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Preliminary Studies on the Environment Friendly Electric Vehicles - Are Electric Vehicles Really Greener

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Abstract

Natural resources have been overused and polluted over time, necessitating the use of renewable and environmentally friendly products. Electric vehicles are one of them. These take the place of cars that run on petrol. These are among the most important new technologies at the moment. But are they really as eco-friendly as they are marketed to be? The major goal of this paper is to determine whether or not electric cars are truly environmentally good over the course of their whole lives. To compile information and finish this particular work, a number of study papers that have already been released by renowned writers, journals, and websites were examined. After reading these articles, it became clear that electric vehicles are not at all environmentally beneficial; rather, when compared to regular gasoline vehicles, they produce higher emissions of dangerous greenhouse gases. The fact that electric vehicles produce no emissions from their tailpipes while they are in motion is well known, yet these emissions are already produced during the production and assembly of the vehicles as well as when they are being charged. These manufacturing facilities are already contributing to pollution on behalf of the electric industry since the industries where they are assembled and manufactured are powered by electricity, which is created by igniting fossil fuels such as coal. After an electric vehicle's life cycle is complete, disposing of the batteries can be a difficult issue because they contain potentially dangerous compounds for the environment. The primary solution is to power assembly plants and manufacturing facilities with clean energy such as renewable energy sources (solar and wind). This will have a significant positive impact. It will also make electric vehicles much greener and

better for the environment, if all charging stations are powered by clean energy sources. When these cars' lives are through, their batteries must not be thrown away but rather utilized for secondary functions in businesses and homes, solving the problem of battery disposal. For a quicker uptake of electric vehicles in the Indian auto market, the government has also announced a plan to install a large number of charging stations across the nation and offers subsidy programs like FAME. The future of transportation will thus be electric vehicles, but only if they are powered throughout their entire life cycle by clean and renewable energy sources.

Keywords: Electric Vehicles, Energy, Environment, Climate Change

1. Introduction

Electric cars are those that are propelled by an electric motor. Because they have fewer moving components to maintain, electric vehicles are more affordable to run than those powered by conventional fuels. They consume little to no fossil fuel, which makes them significantly more environmentally friendly (petrol diesel). Electric locomotives, metro trains, and trams can run on transmission lines since they have an electric motor. It is produced by a single connected battery or a network of connected batteries in electric bicycles and cars. Moreover, it can be produced using a fuel cell within the vehicle [1].

Electric motors are used to propel electric vehicles, while other storage devices such as rechargeable batteries are used to provide a steady power supply. These vehicles produce fewer greenhouse emissions, consume less energy, and significantly lessen the noise pollution brought on by moving automobiles. However, lithium-ion batteries are now regarded as the best in today's society. Some electric vehicles employ lead-acid or nickel-metal hydride batteries. With a self-discharge rate of only 5% in a month, they have a long lifespan and are excellent energy savers. Despite all of this increased efficiency, thermal runaway and other problems can still affect these batteries.

Following are the many electric car categories:

Hybrid Electric Vehicle HEVs: Vehicles with a combination of an electric motor and a gasoline engine that draw power from batteries are known as hybrid electric vehicles, or HEVs. The battery of a hybrid car must be charged through internal combustion engine and regenerative braking, not by plugging it in. The electric motor's added power may enable the use of a smaller engine

Plug In Hybrid Vehicle PHEVs: Given that an internal gasoline engine and an electric motor each power one of them, these are comparable to hybrid electric vehicles. They differ in size due to their enormous batteries and compact engines, which can be charged by connecting them to an external electric power source. Similar to hybrids, most plugged-in hybrid cars can go 20 to 40 miles on electricity alone before transitioning to a gasoline-only mode. The negatives of plug-in hybrid vehicles, such as the need for

maintenance, engine noise, and the cost of fuel and diesel, are the same as those of combustion-engine vehicles.

Battery Electric Vehicles BEVs: Since BEVs don't have internal combustion engines and only use electric motors to move, batteries are used as their energy storage system [2]. They depend on outside power sources for their needs. To give them a range adequate for the majority of excursions, battery electric cars can be charged overnight at home. Depending on the speed of the charging station and the size of the battery, the typical charging period might be between half an hour to twelve hours. Due to the fact that they don't require fossil fuels, they are extremely quiet and never get tired.

