

Analysis of the possibility of using electric vehicles in a transport company

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Abstract. The article analyses the possibility of stopping electric vehicles in a transport company. Courier companies use electric vehicles to make short-distance deliveries in urban areas. Public transport is also contributing to the popularity of electric vehicles, which reduce harmful emissions in cities.

1 Introduction

The history of transport is inextricably linked to the development of civilisation, as the constant need to move is one of the basic existential needs. From primitive means of transport to today's high-tech.

Electric vehicles are gaining popularity as a potential solution to these problems. A distinguishing feature of electric vehicles is the lack of harmful gas emissions, which translates into a reduction in air pollution and an improvement in the quality of life in cities, where pollution is particularly severe. In addition, the use of renewable energy sources to charge electric vehicles can help reduce CO₂ emissions, which is a key element in the fight against climate change. Transport companies can reap numerous benefits from the implementation of an electric vehicle fleet. Reducing vehicle operating costs, especially in the long term, is one of the most important assets. While the initial investment may be higher than traditional vehicles, significant fuel savings and reduced maintenance costs translate into financial benefits for the business.

2 Advantages and disadvantages of electric vehicles

2.1 Impact of electric vehicles on the environment

One of the advantages of electric vehicles is that they are zero-emission while driving. Electric vehicles do not emit exhaust fumes, which contributes to improving air quality and reducing environmental pollution. They are more climate-friendly than traditional combustion vehicles, although it should be remembered that much depends on the energy sources used to charge them [7,22].

Although an electric car does not emit exhaust fumes through the tailpipe, this does not mean that the technology is completely clean. After all, the electricity we use to charge our batteries has to be produced in some way. In the case of conditions in Poland, this almost always means energy from burning coal. Marcin Popkiewicz, in his commentary on MacKay's book, estimates that for every kilowatt hour of electricity 1 kg of CO₂ is emitted. This means that driving 100 km in an electric car generates 20 kg of CO₂ emissions - the same as a large petrol off-roader. Unfortunately, the bad news doesn't end there. It turns out that the production of one battery for a Tesla car releases as much carbon dioxide into the atmosphere as is emitted by a gasoline-powered car during 8 years of driving [14]. Some electric cars are powered by 100 percent energy from renewable sources such as wind or

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solar power. However, there are also electric vehicles whose charging is based on energy generated using fossil fuels such as coal, natural gas or oil [22].

2.2 Advantages of electric vehicles

The electric car is equipped with four wheels, a steering wheel, turn signals, a multimedia screen, airbags and aluminum wheels. On the surface, it may seem similar to a typical car, but the difference lies in the use of a different type of engine. However, this is a misconception, because electric motors are a real revolution. Electric cars have undergone a remarkable transformation, and the list of their benefits and driving pleasure goes far beyond what drivers have experienced over the past 120 years [4].

Comfort

Traveling in a vehicle with an electric motor offers more comfort and enjoyment compared to other modes of transport. Thanks to the quiet operation of the electric motor, smoothness during starting and braking, travelling in such a vehicle is much more comfortable and pleasant [16]. Electric motors provide virtually soundless operation compared to traditional internal combustion engines, which makes traveling much quieter and more relaxing for both driver and passengers. In addition, the electric motors have instant access to full torque, which makes acceleration smooth and hassle-free. During braking, the electric motor uses recuperation technology to recover kinetic energy, which leads to a smooth and controlled stopping of the vehicle. The electric motors also work without major vibrations and vibrations, which translates into even greater comfort while driving. No vibration guarantees a more stable and peaceful travel experience. With an even distribution of torque, electric vehicles often offer a smooth and stable ride. Eliminating the need to change gears, which is characteristic of cars with internal combustion engines, eliminates jerking during acceleration and reduces speed fluctuations [2].

