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Break-even analysis of electric vehicles in business operations

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Abstract. The electrification of commercial transport is regarded as a promising approach to reducing operating costs and local emissions; however, the economic benefits of electric vehicles are not universal and depend on the conditions of use. The relevance of this study is driven by the need for businesses to have quantitative criteria for choosing between an electric commercial vehicle and a comparable fossil-fuel-powered alternative under different operating conditions and energy pricing structures. The aim of the study was to develop a calculation-based approach for determining the break-even annual mileage above which the use of an electric vehicle becomes economically viable, as well as the maximum acceptable purchase price of an electric vehicle below which its acquisition is economically justified. The research methods included a comparative analysis of the economic feasibility of alternative technologies; analysis of secondary data on prices, tariffs, and maintenance costs to establish model input parameters; economic and mathematical modelling based on total cost of ownership; analytical methods for deriving break-even formulas; scenario analysis of different electric vehicle charging options; and consideration of the time value of money through the application of a discount rate and an annuity present value factor. Within the framework of a model case study (10-year horizon, 5% discount rate), it was established that the break-even annual mileage of an electric van ranges from 34,529 to 200,932 km depending on the tariff and charging method, while at an annual mileage of 60,000 km, the maximum economically justified purchase price ranges from UAH 2.25 million to UAH 4.44 million. The article analyses the factors determining the feasibility of transitioning to electric vehicles, evaluates the impact of initial investments, operating costs, and existing support mechanisms on the overall economic viability of electric vehicle use in business activities, and proposes formulas for calculating both the break-even mileage of electric vehicles and the maximum initial purchase price below which their acquisition is economically advantageous for different types of commercial use. The practical value of the study lies in the possibility of applying the proposed formulas by transport and logistics companies and commercial fleet operators to support fleet renewal decisions based on the present value of ownership costs

Keywords: total cost of ownership; annual mileage; operating costs; threshold purchase price; internal combustion engines; economic viability

Introduction

The electrification of commercial transport in business operations requires a quantitative justification, as the higher purchase price of an electric vehicle is offset by lower operating costs only under certain conditions

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regarding mileage, electricity tariffs, service life and assumptions regarding residual value. Additional uncertainty arises from differences in charging availability (own infrastructure, commercial stations), tariff fluctuations, and varying vehicle usage profiles in logistics and service business processes. Under such conditions, it is essential to provide a quantitative justification of the economic viability of electric transport compared to traditional solutions equipped with internal combustion engines.

Current studies on the transition to electrification show that the pace of implementation depends on infrastructure and energy constraints, as well as on government support and planning. H. Kostenko (2023) emphasises the need to align the development of electric transport with the capabilities of the power system. The impact of incentives and policy on the dynamics of the electric transport market in Ukraine and Europe is highlighted by S. Matusiak & E. Romaniuta (2025), whilst the broader context of electric mobility development in Ukraine and its institutional constraints are explored by O. Stetsiuk *et al.* (2024). Global trends and possible directions for Ukraine's integration into the electric vehicle ecosystem are systematised by E. Prushkivska *et al.* (2024), which reinforces the argument that the transition is a process of economic and technological significance.

International publications also consistently point to the multifactorial nature of electrification barriers and the need for comprehensive solutions. A. Pamidimukkala *et al.* (2023) empirically assess groups of barriers to the adoption of electric transport, highlighting financial and infrastructure factors, whilst L. Delina & L. Shi (2025) demonstrate in a comparative policy analysis that the success of the transition is determined by a combination of incentives, infrastructure and institutional capacity. Institutional constraints on scaling up infrastructure solutions for the freight sector are examined by A. Scherrer *et al.* (2026). Meanwhile, J. Dixon *et al.* (2023) emphasise that even in the presence of common strategies, the outcomes of the transition depend on the local context and the coordination of stakeholders' actions. Among the practical constraints of electric transport in commercial operation are range and charging time, which can affect the continuity of the transport process. In this context, V. Porfirenko & Y. Kudin (2024) justify the advantages of a modular approach to the sectional release and replacement of battery packs for international transport as a means of reducing "refuelling" time, whilst Y. Li *et al.* (2024) develop a standardised modular approach to battery replacement and charging as a means of enhancing the operational flexibility of electric transport.

Alongside technological and infrastructural factors, economic viability remains a key criterion for businesses; in academic literature, this is typically assessed in terms of the total cost of ownership. P. Romeral & E. Zancul (2025) summarise the critical factors that determine the total cost of ownership of electric vehicles and emphasise that conclusions depend on the composition of costs and the assumptions made regarding energy sources, service life and residual value. The literature also highlights that no universally accepted "single formula" for total cost of ownership has been established, as researchers differ in their definitions of cost components, including or excluding specific expenditure categories, applying different approaches to modelling residual value and service life, and using alternative methods to account for the time value of money. Additional variation arises from different energy price scenarios and charging regimes, which affect variable costs and consequently the overall assessment of economic viability. This is precisely why evaluating electric transport solely on the basis of purchase price is insufficient for business purposes, as the higher initial cost of an electric vehicle can be offset by lower costs for energy, maintenance and certain operational components throughout its useful life. At the same time, such compensation does not occur automatically, but depends on the intensity of the vehicle's use, access to cheaper charging, tariff stability, route structure and the duration of ownership. For commercial transport, annual mileage is of particular importance, as it is through the accumulation of mileage that savings in variable costs are generated, capable of offsetting the initial cost difference between an electric vehicle and its internal combustion engine counterpart. In this context, the total cost of ownership presented here serves not only as a tool for comparing alternatives but also as a methodological basis for determining the threshold conditions under which electric transport becomes economically viable for a business. A separate strand consists of publications describing break-even analysis as a practical way of interpreting the difference between higher initial investment and lower operating costs of electric transport. H. Hafsah *et al.* (2024) apply the break-even approach to compare electric and conventional vehicles in the Indonesian market and highlight the scenario-dependent nature of the threshold conditions in relation to mileage and cost structure.