Over the past 10 years, the demand for electric vehicles has grown, and with new pricing models, it is projected that growth will be even larger. This shift to electric vehicles, and in particular to electric cars for private transportation, is viewed as a significant potential to both decarbonizes the transportation sector and to improve the air quality in heavily populated urban areas. We have had to change our transportation habits due to the rising cost of fossil fuels and the damaging consequences their emissions have on the environment [3]. Electric vehicles are gaining popularity in the industry that was previously powered by internal combustion engines. A quarter of greenhouse gas emissions are produced by the transportation industry alone [2]. China produces 29% of the world's greenhouse gas emissions, the USA 13.87%, and India 7.45%, all from automobiles [2].

Burning fossil fuels resulted in the release of 28,000,000,000 metric tons of carbon dioxide in 2005, which led to a rise in the atmosphere's gas content. The primary greenhouse gas is carbon dioxide, which traps long-wave radiation that would otherwise escape from the surface of the earth into space and raises the average surface temperature of the entire planet. More people are becoming aware of climate change as a result of recent temperature increases that have caused snow and ice to melt in the Arctic Ocean [4] and the massive Antarctic ice sheet to collapse in March 2008. As per [5] Burning fossil fuels like coal, petroleum, and diesel also contributed to acid rain because the sulphate and nitrate inherent in these fuels causes chemical reactions that result in sulphuric acid (H2SO4) and nitric acid (HNO3), which combine with rain and fall to the earth as acid rain.

India currently ranks fourth among the world's emitters of greenhouse gases. Only India's transportation industry accounts for all of the country's energy-related carbon dioxide emissions [6]. It is crucial to reduce automobile pollution in India because 13 of the 20 cities with the highest pollution levels worldwide are located there. 2008 saw the launch of India's National Action Plan for Climate Change (NAPCC), which acknowledges that adopting a sustainable strategy can reduce greenhouse gas emissions from transportation through a variety of actions, such as increasing usage of public transportation, increasing the use of biofuels, and improving the energy efficiency of transportation vehicles [1].

Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME), which gives subsidies for Electric vehicle production and upgrading infrastructure, is another initiative done by the Indian government. The reserves of fossil fuels like gasoline and diesel are depleting at an alarming rate and cannot be replenished. Nobody is hiding the growing ecological issues caused by pollutants from fuel burning. As a result, the industry's growth for electric vehicles has accelerated.

The transportation industry is mostly to blame for air pollution, with major worldwide cities' vehicle transportation adding significantly to the problem. Nearly one-fourth of all greenhouse gas emissions are produced by it. More than 70% of the greenhouse gas emissions from the transportation industry were attributed, in particular, to road transport in 2014 [7].

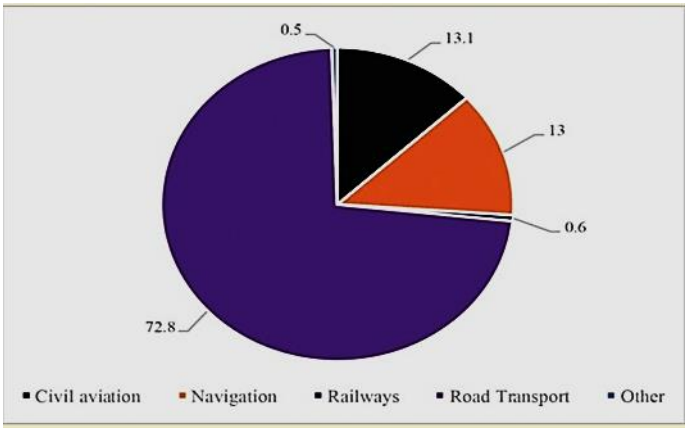

Figure 1: GHG emission from transport by mode in 2014

The Paris Agreement, which aims to fight climate change, cut greenhouse gas emissions worldwide, and keep the average global temperature below 2 degrees Celsius, was adopted by 195 countries in December 2015. The Intergovernmental Panel on Climate Change (IPCC) holds that two degrees Celsius is the highest emission threshold after which irreversible climate harm will have occurred. It is essential to firmly begin greenhouse gas emission in order to avoid the onset of unsustainable climate conditions [7].