Greater predictability of electricity costs

Communication via electric vehicles contributes to reducing the influence of countries on volatile oil prices and markets, as well as on unpredictable international events. This type of communication offers us the opportunity to use renewable energy sources such as solar, wind or tidal energy to generate the electricity necessary to power vehicles. With electric vehicles using renewable energy sources to power themselves, we are no longer as dependent on fossil fuels such as oil. This results in less vulnerability to fluctuations in oil prices and changes in global energy markets. In addition, the use of renewable energy contributes to reducing the negative impact on the environment, reducing the emission of harmful substances and greenhouse gases [18]. The introduction of electric vehicle-based communication also enables countries to develop their own renewable energy sources, which in turn brings economic and strategic benefits. Using solar, wind or tidal energy to produce electricity creates opportunities for local industries to grow, create jobs and build energy independence. As a result, communication through electric vehicles that use renewable energy contributes to reducing the country's dependence on inappropriate external factors, such as fluctuations in oil prices and international conflicts. At the same time, it promotes clean energy and sustainable development, which is good for both our planet and local economies [18].

Lower exploitation costs

Vehicles equipped with electric motors are much more efficient compared to vehicles with internal combustion engines. The energy efficiency of these vehicles is between 75% and 80%, while internal combustion vehicles only reach between 15% and 20%. As a result, electric vehicles consume up to 90% less energy compared to traditional internal combustion vehicles. The difference in efficiency is due to the differences in the design and function of the two types of engines. Electric motors are much better suited to converting electrical energy into mechanical energy, which means less energy is lost in the conversion process. Internal combustion engines, on the other hand, generate large losses, resulting from

mechanical friction, heat losses and exhaust losses. The benefits of higher efficiency of electric vehicles are not only energy savings [8]. The use of electric motors eliminates the need for regular replacement of traditional components and maintenance fluids. For internal combustion vehicles, spark plugs, engine oil, coolant and brake fluid must be replaced regularly. Electric vehicles do not have such maintenance requirements, which translates into savings in maintenance time and costs. In addition, electric vehicles do not require the replacement of oil and fuel filters, which are necessary for internal combustion engines[8].

Simplified Controls

Simplified controls in electric vehicles are designed to reduce complex controls such as the steering wheel and pedals in favor of simpler and more intuitive solutions. The main goal is to make it easier for drivers to operate an electric vehicle by simplifying the user interface. One potential solution is to replace the steering wheel with a joystick, similar to those used in computer games. With a joystick, the driver could control the direction of travel by moving it in the right direction, eliminating the need to turn the steering wheel. Such a control method would be aimed at providing greater convenience and simplicity of operation. In addition, in the simplified control of electric vehicles, the accelerator and brake pedals can also be replaced with simpler solutions. For example, instead of traditional pedals, the driver could use buttons or joysticks to control the speed of the vehicle. Such a modification would allow for further simplification of the user interface. The benefit of simplified controls is that the vehicle is easier to operate for drivers, especially for those who are not used to traditional controls [8].

In addition, such a solution could increase the accessibility of vehicles for people with disabilities who may find it difficult to operate standard controls. However, before introducing simplified controls in electric vehicles, in-depth research and testing is necessary to ensure that the new solutions are sufficiently precise, safe and reliable. Road safety regulations and standards also need to be adapted to take account of possible changes in the vehicle control system [5].

2.3 Disadvantages of electric vehicles

Limited Range

One of the main drawbacks of electric vehicles is their limited range. Compared to conventional vehicles with internal combustion engines, electric cars have a smaller battery capacity, which translates into a shorter distance that can be covered on a single charge. This presents a challenge for frequent long-distance travelers who may need to be charged more frequently [3].

Long charging time

Another disadvantage is the lengthy process of charging electric vehicle batteries. Compared to refueling, charging the battery requires much more time. Even when using fast charging stations, it takes much longer to fully charge the battery than refueling a traditional vehicle [3].

Charging infrastructure

The current state of EV charging infrastructure still leaves a lot to be desired. There is a lack of sufficient charging stations, especially in rural areas and smaller towns. Additionally, some charging stations may be unavailable or not meet certain standards, making it difficult to use electric vehicles [3].

