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COMPARATIVE ANALYSIS OF SELECTED ASPECTS OF THE OPERATION OF COMMERCIAL VEHICLES WITH CONVENTIONAL AND ELECTRIC DRIVES

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Abstract – In the face of growing air quality issues and increasing carbon dioxide emissions from the transport sector, there arises a necessity to limit the release of harmful substances into the atmosphere. National and European institutions are introducing stringent emission standards, forcing the transport industry to adapt and seek alternative sources of propulsion. The article analysed the impact of operating conventional and electric delivery vehicles in a courier company, taking into account their environmental impact and economic efficiency.

Key words – Commercial vehicles, electric vehicles, electromobility, environmental emissions

JEL Classification – L62, L69, L90, L92, L94

INTRODUCTION

Nowadays, we are witnessing increasingly serious air quality problems in large urban agglomerations. It is, therefore, becoming crucial to find effective methods of reducing emissions of harmful substances into the atmosphere. It is particularly important in the context of increasing carbon dioxide emissions from year to year, a significant part of which is accounted for by the transport sector. Recent decades have seen a dynamic growth of the transport industry, with a consequent increase in greenhouse gas emissions [2]. Analyses indicate that carbon dioxide emissions generated by the transport sector have increased by 33.5 per cent over the last three decades (1990-2019), becoming a serious environmental problem. In response to the above challenges, national and European institutions are tightening regulations on the emission standards of harmful substances emitted by vehicles into the atmosphere. Modern regulations aim to reduce the negative impact of transport on the environment and promote more environmentally friendly means of transport [3]. As a result of these changes, companies in the transport industry face the challenge of adapting their fleets to new requirements and searching for alternative propulsion sources. This article presents a comparative analysis of selected aspects of the operation of commercial vehicles with conventional and electric drives. A comparison is made between the two solutions' environmental impact and their economic efficiency in a courier service company.

1. CHARACTERISTICS OF THE OPERATING CONDITIONS OF THE TESTED VEHICLES

Until recently, the most common engines in delivery vehicles used by courier companies were high-compression engines, the so-called "Diesels", powered by diesel fuel. The operating environment of the subject case study is an urban agglomeration and moderately urbanised areas. Due to the high density of delivery points, their high degree of fragmentation in the inner city and the concentration of transport tasks in a spatially limited area, the vehicle travels short distances between delivery points. In addition, this forces the driver to restart the combustion engine frequently. Unfortunately, this is not recommended for a car equipped with a diesel

engine; moreover, it also loses one of its greatest advantages, namely low fuel consumption. These engines have the lowest fuel consumption when travelling long distances [4].

Moreover, diesel engines are characterised by high noise and the highest CO_2 emissions to the atmosphere, averaging as much as 122.2 g/km according to the analytical firm Jato data for 2021 [5], where the standard in EU countries is 95 g/km for diesel engines. This results in imposing increasingly stringent exhaust emission requirements and forces manufacturers to introduce technical solutions that minimise emissions of carbon dioxide and other harmful substances. As a result, their construction is becoming increasingly complex and problematic [6].

The following exhaust after-treatment systems are used on diesel engines to improve exhaust gas quality:

- Adblue,
- particulate filter,
- catalytic converter,
- CRT system,
- exhaust gas recirculation system, the so-called EGR valve,
- SCR technology.

Unfortunately, the presence of these systems in a vehicle used in urban traffic leads to frequent problems and failures. Examples include a frequently clogged particulate filter, the EGR exhaust gas recirculation valve requiring frequent cleaning and problems related to the operation of the Adblue system with the SCR converter.

2. ACQUISITION COSTS OF A DIESEL VEHICLE

The analysis was based on a Volkswagen Crafter 2022 in a van-type body equipped with a 1968 cc diesel engine with 140 hp; the price in this configuration is 44,219.72 EUR. It is one of the most popular vehicles in large courier corporations, which is most commonly equipped with a diesel engine. The technical parameters of the Volkswagen Crafter 2.0 TDI van body vehicle are available in [7].

Manufactured in Poland in Września near Poznań, the vehicle is well-built and features a highly ergonomic driver's cab and load compartment. It is worth pointing out that in delivery vehicles, great importance is attached to the driver's cabin, which is the place where the driver works. It should, above all, be ergonomically designed and equipped with a range of solutions to facilitate the driver's daily work [8].

2.1. OPERATING COSTS ANALYSIS

A vehicle life of three years was assumed for the analysis of the running costs of a diesel vehicle. An important aspect in determining the vehicle's useful life is that the vehicle should be replaced before the time at which repair costs increase noticeably. For the analysis, it was assumed that the vehicle was purchased as new from the manufacturer, and its purchase was financed from the company's own resources. It was assumed that the vehicle would be used over a period of three years, with an estimated daily mileage of 100 km, giving a total mileage over the vehicle's lifetime of 75,100 km.

