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The Role of Electric Vehicles in Reducing Air Pollution and Improving Public Health

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Abstract: As a greener and cleaner form of transportation, electric vehicles (EVs) are growing in popularity. Because EVs run on electricity rather than gasoline or diesel like conventional cars do, fewer hazardous gases are released into the atmosphere. In addition to being significant contributors to air pollution, these gases—such as carbon dioxide and nitrogen oxides—can cause substantial health issues like cardiovascular sickness, lung illness, and asthma. By converting to electric cars, we can reduce urban pollution and improve the quality of the air we breathe. This enhances people's general health and well-being, particularly for youngsters and senior citizens, in addition to protecting the environment. In this sense, electric cars are crucial to building a healthier and cleaner future for all. In addition, EVs assist minimize noise pollution because they run more softly than traditional automobiles. Additionally, they promote the use of pure electricity to power sources of clean energy like sunlight and wind power. We are getting closer to creating harmless and sustainable communities for coming generations as more individuals choose EVs.

Keywords:- Electric vehicles, air pollution, public health, clean energy, sustainable transport, noise pollution, renewable energy, harmless communities.

I. INTRODUCTION

The automobile industry has established itself as an important contributor in the field of research and development (R&D), as well as in the worldwide economy. As a result of ongoing technological advancements, cars now include mechanisms that put both parties' safety first i.e. pedestrians and passengers [1]. This has led to a growth in the number of vehicles on to the streets, providing with the comfort of rapid and joyful travel. However, this progress arrives at a cost. Sulfur dioxide (SO2), nitrogen oxides (NOX), carbon monoxide (CO), and particulate matter (PM) are among ecological contaminants that have sharply grown. In metropolitan regions [2].

It is critical to recognize the positives and negatives consequences that the automobile zone has had on our daily existence. Although technology has greatly enhanced electronics and shipping, but it has also contributed to the deterioration of the planet. As we move ahead, we must prioritize identifying measures to reduce the environmental damage caused by auto manufacturing. It is generally acknowledged that the world is becoming more and more vulnerable due to the availability of oil and greenhouse gas emissions. Regarding energy users, the shipping industry has the largest effect on the natural world as a whole, contributing more over 25% of the globe's energy consumption and greenhouse gas emissions.

Highway on roads accounts for about 70% of the sector's emissions [3, 4]. Nowadays, the concept of "attainable movement" is promoted as a remedy for the problems of waste reduction and oil reliance.[5]. EVs with "tank to-wheels" frequently outperform internal combustion engine-powered vehicles by a factor of three. (ICVs). Besides, sounds and vibration are minimized with electric autos [6]. Many countries are encouraging EVs because of their advantages and the pressing need to address climate change and energy stability. More than 275,000 plug-in electric vehicles (PEVs) are already on the streets statewide in the American States, a notable increase in PEV installation since 2011. In Europe, shipments of EVs have increased by two times yearly since they were first introduced to the market in 2010, and by 2013, there were almost 60,000 EVs sold. As of September 2021, more than 2 million electric vehicles had been sold in Europe [4]. Due to their high initial costs, long intervals for charging, and restricted range, EVs are less desirable to the average consumer. A different approach major barrier to the broad adoption of EVs is the scarcity of charging facilities.

II. LITERATURE SURVEY

One of the biggest environmental challenges in the world is air pollution, which is associated with major health concerns like heart sickness, strokes, and respiratory infections. The World Health Organization (2021) estimates that contact with dirty air kills roughly seven million people year, with car emissions being a major contributing factor, particularly in urban areas. Conventional gasoline and vehicles running on deisel emit a lot of harmful gases, including as greenhouse gases (GHGs), nitrogen oxides (NOx), Caarbon monoxide (CO), and particulate matter (PM), all of which are bad for the environment and human health. Electric vehicles (EVs) have become a viable substitute for reducing pollutants in the air in recent years. Since EVs do not emits tailpipe emissions, they do not emit any dangerous gases while they're in use[6]. According to a number of studies, switching to electric vehicles from conventional ones can greatly enhance the quality of the air. For instance, research conducted in the US and Europe has shown that cities with greater EV adoption have shown observable reductions in air pollution (Huang et al., 2021). Adopting electric vehicles throughout periods of extreme air pollution might potentially save numerous premature deaths, according to a study that predicted the consequences of EV use in China and was published in The Lancet Planetary Health (Zhang et al., 2021). According to a different analysis that appeared in Environmental Research, which looked at more than 50 research, the majority of them found that using EVs was associated with health benefits, such as fewer incidences of asthma and decreased medical expenses (Pennington et al., 2024). However, the electrical sources used to charge EVs also affect their positive environmental impact. The overall reduction in pollutants may be reduced if coal or other fossil fuels are used to generate the power. Therefore, experts advise that EVs should be used in conjunction with renewable energy sources like solar, wind, or hydropower in order to fully appreciate the health and ecological benefits (Breetz et al., 2018).