High costs

Electric vehicles tend to be more expensive than traditional internal combustion engine vehicles. The costs of batteries, technology, and electrical components are still significantly higher than those of traditional automotive solutions. This can be discouraging for potential buyers who are on a budget.

3 Possibility of using electric vehicles in transport companies

3.1 Use of electric vehicles in public transport

The use of buses with a diesel engine inevitably leads to the emission of harmful pollutants. This problem is particularly evident in highly urbanized areas, where low average vehicle speeds, frequent stops and braking are conducive to pollution. In this context, the benefits of using electric buses are significant, due to their high environmental efficiency. No harmful substances are emitted during the operation of these vehicles, which significantly improves air quality. In addition, electric buses generate significantly less noise than diesel vehicles [15].

Another important benefit of using electric buses is the diversification of energy sources in public transport, which makes it possible to become independent of the availability and price of oil. In these times, when oil prices are very volatile, this approach becomes particularly attractive to public transport operators. Electric buses can be powered by a variety of energy sources, such as hydropower, wind, solar or nuclear. This increases the independence and flexibility of the system, which is crucial for the sustainable development of the transport sector [15].

One of the most important advantages of electric buses is the ability to recover energy during braking, which leads to energy recuperation in urban traffic at the level of up to 30% [15].

Through the use of energy recovery systems, the kinetic energy that is normally lost during braking is converted and stored in the vehicle's batteries. This energy can then be used to power the bus when accelerating. This energy efficiency leads to a reduction in electricity consumption and an increase in the range of the vehicle [15].



Fig. 1. Charging an electric bus with a plug-in plug [18].

In addition to the environmental benefits, the use of electric buses also has a positive impact on the national power system. The planned charging of the battery-powered buses contributes to stabilising the load on the grid. Charging management systems can be designed to charge vehicles at times with low energy demand, i.e. at night. This makes it possible to make better use of the electricity infrastructure. In addition, with a large fleet of electric buses, they can serve as energy storage resources that can be charged during periods of excess energy and discharged during peak hours, contributing to the sustainability and efficiency of the power system. The bottom line is that the use of electric buses has many benefits for the environment, the economy and energy. Pollutant emissions are eliminated, noise is reduced,

and dependence on fossil fuels is reduced. In addition, through integration with the national power system, it is possible to optimally use electricity and stabilize the grid. That is why more and more cities and public transport operators are choosing to introduce electric buses, aiming to improve the quality of life in the city, reduce CO₂ emissions and achieve sustainable transport development [15].



Fig. 2. Charging an electric bus with a stationary pantograph charger [20].

Another example of an electric vehicle used in public transport is the **tram**. There are two types of power supply for trams:

- 1) **Overhead contact line power system:** In this system, trams use a catenary that supplies electricity by means of a pantograph or current collector located on top of the vehicle that connects to the overhead contact wires above the track. These wires conduct electricity from power plants or power substations to trams on the trackbed [21].



Fig. 3. Tram equipped with a power supply system from the overhead contact line [1].

- 2) **Battery-powered system:** Recently, battery-powered trams that are placed on board the vehicle have been used more and more often. These trams may use the overhead contact line power supply for a short period of time at the stops or charging stations and then use the energy stored in the batteries while driving on the road [26].

Both of these solutions have their pros and cons. The overhead contact line power system is more traditional and more reliable for fixed tram routes, but requires traction infrastructure, which can be costly. On the other hand, the battery power system offers greater flexibility in route selection, as a permanent connection to the catenary is not required. It is also more cost-effective if the overhead contact line infrastructure is not yet sufficiently developed or the upgrade is too expensive [26]. These power systems are designed to provide a clean and environmentally friendly means of transport, reducing emissions and environmental impact [26,21].