Beijing implemented odd-even traffic restrictions beginning on July 20 for a time of two months to be able to aid with congestion and pollution during the Olympics (a car with even number tag to be used in even date). This was an incredibly simple and creative move made by Beijing officials at the 2008 Olympics, and it also worked. The city's air quality greatly improved, indicating that it was a huge success. These are the little actions that will enable us to make significant environmental savings. Imagine what electric vehicles will be able to accomplish and how much better the air will be after everyone uses them, if such a simple step can perform these wonders

If we hasten the transition to electric vehicles, the economy would benefit enormously from the move away from gasoline and other fossil fuels. A country like India, where the unemployment rate is so high, would need fewer fuel-powered vehicles. Thanks to the increased use of electric vehicles and the expansion of the industry would also help provide more job possibilities.

Electric cars have gained popularity over the past ten years, largely due to their low fuel gas emissions and reduced dependency on oil. By 2022, there will likely be more than 35 million electric vehicles on the road worldwide. However, there are also some serious issues with electric vehicles, such as their high penetration rates, clogged transformers, and excessive electricity consumption on the power grid. Electric vehicles only utilize energy to operate; they do not emit greenhouse gases directly. However, in a major portion of the world, electricity is still produced by burning fossil fuels. The car, in especially the battery, is made using energy as well. The majority of the emissions from the creation of the batteries are caused by the electricity used in their manufacturing and assembly. The energy and equipment required to create and maintain electric vehicles result in greenhouse gas emissions, which together comprises the vehicle's entire life cycle emissions. For instance, energy for electric vehicles is frequently provided by coal-fired power stations. Including local energy generation, such as renewable energy sources, in terms of infrastructure for electric vehicle charging is one of the most effective ways to mitigate the effect [7]. Solar and wind energy are the primary renewable energy sources that can be used to operate and satisfy the daily needs of the electric vehicle market. The technology for solar and wind energy is now ready for applications [8], but the expense will be very difficult to bear if we begin to neglect the environmental problems brought on by the combustion of fossil fuels [9].

Solar energy can be transformed into different energy sources directly or indirectly, including heat and electricity. Solar radiations have the ability to convert atmospheric carbon dioxide into biodiesel through photosynthesis in vegetation. Solar cells are used with photovoltaic cells to produce electricity. High latitudes have poor solar energy resources. Due to significant cloud absorption and scattering over the Amazon Rainforests, it is also low there. Contrarily, the solar radiation over deserts and bare soils at low latitudes is abundant [9]. The location must be carefully chosen before installing a solar power plant since it will serve the purpose best if it is where the sun shines the most. In order to maintain the power plant's efficiency, additional factors including population, regional energy needs, and transportation costs for energy all play a significant influence. In 2019, China produced 205 GW of solar energy, which is the most in the world. The country generated 223.8 tera watt hours (Twh) of solar energy in that same year.

Another renewable energy source is wind energy. Wind energy is the kinetic energy of the air that is based on its mass and velocity. The enormous kinetic energy present in this atmospheric motion can be put to numerous useful uses. The tops of rounded hills or

coastal regions are the ideal locations for wind farms. At a rate of roughly 67 mph (3 m/s), wind turbines generate energy. This range of speeds is frequently used to characterize the generating capability of a turbine. A turbine will reach its nominal or rated power at approximately 26 to 30 mph. More than a third of the world's wind energy production capacity is produced in China. China boasts the largest onshore wind farm in the world, with a 7,965 MW capacity. When putting up wind farms, the location must also be carefully chosen. The ability to foresee these renewable energy sources were a challenge, but that issue is now resolved with the use of cutting-edge Google map tools and cutting-edge weather satellites. These enable us to forecast weather conditions days in advance of when they really occur. A concern was raised regarding what would happen on overcast days and in the winter, when solar energy is not at its peak for producing electricity. The issue can be solved easily by building large, powerful batteries that can store energy. These batteries can then be used to prevent any interruptions in the charging of electric vehicles, even on cloudy or chilly days.