When making a comparative analysis of operating costs, the costs of service (inspections and preventive maintenance) and the costs of emergency repairs should be taken into account. Important aspects at the time of optimising the costs associated with owning a fleet of vehicles are their reliability, durability and fuel consumption. The analysis of maintenance costs takes into account the recommendations of the vehicle manufacturer, Volkswagen Group Polska sp. z.o.o., regarding mileage and operating time for individual servicing operations, which are performed at intervals of every 15,000 km.

It was assumed that the inspections and servicing of the analysed vehicle will take place at an authorised Volkswagen service station, due to the necessity of maintaining the continuity of the vehicle warranty. It should be noted that regular and timely performance of inspections recommended by the manufacturer allows for the elimination of unplanned failures and, consequently, the inability of the vehicle to perform the transport tasks for which it was purchased. For the purpose of the analysis, the costs of particular service activities were estimated on the basis of information received from an authorised Volkswagen service station. The prices taken into account are (gross) prices and include the cost of labour and materials necessary to perform a given service activity.

With timely maintenance and regular servicing of the vehicle, no major repairs or breakdowns should occur to the drive system, transmission system, suspension system or electrical system during the assumed 3-year useful lifecycle of the vehicle and at a projected mileage of 75,100 km.

Following the maintenance schedule recommended by the manufacturer, the vehicle will require five service visits throughout its lifetime. The Figure 1 shows the cost of each service visit.

The total gross cost of servicing the vehicle over a period of three years is 4,490.83 EUR. The vehicle's operating costs should also include the costs incurred for the purchase of fuel, which were estimated on the basis of the average price of diesel fuel on 10.12.2022 of 1,75 EUR per litre. The other data used to calculate fuel costs are summarised in Table 1.

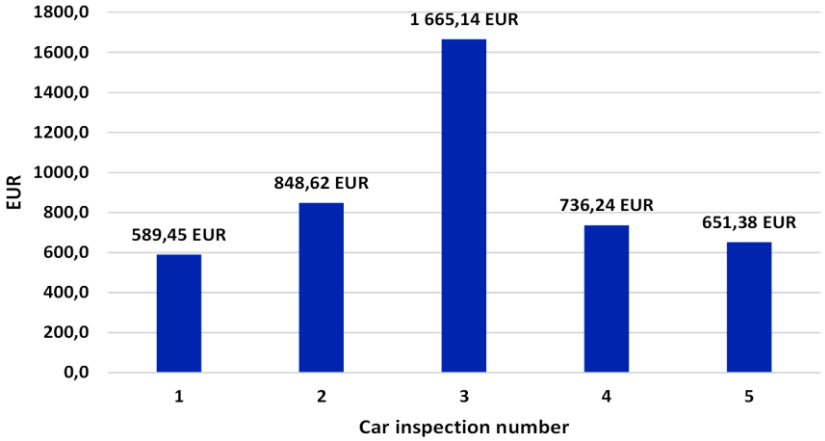

Fig. 1. Overview of VW Crafter 2.0 TDI vehicle maintenance costs

Table 1. Summary of fuel costs for VW Crafter 2.0 TDI

Average price of diesel fuel (ON) in Poland on 10.12.2022	EUR 1.75/litre
Average vehicle combustion in the urban cycle	10 l/100km
Kilometres covered	75,100 km
Fuel cost:	**EUR 13,194.17**

Table 2. Summary of running costs for vehicle maintenance

Summer/winter tyre change	EUR 41.28
Winter/summer tyre change	EUR 41.28
Third party liability+AC+NW+Asistance* vehicle insurance	EUR 567.61
Total for three years of operation:	**EUR 608.89 x 3 years of operation = 1,826.68 EUR**
Purchase of Vredestein Comtrac 2 205/75 R16 winter tyres*	EUR 447.68
TOTAL:	**1,826.68 + 447.68 = 2,227.38 EUR**

*Calculations for insurance costs and one-off tyre purchases are based on market information

Table 3. Summary of the costs of maintaining the vehicle clean

Costs related to keeping the vehicle clean (car washes, vacuum cleaners) for three years 30 times (10 times a year)	EUR 206.42
Current repairs	EUR 1,605.50
TOTAL:	**1,811.92 EUR**

The total fuel cost of a diesel vehicle over a period of three years with a mileage of 75,100 km calculated on the basis of the data adopted is EUR 13,194.17. In addition, the analysis took into account the costs associated with ongoing maintenance of the vehicle over the lifetime, consisting of tyre changes and insurance. These are summarised in Table 2.

The total cost of the above-mentioned activities over the entire period of operation is EUR 2,227.38.

The analysis takes into account the costs associated with keeping the vehicle clean and an additional budget for unforeseen ongoing repairs that may occur during three years of vehicle operation, pictured in Table 3.

2.2. SUMMARY OF THE RESULTS OF THE DIESEL VEHICLE ANALYSIS

The summary of the results of the analysis carried out for the Volkswagen Crafter 2.0 TDI vehicle includes all costs and financial burdens incurred for the purchase of the vehicle, costs of inspections and servicing, purchase of fuel, costs of vehicle maintenance and other costs resulting from maintaining the vehicle in readiness to perform transport tasks. Figure 2 presents a summary of all the above-mentioned costs over a period of three years of operation; the amounts shown are gross amounts.