Trams are an excellent means of urban transport, with many advantages that make them extremely attractive and beneficial for cities and their residents. They are distinguished primarily by their considerable capacity, which is their main advantage over cars. For example, a typical two-car 805Na can carry up to 198 passengers at a time, while cars on average carry only 1.4 passengers. This means that trams are a much more efficient and economical solution. The actual capacity of a tram train corresponds to the capacity of as many as 40 cars, which makes trams particularly attractive for large cities where traffic is high [21,1].

3.2 The use of electric vehicles in logistics companies

The transition of logistics companies to electric vehicles has a myriad of benefits that have a positive impact on both the companies themselves and the environment. This transformation encompasses many aspects that are crucial to the strategy and long-term development of the logistics industry [11].

One of the most important assets is the sustainability and reduction of greenhouse gas emissions. Logistics companies that opt for electric vehicles significantly reduce the negative impact of their operations on the environment. Compared to internal combustion vehicles, electric vehicles do not emit harmful air pollutants or greenhouse gases, resulting in a significant reduction in their carbon footprint. In the face of the growing problem of climate change, switching to an electric fleet is an important step towards sustainable development and protecting our planet [23].

Another key advantage is the saving of operating costs. Although the initial investment in electric vehicles may be higher than for internal combustion vehicles, in the long term, the operating costs are typically much lower. Electric vehicles use cheaper energy, which translates into lower fuel costs, especially for logistics companies that manage large fleets of vehicles. In addition, reduced wear and tear of consumables and reduced engine maintenance contribute to lower fleet maintenance costs in the long term [24].

It is also worth highlighting the quiet operation of electric vehicles, which has a positive impact on the quality of life in urban areas, where logistics companies often conduct their operations. The noise generated by traditional internal combustion vehicles can be a nuisance for residents, especially at night. Switching to electric vehicles minimises this nuisance, contributing to a better quality of life in local communities. The aspect related to the company's image is another factor that attracts customers and investors. Nowadays, society pays more and more attention to social and environmental responsibility, so logistics companies that are committed to environmental protection gain a competitive advantage. The use of electric vehicles is proof of the company's commitment to sustainability, which attracts customers who want to support green solutions [24].

The use of regulations and incentives, such as exemptions from vehicle registration fees, tax breaks or subsidies for the purchase of electric vehicles, is another factor that encourages logistics companies to invest in electric vehicles. Such support can significantly reduce investment costs, making the transition to electric vehicles more economically viable [5].

Avoiding restricted traffic zones is another practical advantage for logistics companies. Limited traffic zones for internal combustion vehicles are being introduced in many cities

and regions to improve air quality. Electric vehicles are often exempt from these restrictions, giving logistics companies free access to specific areas without worrying about possible traffic restrictions.

Fleet monitoring and route optimization is another important argument for the use of electric vehicles in logistics companies. Thanks to advanced telematics systems, many electric vehicles are equipped with tools that allow them to monitor their fleets in real time. This makes it possible to effectively manage the fleet, optimize delivery routes and minimize operating costs [6].

An example of a logistics company that uses electric vehicles is InPost. InPost, which is a European leader in e-commerce solutions, is getting closer and closer to creating an eco-friendly delivery method. Thanks to systematic investments and expansion of the electric vehicle fleet, the company has achieved the ability to deliver as many as 29,940,438 parcels using a zero-emission fleet. By the end of 2022, there were 463 electric cars marked with the InPost logo on Polish roads, which together covered almost 8 million kilometers [9].

Currently, the company has 463 electric vans in its fleet, and their plan is to double that number by the end of the year. This is a decisive step towards reducing greenhouse gas emissions and reducing the negative impact on the environment. Environmentally friendly solutions are also regularly implemented in InPost branches. One example is the installation of charging networks for electric cars. 401 charging points have already been installed in 30 branches of the company, which is conducive to the development of electromobility and enables the use of more environmentally friendly means of transport [9].



Fig. 4. Electric Ford E-Transit for InPost couriers [19].