Solar and wind energy are significantly more abundant, sustainable, and clean than the global energy needs. Using electric cars that are powered by solar and wind energy allows us to achieve zero emissions [9]. Utilizing electric vehicles won't have a negative impact on the economy, but it will result in numerous job possibilities in the construction and operation of new power charging stations, the manufacture of batteries, and the design and manufacture of new automobiles. Electric vehicles driven by solar and wind energy, the environment, and the climate all have an impact. The distribution of solar and wind energy, however, will be impacted by climate change in the future because these two sources of energy are dependent on weather. Therefore, these climate change scenarios must be taken into account while making decisions about the growth of renewable energy sources.

2. Literature Review

The primary themes of this literature search are electric vehicles and how they contribute to a healthier, cleaner environment. The analysis of the literature and articles presented below reveals the fundamental principles and favourable outcomes anticipated in the interest of the environment. Chemical batteries, fuel cells, ultra-capacitors, flywheels, and an electric motor serve as the traction sources for electric vehicles. Compared to normal ICE vehicles, electric vehicles have advantages in terms of emissions, high efficiency, and smooth operation. The working of electric vehicles was contrasted to that of traditional internal combustion engine vehicles in the study papers below, and their benefits and drawbacks were emphasized.

2.1 Holms et al, 2010

High-efficiency, safe, and low-emission transportation has been stressed in transportation-related operations. Studies have shown how financial incentives and the socioeconomic status of consumers enhance the adoption of electric vehicles in various nations. Electric vehicles are a strong challenger to replace conventional automobiles in the future. Many governments, including India, have started financial programs to encourage the use of electric vehicles, but for them to be successfully implemented, decision-makers must embrace a long-term perspective Analyzing the demand for hybrid automobiles in India's major cities revealed that some alternative fuel is necessary for sustainability because fossil fuel supplies are being depleted at an alarming rate, which in turn is contributing to the environment's problems and global warming.

This survey shows that those that think traditionally are more worried about the environment, and Indian buyers are willing to pay any extra money for an environmentally friendly vehicle.

2.2 SHUKLA et al, 2014

EV Four Wheelers: The primary form of transportation in cities is the four-wheeler, which runs mostly on gasoline and other fossil fuels. However, in recent years, four-wheelers that run on compressed natural gas (CNG) have also grabbed a sizable portion of the market. In the Business as Usual (BAU) scenario, small electric four-wheelers with prices below $1500 would be commercially viable starting in 2030. However, electric four-wheelers with significantly larger batteries, greater payload capacities, and longer driving range won't be commercially viable until 2035.

Due to subsidies for electric vehicles, small electric vehicles become economically feasible in the electric vehicle scenario starting in 2020, although market adoption is constrained by the vehicles' technical constraints, such as their payload capacity and range.

Electric vehicles plus a 2-degree scenario under this scenario, the cost of carbon is still high, which disadvantages electric four-wheelers until 2025. Since the majority of the energy required to power electric vehicles comes from fossil fuels, which in turn release carbon dioxide into the atmosphere, the process of producing electricity still produces a significant amount of carbon dioxide. However, as electricity begins to decarbonize and we begin to produce it using renewable energy sources like solar and wind to power electric vehicles, their market penetration will surpass that attained in the electric vehicle scenario.