Summing up all the costs incurred resulting from having one Volkswagen Crafter van with a 2.0 TDI diesel engine in the company, we arrive at a gross amount of EUR 66,114.89.

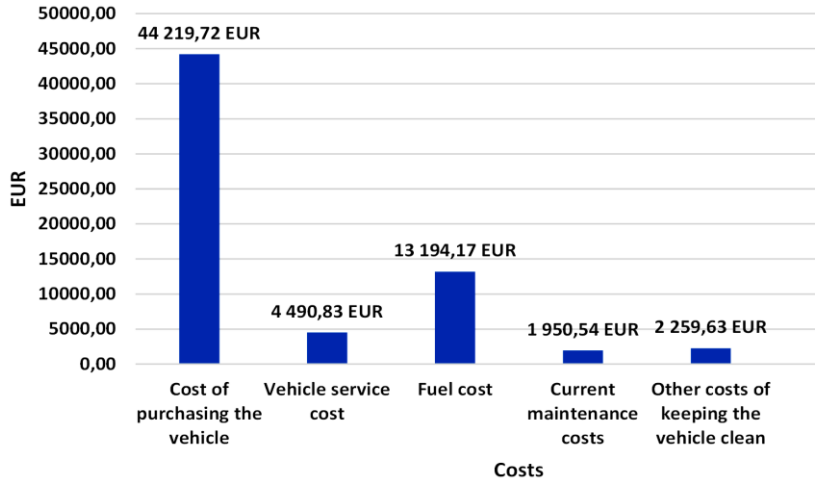

Fig. 2. Summary of the cost of ownership of a VW Crafter 2.0 TDI vehicle over a 3-year period of operation

3. COST ANALYSIS OF AN ELECTRIC VEHICLE

A comparative analysis of the operating costs of a conventionally and electrically powered delivery vehicle was based on the example of the Volkswagen Crafter TDI (140 hp) and the e-Crafter (136 hp). In order to regulate the issue of environmental pollution by vehicles with internal combustion engines, the European Union imposed the so-called "emission classes". An exhaust emission class is a multi-stage scale that defines the degree of exhaust emissions for cars and other equipment with internal combustion engines that travel within the EU and the European Economic Area [9]. These standards have been published in a series of European directives, each successive one increasing its exhaust gas quality requirements. As of today, the Euro 6 standard enacted in 2014 is applicable in EU countries [10]. Under the new provisions, the current Euro 6 standard is to be maintained until July 1, 2030, in the case of passenger cars and vans.

3.1. COST ANALYSIS FOR THE ACQUISITION OF A VEHICLE WITH AN ELECTRIC MOTOR

For the purpose of the analysis, the same vehicle model was selected, but in a 100% electric version, i.e., the Volkswagen e-Crafter. It is equipped with a 100 kW electric motor and batteries, which, according to the manufacturer, allow driving 114 km on a single charge. The price of the vehicle in the discussed configuration is EUR 78,200.92. More and more courier companies are introducing this vehicle model or its twin equivalent from the MAN brand, more specifically the e-TGE model, into their fleets. Detailed technical parameters of the VW e-Crafter vehicle can be seen in the specification on page [11].

The Volkswagen e-Crafter does not differ much from the conventionally powered Crafter except that it is equipped with a 100 kW (136 hp) electric motor and a 35 kWh battery, giving a range (according to the manufacturer) of 114 km. It might seem that a range of 114 km in a delivery vehicle is far too short, but the main place of work for such a vehicle is the city, which changes things considerably. The delivery e-Crafter is, in a sense, a car tailor-made for the courier profession. Research conducted on behalf of Volkswagen shows that couriers working in the city travel between 70 and 100 km per day. Therefore, regardless of the nature of the vehicle's use, it is guaranteed to cover 100 km on a single charge. Even with a full permissible load or often accelerating with the accelerator pedal

pushed to the maximum. Moreover, the maximum speed of the vehicle is 90 km/h, which is rarely exceeded in cities, if possible only on ring roads. This aspect indicates the urban nature of the vehicle. The electric motor provides good dynamics and high flexibility. The cabin is quiet, and only when the accelerator pedal is pressed harder can the swish characteristic of electric vehicles be heard. The equipment of the driver's cabin is the same as in the above-mentioned model equipped with a diesel engine. During the test of a vehicle in which 14,000 km were driven with economical driving (up to 70 km/h), you can drive up to 165 km on one charge. This is possible thanks to an efficient recuperation system, i.e., energy recovery from braking. It should also be mentioned that during the test, the temperature did not drop below 0° Celsius, an important factor for electric cars because, as the temperature drops, their range also decreases. In addition, the vehicle carried loads not exceeding 500 kg. In contrast, the payload capacity of the Volkswagen e-Crafter is 956 kg.

3.2. VEHICLE OPERATING COSTS ANALYSIS

The service life adopted for the analysis for the electric vehicle was set at three years, the same as for the diesel vehicle. For the analysis, it was assumed that the vehicle was purchased as new from the manufacturer and that its purchase was financed from the company's own resources.

