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ENVIRONMENTAL POLLUTION DUE TO ROAD VEHICLES, ALTERNATIVE SOLUTIONS (ELECTRIC VEHICLES, HYBRIDS, BICYCLES) SUSTAINABILITY OF CROWDED CENTERS OF CITIES

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Abstract

Currently, the level of air pollution, especially in big cities, is above the allowed limits and this affects the health of the inhabitants and the environment. High levels of air pollution can cause a few respiratory and cardiovascular diseases. Based on these considerations, we draw attention to the major importance of research in the field of pollution, finding solutions to improve and minimize the negative effects of air pollution in general on the planet. Greater attention needs to be paid to actions to identify the sources of air pollution and its chemical composition, as well as to establish measures to monitor and improve the quality of the atmosphere. It is known that the level of air quality is influenced by the level of pollutant emissions. In the air we breathe, these emissions come from both stationary and mobile sources of pollution. Mainly road traffic, but also heating installations that use fossil fuels are the main suppliers of polluting emissions.
The rapid evolution of technology, as well as fierce competition from car manufacturers, is having an increasing impact on global consumption trends, and in the coming years, until 2025, several major changes are announced. Carbon dioxide emissions are expected to decrease due to fuel efficiency and the use of ultra-efficient hybrid cars. It is estimated that by 2025, almost a third of the car's carbon dioxide emissions will be reduced, so a natural question about the resource consumption of these cars will be higher or lower. Europe is made up of 50 states, in 31 of which natural gas, compressed or liquefied, is used as fuel for light or heavy commercial vehicles. According to studies carried out by the European Environment Agency, it has been concluded that the change in pollutant emissions is directly related to the speed of traffic. Thus, the carbon emissions increase 1.5 - 2 times during the acceleration / braking cycles and up to 25 times in the case of idling and the concentration of the emission of noxious substances increases in proportion to the speed.

Key words: *alternative transport, electric, environment, hybrid, pollutant emissions.*

INTRODUCTION

The atmosphere can be likened to a large chemical reactor that contains a multitude of chemicals. Among the anthropogenic activities, encountered mainly in urban areas, those that make a significant contribution to air pollution are industrial activities, means of transport, thermal power plants etc., which emit considerable amounts of pollutants into the atmosphere such as: suspended dust, carbon oxides, sulfur dioxides, nitrogen oxides. Dry air represents 99.964% of the total air. If water vapor is removed from the air, as well nitrogen, oxygen, argon, the remaining 0.036% air is the standard composition of the lower atmosphere and consists of carbon dioxide (0.0325%), neon (0.00182%), helium (0.000524%), methane (0.00015%), krypton (0.000114%), hydrogen (0.00005%). The other three dominant gases in the atmosphere are nitrogen (78.84%), oxygen (20.946%), argon (0.934%) (Green Paper 2007).

Today, the investigation of the level of air and environmental pollution is in a period of great interest because the problems related to urbanization and industrialization, negatively influence life in an increasingly aggressive way by increasing the level of pollution, by changing the climate, but also by multiplying extreme phenomena.

In the process of degradation of air quality, natural sources also contribute to some extent, but the major cause of environmental pollution are anthropogenic activities, more and more intense, namely industrial activities, means of

transport, thermal power plants etc., which emit considerable amounts of pollutants into the atmosphere, such as suspended dust and gases, mainly carbon oxides, sulfur dioxide, nitrogen oxides etc. (Development Strategy, 2014-2020; Preliminary Reports, 2015-2019; Ruscă, 2022).