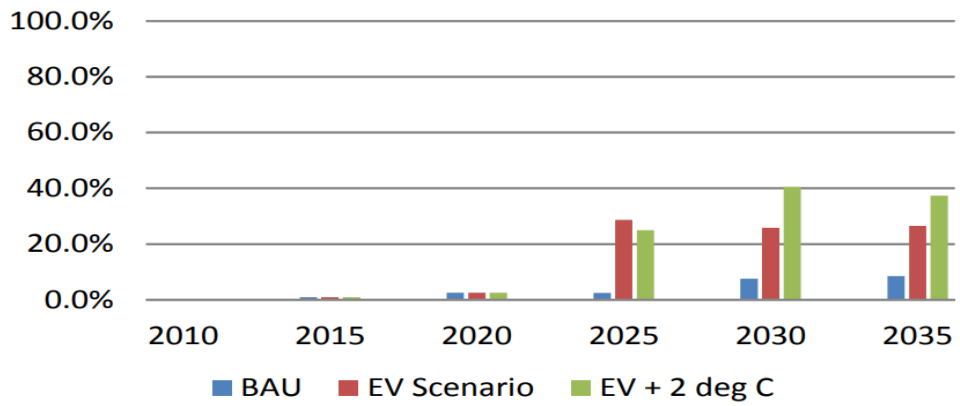

Figure 1: Share of Electric, Hybrid and Fuel cell four wheelers

Electricity demand and fuel mix: The biggest factor influencing how much power is needed in the transportation industry is rail transportation. In the not-too-distant future, the demand for electricity from train travel is anticipated to increase, peaking at 48% in only the Business as Usual (BAU) portion. The remainder of the required electrical power is used for both private and public transportation (EV-2 and EV-4 wheelers) (trams, electric buses and metros). According to the BAU scenario, 15% of all consumption in 2035 will be made up of two- and four-wheeled electric vehicle demand.Due to the increasing adoption of electric two-wheelers and four-wheelers, the electric vehicle scenario has a larger demand for electricity than a business as usual (BAU) scenario. By 2035, the share of electric two- and four-wheelers will account for 41% of transportation's electricity consumption, surpassing rail-based transportation as the source of the greatest demand for electricity.

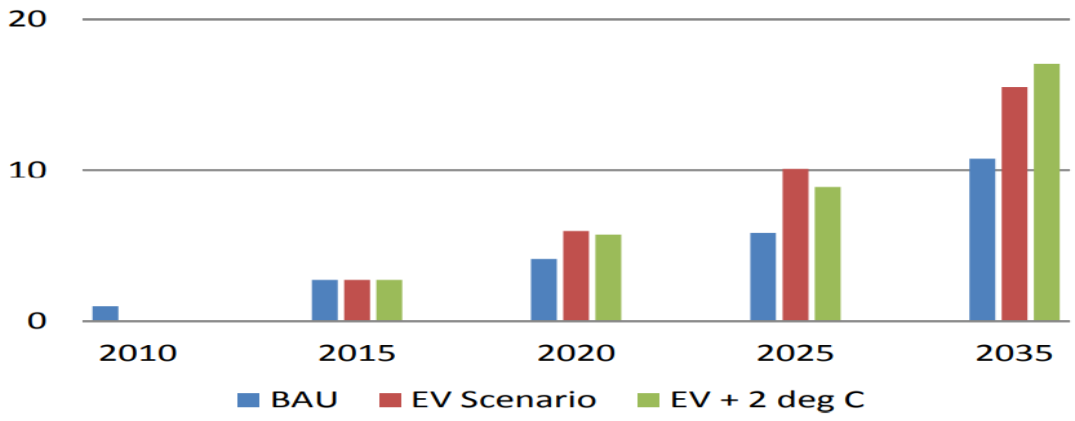

Figure 2: Electric demand for transport Mtoe

The contribution of electric two-wheelers and electric four-wheelers in electricity demand is considerably higher in the electric vehicle plus 2-degree scenario, reaching 47% of electricity demand by 2035. Electricity demand from transportation will total 198 Twh in 2035 under the electric vehicle plus 2-degree scenario. In the electric vehicle + 2-degree scenario, there is therefore a higher demand for power, which is complemented by a higher magnitude in the system. Renewable energy resources like solar and wind, which are abundant on the Earth's surface, could provide this rising demand for electricity. Additionally, because these energy sources are completely environmentally benign and do not emit any greenhouse gases, such as carbon dioxide or any other, they help prevent the "electric vehicle plus 2-degree scenario" from happening. In the BAU and electric vehicle scenario, coal dominated the energy production sector. In the electric vehicle plus 2-degree scenario, however, coal loses its dominance and is replaced by renewable energy sources like solar and wind, natural gas, and nuclear energies.