It was assumed, as for the diesel vehicle, that the vehicle would be operated over a period of three years, the estimated daily mileage being 100 km per day, giving a total mileage over the vehicle's lifetime of 75,100 km.

In the case of an electric vehicle, inspection, servicing, and service intervals differ significantly from those of a diesel vehicle. This is due to the use of an electric motor. This solution avoids the costs associated with oil servicing, replacement of timing gears, replacement of glow plugs and many other components that a vehicle with an internal combustion engine is equipped with. When it comes to suspension, steering and air conditioning, there are no major differences between an electric car and a combustion car because they are the same in both cases. Sometimes, heat pumps are used instead of traditional air conditioning, which draws large amounts of electricity. Heat pumps, on the other hand, store energy that they can later give back, heating or cooling the interior. In addition, recuperation, i.e. the recovery of braking energy, significantly extends the service life of brake discs and pads. This reduces the dust associated with pad wear emitted into the atmosphere, recharges the vehicle battery and saves on service costs. The manufacturer recommends a vehicle inspection every two years. This includes checking the electric motor assembly, the battery, and the high-voltage wires. Once a year, the air-conditioning system should be inspected and possibly serviced, including changing the cabin filter.

The vehicle will be serviced at an authorised Volkswagen service station due to the need to maintain the continuity of the vehicle warranty. For the purpose of the analysis, the costs of particular service activities were estimated on the basis of information received from an authorised Volkswagen service station. The prices taken into account are (gross) prices and include the cost of labour and materials necessary to perform a given service activity. It should be noted that the analysis took into account the services and repairs of the vehicle resulting from the inspection and repair schedule developed by Volkswagen Group Polska Sp. z.o.o.

Based on the data from containing the maintenance schedule for the VW eCrafter vehicle, the vehicle will require five service visits within the period of three years of operation, including inspection and activities related to the operational replacement of individual parts. It is worth noting that in this vehicle, the periodic inspection with checking the electric motor, battery and high-voltage cables is performed every two years, and not, as in the case of a diesel vehicle, every 15,000 km or once a year. Figure 3 summarises the costs of individual services of an electric vehicle.

The total cost of servicing an electric vehicle over a period of three years is EUR 1,417.43. When owning an electric vehicle, financial expenditures related to charging the vehicle should be included in the calculation of operating costs.

The nature of the courier company's operation means that the vehicles distributing parcels to end customers mainly work between 8:00 and 20:00; thus, the time when they are not working is used to charge them. The analysis assumes that the company has the so-called "wallbox" from Green Cell for charging a vehicle with the parameters shown in Table 4.

This charger charges the vehicle from 0 to 100% of the battery capacity in 5 hours and 20 minutes, assuming a power supply of 7.2 kW and alternating current (AC). This type of charging is defined as Mode-3 and is referred to as fast or semi-fast with alternating charging current. This is the optimal type of vehicle charging which does not adversely affect the condition of the battery. The charging costs for the vehicle were estimated on the basis of data from Table 5 for the period of 3 years of operation and daily mileage at the level of 100 km.

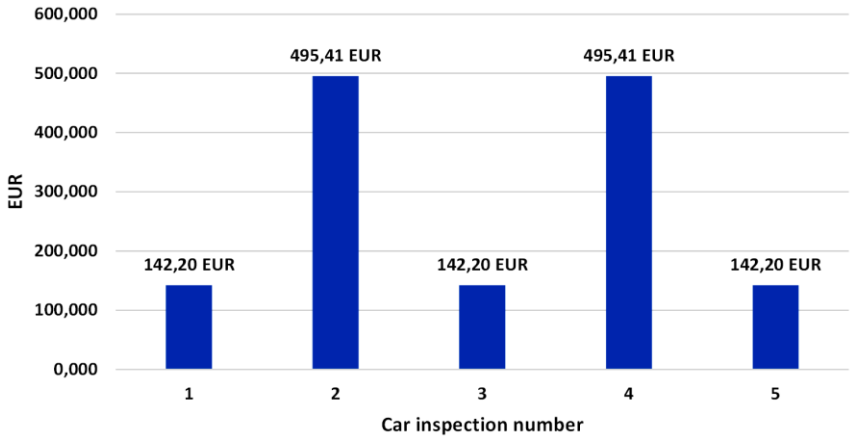

Fig. 3. Summary of costs of individual VW eCrafter vehicle services

Table 4. Summary of parameters of the Green Cell Wallbox 22kW wall charger with a Type 2 cable (compiled on the basis of [12])

Power supply capacity:	Max. power 22kW
Power supply parameters:	380V+/-20V/32A(max)/50Hz
Type of charging:	Mode-3 (AC, fast/semi-fast)
Available connectors:	Type 2
Operating temperature range:	-40°C - +55°C
Degree of protection:	IP 66
Cable length:	6 m

Table 5. Summary of electricity costs for charging the VW e-Crafter over a 3-year period of operation