MATERIALS AND METHODS

Solving the problem of air pollution in big cities is still a thorny issue even for experienced states. Reducing environmental pollution requires a multidisciplinary approach in which specialists in various fields must be trained: environmental protection, chemistry, specialists in the field of urban planning and landscaping, public health, police, environmental research, computer science, engineering, media, non-governmental organizations, etc. In urban centers where there are many cars, it is very important for the health of the inhabitants to reduce the pollution due to the cars. It is known that about 15% of the EU's CO_2 emissions are due to cars and buses, as well as other vans. The EU has passed a law to strengthen gas emission standards, introducing a CO_2 reduction target of 37.5% for new cars and 31% for new vans by 2030.
Two methods are mainly used to determine particles in the atmosphere, namely:
Gravimetric method - a pump draws from the ambient air a constant flow, in a special device where the particles are separated depending on the size; the filtered particles are then collected on a special filter which is then weighed; weighing takes place in a controlled environment in terms of temperature and humidity; the total volume of aspirated air is known, and by weighing and performing the difference in weight of the filter, before and after sampling (measured in µg/ m^3);
Optical methods - photometry is the part of optics in which the intensity of radiation sources is studied, as well as some quantities related to this intensity (luminous flux - Φ, intensity of scattered light, intensity of absorbed light). Photometers are composed of a sensor, which changes certain electrical properties under the action of lighting, placed in a suitable electronic circuit to detect those changes.
Particle analyzers - new generations, perform real-time measurements of aerosol fractions; The advantage of this device is that the model of this photometer combines the functions of a photometer with an optical particle counter; it records several dimensions of the optical particles and calculates their mass on several mass fractions measured simultaneously (Monitor Aerosol DUST TRAK).
The measurements on the level of air pollution caused by heavy traffic were made in the city of Alba-Iulia. Measurement areas have been established based on heavy traffic criteria and the importance of air quality in certain more special areas, such as near schools and hospitals.
To establish the air quality measurement points in Alba Iulia, we started from the idea of performing two stages of measurements: one in spring to summer and one in autumn to winter, to have different climatic conditions.
In both stages, the establishment of points with heavy traffic in the municipality was considered, as well as the establishment of measuring points with a high degree of impact, is sensitive areas for the population (schools and kindergartens, hospitals, agri-food market).

RESULTS AND DISCUSSIONS

The main pollutants found in the measurement areas are carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM_{10}, $PM_{2.5}$), sulfur dioxide (SO_2), volatile organic compounds (VOCs). The sources of these substances are different, as is the impact on human health, which makes air pollution a difficult and complex process to combat. PM_{10} is primarily caused by road activity, burns and fuel emissions, due to brake wear, tires, and the removal of anti-skid material from the road (Suciu, 2015).
We will present the results obtained in the two stages in which the values of the fine particles PM_{10} and $PM_{2.5}$ were determined for the chosen points, the analysis and interpretation of the results and finally the conclusions that can be drawn from these determinations.
The following conclusions can be drawn regarding the two stages in which 10 measurement points were established each time:
the average values of $PM_{2.5}$ suspended particles were 37.60 µg/m^3; the average values of PM_{10}

suspended particles were 34.70 µg/m^3; the mean value of volatile organic compounds VOC was 1.201 mg/m^3; the average value of the carbon dioxide was 570.60 ppm. These results can be seen in the Figures 1, 2, 3 and 4. The centralization of measurements are presentet in Tables 1 and 2.

Table 1. Centralization of measurements in the first stage

Measuring point	$PM_{2.5}$ µg/m^3	PM_{10} µg/m^3	COV mg/m^3	CO_2 ppm	Nr. Auto-vehicles
1	36	25	6.7	607	59
2	27	28	0.6	559	48
3	45	57	1.3	556	65
4	29	28	1.4	557	46
5	33	32	0.3	553	57
6	39	31	0.2	581	55
7	40	40	0.3	537	44
8	39	38	0.5	562	57
9	41	36	0.3	555	48
10	47	32	0.4	639	50
Average value	37.60	34.70	1.201	570.6	52.9

Table 2. Measurement summary in the second stage

Measuring point	$PM_{2.5}$ µg/m^3	PM_{10} µg/m^3	COV mg/m^3	CO_2 ppm	Nr. Auto-vehicles
1	73	95	6.4	608	74
2	72	93	9.0	686	73
3	68	90	4.1	448	68
4	66	82	3.1	448	64
5	45	48	0.2	445	48
6	46	39	0.2	597	-
7	45	45	0.2	399	-
8	43	44	1.6	415	48
9	45	42	0.2	405	-
10	68	87	1.4	562	63
Average value	57.10	66.50	2.62	501	65.3

