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# Advantages and Disadvantages of Electrical Vehicles

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*Abstract* – **Electric vehicles are electric motor drives, which are driven by an electric motor powered by the electrical energy stored in an accumulator or battery. The advantages of these vehicles compared to conventional vehicles with an internal combustion engine (ICE) mainly relate to lower air pollution in cities, independence (or rather, lower dependence, due to battery power) from fossil fuels, greater profitability over a longer period, etc. The energy needs of humanity are divided into 3 (three) large groups: electricity, transport and heating.**

*Keywords* – **internal combustion engine (ICE), Electrical vehicles, Baterry charger, Electricity sources.**

## I. INTRODUCTION

The development of electric vehicle technology in the past decades and the expected disappearance of fossil fuels herald an increasing use of electric vehicles. According to Bloomberg estimates, in 2035 half of all vehicles sold worldwide will be electric. Electric vehicles have numerous environmental advantages, but it is necessary to pay attention to the origin of electricity, i.e. how it is created. From information still 2019, 84.3% of the energy consumed comes from fossil fuels. It is clear that almost all energy for transport is drawn from fossil fuels, primarily oil and its derivatives. According to Our world in data, 2019, 63.3% of the electricity produced is based on fossil fuels. Road transport is responsible for 22% of total CO2 emissions, a record 40% of NOx and 12% of particulate matter (PM10 and PM2.5). Some countries are developing energy systems that pollute less or do not pollute the environment at all, thanks to renewable energy sources. This paper presents a comparative analysis of air pollution from vehicles with ICE and electric vehicles. However, electric vehicles are still not widely available, i.e. their use is lagging behind forecasts. It is estimated that in 2020, 6.8 million electric vehicles were in use worldwide, of which 3 million (44%) began to be used that year, [1], [2]. It should not be overlooked that in parallel with the development of electric vehicles, ICE are also being improved and the production of cheaper fossil fuel vehicles is increasing. This situation slows down the growth of the number of electric vehicles. However, it is still predicted that electric vehicles will become dominant in the near future. At this point, it is assumed that about 63% of residents of developed countries are interested in switching to an electric car (Union of Concerned Scientists, 2019). The main reasons why interest is not greater are the high price of electric cars, the small distance (km) they can travel on a single charge, and the long battery charging time (h).

This paper will examine the main problems with electric vehicles. The impact of electric vehicles on the environment will be shown, by comparing them with conventional ICE. Different vehicle models and different countries are compared. The impact of direct and indirect effects is examined using the Climobile App application of the Luxembourg Institute of Science and Technology.

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## II. MAIN PROBLEMS IN THE DEVELOPMENT OF ELECTRIC VEHICLES

### A. High initial cost

It is estimated that in the United States the price of electric cars should be around $36,000 (Castrol, 2020) to increase their sales. The prices of the 3 best-selling electric cars are in that range: 1. Tesla Model 3 - $38,000, 2. Chevy Wolt - around $32,500, 3. Nissan Leaf - around $32,500. The Automotive Engineering magazine writes that the cost of purchasing an electric car in the United States is on average about $12,000 higher than that of conventional cars. Taking into account operating and maintenance costs, an electric car is certainly a more profitable investment. However, the initial difference is still too large for a larger number of buyers to opt for an electric vehicle. Greater sales of electric vehicles would cause more mass production, and thus a reduction in their price. This leads to the "chicken and egg" problem, where it is not yet possible to reduce the price to increase sales, and sales are not growing due to the high price. The majority of owners own new electric vehicles. With the increase in the number of vehicles, the number of used vehicles on the market is also growing. In the coming years, an increase in the number of used vehicles can be expected, and with it the purchase of an electric car at a lower price. The most expensive part of an electric vehicle is the battery. Leading companies have been successfully fighting this problem in recent years and have succeeded in significantly reducing the price of the most expensive component. In 2013, the average battery of a Tesla car cost $ 668 / kWh, which means that it was worth 2/3 of the total price of the car. By 2020, the price of the battery had fallen to $ 137 / kWh, and today it is estimated to be around $ 100 / kWh.

### B. The problem of charging electric cars

Electric car manufacturers have found through research that buyers want to charge their car batteries from 0-100% in 31 minutes (Castrol, 2020). This poses a real challenge for manufacturers, considering that some models still do not have fast charging capabilities. For example, Chevrolet will only launch a fast-charging model in 2021, which charges the battery only up to 38% in 31 minutes. Nissan has a model with better performance, so it charges the battery up to 62% in the same time. The Tesla Model 3 has the best charging, up to 83% in ideal conditions, with the fastest supercharger model. However, this only allows for a range of 315 km. In colder weather, the charging time increases and the range decreases.