Average price of kWh in Poland (supplier Tauron) on 10.12.2022	EUR 0.14/kWh
Average energy consumption of the vehicle in the urban cycle	26 kWh/100 km
Vehicle battery capacity	35 kWh
Effective range on a single charge	100 km
Cost per charge	EUR 5.05
Number of vehicle charging cycles	751 cycles
Kilometres covered	75,100 km
Charging costs	**3,798.06 EUR**

Table 6. Summary of running costs for vehicle maintenance during the 3-year operation of VW eCrafter

Summer/winter tyre change	EUR 41.28
Winter/summer tyre change	EUR 41.28
Third party liability+AC+NW+Asistance* vehicle insurance	EUR 831.64
Total for three years of operation:	**EUR 914.20 x 3 years of operation = 2,742.62 EUR**
Purchase of Vredestein Comtrac 2 205/75 R16 winter tyres*	EUR 447.70
TOTAL:	**2,742.62 + 447.70 = 3,190.33 EUR**

**Calculations for insurance costs and one-off tyre purchases are based on market information*

Table 7. Summary of other operating costs over a 3-year period resulting from ownership of a VW eCrafter vehicle

Costs related to keeping the vehicle clean (car washes, vacuum cleaners) for three years 30 times (10 times a year)	EUR 206.42
Purchase of a GREEN CELL 22kW wallbox	EUR 605.27
Current repairs	EUR 1.605,50
TOTAL:	**2.417,20 EUR**

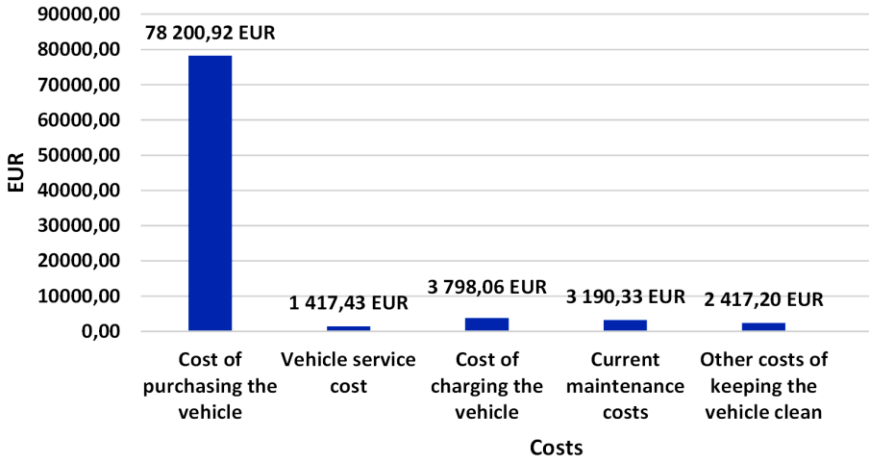

Fig. 4. Overview of the costs of owning a VW eCrafter vehicle

The total financial burden related to charging an electric vehicle over a 3-year period is EUR 3,798.06. In addition, the budget associated with lifetime costs resulting from vehicle ownership and maintenance activities should be included in the analysis. The above-mentioned costs are summarized in Table 6.

Adding up the annual costs resulting from the ongoing maintenance of the vehicle for the three-year lifespan results in an amount of EUR 3,190.33.

The analysis also took into account the costs associated with the one-off purchase of winter tyres, as the vehicle left the factory on summer tyres, the costs associated with keeping the vehicle clean and an additional budget for unforeseen running repairs that may occur during the vehicle's 3-year life. The costs are summarized in Table 7.

3.3. SUMMARY OF THE RESULTS OF THE ANALYSIS OF THE ELECTRIC MOTOR VEHICLE

The summary of the results of the analysis carried out for the Volkswagen eCrafter electric vehicle includes all costs and financial burdens incurred for the purchase of the vehicle, inspection and servicing costs, vehicle charging costs, vehicle maintenance costs and other costs associated with keeping the vehicle ready for transport tasks. A summary of the above-mentioned financial burdens for the company is shown in Figure 4.

The most considerable cost incurred by a company deciding to choose an electric vehicle is the cost of its purchase. The financial expenditures for its charging and maintenance are at a similar level, while the costs of servicing the vehicle consume the least financial resources. Dividing the costs into three main categories, i.e.:

- the cost of purchasing the vehicle,
- the cost of charging,
- costs of servicing and maintaining the vehicle.

It can be seen that the purchase cost exceeds the other operating costs of the VW eCrafter by a factor of seven.

Adding up all the costs incurred as a result of having one Volkswagen eCrafter van powered by electricity in their company, we arrive at a gross amount of EUR 89,023.94.

4. COMPARATIVE ASSESSMENT OF THE ACQUISITION AND OPERATING COSTS OF A DIESEL VEHICLE COMPARED TO AN ELECTRIC VEHICLE

When comparing the acquisition costs of a Volkswagen Crafter with a diesel engine and a Volkswagen eCrafter with an electric engine, it

can be seen that the acquisition cost of an electric vehicle is significantly higher than a vehicle powered by conventional fuel. This is due to the fact that much larger amounts of electronics and integrated circuits are used in the production of electric vehicles, and expensive high-capacity battery cells are needed to power the vehicle. A comparison of the acquisition costs of a diesel vehicle and an electric vehicle is shown in Figure 5.