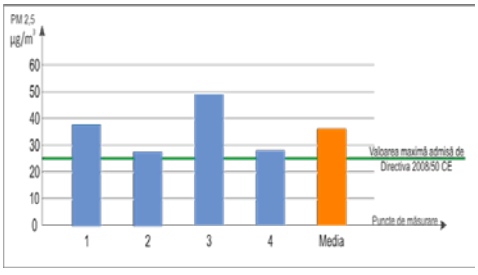

Figure 1. Representation of values $PM_{2.5}$ in the first stage

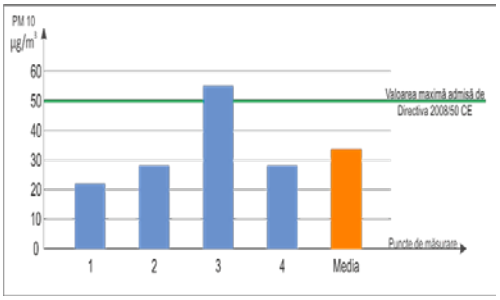

Figure 2. Representation of values PM_{10} in the first stage

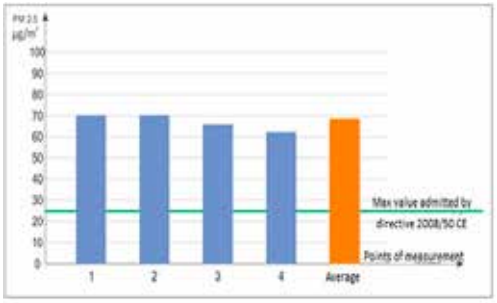

Figure 3. Representation of values $PM_{2.5}$ in the second stage

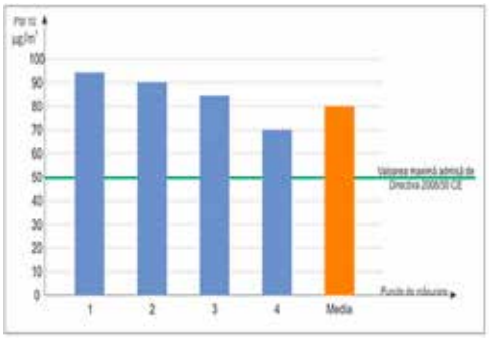

Figure 4. Representation of values PM_{10} in the second stage

It is found that even at this stage:
- the average values of $PM_{2.5}$ suspended particles were 57.10 µg/m^3,
- the average values of PM_{10} suspended particles were 66.50 µg/m^3,
- the mean value of VOC volatile organic compounds was 2.62 mg/m^3,
- the average value of the carbon dioxide was 501 ppm (Development Strategy, 2014-2020; Preliminary Reports, 2015-2019; Ruscă, 2022).

Alternative transport - benefits and necessity

Solving the problem of air pollution in big cities is still a thorny issue even for experienced states. Reducing environmental pollution requires a multidisciplinary approach in which specialists in various fields must be trained: environmental protection, chemistry, specialists in the field of urban planning and landscaping, public health, police, computer science, engineering, media, non-governmental organizations etc.

In urban centers where there are many cars, it is very important for the health of the inhabitants to reduce the pollution caused by the cars. It is known that the cars and buses, as well as vans cause about 15% of the EU's CO_2. EU adopts law to strengthen gas emission standards, introducing a CO_2 reduction target of 37.5% for new cars and 31% for new vans by 2030.

The main measures to reduce road traffic pollution in urban centers could be the following:

- reduction of road traffic through the locality;
- control of industrial pollutant emissions, as well as the establishment of clear rules on the accepted level of emissions from motor vehicles;
- develop and update local and regional action plans that set out the conditions to be taken to improve air quality;
- use of electric vehicles;
- use of catalytic converters;
- maintaining street cleaning;
- placement of sound-absorbing and sound-insulating panels.

The serious problem is that pollutants gases are eliminated very close to the ground, which leads to the achievement of high concentrations at very low levels, in the area of human respiration, even for these gases that have a low density and high diffusion capacity in the atmosphere.

From an environmental point of view, it is necessary to keep in mind that "alternative" fuel sources are not enough. Fuels must come from renewable sources if we want to have a viable transportation system. Among a wide range of options, the focus is on processed organic fuel, namely biofuels. They offer some gains to the transport sector. Car transport removes up to 50% of the number of hydrocarbons in the atmosphere, being considered the main pollutant with organic substances in urban areas (www. carbon solutions lobal.com). It is estimated that in the European Union, about 28% of greenhouse gas emissions are caused by transport, 84% of which come from road transport. Traffic in urban areas of the European Union accounts for more than 10% of carbon emissions. Pollution regulations are intended to reduce the polluting emissions of motor vehicles (Green Paper 2007; Tănăsescu, 2012; Vasile N., 2010).

Around 65% of the EU population is exposed to unacceptably high noise levels, mostly caused by urban traffic, causing discomfort and health problems (higher heart rate, mental and sleep disorders, hearing problems, stress, etc.) The energy sector will only halve the number of emissions needed to limit global warming by 2 degrees Celsius by 2050.