3.3 The use of electric vehicles in taxi companies

Taxi companies play a key role in the transport systems of cities and regions. Traditionally, these types of companies have used vehicles with internal combustion engines, but in recent years we have seen a significant increase in interest in electric vehicles. The introduction of electric vehicles into the taxi fleet can bring numerous benefits, both for the environment and for the companies themselves. In this paper, we will focus on analysing the pros and challenges of using electric vehicles in taxi companies, as well as presenting examples of companies that have already decided to use this innovative solution. Here are some examples of taxi companies using electric vehicles:

- I. Greentomatocars: Greentomatocars is a pioneer in the taxi industry in London, as it was one of the first companies to completely switch to an electric vehicle fleet. The company was founded in 2006 and operates on a zero-emission basis, consistently supporting environmental protection. Currently, their fleet consists of various models of electric vehicles, such as Nissan or Tesla [13].



Fig. 5. One of the electric cars in the Greentomatocars fleet with the company's logo [13].

- II. Blue Bird Group: This is an Indonesian taxi company that has introduced electric taxis to its fleet in order to reduce emissions and air pollution in Jakarta. Blue Bird Group is one of the largest taxi operators in Asia and actively invests in the development of sustainable transportation, including electric vehicles.
- III. Green Cabs: This is a New Zealand taxi company that has committed to having only electric vehicles in its fleet. Green Cabs operates in several cities in New Zealand and is consistently expanding its fleet of electric vehicles [12,25].

All of these companies demonstrate their commitment to green transport and contribute to reducing the negative impact of taxis on the environment through the use of electric vehicles in their fleets.

The largest companies that provide taxi services and at the same time largely focus on the use of zero-emission vehicles are Bolt and Uber.

Bolt, formerly known as Taxify, is an international ride-hailing platform that operates in more than 150 cities around the world. The company was founded in Estonia and started its operations in 2013. As the problem of air pollution and climate change becomes more pressing, Bolt has joined numerous companies seeking to improve the situation by introducing electric vehicles into their fleets.

Uber, the world's ride-hailing platform, was founded in 2009 in the United States and now operates in more than 900 cities around the world. Uber has become a leader in taxi services and has also played a significant role in promoting and developing green rides [10].

4 Summary

The use of electric micro-mobile vehicles in transport companies is becoming increasingly popular due to the numerous benefits for the environment and the transport industry. Electric micro mobiles, such as scooters, cargo bikes or three-wheeled scooters, are seen as an efficient and eco-friendly solution for fast and flexible deliveries in cities.

Transport companies, especially courier companies, can use these vehicles to make short-distance deliveries in congested urban areas. Thanks to them, they can avoid traffic jams, parking problems and reach places that are difficult to reach for traditional delivery vehicles. An example of such a strategy is DHL, which has introduced e-bikes to its fleet as part of its GoGreen initiative, reducing CO₂ emissions and striving for sustainability.

For enterprises with large sites, micro mobile electric vehicles, such as electric forklifts, can be used for internal transportation. Electric pallet trucks enable the rapid picking and distribution of materials inside warehouses, eliminating the need for forceful operator effort.

In public transport, electric vehicles such as electric buses and trams are gaining popularity due to their environmental friendliness and ability to reduce harmful emissions.

Electric buses can be powered by various energy sources, such as hydropower, wind or solar power plants, which allows them to become independent of fossil fuels.

Trams, as a means of urban transport, have many advantages, such as high capacity, low impact on the urban planning of the city and environmental friendliness. By sustainably managing their electric vehicle fleets, logistics companies can significantly reduce their environmental impact, which contributes to gaining a competitive advantage and a positive image.

The transition to electric vehicles in transport companies is a step towards a more sustainable and greener future, as part of the global effort to protect the environment and fight climate change. Investments in electromobility bring numerous benefits for the environment, economy and the quality of life of local communities, which is why the growing interest in these solutions is a promising trend in the field of transport.

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