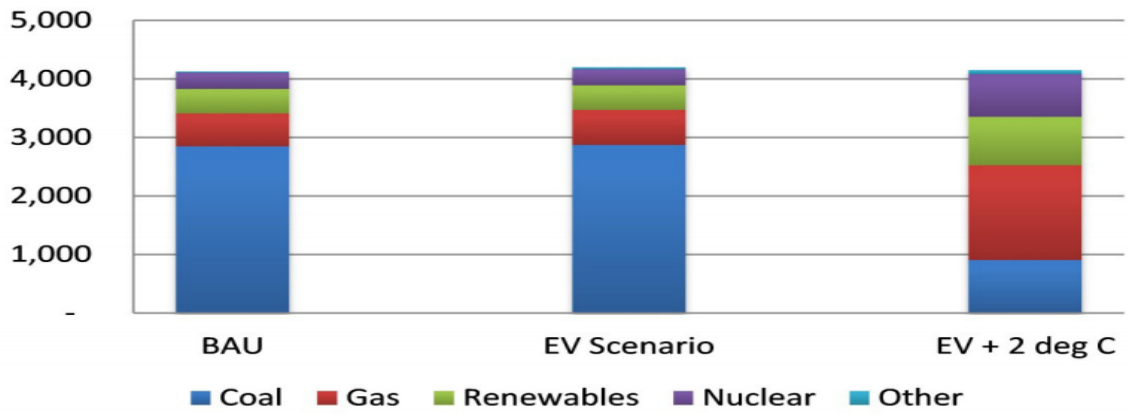

Figure 3: Electricity output (Twh) by fuel type in BAU, EV and EV+2-degree scenario

Carbon Dioxide emission: Between 2010 and 2035, carbon dioxide emissions rise, although they do so at a little slower rate than the rise in energy consumption. Because of the diversification of the fuel mix toward bio fuels and natural gas as well as the decrease in the carbon dioxide intensity of electricity, there is a decoupling between energy and carbon dioxide emissions. The carbon dioxide intensity decreases from 0.80 million TCo2 per GWh in 2010 to 0.75 million TCo2per GWh in 2035 under the Business as Usual (BAU) scenario. (CEA, 2012)Since the entire amount of power produced is carbon dioxide intensive, the electric vehicle scenario achieves a very minor reduction in carbon dioxide emissions. Meanwhile, a higher decrease in carbon dioxide emissions is seen in the electric vehicle + 2-degree scenario. There are primarily two causes for this situation: first, electricity is produced using renewable resources, which results in much reduced emissions; second, the market penetration of more energy-efficient vehicles has resulted in a decrease in overall energy consumption. As a result, while the decarbonisation of

energy is now modest, it will pick up speed by 2025 and reach only 0.17 million TCo2 per GWh by 2035.Furthermore, a significant shift away from coal and toward renewable energy sources is necessary to decarbonise electricity. Emissions of carbon dioxide from transportation will decrease under the Electric vehicle plus 2-degree scenario.

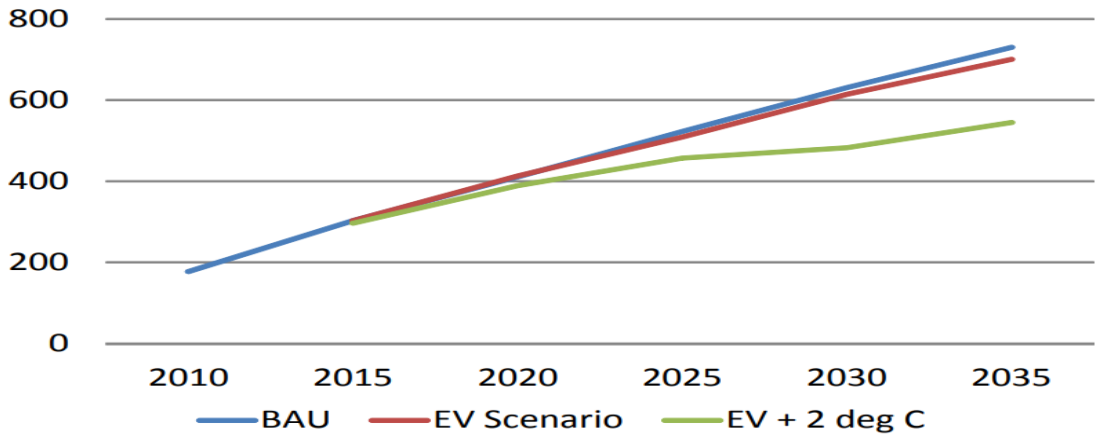

Figure 4: Emissions (tonnes) in BAU, EV and EV+plus 2-degree scenario.