The aim of the study was to develop a calculation approach based on the present value of total cost of ownership for determining the break-even annual mileage of an electric commercial vehicle and the threshold (maximum acceptable) purchase price at which cost parity is achieved with a comparable vehicle equipped with an internal combustion engine.

Materials and Methods

The article proposes analytical relationships for determining the break-even annual mileage of an electric commercial vehicle and the threshold maximum purchase price at which parity in the present value of ownership costs is achieved with a comparable vehicle equipped with an internal combustion engine. When the purchase price is below this threshold, an economic advantage of the electric vehicle is established according to the criterion of discounted ownership costs. To demonstrate the application of the proposed formulas, a model case study was developed using secondary data on market prices of vans, electricity tariffs under different charging regimes, energy prices for conventional vehicles, as well as maintenance and related operating costs. The time frame for the preparation and execution of the analytical calculations covered the period from 1 April 2025 to 25 June 2025.

Operating conditions are described by the usage horizon T (years), the discount rate r, and the annual mileage L (km/year). Operating costs are divided into fixed annual costs F, which are independent of mileage, and variable costs per kilometre V, which depend on mileage. For electric vehicles, the value of is defined on a scenario basis according to the charging regime, enabling the impact of electricity tariffs on the threshold conditions of economic viability to be taken into account. The formulas were developed according to the principle of the classical break-even point, adapted for the comparison of the present value of total cost of ownership, PV(TCO). Unlike the conventional total cost of ownership (TCO), the present value of total cost of ownership, PV(TCO), incorporates the time value of money through the discounting of costs (Twin, 2025; APS Smart, 2025). To convert uniform annual costs into present value terms, the annuity present value factor was applied:

$$A(r,T) = \sum_{t=1}^{T} \frac{1}{(1+r)^t} = \frac{1-(1+r)^{-T}}{r}, \tag{1}$$

where $A(r,T)$ – annuity discount factor; r – discount rate; T – valuation horizon (service life), in years.

The present total cost of ownership of a vehicle over the usage period T is determined using the well-known formula as the sum of the present capital component (taking into account the residual value), present fixed costs and present variable costs, proportional to the annual mileage:

$$\begin{aligned} PV(TCO) = P \times (1 - *(1+r)^{-T}) + \\ + (F \times A\ (r, T)) + (V \times L \times A(r, T)), \end{aligned} \tag{2}$$

where PV (TCO) – the present value of total cost of ownership of the alternative under consideration (either the electric vehicle or the comparable internal combustion engine vehicle); P is the initial cost (purchase price of a new or used vehicle); F represents fixed costs; V represents variable costs (commonly referred to in the literature as operating costs), calculated per kilometre travelled; L is the average (or expected) annual mileage; T is the vehicle service life; α is the residual value (the expected resale value or percentage of the vehicle's remaining value at the end of its service life); $A(r,T)$ is the annuity present value factor; and r is the discount rate.

The subsequent threshold formulas were derived by analytically solving this equality with respect to either annual mileage or the purchase price of the electric vehicle while holding the operating parameters constant. The break-even annual mileage, TB_m в was determined from the condition of parity between the present value of ownership costs of the electric vehicle, $PV(TCO)_{EV}$, and those of its comparable internal combustion engine counterpart, $PV(TCO)_{ICE}$, by solving the equation with respect to L:

$$TB_m = \frac{P_{EV}(1-\alpha_{EV}*(1+r)^{-T}) - P_{ICE}(1-\alpha_{ICE}*(1+r)^{-T}) + (F_{EV}-F_{ICE})*A(r,T)}{(V_{ICE}-V_{EV})*A(r,T)}, \tag{3}$$

where P_{EV} – the initial purchase cost of the electric vehicle; P_{ICE} – the initial purchase cost of the vehicle equipped with an internal combustion engine (ICE); V_{EV} – the annual variable costs associated with the electric vehicle; V_{ICE} – the annual variable costs associated with the internal combustion engine vehicle; $_{EV}$ – the residual value of the electric vehicle, expressed as a percentage,%; $_{ICE}$ – the residual value of the internal combustion engine vehicle, expressed as a percentage, %; F_{EV} – the annual fixed costs of the electric vehicle; F_{ICE} – the annual fixed costs of the internal combustion engine vehicle; r is the discount rate; T is the service life, in years; and $A(r, T)$ is the annuity present value factor.

The threshold (maximum economically acceptable) purchase price of an electric vehicle P_{EV}^{max} is determined from the same condition of parity, $PV(TCO_{EV}) = PV(TCO_{ICE})$, but by solving the equation with respect to P_{EV} for a given annual mileage L:

$$P_{EV}^{max} = \frac{P_{ICE}*(1 - \ _{ICE}(1+r)^{-T}) + (F_{ICE}-F_{EV})*A(r,T) + (V_{ICE}-V_{EV})*L*A(r,T)}{1-\alpha_{EV}(1+r)^{-T}}, \tag{4}$$

where P_{EV} – the initial purchase cost of the electric vehicle; P_{ICE} – the initial purchase cost of the vehicle equipped with an internal combustion engine (ICE); V_{EV} – the annual variable costs associated with the electric vehicle; V_{ICE} – the annual variable costs associated with the internal combustion engine vehicle; $_{EV}$ – the residual value of the electric vehicle, expressed as a percentage; $_{ICE}$ – the residual value of the internal combustion engine vehicle, expressed as a percentage; F_{EV} – the annual fixed costs of the electric vehicle; F_{ICE} – the annual fixed costs of the internal combustion engine vehicle; r – cthe discount rate; T – the service life, in years; and $A(r, T)$ – the annuity present value factor.

