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DEVELOPMENT OF ELECTRIC TRANSPORT INFRASTRUCTURE IN KAZAKHSTAN

Abstract.

Electric transport has become possible thanks to modern technologies and innovations in the field of energy. Today, the world is actively switching to the use of environmentally friendly transport in order to reduce the harmful impact on the environment. Leading scientists in this field have done a great job to ensure the smooth operation of electric transport. The main problem of electric transport is the limited charging of batteries and the lack of infrastructure of charging stations. Leading scientists are working on this issue and finding new solutions to ensure safe and fast charging. The main purpose of the study is to study the problems and prospects of the development of electric transport infrastructure in Kazakhstan. The study summarizes statistical indicators of the development of electric transport infrastructure in Kazakhstan, obtained from official sources of the Bureau of National Statistics of the Republic of Kazakhstan. The analysis made it possible to identify the primary tasks, the solution of which will simplify the spread of electric transport: creating a favorable economic environment for the development of the electric transport market, the introduction of electric buses in cities, stimulating business to create enterprises for the utilization of traction batteries and electric vehicles, supporting and developing the production of electric vehicles in the country, training and training of specialists in the field of electric transport, development of electric transport management plans and monitoring its use.

Key words: electric vehicle, infrastructure, prospects, charging stations, Kazakhstan.

Introduction.

Due to the increase in the number of cars and environmental pollution, many countries and regions, including Kazakhstan, are beginning to actively develop electric transport infrastructure.

First of all, the development of electric transport in Kazakhstan will reduce emissions of harmful substances into the atmosphere. This is important for the preservation of public health and environmental sustainability of the region. In addition, it will reduce dependence on oil products and increase the energy security of the country.

The second important reason for the development of electric transport is economic efficiency. Electric cars have a low cost of operation and maintenance, which is an important factor for business and private owners. In addition, the presence of own production of electric vehicles can contribute to the development of the domestic industry and increase competitiveness in the world market.

The third reason is the improvement of the mobility of the population. Electric cars have high speed and maneuverability, which makes them more convenient to move in an urban environment. The development of electric transport infrastructure also contributes to the improvement of public transport and the creation of new jobs.

Also, when burning fuel, a large amount of greenhouse gases is released, which have long threatened us with global climate warming. Due to this, not the best, situation, the XXI century requires us to find new solutions to this number of problems [1], [2].

However, despite all the advantages, the development of electric transport in Kazakhstan faces a number of problems and challenges. Insufficient number of charging stations, limited power reserve, high cost of electric vehicles - all this complicates the spread of this type of transport. In this regard, it is important to develop state programs and attract investments in the development of electric transport infrastructure.

The main purpose of the study is to study the problems and prospects of the development of electric transport infrastructure in Kazakhstan.

Materials and methods of research.

The article presents data from the Bureau of National Statistics of the Republic of Kazakhstan on the development of the electric transport industry.

The information base for the formation of data on the statistics of electric motor transport is the primary statistical data of national statistical observations of monthly, quarterly and annual frequency:

1) statistical observations of legal entities of monthly and annual frequency;

2) statistical observations of individual entrepreneurs of quarterly frequency;

3) administrative data of state bodies on the fleet of vehicles.

Results and its discussion.

One of the ways to solve the problem of inner-city transport is the introduction of electric vehicles. To date, their implementation and active use is becoming more accessible. Large European and American firms, in pursuit of modern trends, have long taken a guideline for this type of transport, the use of which, on the one hand, requires considerable costs for the state (in terms of re-equipment of infrastructure), but at the same time brings significant benefits in line with efficiency for drivers and environmental friendliness for the state as a whole.

The first models of electric cars appeared in the twentieth century, but they were never put into mass production because of their low power. The maximum speed of movement of such cars was 90 km/ h, and they could drive less than a hundred kilometers without replacing the batteries. Modern mass-produced electric vehicles began to enter the market relatively massively in the late 2000s. More or less significant sales statistics begin in 2010, when the bill for electric cars sold went to tens of thousands annually [3].