For the mass use of electric cars, it is necessary to provide widely available fast chargers that would meet the demands of drivers. Charging the battery at home is a serious problem. The Tesla Model 3 has a 50 kWh battery, which requires a powerful inverter for fast charging, which is practically impossible at home. There is a 7.7 kW rectifier, a relatively inexpensive device with a standard connection to a home installation, but with it the battery can be charged from 0-100% in about 10 hours. If this charging method is compared to refueling at existing stations for vehicles with ICE, it is clear that electric cars do not seem attractive for long distances. In order for electric cars to become more competitive, an adequate solution must be found for charging their batteries. A 250 kW inverter, which would charge the battery in about 30 minutes, is available on the market and costs about $ 57,000. It is impossible to expect individual users to accept such an expensive solution, let alone the significantly lower costs for the accompanying equipment that electric cars require. For the mass use of electric vehicles, a large number of widely available fast chargers are needed. States are not yet interested in such investments, and it must be noted that this is related to the development of electrical sources and the network. Electric car manufacturers are trying to help solve this problem, but they cannot do it alone. Tesla has provided its customers with a station with 6-8 fast chargers with a power of 120-150 kW, but it costs about $ 250,000. The closest equivalent of a Volkswagen station for the American market would cost about $ 350,000 (Electrify America, 2020). The properties of the batteries themselves are an additional problem when charging them. In lithium-ion batteries, the charging speed is not constant, as in all batteries, but depends on the degree of charge of the battery. At the beginning, 0-20%, the charging speed is much higher than at the end 80-100%. The charging speed does not depend directly on the power of the station, but on how much electricity the battery can accept. These battery properties show that it is more useful to charge it from 0-50% and drive it until it is empty, than to charge it from 0-100% and drive it until it is empty. A higher power of the charger does not mean a faster charging of the battery, especially at the beginning, so the charging times do not vary significantly for 150-250 kW chargers. Therefore, the number of fast chargers is more important than their power, but it is also a significant problem considering the cost of fast chargers. The average US resident lives 4 minutes from a liquid fueling station, and 30 minutes from a Tesla fast charger station. In order to achieve fast chargers within 5 minutes of the user, in addition to the existing 1000, another 30000 fast charger stations need to be built, which would cost about 8 billion dollars (Tesla, Inc., 2017). This leads to a situation in which sales of electric vehicles do not grow due to an insufficient number of fast charger stations, and the number of stations does not increase due to insufficient sales of electric vehicles, which is another "chicken and egg" problem.

In addition to the above, there is also a struggle in the market between different manufacturers of electric vehicles, which results in incompatible chargers for different vehicles. Tesla chargers have their own connector, and can also use the J1772 connector. With a special accessory, they can also use the CHAdeMo charger connector. There is also a 4th (fourth) type of CCS connector, with which Tesla cars are not compatible. The total number of chargers in the US could be sufficient if the problems of different chargers were overcome, but the struggle of different manufacturers for a monopoly leads to additional complications for users. In the EU this problem does not exist, because the CCS model is the standard.

C. The problem of energy storage

If we compare the energy potentials of liquid fossil fuels used to power conventional vehicles and the battery in which electricity is stored to power electric cars, a clear difference is noticeable, to the detriment of the battery. Existing technologies for storing energy in batteries are not efficient enough. Batteries are too large in volume and too heavy in relation to the stored energy and cannot compete with liquid fossil fuels.

For example, 1 gallon (3.78 l) of gasoline has an energy content of 33.7 kWh (8.9 kWh/l), according to the US Environmental Protection Agency. In a 2018 study that included 8 different manufacturers of lithium-ion batteries [1], [3], it was determined that the best existing battery cell used in cars stores 684 Wh/l, i.e. 13 times less than gasoline. If we take into account the supporting structure, cables and the battery cooling system, it becomes clear that liquid fossil fuels are superior in this aspect compared to batteries.

An even bigger problem for electric car manufacturers is the mass of the battery. Using the previous data, it is easy to conclude that 1 gallon of gasoline has a mass of approximately 2.7 kg with an energy density of 12.48 kWh/kg. The most efficient battery has an energy density of only 240 Wh/kg, which is 51.67 times less than gasoline, considering only the battery cell, without additional necessary equipment.