When assessing the threshold purchase price of a used electric vehicle, it is advisable to account for additional one-off costs, C_{one}, associated with uncertainty regarding the vehicle's technical condition. These may include diagnostic inspections, costs of bringing the vehicle into operational condition, unplanned repairs, and potential expenditures related to high-voltage system components. In the model example, calculations were performed for new vans, as the cost parameters for such vehicles are more clearly defined and the risk of unforeseen one-off expenditures is partly mitigated by warranty coverage and predictable maintenance schedules. Owing to the absence of reliable statistical data concerning the probability and magnitude of such one-off costs for used electric vans, the demonstration case assumes $C_{one} = 0$ UAH. Verification of the break-even condition was carried out for the threshold prices P_{EV}^{max} by substituting the calculated values into the formula for the present value of ownership costs, $PV(TCO)_{EV}$ according to Equation (2), and by checking compliance with the parity condition between the present value of ownership costs of the electric vehicle, $PV(TCO)_{EV}$ and those of its comparable internal combustion engine counterpart, $PV(TCO)_{ICE}$ subject to rounding precision. The calculations were implemented in a spreadsheet environment, ensuring reproducibility of the results when input parameters are modified.

Results and Discussion

Over recent years, electric vehicles have gained substantial popularity and have become more accessible to consumers. Various automotive manufacturers now offer a wide range of electric vehicle models with differing technical specifications, price ranges, and propulsion systems (E-AUTO, 2023; Encyclopedia, n.d.). To define the scope of the study correctly, it is useful to distinguish between different types of electrified vehicles according to their energy source and propulsion principle. This classification serves as a reference framework for selecting the modelling object and interpreting the results. The different categories of electric vehicles are presented in Figure 1.

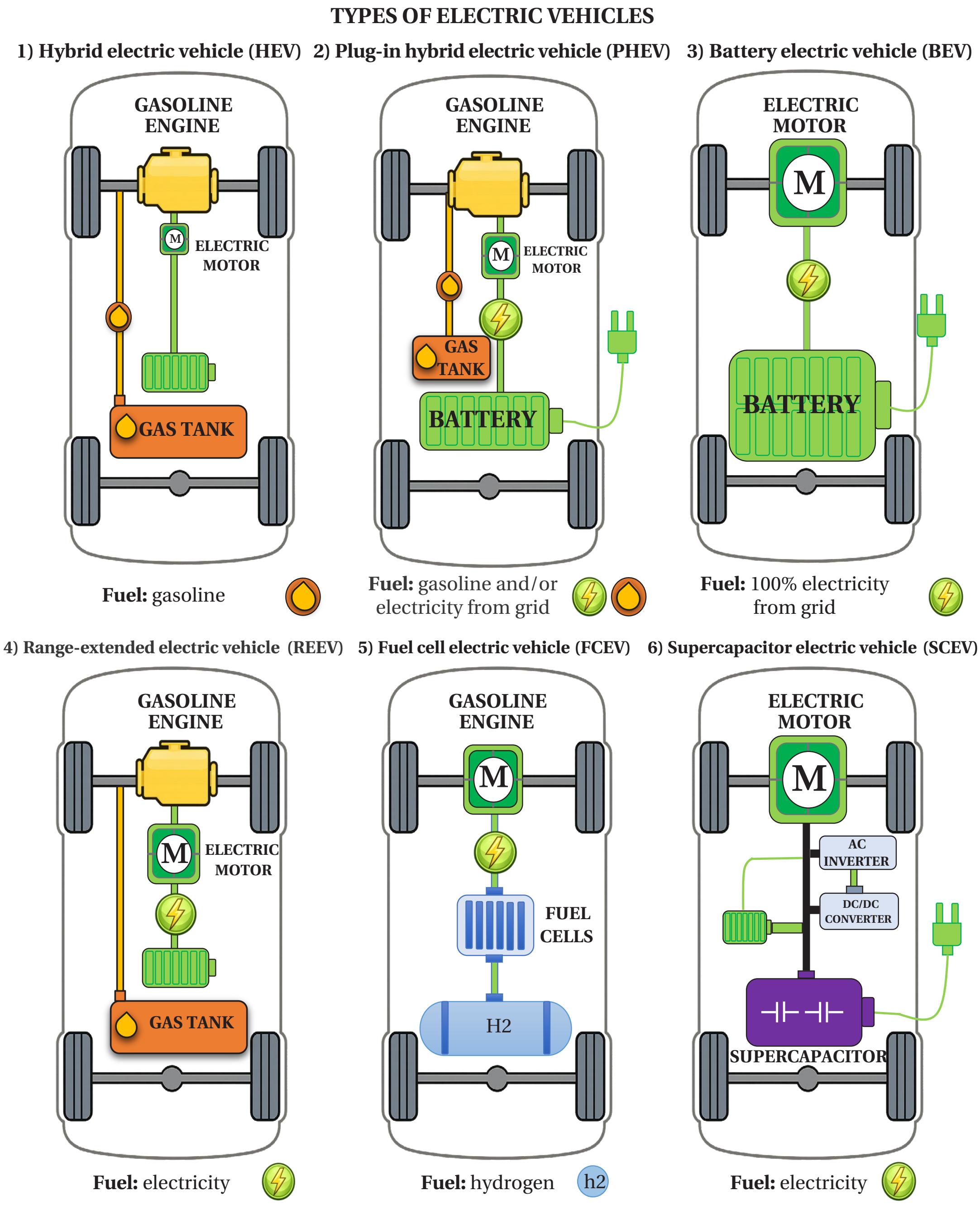

Figure 1. Block diagram of electric vehicle types

Source: compiled by the authors based on E-AUTO (2023), Encyclopedia (n.d.)

An HEV (Hybrid Electric Vehicle) is a type of hybrid system that uses a combination of an internal combustion engine and an electric motor; the battery is charged whilst the internal combustion engine is running via a generator, which reduces fuel consumption compared to vehicles powered solely by an internal combustion engine. A PHEV (Plug-in Hybrid Electric Vehicle) differs in that the battery can be charged from an external power supply, which increases the proportion of driving in electric mode and extends the range provided that charging is available. A BEV (Battery Electric Vehicle) is a fully electric vehicle without an internal combustion engine and operates exclusively on battery power; its range is determined by the battery capacity and operating conditions. A REEV (Range-Extended Electric Vehicle) combines an electric drive with an internal combustion engine (ICE) range extender: the electric motor plays the primary role, whilst the ICE is used to generate electricity when the battery charge level drops. FCEV (Fuel Cell Electric Vehicle) uses an electric motor, with electricity generated by fuel cells through the conversion of hydrogen and oxygen. SCEV (Supercapacitor Electric Vehicle) stores energy in supercapacitors, which ensures very fast charging and high cycle durability; however, the low energy density of supercapacitors compared to lithium-ion batteries limits the range and makes them suitable primarily for routes with frequent stops and the possibility of regular recharging (Encyclopedia, n.d.).