The Mitsubishi I-Miev, which appeared in 2009, became the first modern electric car capable of driving along motorways on a par with conventional cars. Mitsubishi I-Miev holds a kind of record – in February 2011, it became the first mass-produced electric car in history, the sales volume of which exceeded 10 thousand units. However, already in 2011, the Nissan Leaf became the best-selling electric car.

Aspects of using an electric vehicle include:

First of all, because of the price: in almost all countries, buyers do not want to overpay for electrification. The real surcharge for an electric motor under the hood is, on average, at least $ 10,000. In the USA, there were no more than 9% of them, and in Russia less than 1%. The second factor of disappointment was the maximum mileage on a single charge: it must be at least doubled [4].

Most customers need their electric car to be able to travel at least 320 km. And the third is the charging time. Ideally, its duration should not be longer than that of fuel cars.

At least less than two hours. This will be possible if all owners of electric vehicles are equipped with special 340-volt express chargers, which are equipped with specialized gas stations. In the meantime, the charging time from a standard power grid, depending on the voltage, can range from eight hours in Europe to twenty in the USA.

According to the Statistics Agency of the Republic of Kazakhstan, as of August 1, 2022, 448 electric vehicles were registered in the country. However, there is not a single company that officially supplies electric vehicles to the territory of the Republic of Kazakhstan. The fleet of electric vehicles in Kazakhstan is shown in Figure 1.

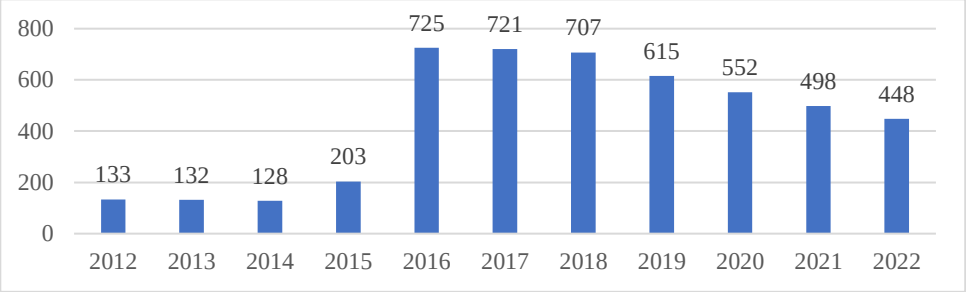

Figure 1 – The number of registered passenger electric vehicles from 2012 to 2022

Note: Compiled by the authors according to the data of the Bureau of National Statistics of the Republic of Kazakhstan [5].

Figure 1 shows the number of registered passenger electric vehicles in Kazakhstan from 2012 to 2022. The number of electric vehicles is measured in thousands, and it has changed over time.

In 2012, 133 thousand passenger electric vehicles were registered, and in 2013 this number decreased to 132 thousand. In 2014, the number of registered electric vehicles further decreased to 128 thousand.

However, since 2015, the number of registered electric vehicles in Kazakhstan has been increasing. In 2015, 203 thousand passenger electric vehicles were registered, and in 2016 this number increased to 725 thousand. In 2017 and 2018, the number of registered electric vehicles continued to grow, peaking at 707,000 in 2017 and then dropping to 615,000 in 2018.

From 2019 to 2022, the number of registered passenger electric vehicles in the world continued to grow, but at a lower level than in previous years. In 2019, 552 thousand electric vehicles were registered, and in 2020 and 2021 this number decreased to 498 thousand and 448 thousand, respectively.

The total number of registered passenger electric vehicles in the world has increased over time, although growth has slowed in recent years.

Each electric vehicle is equipped with a power supply that can charge the car battery to full charge within 8-12 hours by connecting to a household outlet. On a full charge, these electric vehicles can travel from 100 to 400 km, depending on the car model and the capacity of the installed battery.

In Kazakhstan, owners of electric vehicles pay about 100 tenge per 100 km of mileage. If we take into account the minimal need for lubricants in an electric vehicle, then the operating cost of such a vehicle becomes very low, despite its high starting cost [6].