3. Methodology

The primary goals of this study were to determine whether or not electric vehicles are superior to conventional vehicles, how much greener they are, and whether they emit any emissions at all over the course of their whole life cycle, while having zero tailpipe emissions when in operation. Secondary research, which makes use of evidence that has previously existed, was the method employed to frame this paper. This type of strategy was chosen mostly as a result of the Covid issue our nation was experiencing. Due to the stringent standard requirements, it was not possible to go out and gather data on a regular basis. In order to protect oneself and everyone else involved in this paper, a secondary method was chosen.

The information for this study was gathered through analysing a large number of research publications, journals, and websites. To gather information for this work, which primarily focuses on determining how much greener electric vehicles are throughout their full life cycle, only those articles, journals, and websites were examined. All research articles, journals, and websites were carefully examined; the key points from these studies were then picked out and summarized in this paper. As was already mentioned, since the research was secondary in nature, content-based qualitative data from the analysis of other articles was utilized.

The only drawback I see in this technique is that a survey and questionnaire should have been designed and completed in order to gather the primary data for this study. If it

weren't for the Covid crisis, this methodology would have been the major one. Despite the fact that framing this paper required a lot of patience and time, there were no significant challenges I faced because the data had already been gathered. However, there is no assignment on Earth that a man cannot complete if he/she is totally willing and committed to do so.

Some of the major Research papers studies to frame this paper are as under.

- Electric vehicle Scenario and a Roadmap for India by Shukla, P.R Dhar, S. Pathak and Bhaskar (2014).
- Electric Cars with Solar and Wind energy may change environmental and economy by Liu. Q. (2013).
- A study on adoption of electric vehicles in India by Anil Khurana (2006).
- A comprehensive LCA of electric vehicles and ICE using appropriate power mix by Girardi P, Gargiolo A. (2015).
- Environmental information for Solar and Wind energy facilities by Weng, F., Q, Liu and X. Zoo (2012) [10].

4. Results

Secondary data were used in this paper. Before structuring this work, other research publications were examined. The approach that was employed in this work was also optional, and the application of the methodology that is described in this paper raises a final query that has been attempted to be addressed. Which is more environmentally friendly, gas or electric-powered vehicles? Given that electric cars don't have exhaust systems and don't produce greenhouse emissions while they are moving, the answer to this question could appear glaringly obvious. Although they have their own set of pollution issues, electric vehicles are not without flaws. Notably, it takes a lot of energy and materials to locate and extract the battery's constituent parts, including lithium. But the lifespan of an electric car includes more than just battery production. If we compare the emissions produced by electric automobiles over the course of their whole lives from the mining of the metals needed for the batteries to the creation of the electricity that powers them—to the typical emissions of gas-powered vehicles. It was discovered that because electric automobiles use coal-powered electricity to recharge, they are really worse for the environment than regular gasoline vehicles.

It is quite difficult to dispute the extent of climate change, and if we reach a temperature increase of 2 degrees Celsius, there will be more to come. Examples include the melting of sea ice, rising sea levels, and the recurrence of extreme occurrences like storms, droughts, and intense heat waves.

In an effort to mitigate these effects, scientists have been looking into what might be the main driver of climate change [11]. They found that greenhouse gases including carbon dioxide, methane, nitrous oxide, and aerosols are changing the atmosphere and exposing the world to more danger.

14% of the 49 Gt of CO2 released into the atmosphere in 2010 came from transportation, according to the Inter-Governmental Panel on Climate Change (IPCC). Cars are responsible for 72% of this sector's carbon dioxide emissions, with aircraft coming in second at 10%. As a result, the market for electric cars has been growing, and it seems to be a promising strategy for addressing climate change. But are the emissions produced by electric cars actually zero?