In commercial operation, electric transport is viewed as an alternative to traditional vehicles given the potential to reduce energy costs and certain service costs; however, the economic viability of the transition is not universal. The main factor of uncertainty is the higher initial investment in vehicles and charging infrastructure. Additional constraints include range and charging time, which affect the continuity of the transport process and the operating schedule: for commercial electric trucks, a typical range is between 150 and 350 km, depending on battery capacity and operating conditions, whilst charging can take approximately 4-12 hours with slow alternating current (AC) charging or around 30-60 minutes with fast direct current (DC) charging. Alongside these limitations, decisions regarding electrification are influenced by regulatory and economic factors, as set out in Regulation (EU) No. 851… (2023) of the European Parliament and of the Council. For businesses, potential differences in energy and maintenance costs are of additional significance, as is the reduction in local emissions during operation, which may be relevant for urban logistics and service operations in areas with environmental restrictions.

In many countries, financial incentives for the transition to electric transport are created through a combination of subsidies, tax breaks and reductions in certain fees associated with vehicle registration and operation. Additional incentives may include discounted or free access to parking in cities and tiered charging tariffs. The practice of supporting electric mobility in Ukraine has included exemption from value-added tax on imports, the absence of excise duty and import duties, as well as reduced registration fees; at the local level, specific measures were implemented regarding parking and the use of public transport lanes, whilst programmes supporting investment in electric transport and charging infrastructure were available for legal entities. The validity of certain preferential schemes was time-limited and specified as remaining in force until 2026. Despite the technological advantages and incentives, the economic viability of investments in the electrification of the commercial vehicle fleet requires a quantitative financial justification, taking into account the operational profile, electricity tariffs and assumptions regarding residual value. In the context of further analysis, such justification is provided by the calculation of the break-even annual mileage and the marginal purchase price of an electric vehicle, at which the levelised cost of ownership is equal to that of a comparable vehicle equipped with an internal combustion engine.

The break-even annual mileage of an electric commercial vehicle is determined by formula (3) as the threshold value of annual mileage at which the discounted ownership costs of the electric van equal the discounted ownership costs of a diesel counterpart. The threshold value is interpreted as the limit beyond which the electric van provides a lower total cost of ownership compared to a vehicle equipped with an internal combustion engine, under fixed assumptions regarding service life, discount rate, cost structure and residual value. To demonstrate the application of this approach, a model scenario comparing a diesel van and a similar electric van is considered. The FORD TRANSIT VAN 350 TREND is taken as the base vehicle with an internal combustion engine, and the FORD E-TRANSIT VAN 350 as the electric alternative; the gross vehicle weight is 3,500 kg. The initial prices and technical parameters are based on the manufacturer's price lists, and the numerical cost values are used as illustrative input parameters for the model example, fixed as of 2025. The annual mileage in the model example is assumed to be 60,000 km, the useful life is 10 years, and the discount rate is 5%. There is no single discount rate for all enterprises in Ukraine, as it is determined individually for a specific project, asset or company. In the model example, a discount rate of 5% is adopted as a standard assumption for discounting costs over time; in practical calculations, the discount rate may vary depending on the cost of capital and the level of risk.

To standardise subsequent calculations, costs are divided into the capital (investment) component of ownership, fixed annual costs and variable costs per 1 km of mileage. Capital costs include the initial cost of the vehicle and an assumption regarding the residual value at the end of the operating period. In the model parameters, the initial cost of a diesel van is UAH 1,935,734, and that of an electric van is UAH 3,316,615 (Ford, n.d.). Different residual value rates have been applied, as the depreciation patterns for internal combustion engine vans and electric vans differ. For the diesel van, the residual value ratio is set at 35% as a generalised assumption based on a review of market offers for similar vehicles with a service life of around 10 years on the AUTO.RIA website. For electric vans of a comparable class, long-term resale statistics are less certain, and the risk of additional depreciation is linked to the potential degradation of the battery after prolonged use; in view of this, a more conservative residual value of 25% of the original price has been adopted in the model example.

Annual fixed costs include insurance and the driver's salary. In this example, the average cost of van insurance, based on quotes from leading insurance companies in Kyiv, is assumed to be UAH 10,486.17 per year. The driver's salary is set at UAH 360,000 per year; the total annual fixed costs amount to UAH 370,486.17. The uniformity of these fixed costs in the model example is due to the fact that the driver's salary does not depend on the type of power plant, whilst insurance costs for vans are determined primarily by the vehicle category and insurance terms, rather than the type of fuel. Variable costs per 1 km are calculated as the sum of energy costs, maintenance costs and associated operating costs, which depend on mileage. According to the FORD TRANSIT VAN 350 TREND price list, diesel fuel consumption can be up to 10.5 litres per 100 km; for the purposes of this calculation, 11 litres per 100 km has been used as a conservative estimate. For the FORD E-TRANSIT VAN 350, the price list specifies an electricity consumption range of 26-38 kWh per 100 km; in the model example, an average value of 32 kWh per 100 km has been adopted. The price of diesel fuel is set at UAH 58.99 per litre as the baseline parameter for the model example, based on pricing from a large network of petrol stations. The cost of electricity is differentiated depending on the charging scenario: for the on-site charging scenario, two indicative tariffs of 6 and UAH 10 per 1 kWh are used, and for commercial charging infrastructure – UAH 13.50 per 1 kWh for the slow alternating current (AC) charging scenario and UAH 18.50/kWh for the fast direct current (DC) charging scenario (Ford, n.d..).