The main problem in the operation of an electric car is the attitude of motorists to the power reserve. We used to talk about the mileage of the car in “liters”. You can't treat an electric car the same way. Electric vehicles have a lithium-ion battery, the same as in laptops and phones, which does not really “like” full discharge and fast charge. When operating an electric vehicle, it is advisable to charge the battery at any opportunity and not bring its discharge to a low level. That is why the development of the infrastructure of charging stations is extremely important for owners of electric cars. At the moment, due to the lack of charging stations in Kazakhstan, electric vehicles are charged from household outlets or in places where there is physical access to electrical outlets. This nuance significantly slows down the wider spread of electric vehicles in Kazakhstan.

Thus, there is no more environmentally friendly and inexpensive alternative to electric vehicles in the near future for inner-city vehicles that provide transportation over relatively short distances at low speed.

As prospects, let us turn to vivid examples of improving the infrastructure of charging stations in Europe, America and China.

So, in the USA, the network of charging stations began to increase rapidly after the launch of the government subsidy program for electric cars in 2008 and the start of sales of the most popular electric car NissanLeaf in 2010.

Electric vehicle charging stations have been one of the key infrastructure challenges faced by the electric vehicle industry in the US since 2008. However, over the past few years, the situation has started to change, and charging stations have become more affordable and convenient to use.

In the early 2010s, there were only a few charging stations for electric vehicles in the United States, and most of them were located in California. However, in 2011, the Electric Vehicle Road project was launched, which was created with the aim of expanding the network of charging stations throughout the country. Since then, the number of charging stations in the United States has grown from several hundred to several thousand.

In 2016, the Obama administration announced a plan to build a network of charging stations across the country to enable the transition to electric vehicles for a wider audience. As part of this plan, it was planned to install more than 48 thousand charging stations in the United States by 2025.

By 2021, the USA has more than 100 thousand charging stations for electric vehicles. They are located all over the country and are located both on main highways and in cities and suburbs. In addition, in recent years, most electric vehicle manufacturers have started building their own charging stations to provide convenience for their customers.

The tax credit for hybrid electric vehicles was introduced in the United States in 2012 in order to stimulate sales and use of environmentally friendly vehicles. This loan provides a substantial tax discount for buyers of hybrid cars, which makes them more affordable for many consumers.

Over the years, the U.S. hybrid electric vehicle tax credit program has gone through several changes. In 2014, the maximum loan size was set at $7,500, which is a fairly significant amount. However, the credit is starting to decrease for manufacturers whose cars have already been sold in the amount of more than 200,000 units. Such manufacturers include Tesla and General Motors.

In addition, in 2018, the tax credit for hybrid cars was changed during Trump's tax reform. According to the new rules, the loan is granted only for cars with a smaller battery capacity. Specifically, for cars with a battery capacity of 16 kWh or more, the loan is no longer provided. This has significantly reduced the availability of credit for buyers of hybrid cars.

Nevertheless, the tax credit program for hybrid cars continues to exist at the present time. And although some restrictions have been introduced in recent years, credit can still be a significant factor when buying environmentally friendly cars. This helps not only car sellers, but also the ecological state of the planet as a whole.

Thus, the USA has developed one of the largest infrastructure networks for electric cars in the world – 30,868 stations and high-speed charging without taking into account home [7].

Since 2010, China has been actively developing the production of electric vehicles and supporting their sales through government subsidies. In 2014, the Chinese government set a goal of selling 5 million electric vehicles by 2020. This goal was achieved in 2021.

Chinese car manufacturers such as BYD, NIO, and BAIC have become leaders in the electric vehicle market in China. BYD is the largest manufacturer of electric vehicles in China and sells its cars in more than 50 countries around the world. Founded in 2014, NIO offers high-tech electric vehicles and innovative charging station infrastructure.

In addition, international car manufacturers such as Tesla are also actively developing their presence in the Chinese market. In 2019, Tesla launched its largest factory in China, which is a key part of the company's strategy to expand its business in China and Asia.