III. ELECTRIC VEHICLES

Electric vehicles (EVs) are a famous mode of public transit that has garnered a lot of attention lately because of their capacity to reduce dependence on petroleum and coal and release of greenhouse gases. An electric vehicle, as opposed to one that runs on gasoline or diesel, is driven by an electric motor that uses rechargeable batteries as electricity. The number of people using electric vehicles (EVs) is anticipated to climb thrice by 2030 compared to 2011. This is the result of innovations in battery technology and their effects on autonomous driving. One of the primary advantages of electric cars is their impact on the environment. The energy-related carbon dioxide emissions in the United States America, China, Europe and other Countries from 1983 and 2010 are depicted in Figure 1.

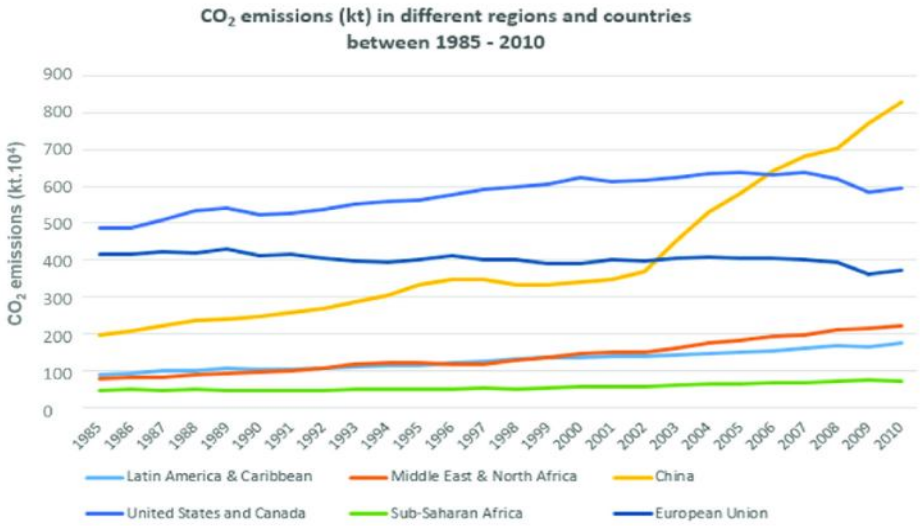

Fig 1- CO2 emission from 1983 to 2010 [7]

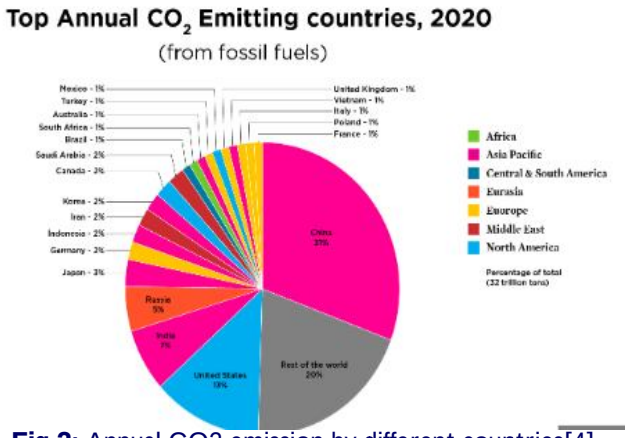

Fig 2: Annual CO2 emission by different countries[4]

Although both China and the US have seen an increase in the sales of electric vehicles, It is important to remember that a large number of conventional fossil fuel-powered cars are also in use in these nations. Furthermore, these nations' growing energy needs have resulted in a rise in the usage of coal, which is the main source of carbon dioxide emissions. Automobiles in terms of environmental impact and cost-effectiveness. EVs may initially cost more, but because of cheaper gasoline and less servicing costs, they can end up saving owners money over the years. EVs frequently last longer than traditional cars since electric motors need minimal upkeep and have lower working components. Consequently, the global adoption of electric vehicles is imperative[7]. In this regard, government subsidies are essential for boosting EV sales because they make them more accessible and inexpensive for the general population. China is a good example of this since the ruling parties has implemented a number of incentives and laws to promotes the use of EVs. These incentives have led to a surge in sales of electric car models, making China the most significant buyer of such cars globally. The global inventory of electrically powered vehicles, such as battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs),is shown by the nation in Figure 2. As seen in Figure 3, China also has the most public EV charging facilities.