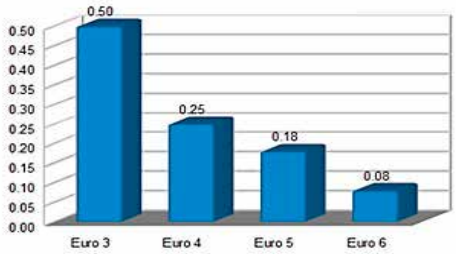

Figure 5. Emission limit of vehicles with diesel engines (g/km), https://www.e-automobile.ro/categorie-motor/19-diesel/140-adblue-motor-diesel-uree-scr.html

The EU must to improve energy efficiency and to promote renewable energy sources in order to significantly reduce CO_2 emissions, by 80-95% compared to 1990 levels, such that avoid catastrophic changes in the natural environment.

Around 98,000 electric vehicles were sold in EU during the year 2016. In 2020, at the level of the EU, a number of 538,772 electric cars were registered, which means an increase of 117.4% compared to 2019. In other words, the result translates as follows: one of 20 cars registered last year in the EU it was an electric one (Tănăsescu, 2012; Vasile N., 2010; Preliminary Reports, 2015-2019).

The electric cars are more efficient and more environmentally friendly, but their impact will depend on the way that electricity is produced.

If the electricity is produced by wind, solar or nuclear energy, carbon dioxide emissions will disappear, as a result air quality will improve and, in addition, the costs of producing electricity will be lower than those for the purchase of fuel (Figure 6).

Figure 6. Power supply stations
(https://cleantechnica.com/2012/08/26/solar-powered-electric-vehicle-charger-launched/)

Given that the purchase price of an electric car can exceed by more than 100% the price of a conventional car, whether it is petrol or diesel, it is unlikely that in the near future there will be a change in the perception of buyers.

A particularly important problem facing electric cars, apart from the high price, is their autonomy, which can reach a maximum of 500 kilometers (Tesla cars) under certain conditions, and the usual ones at a maximum of 100 kilometers.

However, the growth of the new electric car fleet in 2021 was a total success, with the number of new vehicles sold this year approaching the value of the national electric car fleet at the end of 2020 (Figure 7).

A number of 6340 vehicles were registered in total, of which 398 were used vehicles.

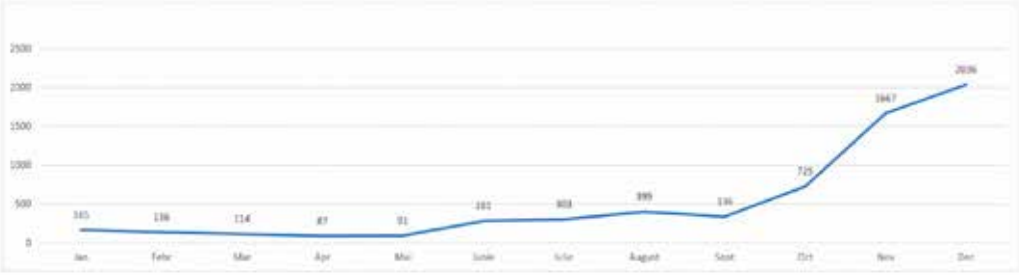

Figure 7. Romanian situation of vehicle registration in 2021
(https://electromobilitate.com/situatia-inmatricularii-autovehiculelor-electrice-noi-in-2021/)

On the other hand, many European countries want a major boost to the development of cycling infrastructure and will ban car access to central areas as an additional measure in its fight against road traffic pollution. The annual economic value of the benefits of cycling in the European Union has recently been calculated based on data provided by the European Cycling Federation.

At the European level, the manufacture of bicycles brings revenues of about 4.3 billion euros, their sale and repair generate transactions of almost 1 billion euros, and tourism and other small businesses also benefit from the use of the bicycle (Horizon 2014-2020; Green Paper 2007; Vasile N., 2010).

Furthermore, giving up cars, the citizens save fuel worth almost 3 billion euros. By increasing the proportion of walking, cycling, car sharing programs and by introducing mobility plans, work flexibility, training and awareness, the following benefits are obtained: less congestion in cities; low CO_2 emissions; increased skills and quality of life, productivity at work and a longer life; decrease in cases of obesity caused by inactivity, heart disease, health costs; avoiding new and expensive infrastructure by making full use of existing capacity; increasing job stability for employees. Authorities are encouraged to make the transition to renewable energy, improve public transport and manage their natural resources sustainably. In addition, these are encouraged to create the necessary conditions for sustainable and inclusive economic growth, social and cultural development, and the protection of the environment.