Maintenance costs are calculated based on scheduled intervals. For a diesel van, the indicative cost of a single service is set at UAH 8,000 for a 15,000 km interval. For the electric van, maintenance costs are assumed to be 50% lower, or UAH 4,000 for the same interval, in line with general findings regarding lower maintenance costs for electric transport compared to fossil fuel-powered transport (Heisel, 2020; Denzadnem, 2025). Variable costs also include washing costs of UAH 300 per 1,000 km of mileage and tyre costs: the average cost of a set of tyres is assumed to be UAH 21,494 for an expected mileage of 60,000 km. A separate environmental tax on CO_2 emissions for a diesel van is not itemised in the company's costs, as the relevant fiscal components are factored into the final fuel price. Based on these assumptions, the aggregated values for capital costs, variable costs per 1 km and fixed costs are presented in Table 1 and used to further determine the threshold mileage for the charging scenarios.

Table 1. Data used for the break-even model calculation

Cost category	Diesel van (ICE)	Typical electric van (EV)
Initial purchase cost (P)	UAH 1,935,734	UAH 3,316,615
Residual value (α)	UAH 677,506.90 (35%)	UAH 829,153.75 (25%)
Service life (T)	10 years	10 years
***Annual fixed costs (annual insurance, annual driver salary) (F)**	UAH 10,486.17 + UAH 360,000 = **UAH 370,486.17**	UAH 10,486.17 + UAH 360,000 = **UAH 370,486.17**
Variable costs per kilometre (V):		
Fuel/electricity	UAH 6.49/km (11 L/100 km × UAH 59/L)	UAH 1.92/km (32 kWh/100 km × UAH 6/kWh) UAH 3.20/km (32 kWh/100 km × UAH 10/kWh) UAH 4.32/km (32 kWh/100 km × UAH 13.50/kWh) UAH 5.92/km (32 kWh/100 km × UAH 18.50/kWh)
Maintenance and repairs	UAH 0.53/km	UAH 0.27/km
Other costs (washing, tyres)	UAH 0.30/km UAH 0.36/km	UAH 0.30/km UAH 0.36/km
Total variable costs per kilometre	**UAH 7.68/km**	**UAH 2.85/km (UAH 6/kWh)** **UAH 4.13/km (UAH 10/kWh)** **UAH 5.25/km (AC charging)** **UAH 6.85/km (DC charging)**

Source: compiled by the authors

The parameters presented in Table 1 were used to determine the break-even annual mileage threshold for an electric van using the approach proposed in this study. The calculations were performed using a scenario-based framework, as the charging tariff represents the principal source of uncertainty affecting the electric van and directly influences its variable costs per kilometre travelled. Given fixed assumptions regarding service life, discount rate, initial purchase prices, and residual value percentages, only the energy component of the electric van's variable costs changes across scenarios. For the diesel van, the assumptions relating to fuel price and fuel consumption remain unchanged. The results confirm that an increase in the charging tariff reduces the difference between the variable costs of the electric van and its diesel counterpart. Under the scenario of charging at the company at a tariff of UAH 6/kWh, the variable costs of the electric van amount to UAH 2.85/km, whereas for the diesel van they amount to UAH 7.68/km; under the scenario of charging at the company premises at a rate of UAH 10/kWh, the variable costs of the electric van rise to UAH 4.13/km. The switch to commercial charging rates further increases the variable costs of the electric van to 5.25 UAH/km under the scenario of charging at a slow charging station (AC) and to UAH 6.85/km when charging at a fast charging station (DC), which brings the electric van's cost profile closer to that of its diesel counterpart and increases the break-even mileage required to offset the higher initial cost of electric transport under the model's assumptions.

The resulting break-even annual mileage thresholds demonstrate a pronounced dependence on the charging tariff. Under the scenario of charging at company premises at UAH 6/kWh, the break-even annual mileage is 34,529 km per year. Under the scenario of charging at company premises at UAH 10/kWh, the threshold increases to 46,979 km per year, reflecting the reduction in savings from lower variable costs. For commercial charging modes, the break-even points increase significantly: 68,631 km/year for the slow charging station (AC) scenario and 200,932 km/year for the fast charging station (DC) scenario. This trend is explained by the fact that, at high charging tariffs, the difference in variable costs between an electric van and a diesel van becomes insufficient to offset the capital component of ownership within the scope of practically typical operating modes for a commercial van. The practical interpretation of the results is that achieving economic parity based on the criterion of levelised cost of ownership requires a combination of sufficient usage intensity and an affordable charging tariff. Under the given parameters of the model example, lower corporate charging tariffs significantly reduce the threshold mileage, whilst commercial charging infrastructure tariffs shift the threshold value into the high annual mileage range. A graphical representation of the obtained threshold values is shown in Figure 2.

