Reduced energy consumption when separate sectors are allocated for electric vehicles in urban parking lots

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Abstract. The study проведен analyzes the reduction of energy consumption based on the allocation of separate dedicated sectors for electric vehicles in urban parking lots. The analysis of the reduction of energy consumption of electric vehicles in the presence of a dedicated sector in urban parking with three levels of parking congestion (15-30%, 30-60% and 60-90%) is carried out. The data obtained reflect the level of reduction in the energy consumption of electric vehicles for parking search when there is a dedicated sector for electric vehicles in the city parking lot. These studies can be used in research aimed at reducing the energy consumption of electric vehicles operated in urban environments.

1 Introduction

Reducing the energy consumption of electric vehicles operated in urban environments is an urgent scientific problem. This study is aimed at проведение analyzing a reduction in energy consumption based on the allocation of individual sectors for electric vehicles in urban parking lots.

City parking lots have different traffic levels at different times of the day. Accordingly, the time spent by drivers of electric vehicles searching for an empty parking space also differs.

City parking congestion can be divided into three levels:

- 15-30%;
- 30-60%;
- 60-90%.

Parking congestion directly affects the time spent by drivers of electric vehicles searching for an empty parking space. The time spent by drivers of electric vehicles searching for an empty parking space, in turn, determines the level of energy consumption of the electric vehicle at the moment of movement of the electric vehicle.

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2 Materials and Methods

This study is aimed at проведение analyzing a reduction in energy consumption based on the allocation of sectors for electric vehicles in urban parking lots. An analysis of the reduction of energy consumption of electric vehicles in the presence of a dedicated sector in urban parking with three levels of parking congestion is carried out (Table 1).

Table 1. The level of congestion in the city's parking lot.

Levels of parking congestion	%
Level No. 1	15-30%
Level No. 2	30-60%
Level No. 3	60-90%

For the purposes of collecting and processing data ona reducing the energy consumption of electric vehicles, various methods were considered when allocating sectors for electric vehicles in urban parking lots [1-23].

3 Results

3.1 Results of the analysis of reduction of energy consumption of electric vehicles in the presence of a dedicated sector for electric vehicles in urban parking, with three levels of parking congestion (15-30%, 30-60% and 60-90%)

3.1.1 Results of the analysis of the reduction of energy consumption of electric vehicles in the presence of a dedicated sector for electric vehicles in urban parking at the first level of parking congestion

The results of the analysis of reducing the energy consumption of electric vehicles in the presence of a dedicated sector in urban parking at the first level of parking congestion are presented in Figure 1.

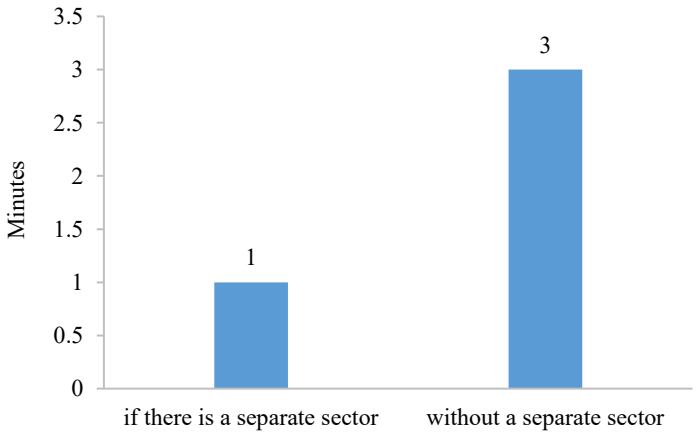

Fig. 1. Measurement of energy consumption of electric vehicles in the presence and absence of a dedicated sector for electric vehicles in the city parking lot at the first level of congestion of the parking lot.

3.1.2 Results of the analysis of the reduction of energy consumption of electric vehicles in the presence of a dedicated sector for electric vehicles in urban parking with the second level of parking congestion

The results of the analysis of reducing the energy consumption of electric vehicles in the presence of a dedicated sector in urban parking with a second level of parking congestion, are presented in Figure 2.

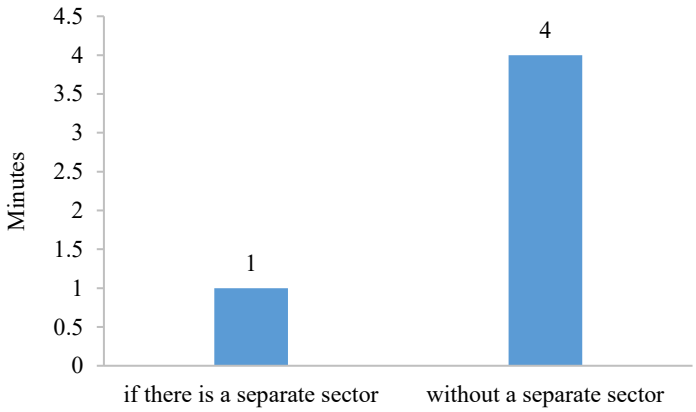

Fig. 2. Measurement of energy consumption of electric vehicles in the presence and absence of a dedicated sector for electric vehicles in the city parking lot with the second level of congestion of the parking lot.