The transport policy aims to promote efficient and safe transport services, but also responsible in terms of environmental protection and social

implications. Under these conditions, all cities in Romania have the opportunity to switch to a green public transport. However, non-reimbursable financing comes with some requirements. In the case of the purchase of new vehicles, the existence of a public service contract between the operator and the competent authority is strictly necessary. In addition, the private companies carrying out local public transport must have a fleet of 50% of electric vehicles starting with 2020. In the explanatory memorandum, the parliamentarians also provided some interesting statistics, according to which, in the European Union, 28% of greenhouse gases are emitted by means of transport, and 10% of them come from urban traffic. Most cities in Romania will have to buy electric buses (Horizon 2014-2020; Vasile N., 2010).

Figure 8. Economic benefits due to the use of the bicycle (https://cyclingindustry.news/ecf-presentation-to-place-cyclings-economic-contribution-at-e1000-per-head-per-year-across-eu-28/)

Figure 9. Electric buses, means of transport in the future (http://europa.eu/!hd87pN)

Heliox a manufacturer of electric batteries, has combined decades of experience in power generation with environmental skills specific to today's era and has invented a fast-charging battery system for zero-emission public transportation. This great manufacturer saw the potential for a sustainable solution and built an innovative technology that could charge an electric bus in just 2-5 minutes, an invention that creates the premises for a non-stop public transport system with zero emissions and fully powered by renewable energy. The manufacturer has developed integrated electrical networks for trucks. These systems will supply green electricity to the refrigeration system of goods, to increase fuel efficiency and reduce emissions during long-distance travel in the EU. From our point of view, the monopolization of the market with electric vehicles would significantly reduce the impact that the transport activity has on the environmental factors. This would substantially reduce greenhouse gas emissions, as those caused by road transport account for 84% of total emissions from transport activity.

The need for electric and hybrid vehicles

It is not a novelty that in our country most of the electricity is produced by thermal power plants, which is a major disadvantage, because to charge our car, we will pay a really high price. The LPG system outperforms petrol and diesel cars, but electric cars are the future of the automotive industry; the road to production at a reasonable cost and with minimal impact on the environment is quite long. Based on these realities, we believe that at the moment the best solution is to buy a petrol car, which we will later equip with LPG, and thus we have a more environmentally friendly vehicle, which ends up eliminating around 100 grams of carbon dioxide per kilometer, instead of 150 grams per kilometer, as it produces in the classical system. Hybrid engines (thermal engine + electric motor) combine the advantages of both thermal and electric motors and can be designed to achieve different objectives: low fuel consumption or high dynamic performance. A car with a hybrid propulsion system maintains and even increases the autonomy of a classic car with thermal engine. In the case of a hybrid car, the heat engine is designed to run optimally in terms of consumption. Also, the kinetic energy during the car's braking (mechanical energy) is

recovered (electricity) and stored in batteries (chemical energy) for later use. In situations where strong accelerations of the car are required, the electric motor can assist the thermal engine for a short time when the car leaves the place, the propulsion is purely electric, and while the car is parked the thermal engine is stopped, to avoid unnecessary consumption of fuel during idling (idling). The main disadvantage of hybrid cars is the high price, well above the level of a conventional car with similar consumption and dynamic performance (Green Paper 2007; Vasile N., 2010; www.e-automobile.ro).

Electric cars are powered by electric motors, powered by electricity stored in batteries.

A peculiarity of electric motors, used for the propulsion of cars, is given by the fact that they can also operate in generator mode. Thus, when braking or descending long slopes, electric cars produce electricity that is stored in batteries. The advantage of electric cars is the absence of pollutant emissions, quiet operation and lower maintenance costs. All these advantages are overshadowed by a number of disadvantages: high price (mainly due to the battery) and low battery life. A large proportion of electric cars (and a growing number of combustion-engine cars) have braking energy regeneration systems, which convert the energy lost during braking into electricity. A major increase in the future use of these systems is expected.

Benefits

1. Consumes little fuel - 0 l/km, even when running on range extender - 6.5 l/100 km (petrol).
2. They have a phenomenally fast start due to the torque available fully instantly in electric mode.
3. Overtaking is done very quickly also due to the torque.
4. The feeling of floating on the asphalt.
5. The electric cars are silent.
6. You don't pollute the city, even if you still don't save the planet. But you breathe easier, and as electricity is produced from renewable resources, you really become “eco”.
7. The heating systems run very fast; they do not depend on the engine heating.
8. Reliability - electric motors are much simpler than combustion engines.
9. The electric cars are a lower center of gravity; the roll is absent and you feel crank in short maneuvers.
10. Overall, an electric car is always fun, regardless of generation.
11. The great advantage of 100% electric cars (so powered only by electric motors, powered by batteries, without other auxiliary propulsion systems) is that they do not pollute during operation. This also applies to cars that use hydrogen, because during operation such a car only removes water vapor.