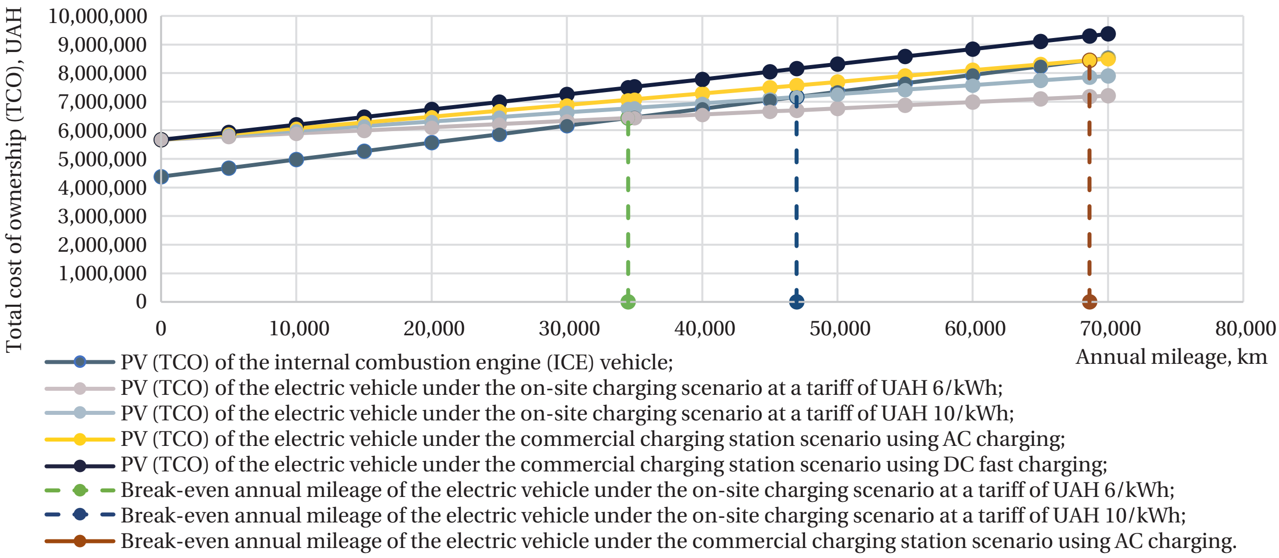

Figure 2. Break-even range graph for an electric vehicle

Source: compiled by the authors

The break-even annual mileage chart provides a visual representation of the threshold at which the use of an electric van becomes economically viable compared with a diesel equivalent under different charging scenarios. Its interpretation is based on identifying the mileage threshold beyond which the lower variable operating costs of the electric vehicle offset its higher initial purchase cost. The results indicate that the economic performance of the electric van is highly dependent on both the charging tariff and the intensity of vehicle utilisation. As electricity prices increase, the break-even mileage also rises, reducing the economic attractiveness of electric vehicles for businesses with relatively low annual mileage. Determining the threshold, or maximum acceptable, purchase price (initial cost) of an electric van involves identifying the acquisition price at which the present value of total ownership costs of the electric van, for a given service life and expected annual mileage, reaches parity with the corresponding value for a diesel equivalent. When the purchase price falls below this threshold, the electric van gains an economic advantage according to the criterion of discounted ownership costs, taking residual value into account. The calculations were performed using the approach presented in Equation (4), applying the same assumptions regarding service life, discount rate, capital cost component, annual fixed costs, and variable costs per kilometre as those used in the previous model example. The only unknown variable is the initial purchase price of the electric van, which is determined as the threshold value. The input parameters used in the analysis are summarised in Table 2.

Table 2. Data used for calculating the maximum initial purchase price of an electric vehicle below which its purchase is economically advantageous

Cost category	Diesel van	Typical electric van
Initial purchase cost (P)	UAH 1,935,734	Maximum purchase price to be determined
Residual value (α)	UAH 677,506.90 (35%)	Residual value of the electric vehicle: 25%
Service life (T)	10 years	10 years
Annual fixed costs (insurance, annual driver's salary) (F)	UAH 10,486.17 + UAH 360,000 = **UAH 370,486.17**	UAH 10,486.17 + UAH 360,000 = **UAH 370,486.17**
Variable costs per kilometre (V):		
Fuel/electricity	UAH 6.49/km (11 L/100 km × UAH 59/L)	UAH 1.92/km (32 kWh/100 km × UAH 6/kWh) UAH 3.20/km 32 kWh/100 km × UAH 10/kWh) UAH 4.32/km (32 kWh/100 km × UAH 13.50/kWh) UAH 5.92/km (32 kWh/100 km × UAH 18.50/kWh)
Maintenance and repairs	UAH 0.53/km	UAH 0.27/km
Other costs (washing, tyres)	UAH 0.30/km UAH 0.36/km	UAH 0.30/km UAH 0.36/km
Total variable costs per kilometre	**UAH 7.68/km (based on a fuel consumption rate of 11 L/100 km)**	**UAH 2.85/km (based on electricity consumption of 32 kWh/100 km and charging at the indicative minimum commercial tariff)** **UAH 4.13/km (based on electricity consumption of 32 kWh/100 km and charging at the maximum commercial tariff)** **UAH 5.25/km (based on electricity consumption of 32 kWh/100 km and charging at a commercial charging station using AC charging)** **UAH 6.85/km (based on electricity consumption of 32 kWh/100 km and charging at a commercial charging station using DC fast charging)**

Source: compiled by the authors

The results obtained demonstrate that the threshold purchase price of an electric van is scenario-dependent and determined primarily by the charging tariff, which directly influences the variable cost per kilometre travelled. Assuming an expected annual mileage of 60,000 km and all other parameters of the model example remaining unchanged, the maximum initial purchase price of the electric van amounts to UAH 4,438,825.82 under the scenario of charging at company premises at a tariff of UAH 6/kWh and UAH 3,738,277.62 under the scenario of charging at company premises at a tariff of UAH 10/kWh. For commercial charging scenarios, the threshold values decrease to UAH 3,125,297.94 when using alternating current (AC) charging at a tariff of UAH 13.50/kWh and to UAH 2,249,612.70 when using direct current (DC) fast charging at a tariff of UAH 18.50/kWh. The decline in the threshold purchase price as charging tariffs increase is explained by the reduction in the difference between the variable costs of the electric van and those of the diesel equivalent. As a result, achieving parity in discounted ownership costs requires a lower permissible initial purchase price for the electric van.

Comparing these threshold values with the dealer price of the FORD E-TRANSIT VAN 350 used in the model example allows the practical viability of the purchase decision to be assessed. Under the scenarios of charging at company premises at tariffs of UAH 6/kWh and UAH 10/kWh, the actual purchase price of the electric van remains below the corresponding threshold values, indicating that the investment is economically justified according to the criterion of discounted ownership costs. Under the commercial charging scenarios (AC and DC), however, the actual purchase price exceeds the threshold values, indicating that the electric van does not provide an economic advantage within the assumptions adopted in the model. The validity of the calculated threshold values is confirmed through a parity verification procedure. Substituting the calculated threshold purchase price into the expression for the present value of total cost of ownership of the electric van yields equality between the discounted ownership costs of the electric van and those of the diesel equivalent, subject only to rounding differences. The present value of total cost of ownership for both the electric van and the comparable internal combustion engine vehicle amounts to UAH 7,938,774.99. A graphical representation of the relationship between the threshold purchase price and annual mileage under the different charging scenarios is presented in Figure 3.