D. Car range (Distance traveled on a single battery charge)

In 2018, electric vehicle manufacturers, through a survey of users, came to the conclusion that at least 470 km should be traveled on a single charge. The Chevrolet car traveled 417 km, the Tesla Model 3 traveled 381 km, while the Nissan traveled 240 km. For short-distance driving, electric car users would have no problem. So, with a home battery charge in about 10 hours, at least 240 km could be covered. When it comes to driving longer distances, traveling with an electric car requires much more planning, taking into account the density of fast chargers. It is easy to conclude that 2 parameters are dominant for the range of the car: charging time and battery capacity. The forecast is that these parameters will improve, so the range of electric cars is expected to increase. But this will inevitably increase the price of electric cars. Today, some more expensive Tesla models exceed a range of 650 km.

## III. ANALYSIS OF ELECTRIC CARS FROM AN ENVIRONMENTAL ASPECT

The benefits of using electric vehicles are often overestimated in terms of reducing pollution of the human environment. The general conclusion is that even in the most favorable scenario for the rapid introduction of electric cars, the effects of reducing emissions of greenhouse gases, i.e. improving air quality, will be minimal in the next decade. When considering the effects that vehicles have on the environment, it is necessary to include a large number of parameters, but also to fully analyze the environment for the alternative solution. The amount of pollutants that will be emitted is affected by the type of vehicle, its systems and parts, driving conditions, the type of terrain and road, driving speed, the age of the vehicle and its individual parts, the type of fuel, as well as other factors that are difficult to perceive and valorize in full. Currently, the effect of vehicles on the environment is seen almost exclusively through air pollution, but the impact on water pollution during the extraction of liquid fossil fuels is also significant, as is the pollution of the land due to the leaving (burying) of various substances that are inevitable during the production of vehicles, fuel fuels and other raw materials that are necessary for their use. When using electric vehicles, the greatest pollution is expected during the mining of lithium and other raw materials needed for batteries, as well as during the disposal of batteries after use.

We must remember that a large part of electricity is produced by burning fossil fuels, coal, fuel oil - oil and gas, which also causes negative effects on the environment, i.e. the source of pollution is moved from roads and streets and concentrated at the location of the power plant. It should be noted that not all fossil fuel power plants pollute equally. Coal-fired thermal power plants pollute the most, liquid fuel plants less, and gas-fired plants the least. Even with coal-fired power plants, there are differences, depending on age, country of production, technology. In our country, coal-fired power plants pollute the air more than those in the developed world.

Although renewable sources of electricity, hydroelectric power plants0, wind turbines and photovoltaic sources, are considered ecologically clean sources, they still have negative impacts on the environment. Hydropower plants cover the land with water and destroy especially low-growing forests, endanger animals and their habitats, pollute the water, prevent fish migration (in our country, the eel is disappearing), etc. Mini and micro power plants further destroy the ecosystem of rivers. Wind turbines and photovoltaic power plants often take away useful agricultural land, which should not be allowed as harmful, although it reduces investment due to the more favorable infrastructure in the plains. For such sources, hilly and mountainous terrain with infertile or less fertile soil should be used, although in current cases, there is a disturbance of the flora and especially the fauna in the environment.

In order to draw conclusions about the pollution caused by road traffic, this section analyzes the production of electricity and the exploitation of fossil fuels, as well as pollution during the production of vehicles.

### A. Energy needs and electricity production in North Macedonia

North Macedonia is in the penultimate place in Europe in terms of energy consumption. Energy consumption per capita is more than 2 (two) times lower than the European average. In 2022, energy consumption per capita in our country was only 1.3 toe (1 toe = 1616 kg coal = 954 kg gasoline = 11.63 MWh), which is 58% below the European average, including 3200 kWh (44% below the European average). The country's energy needs for 2024 are estimated at 2750 ktoe, [10], [11], [12], [13]. Transport is the sector with the highest consumption at 35%. All liquid fossil fuels, as well as gas, are imported, as there are no domestic sources.

According to the 2021 census, North Macedonia has a population of 1,836,793, and the number of families is 559,418. They use 477,820 cars, 44,400 trucks, 6,300 tractors and 2,900 buses, [14]. Almost all vehicles (over 99%) are equipped with ICE. The railway is poorly developed, is in a major crisis and is rarely used. The use of gas in road transport is negligible. In 2018, 535,000 t of diesel and 120,000 t of gasoline were consumed. Assuming that the average energy value of liquid fossil fuels is 8.92 kWh/l, according to the fuel consumed in 2018, 5893 106 kWh were used in road traffic, [15],[16].