Disadvantage

1. They lose value quickly because they age quickly - the autonomy doubles every 4 years, the SF interiors yesterday are gone today, and the autonomy of the old batteries decreases from year to year.
2. The autonomy of electric cars is still low to be the only family car.
3. They are generally heavy machines, if they are not built from scratch as electric machines (i3 gets rid of this shortcoming).
4. They are rigid, which can affect comfort.

In the case of electric batteries, the most polluting part of current lithium-ion technology is the extraction and processing of lithium. In the worst case, we could say that this component is equivalent, in terms of pollution, to the production of fossil fuels. In other words, the electricity needed for batteries is slowly but surely becoming more and more "green", meaning that it is becoming less and less polluted for its production. It is known that in the case of an electric car, almost half of its price is attributed to the propulsion system, of which the largest share of the cost is the battery, while the electric motor and other electronic components (especially the inverter) are more expensive. However, the decline in production prices is dizzying compared to conventional propulsion technologies, and electric cars are rapidly becoming competitive. It's all about the low energy density of current batteries, which leads to drastic limitations on battery life. In principle, most current electric cars offer a maximum range of 200 km (Tesla Model S is better, with up to 500 km of theoretical range, but we are also talking about a price 3-4 times higher than other electric cars). Charging from a normal 220V outlet

takes 6-8 hours, while special fast charging systems take 20-30 minutes, providing only 80% of the battery capacity.
In other words, today's electric cars are not suitable for long journeys, but only for short escapades (specific to commuting) or urban transport (Horizon 2014-2020; Vasile N., 2010; www.e-automobile.ro).

CONCLUSIONS

The values set to reduce the level of pollutant emissions provide for a reduction of about 40% by 2030 of pollutant emissions and the use of green energy in a percentage of at least 30%.
It is also necessary to implement and comply with standards for the level of particulate emissions with certain dimensions, also for ozone, sulfur dioxide, carbon dioxide, carbon monoxide nitrogen oxides, lead, VOCs and other pollutants which have a detrimental effect on human health or natural ecosystems.
There is a need to develop and update local and regional action plans that set out the conditions to be taken to improve the quality of the atmosphere.
Some low-emission areas should be established, restricting the access of vehicles with high levels of pollution.
Increasing the green surfaces within the localities by expanding the existing ones and creating new green spaces through the national program to improve the quality of the environment by creating green spaces in the localities, financed by the environmental fund.
The market potential of connected cars will increase in volume almost fourfold by 2023.
The development of new studies on smart cars, connected to the Internet, will dominate the car market in the next five years as an estimated 80 million new vehicles connected to the Internet by the end of 2023.
From the economic point of view related to pollution, in the short and medium term all electric cars would be 100% advantageous over hydrogen cars.
Smart cars, connected to the internet, will dominate the car market for the next 20 years. Estimates show that by 2025 there will be 38.6 billion networked devices, and by 2050 there are an estimated 50 billion connected devices, according to a study. The car industry is now working hard to develop internet-connected cars. Approximately 250 million vehicles connected to the network will already be on the road by 2025. In 2016, 12 million new vehicles were produced, which include these network functions, in 2020 their number reached 60 million pieces.
The market potential of connected cars will increase in volume and by the end of 2025 an increase of up to 100 million new vehicles is estimated to be equipped with such devices. By 2030, the network of connected cars could reach up to 115 billion euros, the largest growth segments would be the autonomous driving area, the safety zone (warnings of possible accident), as well as the one in the wellness area.
From an economic point of view related to pollution, in the short and medium term all electric cars are 100% more advantageous than hydrogen cars.
The degree of pollution of electric cars is closely related to the degree of pollution of sources of electricity, which is not equivalent to saying that "electric cars pollute more than conventional cars", because electricity does not come only from combustion fossil fuels, but also from renewable sources.
Urban pollution triggers symptoms of autism and schizophrenia, urban pollution is the trigger for many diseases, some of which can be fatal. Pollution in big cities also contributes to global warming.
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Pollution in big cities also contributes to global warming.

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