Since 2010, China has been actively developing the infrastructure of charging stations. In 2015, the Chinese government launched a national program to develop the infrastructure of charging stations. The goal of the program is to install 4.8 million charging stations by 2020.

Chinese companies such as State Grid Corporation and China Southern Power Grid are actively involved in the construction of charging station infrastructure. In 2021, more than 1 million charging stations were installed in China.

In recent years, electric cars have become increasingly popular among motorists in Europe. This is due to several factors, including increased awareness of climate change, stricter emission standards and improved electric vehicle technology. The article presents an overview of the evolution of electric vehicles and charging station infrastructure in Europe for the period from 2010 to 2021.

Since 2010, electric vehicle manufacturers have started large-scale production of electric vehicles, and since then the number of electric vehicles on the roads of Europe continues to grow. Over the past few years, some of the largest automakers, such as Volkswagen, BMW and Renault, have begun to offer more affordable models of electric vehicles, which has also contributed to an increase in demand for them.

However, despite a significant increase in the number of electric vehicles on the roads, the share of electric vehicles is still a small proportion of the total number of cars. In 2010, electric vehicles accounted for less than 1% of the total number of registered cars in Europe. By 2021, the share of electric vehicles was about 5%.

Over the past few years, the number of charging stations in Europe has increased significantly. In 2010, there were only a few hundred charging stations in Europe, while by 2021 the number of charging stations reached more than 200,000.

There are various types of charging stations, from slow chargers for home use to fast charging stations in parking lots and on freeways. Currently, most charging stations in Europe are designed to charge at fast and medium speeds.

Thus, there are sufficient prospects for the development of this industry in Kazakhstan. Today, the infrastructure of electric vehicles is one of the most attractive objects for investment, despite the fact that we have only a few hundred electric vehicles so far, 5-10 years later, when the secondary market of electric vehicles from Europe is activated, the infrastructure of charging stations can become a gold mine for resourceful entrepreneurs.

Table 1 – Electric vehicles in the regions of Kazakhstan as of 01.06.2021

Регион	Hybrid	Electro	Total
Almaty	143	244	387
Astana	50	84	134
Almaty region	33	10	43
Karaganda region	24	9	33
Shymkent	21	7	28
Atyrau region	19	3	22
Pavlodar region	13	9	22
Kostanay region	11	9	20
Aktobe region	16	1	17
Zhambyl region	14	2	16
East Kazakhstan region	11	3	14
West Kazakhstan region	12	-	12
Turkestan region	8	-	8
Mangystau region	6	1	7
Akmola region	3	2	5
North Kazakhstan region	4	-	4
Kyzylorda region	2	2	4
Total	390	386	776
Note: Compiled by the authors according to the data of the Bureau of National Statistics of the Republic of Kazakhstan			

As can be seen from the table, we observe an equal ratio of hybrid and electric vehicles for 2021. The total number is 776 units of equipment.

Table 2 – Availability of electric vehicles on 01.06.2021

Type	Количество
Hybrid	390
Electro	386
Total	776
Note: Compiled by the authors according to the data of the Bureau of National Statistics of the Republic of Kazakhstan	

Next, let's look at the top brands in use by the owners. Toyota is the leader in the list with 210 units, Jaguar closes with 45 units of equipment.

Table 3 – Top brands of electric vehicles in Kazakhstan

Brand	Quantity
Toyota	210
Tesla	189
Lexus	71
Honda	61
JAC	46
Nissan	33
BMW	27
Porsche	26
Hyundai	23
Audi	21
KIA	13
Jaguar	11
Прочие	45
Итого	776
Note: Compiled by the authors according to the data of the Bureau of National Statistics of the Republic of Kazakhstan	

In addition to electric vehicles, the fleet of electric buses in Kazakhstan has become actively spread. Consider the table of electric buses with different traction.