Electricity production in the country is mainly based on the use of lignite with a calorific value of 5500 kJ/kg. There are 3 (three) units x 225 MW = 675 MW in REK Bitola. In

Table.1. Average emissions of harmful gases from coal-fired power plants in the EU and the Western Balkans

| Air pollutant | EU (t/MW) | Western Balkans (t/MW) |
|---|---|---|
| Sulfur dioxide $SO_2$ | 4 | 82 |
| PM particles | 0.2 | 3.3 |
| Nitrogen oxide $NO_x$ | 3.9 | 9.5 |

In recent years, North Macedonia has become a leader in the Western Balkans in the introduction of renewable energy sources, [17]. Photovoltaic plants with an installed capacity of over 400 MW are already in operation. The installed electrical power in mini (1-10 MW) and micro (up to 1 MW) is estimated at 130 MW. About 75 MW have been installed in wind farms. However, it must be noted that the power of all vehicles in our country is about 10 times greater than the installed power of all electrical sources. This means that a rapid transformation of conventional vehicles into electric ones is impossible. New sources of electricity are necessary to replace conventional vehicles with electric ones. Creating a network of fast chargers, competitive with liquid fuel stations, is a priority task, primarily because of the foreign drivers passing through the country, but also because of possible domestic users.

B. Pollution in the production of lithium batteries

The main element of the battery of the electric battery is lithium (Li), the lightest of all known metals, which accounts for about 8 kg. In addition to lithium, the average battery contains 35 kg of nickel (Ni), 20 kg of manganese (Mn) and 14 kg of cobalt (Co), according to data from the American laboratory Argon. Lithium is also used for batteries of mobile phones and laptops. With the increase in the application for batteries of electric vehicles, its price is increasing. The largest lithium mines are located in South America, China and Australia, where it is heavily exploited, [5], [6]. The world's largest lithium mining company is known for destroying ecosystems around the world, and even for causing civil wars. Mining lithium has consequences for the ecosystem and can directly threaten human life and health. The environment is polluted primarily by toxic waste tailings, but also by the fumes of aggressive acids used in lithium processing. The production of 1 t of lithium requires about 1900 t of water. The scenario of ecosystem destruction has already been seen in Papua New Guinea, Namibia, Madagascar, Cameroon, Indonesia and other countries, during the mining of the ores needed for the battery. In Nevada, USA, it has been determined that the processes of ore processing have an impact on fish up to 250 km downstream from the mine. (As a reminder, in our country these are distances in the east-west and north-south directions). Cobalt, the most expensive element of the battery, is also a big problem, which is also toxic if not handled properly. In addition to mining the elements needed for the battery, its use can also have negative consequences. Proper handling of the battery is necessary, and in particular, care must be taken with their disposal after use. Used lithium-ion batteries react with certain substances and can cause a fire.

The production of a conventional car generates about 8 t $CO_2$ eq, similar to the production of an electric car without a battery. When greenhouse gas emissions from battery production are added, the total emissions are about 15 t $CO_2$ eq, [7]. It turns out that the greenhouse gas emissions from battery production are almost equal to the emissions from making the car.

C. Pollution from fossil fuel extraction

It is correct to analyze the pollution from the production of electricity for electric vehicles, in comparison with conventional vehicles, to consider the pollution from the extraction of fossil fuel.

Oil is usually found 1800 m underground, and is extracted by pumps on oil platforms, which usually uses electricity worth 120,000 kWh/year. That is the amount of electricity that would drive a Tesla Model 3 673,000 km. In the US alone, there are about 435,000 such oil platforms, and they consume enough electricity to power 15 million electric cars for the same period of time. It is clear that this is an exceptionally large amount of electricity, which is used only to extract oil from the ground. Diesel generators are used to extract oil from the sea to provide electricity. An inevitable problem with extracting oil from the sea is its occasional spillage into the water, which destroys the ecosystem. Oil transportation is also a complex, expensive and polluting process. Ships for transport also use highly polluting fuels. It is estimated that oil transportation emits 100x106 t $CO_2$/year. The next step is oil refining, which also causes pollution and requires a significant amount of electricity, especially in cities and settlements close to humans. Finally, the refined fuel must be transported to liquid fuel stations, which is also a polluting process. The extraction, processing, and use of liquid fossil fuels for EVs is a dirty technology that significantly pollutes the environment at every stage of the process. If these enormous amounts of energy were used to power electric cars, the environment would be much less polluted.