For a vehicle equipped with a Volkswagen Crafter diesel engine, the company has to pay EUR 44,219.72 , while for a Volkswagen eCrafter vehicle equipped with an electric motor, EUR 78,200.92 gross. However, if we compare the costs of servicing a vehicle with a diesel engine in relation to an electric vehicle, we can see a significant difference in favour of the electric vehicle. Its servicing is considerably cheaper due to the lack of need for oil servicing, fuel and air filter changes, checking and topping up the Adblue fluid and replacing pads and discs. This is illustrated in Figure 6, which compiles the costs of individual services for both vehicles.

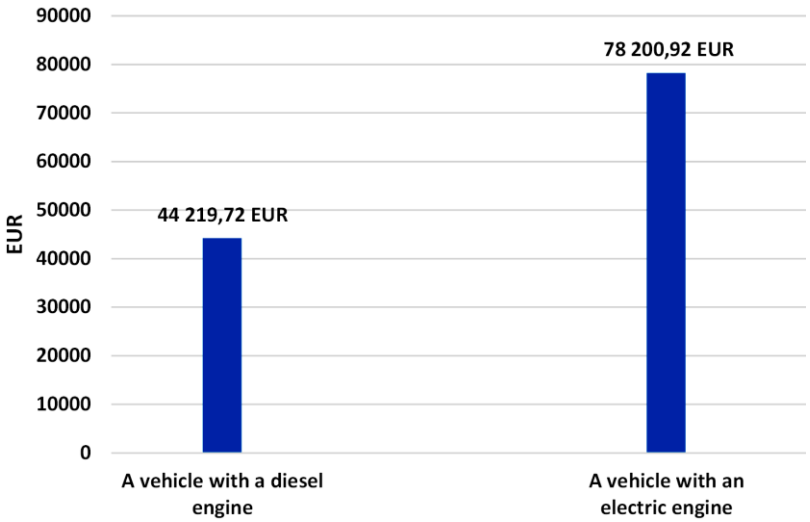

Fig. 5. Comparison of acquisition costs for a diesel vehicle versus an electric vehicle

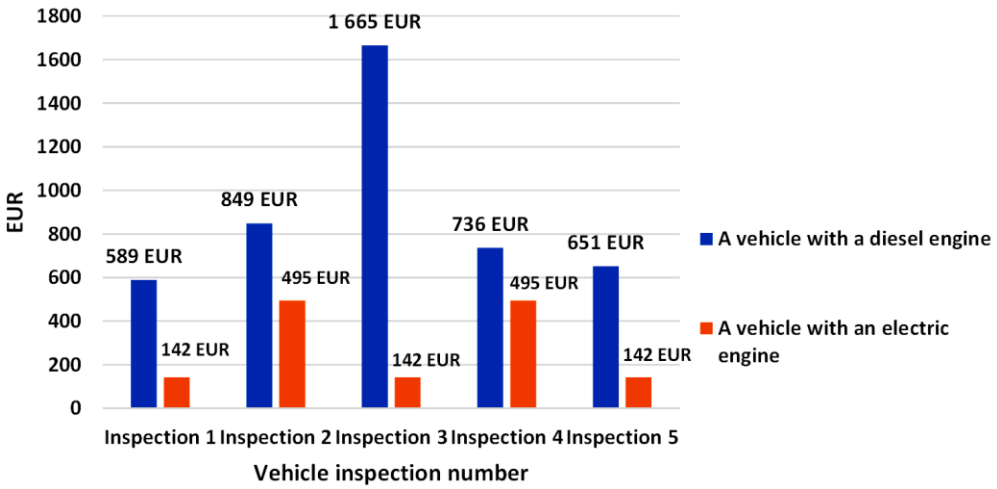

Fig. 6. Service cost comparison for a diesel vehicle versus an electric vehicle

An important aspect for a courier service company is the fuel cost comparison for a diesel vehicle against energy costs for an electric vehicle.

When comparing the costs over a three-year period of operation related to the purchase of fuel for a diesel vehicle, it can be seen that they exceed the cost of electricity of charging the battery of an electric vehicle by three times, shows in Figure 7a.

When analysing the costs resulting from owning a vehicle over a three-year period, which include, among other things, insurance costs and tyre changes, the diesel vehicle compares favourably. This is shown in Figure 7b.

Comparing the last category of costs, i.e. other costs resulting from owning a vehicle consisting of money for the purchase of winter tyres, vehicle maintenance and running repairs, less money is required for a diesel vehicle, this can be seen in Figure 7c.

Figure 7d illustrates a comparison of the total cost of ownership for a diesel vehicle and an electric vehicle over a 3-year lifetime.

A diesel vehicle, when all financial burdens are added up, is EUR 22,909.07 cheaper than an electric vehicle.