Table 4 – Electric buses with electric and hybrid traction on 01.06.2021

Type	Quantity
Hybrid	17
Electro	124
Total	141
Note: Compiled by the authors according to the data of the Bureau of National Statistics of the Republic of Kazakhstan	

Table 5 – Availability of electric buses in the regions

Регион	Hybrid	Electro	Total
Astana	16	87	103
Almaty	-	17	17
Pavlodar region	-	11	11
Mangystau region	-	5	5
Kostanay region	-	2	2

Almaty region	-	2	2
East Kazakhstan region	1	-	1
Total	17	124	141
Note: Compiled by the authors according to the data of the Bureau of National Statistics of the Republic of Kazakhstan			

Development of electric vehicle production in Kazakhstan

– Serial production of the JAC iEV7S electric car has been organized at SaryarkaAvtoProm LLP, OTTS has been obtained

As of June 2021, 97 units of electric vehicles were produced, including 42 units in 2021

– Production of electric buses Yutong, Ankai, Golden Dragon has been mastered

Since 2018, 115 units of electric buses of domestic production have been sold in the cities of Astana, Pavlodar, Aktau

The current infrastructure of electric charging stations Installed 51 EZ in Astana and 53 EZ in Almaty. At the initial stage of development, a decision was made on the ratio of ESS to the number of electric vehicles 1 to 5.

Proposed measures for infrastructure development:

– Creation of fast and free charging networks in major cities of the Republic of Kazakhstan

Allocation of land plots and parking areas for the installation of "fast" charging stations and the supply of electricity to them

– Launch of electric carsharing and electric taxi projects based on electric vehicles of domestic production in large cities

– Providing free charging for electric carsharing and electric taxi projects for a period of 10 years.

Proposed measures to encourage the purchase of electric vehicles:

– Provision of free parking space equipped with chargers

– Provision of free travel on toll roads

– Ensuring the ability to move along bus lanes of public transport

Allocation of priority for the electric taxi project over other modes of transport in places of high demand for taxis

– Updating of public transport with electric buses of domestic production

– Providing free access to national parks and nature reserves

– Additional stimulation of the production of wheeled vehicles with an electric motor in the Republic of Kazakhstan

Allocation of additional funds for the purchase of electric vehicles within the framework of preferential car loans

Table 6 – Availability of EHS networks for 2021

Regions:	High - speed stations
Almaty	12
Astana	5
Almaty region	4
Shymkent	4
Kokshetau	1
Karaganda	1
Pavlodar	1
Semei	1
Taraz	1
Turkestan	1
Astana -Almaty	7
Almaty -Shymkent	3

Astana –Pavlodar-Semey	3
Astana-Kokshetau	2
Total:	46
Note: Compiled by the authors according to the data of the Bureau of National Statistics of the Republic of Kazakhstan	

There are approximately 50 charging stations for electric vehicles across the country. For comparison: there are 225 fuel filling stations in Karaganda, 90 in Kostanay, 120 in Ust–Kamenogorsk. And their profitability is more ensured by the sale of additional services and goods. The commercial efficiency of the EHS in the foreseeable future will be significantly limited by the volume of the existing fleet of electric vehicles. As for quantity statistics, there is a problem of correctness of basic calculations. In particular, it is worth pointing out the number of electric buses in the country's fleet. The BNS data indicates that only seven units of this type of equipment are registered in Kazakhstan. However, only one of the capital's road carriers has one hundred electric buses available [8].

The concept of the development of the electric power industry until 2035, analysts of the Ministry of Energy of the Republic of Kazakhstan provide such forecast data. The number of electric vehicles in the country may double in a year, and in 12 years it will grow to 40.1 thousand units. This is a pessimistic rather than an optimistic forecast.

Table 7 – Forecasts for the growth of the number of electric vehicles in the Republic of Kazakhstan

	2021	2025	2030	2035
Number of electric vehicles, thousand units	0,451	1,125	6,267	40,173
Electricity consumed by electric vehicles, million kWh	1,53	3,8	21,3	136,6
Number of charging stations, units	58	-	-	8 000
Note: Compiled by the authors according to the Ministry of Energy of the Republic of Kazakhstan				

The issue of the development of the ESS network is closely linked to the growth of the number of electric cars. For 40 thousand cars, 8 thousand charging stations will be needed, that is, almost 700 times more than there are now.

