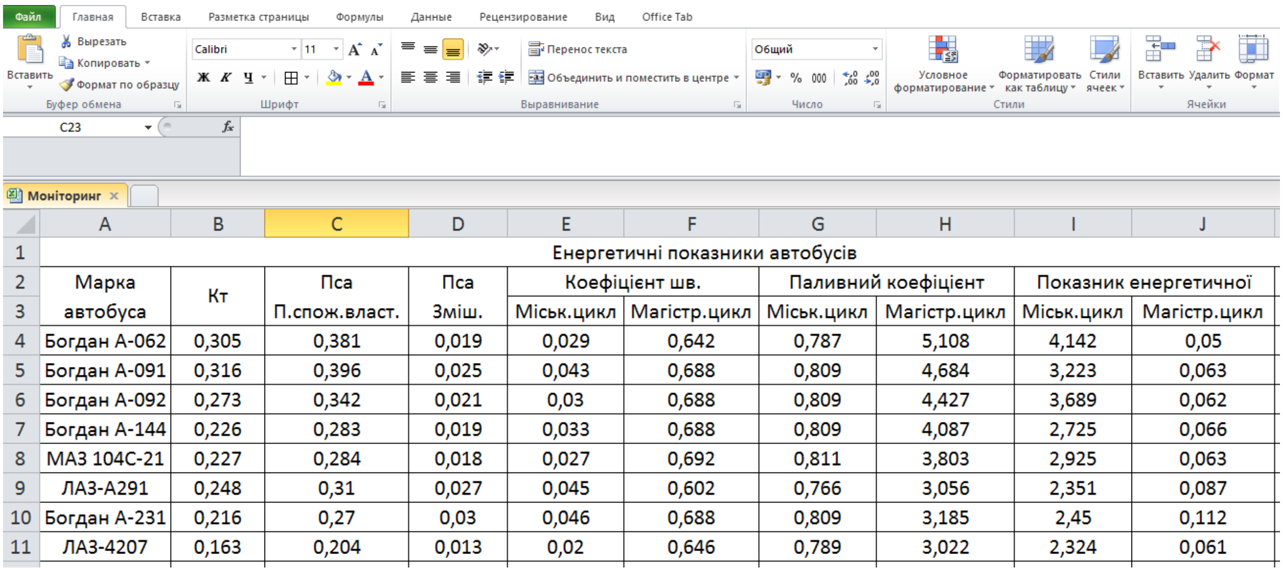
Choosing the option that corresponds to $П_e \rightarrow \max$ will ensure an increase in the bus transport energy efficiency for the given conditions of the bus route.

The level of a bus as a scientific and technical product is determined by the criterion of the consumer property $П_{ca}$, which is a multiplicative function of five indicators of consumer qualities [5]:

$$П_{ca} = П_e \cdot П_д \cdot П_{рн} \cdot П_{те} \cdot П_{pe},$$
$$П_e \geq П_{ej}, П_д \geq П_{дj}, П_{рн} \geq П_{рнj}, П_{те} \geq П_{теj}, П_{pe} \geq П_{pej}, \quad (2)$$

where $П_e$ is the energy efficiency indicator of the motor vehicle, which is accepted as an indicator of the bus comprehensive quality; $П_д$ is a durability indicator (the ratio of the depreciation run of the given bus and its average value for the bus segment); $П_{рн}$ is an indicator of the resource heterogeneity of the bus design, which depends on the aggregate structure of vehicles, the standard run of units, as well as their prices (at this stage, $П_{рн} = 1$); $П_{те}$ is an indicator of product efficiency, which is the ratio of the average price of buses in this market segment to the price of the specific bus (at this stage, $П_{те} = 1$); $П_{pe}$ is an indicator of the level of the bus environmental friendliness according to Euro standards; j is an index that characterizes the limitations of consumer properties in the bus segment.

Thus, it is clear that the higher the consumption property indicator of $П_{ca}$, the higher the perfection of the bus design.



	A	B	C	D	E	F	G	H	I	J
1	Енергетичні показники автобусів									
2	Марка автобуса	Кт	Пса П.спож.власт.	Пса Зміш.	Коефіцієнт шв.		Паливний коефіцієнт		Показник енергетичної	
3					Міськ.цикл	Магістр.цикл	Міськ.цикл	Магістр.цикл	Міськ.цикл	Магістр.цикл
4	Богдан А-062	0,305	0,381	0,019	0,029	0,642	0,787	5,108	4,142	0,05
5	Богдан А-091	0,316	0,396	0,025	0,043	0,688	0,809	4,684	3,223	0,063
6	Богдан А-092	0,273	0,342	0,021	0,03	0,688	0,809	4,427	3,689	0,062
7	Богдан А-144	0,226	0,283	0,019	0,033	0,688	0,809	4,087	2,725	0,066
8	МАЗ 104С-21	0,227	0,284	0,018	0,027	0,692	0,811	3,803	2,925	0,063
9	ЛАЗ-А291	0,248	0,31	0,027	0,045	0,602	0,766	3,056	2,351	0,087
10	Богдан А-231	0,216	0,27	0,03	0,046	0,688	0,809	3,185	2,45	0,112
11	ЛАЗ-4207	0,163	0,204	0,013	0,02	0,646	0,789	3,022	2,324	0,061

Figure 2 – The spreadsheet fragment

Authoring

According to condition (1), it is possible to rank buses within the selected segment according to the degree of their suitability for energy-saving transport technology.

Using the new approach of the proposed methodology, spreadsheets (Fig. 2) have been developed that allow collecting, saving, automatically making calculations and systematizing the initial data (bus characteristics) and calculation results for further use in the selection and justification of the proposed bus fleet. The spreadsheet is divided into parts, which present the initial data, intermediate calculations, and indicators of transport energy efficiency of the assessment of buses, based on which a decision is made on the motor vehicle choice.

Conclusions

The developed monitoring method makes it possible to assess and subsequently predict the suitability of the bus design and its operating modes to increase transport energy efficiency within the selected market segment.

The assessment can also be carried out when choosing buses of the same model series with different combinations of functional and constructive modules of the structural and parametric design organization, which makes it possible to choose the option that is more effective on the route with specific operating conditions.

With the help of the software used by enterprises in the field of vehicle production and the provision of motor transport services, the methodology makes it possible to implement automated calculations, collect, store, and systematize the obtained results, which can be used when justifying the choice of a new bus.

The developed spreadsheets allow collecting, storing, performing automated calculations and systematizing the obtained results used in justifying the choice of a new bus.

References

1. Stanyslav B. Which buses are bought in Ukraine: the ranking of brands and models. *Auto*.24: website. URL: https://auto.24tv.ua/ru/kakie_avtobusy_pokupajut_v_ukraine_rejting_marok_i_modelej_n40463.

2. Organization and management of passenger transportation: a textbook / V.S. Marunych, L.H. Shmorhun. etc.; edited by Assoc. Prof. V.S. Marunych, Prof. L.G. Shmorhun Kyiv: Millennium, 2017. 528 p. ISBN 978-966-8063-80-1

3. Pitsyk M.G. Increasing the transport energy efficiency of urban passenger bus transportation: diss. ... Candidate of technical sciences: 05.22.01. Kyiv, 2020. 164 p.

4. Pitsyk M.G. Operational substantiation of parameters of city buses according to their transport efficiency // Bulletin of the National Transport University. K.: 2012. No. 26(2). P. 254-258.

5. Khabutdinov R.A. Systematic formation of road transportation technology according to criteria of energy and resource release: diss. ... Dr. of technical sciences: 05.22.01. Kyiv, 2003. 332 p.

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