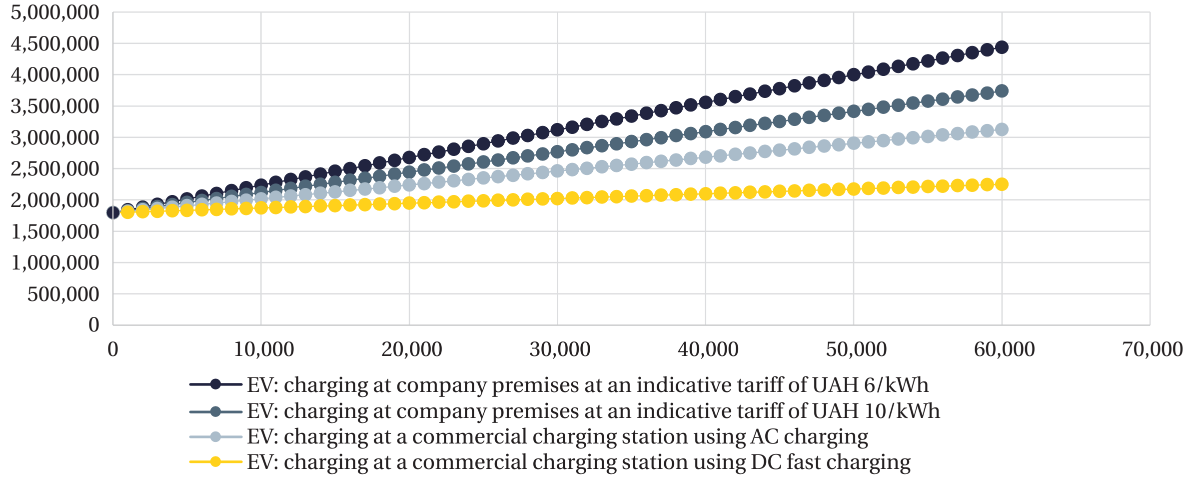

Figure 3. Maximum initial purchase price of a new electric vehicle below which its purchase is economically advantageous

Source: compiled by the authors

Thus, the relationship shown in Figure 3 between the marginal (maximum permissible) purchase price of an electric van and annual mileage reflects the threshold conditions for parity in terms of the levelised cost of ownership compared to an equivalent model equipped with an internal combustion engine, under various charging scenarios. As annual mileage increases, the acceptable purchase price of an electric vehicle rises, as savings on variable costs are realised to a greater extent, whilst an increase in the charging tariff reduces the acceptable price due to rising operating costs. The practical application of the resulting diagram lies in a quick feasibility check: if the actual market price of an electric van is lower than the corresponding curve for a given mileage and charging scenario, then economic parity or the advantage of electric transport is achieved based on the criterion of the discounted total cost of ownership.

A considerable number of studies have been devoted to this topic; for instance, E. Figenbaum's (2022) study focuses on a retrospective assessment of the total cost of ownership of battery electric vehicles using Norway as a case study. The study shows that conclusions regarding the economic viability of electric transport depend significantly on market conditions and incentive policies, as it is the combination of initial investment, operating costs and tax incentive mechanisms that determines the final level of ownership costs. In this context, electric vehicles may prove competitive; however, the outcome is scenario-dependent and requires consideration of local parameters. In the public transport segment, H. Sistig *et al.* (2025) point out that the electrification of bus fleets is linked not only to costs but also to operational parameters, including the need for charging capacity.

K. Shepurov (2025) investigated various methods of charging batteries and their impact on the feasibility of using electric buses, demonstrating that the choice of charging strategies for electric buses and the location of charging infrastructure influence operational organisation and cost components. The study by C. Gil Ribeiro & S. Silveira (2024) aims to assess the impact of financial incentives on the total cost of ownership of electric light commercial vehicles in EU countries. The study emphasises that support mechanisms can significantly alter the cost parity between electric and conventional vehicles by reducing the investment component, and that the effect of incentives varies across different countries and commercial usage segments. The study's conclusions confirm that assessments of the economic viability of fleet electrification must take into account institutional conditions, cost structures and operating profiles.

The study by J. Bauer *et al.* (2025) analyses how energy prices affect the total cost of ownership of battery electric vehicles. The results of the study emphasise that the energy component of operating costs is the key source of variability in conclusions regarding subsidies and charging profiles, and that different charging profiles and electricity pricing regimes can alter the comparative attractiveness of electric transport. This conclusion is consistent with the threshold values obtained by the authors in a model example, where the charging tariff influences the break-even mileage and the maximum acceptable purchase price. P. Miązek & L. Zhang (2025) compared the total cost of ownership of electric and conventional lorries in the Polish context. The study emphasises that for the freight segment, the critical factors are operating intensity, infrastructure conditions and cost structure, and that conclusions regarding the viability of electric lorries depend on a combination of capital investment and variable costs. Consequently, the economic viability of freight transport electrification is evident only under certain mileage and energy supply conditions, which correlates with the concept of threshold criteria used in this article. The study by M. Woody *et al.* (2024) aims to compare the total cost of ownership of electric and petrol-powered vehicles in various US cities. The study shows that even with the same vehicle technology, the final economic assessment varies depending on the local environment, in particular the structure of tariffs, energy prices and operating conditions. The study by L.-I. Dulău (2024), conducted using Romania as a case study, also demonstrates that TCO assessment results are sensitive to the set of initial assumptions and the usage profile. Taken together, these publications confirm that a numerical conclusion regarding the cost-effectiveness of electric transport should be interpreted not as universal, but as a result for a specific set of conditions.