The probability that private investors will invest in the construction and equipment of the ESS without state support will remain low. After all, such investments pay off for a very long time. It is worth noting that in some European countries, Germany, the UK, the development of infrastructure for green transport has progressed significantly, primarily due to public investment. As for the projected number of charging stations, the figure of 8 thousand is very approximate.

In the concept of development of the electric power industry of the Republic of Kazakhstan, this point is reflected only in general terms.

Regarding electric vehicles, in 2021, work continued in Kazakhstan to create conditions for their development. In particular, the subsidy for the purchase of electric vehicles has been increased in the country, as well as the areas of installation of charging stations have been expanded. Moreover, the Government of Kazakhstan continues to work on the creation of legal and tax mechanisms that contribute to the development of the electric vehicle market in the country.

Thus, it can be said that the concepts of the development of the electric power industry in Kazakhstan for 2021 are aimed at improving the efficiency and sustainability of the energy system, as well as creating conditions for the development of the electric vehicle market in the country.

In particular, according to experts of the Ministry, the state needs to create attractive conditions for investors willing to invest in the localization of electric transport in Kazakhstan, the production of domestic traction batteries. Technically, only two Kazakhstani companies can collect EVs so far. "Saryarka Avto Prom" two years ago presented a crossover JAC of its own assembly. Hyundai Trans Kazakhstan announced plans to release a hybrid Hyundai Ioniq [9].

The mentioned national concept of the development of the electric power industry of the Republic of Kazakhstan indicates that stimulating demand for domestic green cars is possible at the level of benefits for lending.

We are talking about a zero down payment and reduced interest rates on a car loan. "When there is a corresponding product, state instruments for stimulating demand can show effectiveness. In particular, the program of preferential car loans, which has been operating for Kazakhstani consumers since 2015. In fact, within the framework of the program, new cars are purchased that comply with Euro-4 and Euro-5 environmental standards. However, like any similar tool, the program has limited funding resources, which in turn affects its effectiveness".

Domestic consumer demand in our country is not so high as to ensure the profitability of domestic manufacturers of electric vehicles. Therefore, investing billions of state investments in the creation of their own production cars, and then trying to compete in foreign markets with China or Europe is not the best prospect. We can take advantage of the technological process that other countries have already achieved, and invest in updating the fleet and infrastructure.

Conclusion.

The Government of Kazakhstan is preparing amendments to the legislation to further stimulate the population to switch to electric vehicles.

The promotion of these initiatives is carried out through the Ministry of Transport of the Republic of Kazakhstan within the framework of the Roadmap for the development of production of wheeled vehicles with electric motors and infrastructure development.

Kazakhstan needs a number of measures to develop electric transport in order to improve the environmental situation and reduce dependence on oil and gas imports. Some of these measures may include:

1. Creating a favorable economic environment for the development of the electric transport market. In particular, Kazakhstan needs to create an infrastructure of charging stations and provide subsidies to stimulate the production and sale of electric vehicles.

2. Introduction of electric buses in cities. This can be especially effective for reducing air pollution in densely populated cities. In this case, the state can provide grants for the purchase of electric buses and charging infrastructure. Benefits when applying for a loan (0% down payment, reduced credit rates, free hard hat). Stimulating infrastructure development for Astana, Almaty, Shymkent Creating conditions for investors planning to invest in the production of traction batteries

3. Stimulating business to create enterprises for the utilization of traction batteries and electric vehicles.

4. Support and development of the production of electric vehicles in the country. Kazakhstan may need to attract investment and technological knowledge to create local production facilities.

5. Education and training of specialists in the field of electric transport. Kazakhstan may need to conduct advanced training courses for engineers, technicians and mechanics in order to guarantee the safety and efficiency of the operation of electric vehicles.