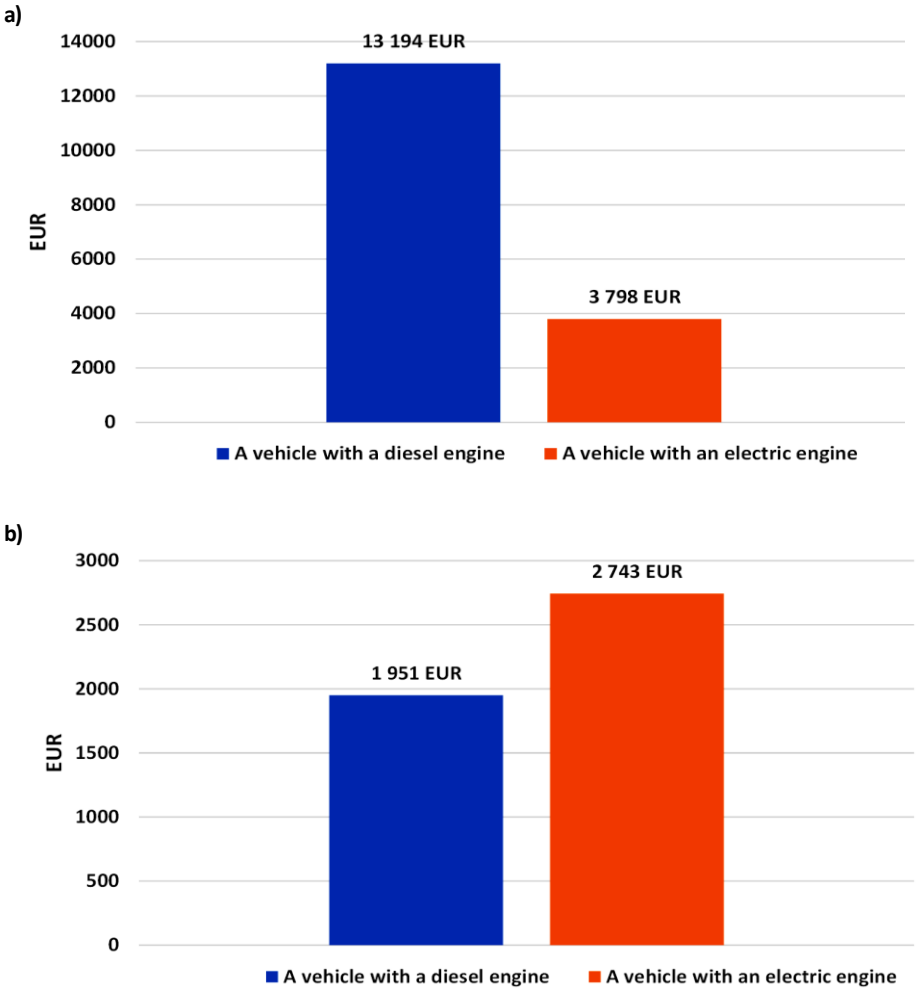

Fig. 7. Cost comparison for a diesel vehicle and an electric vehicle: a) **fuel costs and electricity costs,** b) **ownership costs**