3.1.3 Results of the analysis of the reduction of energy consumption of electric vehicles in the presence of a dedicated sector for electric vehicles in urban parking with the third level of parking congestion

The results of the analysis of reducing the energy consumption of electric vehicles in the presence of a dedicated sector in urban parking with the third level of parking congestion are presented in Figure 3.

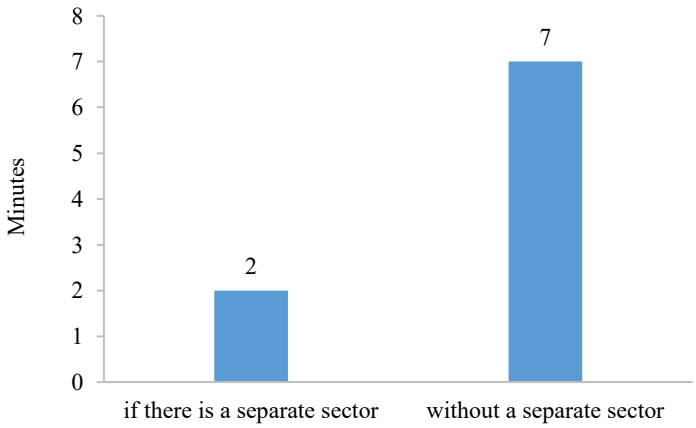

Fig. 3. Measurement of energy consumption of electric vehicles in the presence and absence of a dedicated sector for electric vehicles in the city parking lot with the third level of congestion of the parking lot.

To process the data, analyze the level of drop in battery charge of electric bicycles for different options for night parking during the summer operating season, formulas 1, 2 and 3 were used.

$$SS_{fact} = \frac{\Sigma_j^p T_j^2}{n} - \frac{(\Sigma x_i)^2}{N} \quad (1)$$

$$SS_{total} = \sum x_i^2 - \frac{(\Sigma x_i)^2}{N} \quad (2)$$

$$M = \frac{X_1 + X_2 \ldots + X_i}{n} \quad (3)$$

Processing pethe results of reducing the energy consumption of electric vehicles when allocating separate sectors for electric vehicles in urban parking lots of calculations showed compliance with the conditions of analysis a for reducing the energy consumption of electric vehicles when allocating separate sectors for electric vehicles in urban parking lots.

4 Discussion

Theindicator of reducing the energy consumption of electric vehicles in the presence of a dedicated sector in an urban parking lot with three levels of parking congestion, the time spent searching for parking in the central part of the metropolis is shown in Figure 4. The indicator is presented in minutes and can be converted to kW/h specifically for each model of electric vehicle.

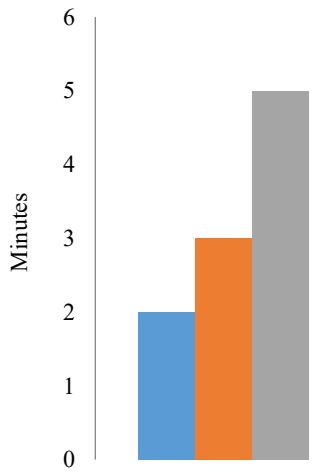

Fig. 4. Ameans of reducing the energy consumption of electric vehicles in the presence of a dedicated sector for electric vehicles in a city parking lot with three levels of parking congestion.

From the data obtained (Figure 4), it follows that the indicator of reducing the energy consumption of electric vehicles in the presence of a dedicated sector for electric vehicles in urban parking with three levels of parking congestion is:

- Level No. 1- 2 min.;
- Level No. 2- 3 min.;
- Level No. 3- 5 min.

5 Conclusions

The results of this work contain data on reducing energy consumption in the allocation of individual sectors for electric vehicles in urban parking lots. The analysis of the reduction of energy consumption of electric vehicles in the presence of a dedicated sector in urban parking at three different levels of parking congestion (15-30%, 30-60% and 60-90%) is carried out. The data obtained reflect the level of reduction in the energy consumption of electric vehicles for parking search when there is a dedicated sector for electric vehicles in the city parking lot. These studies can be used in research aimed at reducing the energy consumption of electric vehicles operated in urban environments.

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