6. Development of electric transport management plans and monitoring of its use. The State can develop strategies for the development of electric transport in accordance with the needs and requirements of the population, as well as establish monitoring systems to collect data on the use of electric transport and its impact on the environment.

7. Cooperation with other countries and international organizations to gain access to advanced technologies and experience in the development of electric transport in other countries.

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ҚАЗАҚСТАНДА ЭЛЕКТР КӨЛІГІНІҢ ИНФРАҚҰРЫЛЫМЫН ДАМЫТУ

Андатпа.

Электр көлігі энергетика саласындағы заманауи технологиялар мен инновациялардың арқасында мүмкін болды. Бүгінгі таңда әлем қоршаған ортаға зиянды әсерді азайту үшін экологиялық таза көлікті пайдалануға белсенді түрде көшуде. Осы саладағы жетекші ғалымдар электр көлігінің үздіксіз жұмысын қамтамасыз ету үшін үлкен жұмыс жасады. Электр көлігінің басты проблемасы батареяларды зарядтаудың шектелуі және зарядтау станцияларының инфрақұрылымының болмауы болып табылады. Жетекші ғалымдар бұл мәселеде жұмыс істеп жатыр және қауіпсіз және жылдам зарядтауды қамтамасыз ететін жаңа шешімдерді табуда. Зерттеудің негізгі мақсаты Қазақстандағы электр көлігі инфрақұрылымын дамыту мәселелері мен перспективаларын зерделеу болып табылады. Зерттеу шеңберінде Қазақстан Республикасының Ұлттық статистика бюросының ресми көздерінен алынған Қазақстанның электр көлігі инфрақұрылымын дамытудың статистикалық көрсеткіштері жинақталды. Жүргізілген талдау электр көлігін таратуды жеңілдететін бірінші кезектегі міндеттерді анықтауға мүмкіндік берді: электр көлігі нарығын дамыту үшін қолайлы экономикалық орта құру, қалаларда электр автобустарын енгізу, тартқыш батареялар мен электромобильдерді кәдеге жарату бойынша кәсіпорындар құру үшін бизнесті ынталандыру, елдегі электр көліктері өндірісін қолдау және дамыту, электр көлігі саласындағы мамандарды оқыту және даярлау, электр көлігін басқару жоспарларын әзірлеу және оны пайдалануды бақылау.

Негізгі сөздер: электромобиль, инфрақұрылым, перспективалар, зарядтау станциялары, Қазақстан.

РАЗВИТИЕ ИНФРАСТРУКТУРЫ ЭЛЕКТРОТРАНСПОРТА В КАЗАХСТАНЕ

Аннотация.

Электротранспорт стал возможным благодаря современным технологиям и инновациям в области энергетики. На сегодняшний день мир активно переходит на использование экологически чистого транспорта, чтобы уменьшить вредное воздействие на окружающую среду. Ведущие ученые в этой области проделали огромную работу, чтобы обеспечить бесперебойную работу электротранспорта. Главной проблемой электротранспорта является ограниченность зарядки батарей и отсутствие инфраструктуры зарядных станций. Ведущие ученые работают над этим вопросом и находят новые решения, чтобы обеспечить безопасную и быструю зарядку. Основной целью исследования является изучение проблем и перспектив развития инфраструктуры электротранспорта в Казахстане. В рамках исследования обобщены статистические показатели развития инфраструктуры электротранспорта Казахстана, полученные из официальных источников Бюро национальной статистики Республики Казахстан. Проведенный анализ позволил выявить первостепенные задачи, решение которых упростит распространение электротранспорта: создание благоприятной экономической среды для развития рынка электротранспорта, внедрение электробусов в городах, стимулирование бизнеса для создания предприятий по утилизации тяговых батарей и

электромобилей, поддержка и развитие производства электротранспортных средств в стране, обучение и подготовка специалистов в области электротранспорта, разработка планов управления электротранспортом и мониторинга его использования.

Ключевые слова: электромобиль, инфраструктура, перспективы, зарядные станции, Казахстан.

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