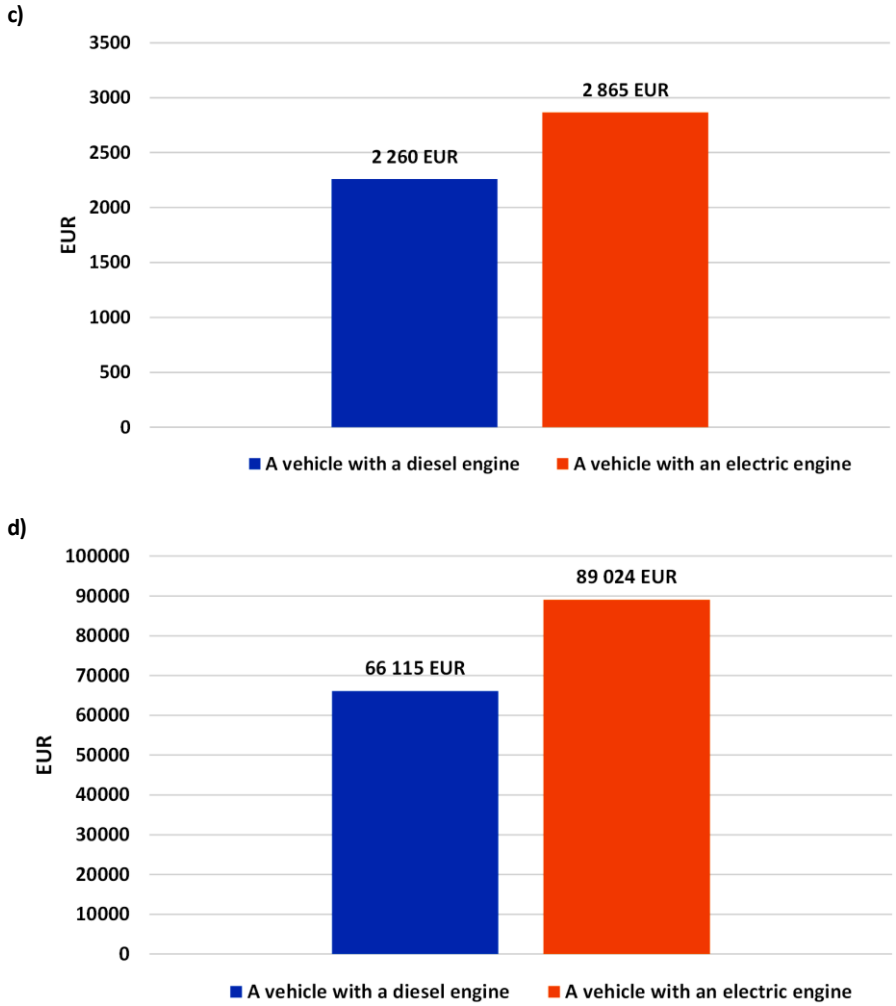

Fig. 7. Cost comparison for a diesel vehicle and an electric vehicle: **c**) **other ownership costs, d**) **total costs**

CONCLUSIONS

Based on the analysis conducted on the basis of data made available by Volkswagen Group Polska Sp. z.o.o., it was concluded that a delivery vehicle powered by conventional fuel has a lower purchase price than an electric vehicle. However, the costs associated with its servicing are much higher than for an electric vehicle. This is due to the more frequent need to change the oil, filters and other components of the vehicle powered by conventional fuel. Attention should also be drawn to the worsening air quality problems in cities and the increasingly stringent standards for pollution emitted into the atmosphere by vehicles. This requires vehicle manufacturers to apply complex and sophisticated technical solutions aimed at reducing the negative environmental impact of such a vehicle. Moreover, taking into account the nature and urban environment of the diesel car used by courier companies, it is necessary to remember about the possibility of frequent malfunctions and failures related to the exhaust after-treatment system and the drive system. When comparing the costs associated with the purchase of fuel for a diesel vehicle and the costs incurred for charging an electric vehicle, you can see significant savings when choosing an electric vehicle. On the other hand, all costs resulting from owning a delivery vehicle powered by

conventional fuel are lower than in the case of an electric vehicle. This is due to the need to purchase a charger for faster charging of an electric vehicle and higher insurance costs for such a vehicle. An electric vehicle, despite a significantly higher purchase cost, has lower servicing and charging costs. In addition, the lack of exhaust after-treatment systems and the simpler design minimises the risk of unplanned breakdowns, rendering the vehicle unfit for transport tasks.

In conclusion, in the final comparison, a vehicle powered by conventional fuel is cheaper than an electric vehicle by a gross amount of EUR 22,909.07. On the other hand, the available solutions for subsidising the purchase of an electric vehicle, reducing its charging costs thanks to renewable energy sources and the facilities provided for owners of electric vehicles, make the electric vehicle more competitive compared to a diesel vehicle. In addition, social pressure and the climate policy of the EU countries aimed at reducing the harmful environmental impact of the transport sector, limiting carbon dioxide emissions and achieving climate neutrality in 2050 speak in favour of choosing an electric vehicle for a courier company.

ABBREVIATIONS

1. **CI engine** - Compression Ignition engine;
2. **TDC** - Top Dead Center of the piston;
3. **VCR** - Variable Compression Ratio.

ANALIZA PORÓWNAWCZA WYBRANYCH ASPEKTÓW EKSPLOATACJI POJAZDÓW DOSTAWCZYCH Z NAPĘDEM KONWENCJONALNYM I ELEKTRYCZNYM

W obliczu rosnących problemów z jakością powietrza i zwiększającej się emisji dwutlenku węgla z sektora transportu, pojawia się konieczność ograniczenia uwalniania szkodliwych substancji do atmosfery. Instytucje narodowe i europejskie wprowadzają rygorystyczne normy emisji, wymuszając na branży transportowej adaptację i poszukiwanie alternatywnych źródeł napędu. W artykule analizowano wpływ eksploatacji pojazdów dostawczych z napędem konwencjonalnym i elektrycznym w przedsiębiorstwie kurierskim, uwzględniając wpływ na środowisko i efektywność ekonomiczną. Porównanie wykazało, że choć pojazdy konwencjonalne są tańsze w zakupie, generują wyższe koszty serwisowe i eksploatacyjne, a także przyczyniają się do zanieczyszczenia powietrza. Pojazdy elektryczne, mimo wyższej ceny zakupu, oferują niższe koszty serwisowania i ładowania, a ich prosta konstrukcja minimalizuje ryzyko awarii. Korzystanie z odnawialnych źródeł energii i programu dofinansowania trwającego do 2025 roku „Mój elektryk", mogą dalej zmniejszać koszty eksploatacji pojazdów elektrycznych. Biorąc pod uwagę korzyści wizerunkowe oraz przyszłe regulacje klimatyczne UE, pojazdy elektryczne stają się bardziej konkurencyjne i są preferowanym wyborem dla firm kurierskich dążących do zrównoważonego rozwoju i neutralności klimatycznej do 2050r.

Słowa kluczowe: pojazdy użytkowe, pojazdy elektryczne, elektromobilność, emisje do środowiska.

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