D. Recycling of used batteries

To meet the projected market needs in the coming years, it is necessary to mine huge quantities of metals. In parallel with the increased demand for metals, the end of the life of used batteries is coming. Mining metals at the beginning and disposing of batteries at the end of use cannot continue indefinitely. For a sustainable system, it is necessary to establish an efficient recycling process for used batteries, [8]. However, a major problem is that recycling metals from lithium-ion batteries is now a more expensive process than mining metals. Therefore, due to the unprofitability of recycling, a solution is often sought in making new batteries. In such a case, used batteries are simply disposed of and become a dangerous source of environmental pollution. Lithium-ion batteries are also composed of phosphates, aluminum, copper, graphite, various types of harmful salts, and plastics, which are extremely harmful to the environment. To solve these problems, it is necessary to include new technologies and agreements between countries. The technology of developing lithium-ion batteries is well on its way to eliminating cobalt and nickel from the battery composition and to improve the recycling process.

The essence is to reduce or completely eliminate the participation of toxic and expensive metals and thus reduce the cost of recycling. By overcoming this problem, materials will be used more efficiently, the need for ore mining will be reduced and the use of electric cars will be facilitated.

## IV. COMPARATIVE ANALYSIS OF AIR POLLUTION

To compare air pollution from the combustion of liquid fossil fuels in conventional ICE and from the production of electricity with dirty technologies, the Climobile App application is used. This application was developed at the Luxembourg Institute of Science and Technology in 2019. and is used to compare the $CO_2$ eq emissions produced by a conventional car with an internal combustion engine powered by liquid fossil fuels and the electricity required to power an electric car, [1], [9]. The application allows the user to select the model of the conventional car with an internal combustion engine, the model of the electric car, the battery life of the electric car and the method of production of the electricity used by the car. It is possible to adjust several other relevant parameters.

For the EU and US countries, the method of production has already been defined, so only the country in which the battery is charged can be selected. For the remaining countries, the method of production of electricity can be selected, namely: biomass, coal, gas, geothermal sources, hydropower, nuclear energy, oil, solar panels and windmills, without the possibility of selecting more than 1 (one) source with the idea of making a comparison between the different sources. It should be commented here that in reality the source of electricity is combined and a real selection cannot be made. As an output, the user receives data on: the average range of the electric car, the amount of electricity required kWh/km, greenhouse gas emissions from the production of electricity with the spatial arrangement of the charging stations, and as the most important data the amount of CO2 eq/km from the conventional car and the selected source of electricity. For conventional cars, data is provided according to NEDC (New European Driving Cycle), which is a theoretical value, but also data on real emissions, which are mainly slightly higher values obtained with the calculations of ICCT (International Council on Clean Transportation), [9]. Each of the listed types of exhaust gas measurements has positive and negative sides and can be applied for different purposes. Laboratory tests refer to testing the car with dynamometers, as force measuring elements. The dynamometers simulate operating conditions according to a predefined test cycle, for stationary and dynamic conditions. All gas emission values displayed by the application are values that the vehicle emits over its entire life.

A. Comparative analysis of air pollution by different vehicle models

In this section, Table T.2 presents the results of comparing conventional cars with ICE and electric cars (E) from the same manufacturer, as well as similar cars from different manufacturers. The aim is to compare as similar car models as possible, with an emphasis on the pollution caused by ICE and the pollution from the production of electricity used by the car. Since the way in which the electricity is obtained to power the car is important for such calculations, the example of Germany is used in these comparisons. The origin of the electricity produced in Germany in 2019 is from the following sources: 47.3% from renewable energy sources, 39.6% from coal and gas, 13.1% from nuclear power plants (Deutsche Welle). The NEDC values represent laboratory conditions, and the real-world values are closer to actual emissions, [1].