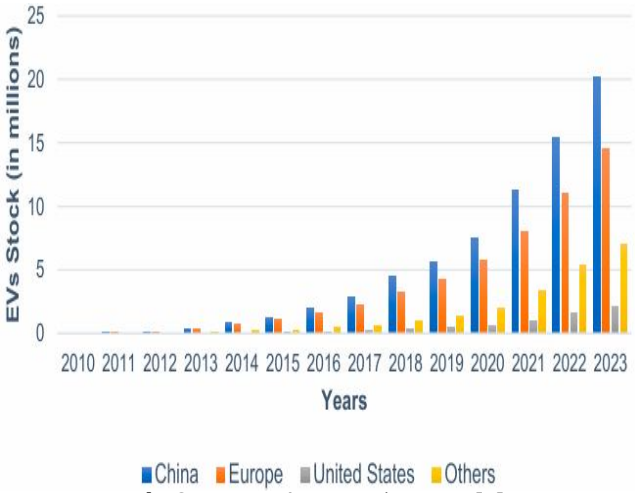

Fig 3- EV stocks over the years[8].

Vehicles powered by batteries (BEVs): The sole power source for BEVs, or electric cars, is rechargeable batteries. They lack a gasoline engine and an extra generators. BEVs are thought to be the most environmentally friendly vehicles because they don't emit any pollution, they are advantageous type of electric vehicle[9]. Nevertheless, since the battery needs to be recharged, their driving range is limited. Hybrid Electric automobiles: those vehicles using both batteries and gasoline engines are known as electric hybrids, or HEVs. The car is propelled at low speeds and during acceleration by an electric motor. At higher speeds and when more power is needed, the combustion engine takes over. HEVs do not need to be implemented in because they replenish their batteries via regenerative braking. They have some exhaust discharge even if they utilize lessen petroleum than previously used gasoline-powered vehicles. Plug-in hybrid electric automobiles (PHEVs) are electric hybrids vehicles (HEVs) with larger capacity batteries that can be re-charged simultaneously by their on-board internal ignition engine powered generator and externally by connecting a cable for charging to an energy source. When converting to a gasoline engine, they can only operate for a limited time on electricity. HEVs)[8]. Before converting to a gasoline engine, they can only operate for a limited time on electricity. Fuel cell electric vehicles (FCEVs) generate electricity by mixing hydrogen gas with climatic oxygen. Their one waste is demolished water, and they lack a power source. Even though FCEVs have a longest driving range than BEVs and can be refueled in a matter of hours or minutes, equipment for hydrogen tanks is still lacking.

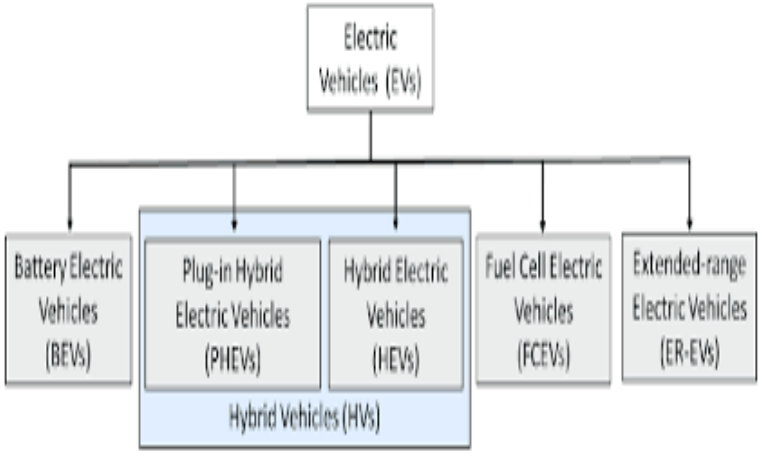

Fig 4- Classification of electric vehicles[5].

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IV.ROLE OF EVs IN REDUCING AIR POLLUTION

By lowering air pollution, electric vehicles (EVs) significantly contribute to the creation of healthier and cleaner surroundings. Since EVs lack tailpipes, they are unable to emit dangerous chemicals like carbon monoxide, nitrogen oxides, or particulate matter, in contrast to gasoline or diesel cars. These pollutants are recognized to have an adverse effect on human health, particularly on the heart and lungs, and are among the primary causes of air pollution in urban areas. We can lessen the quantity of harmful materials emitted into the atmosphere by utilizing EVs. In crowded cities where traffic is a significant source of pollution, this is particularly crucial. Asthma attacks and other pollution-related illnesses are less common when the air is cleaner. Children, the elderly, and those with pre-existing medical issues are also protected. The fact that electric cars emit fewer greenhouse gases is an additional benefit. These are the gases that contribute to global warming by trapping heat in the atmosphere[10]. Therefore, by moving to electric vehicles, we are slowing down climate change in addition to improving the quality of the air we breathe. Charging electric cars with electricity from sustainable sources, such as solar or wind, can make them even more eco-friendly. This lowers pollutants at all levels, from transportation to energy supply. To put it briefly, electric cars are a clever way to cut down on air pollution. They lessen the effects of weather change, contribute to the development of fairer and healthier cities, and guide us toward a more sustainable future.