Unlike the cited works, in which total cost of ownership is mostly used to compare alternatives in specific markets or under given scenarios, this article focuses on developing an applied analytical toolkit for operational decisions. The proposed approach allows break-even to be determined in two complementary ways: via the minimum annual mileage threshold and via the maximum permissible purchase price of an electric vehicle, at which the present value of ownership costs is equal to that of an internal combustion engine equivalent. This formulation establishes a decision-making algorithm for commercial use: under specified operating conditions and tariffs, it is possible to determine threshold values that distinguish the zone of economic advantage for electric transport from the zone in which traditional transport remains the more economically justified option.

Conclusions

Electric vehicles are not always economically advantageous in business operations, as their viability is determined not only by environmental benefits but primarily by the cost structure and operating conditions. Decisions regarding the replacement of commercial vehicle fleets with electric vehicles or comparable internal combustion engine (ICE) vehicles are highly context-dependent and influenced by annual mileage, energy and charging tariffs, maintenance and servicing costs, service life, assumptions concerning residual value, and the presence or absence of financial incentives. This article proposes an analytical approach based on the concept of total cost of ownership (TCO) and the break-even principle, enabling the economic feasibility of transitioning to electric transport to be formalised. The study presents formulas for calculating the break-even annual mileage of an electric vehicle, above which its use becomes economically preferable to an ICE alternative, as well as a formula for determining the maximum initial purchase price of an electric vehicle below which its acquisition is economically justified. These formulas provide business owners with clear and practical decision-making criteria. Such an approach makes it possible not only to determine whether an electric vehicle is economically advantageous but also to identify the threshold values of key operating parameters at which it enters the zone of economic superiority. The proposed formulas and the economic calculations based upon them confirm the hypothesis that there are specific conditions under which the operation of electric vehicles can be profitable and that these conditions should be met to ensure economic viability.

Within the model example (10-year horizon, 5% discount rate), the threshold indicators vary significantly depending on the charging tariff. The break-even annual mileage amounts to 34,529 km per year under the scenario of charging the electric van at company premises at UAH 6/kWh and 46,979 km per year under the scenario of charging at UAH 10/kWh. For commercial charging, however, the thresholds increase to 68,631 km per year when using AC charging (UAH 13.50/kWh) and to 200,932 km per year when relying exclusively on DC fast charging (UAH 18.50/kWh). For an annual mileage of 60,000 km, the maximum initial purchase price of an electric van that ensures parity in discounted ownership costs with a diesel equivalent amounts to UAH 4,438,825.82; UAH 3,738,277.62; UAH 3,125,297.94; and UAH 2,249,612.70, respectively, for the charging scenarios considered. The corresponding PV(TCO) value at the parity point equals UAH 7,938,774.99. These calculations reflect only the economic dimension of the transition to electric transport and do not account for the positive environmental and social benefits associated with the adoption of electric vehicles. If national or municipal authorities seek to promote a cleaner and safer environment, financial resources should be allocated to support this objective through subsidies and substantial incentives that reduce the financial burden of purchasing and operating electric vehicles.

In conclusion, the proposed set of formulas and the procedure for their application can serve as a universal decision-support tool for business owners. Using their own operational data, firms can perform tailored calculations, compare alternative technologies (electric vehicles versus ICE vehicles), and justify fleet renewal decisions according to their specific business circumstances. Further research into the application and operation of electric vehicles should focus on improving the profitability and economic viability of their commercial use, as well as increasing the distance that electric vehicles can travel between charges, reducing battery charging time and cost, and creating the conditions and capabilities necessary for the use of electric vehicles in international and intercity transport. This may be achieved through the implementation of a modular principle based on standardised and interchangeable battery packs, the rapid and cost-effective replacement of which would allow operators to avoid the lengthy charging process currently associated with electric vehicles.

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Conflict of Interest

None.

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Дослідження точки беззбитковості електромобілів у бізнес-процесах підприємницької діяльності

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Анотація. Електрифікація комерційного транспорту розглядається як перспективний напрям зниження експлуатаційних витрат і локальних викидів, однак економічна вигода електротранспорту не є універсальною та залежить від умов використання. Актуальність дослідження зумовлена потребою підприємств мати кількісні критерії вибору між електричним комерційним транспортним засобом і аналогом на викопному паливі за різних режимів експлуатації та тарифів енергопостачання. Мета роботи полягала у формуванні розрахункового підходу для визначення беззбиткового річного пробігу, понад який використання електротранспорту стає економічно доцільним, а також граничної, максимально допустимої ціни придбання електричного транспортного засобу, нижче якої його придбання є економічно виправданим. Методи дослідження включали порівняльний аналіз економічної доцільності альтернатив; аналіз вторинних даних щодо цін, тарифів і витрат на обслуговування для формування вхідних параметрів моделі; економіко-математичне моделювання на основі сукупної вартості володіння; аналітичний метод для виведення формул беззбитковості; сценарний аналіз різних варіантів заряджання електромобіля; врахування часової вартості грошей через дисконтну ставку та коефіцієнт приведення ануїтету. У межах модельного прикладу (горизонт 10 років, ставка дисконту 5 %) встановлено, що беззбитковий річний пробіг електрофургона коливається від 34 529 до 200 932 км залежно від тарифу та способу заряджання, а за пробігу 60 000 км/рік гранична економічно доцільна ціна його придбання становить від 2,25 до 4,44 млн грн. У статті проведено аналіз факторів, що визначають доцільність переходу на електромобілі, оцінено вплив початкових інвестицій, операційних витрат та існуючих механізмів підтримки на загальну економічну доцільність використання електромобілів у підприємницькій діяльності. А також запропоновано формули для розрахунку беззбиткового пробігу електромобілів та максимальної первісної вартості електромобілів нижче котрої їх купувати вигідно для різних видів комерційного використання. Практична цінність роботи полягає в можливості застосування запропонованих формул підприємствами транспортно-логістичного сектору та власниками комерційних автопарків для обґрунтування рішень щодо оновлення парку на основі приведених витрат володіння

Ключові слова: сукупна вартість володіння; річний пробіг; експлуатаційні витрати; порогова ціна придбання; двигуни внутрішнього згоряння; економічна доцільність