Table 2. Comparative analysis of gas emissions of ICE and E cars

In Table 2: Model, Range and energy, EE and emissions

| model | km | km | kWh/ km | gCO2/ km | NEDC/ p |
|---|---|---|---|---|---|
| Reno Fluence 1.5 dCi 2015 MBC | 200000 | | | | 177/ 223 |
| Reno Fluence ZE 2015 E | 200000 | 176 | 0.119 | 73.1 | 119 |
| Toyota Aygo 1.0 2017 MBC | 200000 | | | | 141/ 178 |
| Reno ZOE 2017 E | 200000 | 285 | 0.137 | 84 | 138 |
| KIA Soul 1.6 2017 MBC | 240000 | | | | 178/ 228 |
| KIA Soul EV 2017 E | 240000 | 201 | 0.127 | 78.3 | 135 |
| Mercedes C-63 AMG 2017 MBC | 400000 | | | | 236/ 311 |
| Tesla Model S 100D 2017 E | 400000 | 600 | 0.158 | 97.3 | 150 |
| Volkswagen Up 1.0 75 2017 MBC | 240000 | | | | 148/ 189 |
| Volkswagen Up e 2017 E | 240000 | 152 | 0.117 | 71.9 | 104 |

The results of the comparison of gas emissions (last column in T.2) in the considered examples are different and require comment. In the Reno Fluence model, the electric version emits significantly less pollution, and it is similar with the KIA Soul and Volkswagen Up models. In the higher-class cars, the Mercedes C-63 AMG and Tesla Model S 100D, the electric version emits almost half as much pollution. The results for the Toyota Aygo 1.0 and Reno ZOE are surprising, where the difference in pollution is almost negligible, especially for laboratory conditions. However, it is obvious that the pollution from electric cars in the considered examples is lower, taking the model for electricity production in Germany from renewable sources in the highest percentage of 47.3%.

B. Comparative analysis of air pollution in different countries

For the comparisons in this section, the car models Skoda Citigo 1.0 2017 ICE and Skoda CITIGOe iV 2020 E were used. Newer car models from the same manufacturer were taken, for a better comparison of pollution in countries from Europe and North America. The life span is set to 240,000 km. In table T.3, the second column shows the percentage of electricity obtained from non-renewable sources for each country. The third column shows the emission of polluting gases during the production and distribution of electricity. The fourth column shows the emission of polluting gases per km of the electric car.

Table 3. Comparative analysis of pollution from electric cars in different countries

| Country | EE non-renewable 2019% | EE emissions gCO2/km | Emissions/km gCO2/km |
|---|---|---|---|
| United Kingdom | 79 | 101 | 139 |
| Germany | 40 | 99.3 | 137 |
| Norway | 3 | 5.01 | 38 |
| Slovenia | 32 | 51.8 | 87.3 |
| Serbia | 68 | 94 | 131 |
| Wyoming | 87 | 150 | 190 |
| Vermont | 10(2018) | 4.84 | 37.8 |

The countries were selected to reflect the differences in electricity generation and the impact on electric vehicle use, from Norway, which uses a lot of renewable energy, to Wyoming, which uses a high percentage of non-renewable energy. The results clearly show that states that generate more electricity from non-renewable sources have less potential benefit from electric vehicles. The results for greenhouse gas emissions are proportional to the share of non-renewable electricity sources, mainly from fossil fuels, primarily coal.

## V. CONCLUSION

The aim of this paper is to objectively present the characteristics of electric cars. They are probably overestimated in their potential for improving the environment. Electric vehicles are not completely environmentally friendly. Improvement from an environmental perspective is primarily related to the development of the battery. Battery production must become more efficient, by reducing the number of materials and their environmental hazard, and thus decreasing their mass, accelerating charging and extending their lifespan. Electric cars usually pollute the environment less compared to conventional cars. The benefits of their use are also seen in the increase in the distance traveled, i.e. longer lifespan. It must be taken into account that their technology is at the beginning of development, while conventional vehicles with ICE have a development history of more than 1 (one) century. Here it is very effective to recall what ICE vehicles looked like 100 years ago, which would be analogous to today's level of development of electric cars.

It is very important how the electricity needed to power electric cars and for any application in general is obtained. The share of renewable sources of electricity must be increased, as the Scandinavian countries are an example.

The automotive industry for both electric and conventional vehicles must strive for technologies to reduce greenhouse gas emissions. This is the main priority to stop global warming and save planet Earth.

The Republic of North Macedonia has no chance of reaching 50% use of electric cars in the near future of 10 years. There are not enough electrical sources for that, of any kind. But therefore, intensive work needs to be done on public transport with electric vehicles in all urban areas. At the same time, it is necessary to improve rail traffic. And finally, but perhaps as a priority and most importantly, the network of fast charging stations for electric cars must immediately begin to be developed, for the needs of foreigners, but also as a necessary preparation for our users of electric vehicles.

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