IMPACT ON PUBLIC HEALTH

People's health advantages from switching from conventional fuel-powered automobiles to electric vehicles (EVs) are numerous, particularly for city dwellers. The decrease in air pollution is one of the main benefits. EVs contribute to the reduction of dangerous pollutants including nitrogen dioxide (NO□) and fine particles (PM2.5), which are known to cause major health issues, because they don't emit exhaust. Lung infections, bronchitis, and asthma are among the respiratory conditions that are less common when the air is cleaner. Additionally, it lowers the risk of heart disease, stroke, and even some cancers, all of which are associated with long-term exposure to air pollution. As a result, the population will be happier overall, see fewer hospital visits, and pay less for healthcare[11]. The greatest beneficiaries of better air quality are adults, kids, and those with underlying medical issues. These groups are frequently the first to experience the negative impacts of pollution in places with high traffic volumes. They live in a safer and healthier environment thanks to electric vehicles[12]. Because EVs run more silently than traditional cars, they also lessen noise pollution in addition to air pollution. It has been demonstrated that lower noise levels increase mental health, sleep quality, and stress levels all of which are critical for public health. Because they clean the air, lessen the risk of disease, reduce noise-induced stress, and enhance community well-being, EVs help to improve public health[13]. These health advantages will only increase as more people and governments choose electric vehicles

V. CHALLENGES AND CONSIDERATIONS

The infrastructure for charging: - Since Electric Vehicles related technologies are continuously evolving, it is unclear where they will go in the future. For example, the battery is one of the basic factor of affecting EV adoption and its performance, which has yet to reach its maximum level. Even with recent improvements in Despite improvements in amenities charging stations are still less readily available and more accessible than conventional petrol terminals. Because of this, EV drivers may find it challenging to locate electrical outlets when they need them, especially in distant places. Or on lengthy trips. Another unclear technological component is the rate at which batteries may be charged[14]. Drivers of electric vehicles may worry that they might run out of fuel before arriving at their destination because these vehicles typically have a lower driving range than conventional automobiles. Despite EVs' increasing span, some drivers, especially those who must travel great distances, yet still find it difficult. However, if the customer is able to schedule charging hours ahead of time, they will be informed of the available slots.

VI.RESULTS AND DISCUSSION

Based on the above discussion and studies, EVs have shown various benefits like:-

Improvement in Air Quality: Towns with greater EV usage have seen drops in air pollutants, particularly fine particulate matter (PM2.5) and nitrogen dioxide (NO□).

Benefits to Health: Asthma attacks, bronchitis, and other lung-related illnesses have significantly decreased as a result of lower air pollution.

Noise Reduction: EVs contribute to less noise pollution in cities since they operate more silently than conventional cars, which is good for stress levels and mental health.

Reduced Healthcare Costs: Expenses on public healthcare could be cut if there is cleaner air and fewer illnesses linked to pollution.

The research show that switching to electric vehicles can have a major positive impact on public health. EVs lessen the amount of dangerous pollutants that have an immediate impact on human lungs and cardiovascular systems by eliminating away with tailpipe emissions. In heavily congested cities, where transportation emissions are a major source of contaminants, the biggest benefits are observed. In addition to providing cleaner air, EVs' quieter operation lessens stress and sleep disruptions brought on by continuous traffic noise. For citizens, this improves their general quality of life and mental health. However, a number of variables affect how beneficial EVs are for your health. For instance, pollution is merely transferred from the roadways to electrical plants if coal or other fossil fuels are being used to generate the Electricity needed to charge EVs. For optimum effect, the transition to EVs must coincide with the growth of clean energy. Accessibility and affordability provide further difficulties. EVs are still too costly for the typical individual in many areas.

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To promote broader adoption, government assistance in the form of tax breaks, subsidies, and upgraded infrastructure, such as charging stations, is crucial. All things considered, the data shows that electric cars are essential for safeguarding and enhancing public health in addition to minimizing environmental harm

VII. CONCLUSION

When incorporated into smart cities, electric vehicles (EVs) can significantly improve urban settings by making them more efficient, sustainable, and healthful. EVs' minimal tailpipe emissions contribute to the reduction of air pollution, which in turn lowers the risk of heart issues, respiratory disorders, and other ailments linked to pollution. Even if there are still issues like expensive initial expenses, short range, and poor charging infrastructure, these can be resolved with the help of public awareness campaigns, private sector investment, and supporting government regulations. The development of smart grids and improvements in battery technology will increase the accessibility and convenience of EVs. Cities can benefit from cleaner air, less noise pollution, and a smaller carbon impact as EV usage increases.This shift encourages healthier, more habitable communities for present and future generations while also improving efforts to combat global warming.

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