The technique of converting the Potential energy saved into Kinetic energy is what differentiates conventional and electric cars in terms of their essential operation. In traditional cars, energy is kept in chemical form and released by a chemical process inside the engine. However, even though they also contain chemical energy storage, electric cars use lithium-ion batteries to deliver their stored energy electrochemically rather than through combustion. This indicates that the engine is not burning fuel, and as a result, there is no carbon dioxide pollution of the air while driving. They are more effective than vehicles powered by fossil fuels. But are they more environmentally friendly? Or, to be more precise, not always. If these cars are not fueled by renewable energy sources like solar cells, wind turbines, nuclear power, and hydropower, their carbon dioxide emissions will be substantially higher. Even if an electric vehicle doesn't emit any pollution while it is being driven, it won't matter if the electricity required to charge these vehicles is generated by burning fossil fuels because the pollution was previously created by a distant power plant.

There are very few locations where coal still serves as the sole or primary energy source for electric systems. One of them is China, where it was predicted that coal provided 58% of the nation's electricity in 2019 and is likely still the only source of energy in some regions. However, with increased expenditures in renewable energy sources, China's electricity infrastructure is already improving. For instance, China develops more solar panels each year than any other nation and has double the capacity for wind energy as the US.

The extraction, repurposing, transportation, and manufacture of the raw material into a variety of components that will be assembled to create the real electric automobile are the first stages in the creation of electric automobiles. The method is the same for both gas-powered and electric vehicles. The carbon dioxide emissions from electric vehicles peak toward the conclusion of the production process, though.

Many of you may be wondering why this is the case, and the simple explanation is that huge batteries, which have high environmental costs, are used by electric cars to store energy. The larger the battery, the greater the battery's range. This occurs as a result of the batteries' use of Rare Earth Elements (REEs), such as lithium, nickel, cobalt, or graphite, which are only found below the earth's surface and are thus dependent on mining operations that have a high environmental impact. For example, in order to generate 1 ton of rare earth elements, 75 tons of acid waste must also be produced (which isn't usually done properly), and 1 ton of radioactive waste must also be produced (Chinese Society of Rare Earth). Despite these pollution-related difficulties, data tells us not to worry about the availability of rare earth elements. In particular, research on lithium suggests that enough stocks are present worldwide for the next 185 years, even if the market for electric vehicles triples. As for cobalt, graphite, and nickel, they too appear to be in a good position because the demand for the foreseeable future is anticipated to be very different from what the earth's resources can provide. Let's not overlook the detrimental effects of harvesting these rare earth elements on the ecosystem, such as soil erosion, pollution, deforestation, and acidification, reduced or even eliminated food crops and contamination of local streams and wetlands even though it appears that everything will just work out well given the availability of the resources.

In addition to the weight of Rare Earth Elements (REE), the energy required to create batteries accounts for roughly half of their environmental effect because most energy utilized in manufacturing batteries does not come from low-carbon sources. Despite this, the findings indicate that electricity generation is increasing and that the grid is incorporating more renewable energy sources, which will help reduce the environmental impact of producing these batteries.

The good news is that driving an electric vehicle pays for its higher manufacturing-stage emissions only after two years, as opposed to driving an average conventional vehicle. If charged with renewable energy sources like solar, wind, nuclear, and hydropower energy, the time period decreases to about one and a half years. Electricity used in the production of batteries is responsible for about half of their emissions. About one-fourth of the lifetime emissions from electric vehicles are believed to be produced during battery manufacture, which is comparable to that of the average internal combustion engine vehicle. Over the coming decades, a significant decrease in emissions from battery manufacture is particularly likely to result from the use of cleaner electricity throughout the production process. A 30% reduction in grid carbon intensity would result in a 17% reduction in emissions from the battery manufacture process. Emissions during the manufacturing process could be decreased by using recycled materials and battery chemistries with lower carbon intensities. Additionally, the development of a market for second-life batteries might enable electric car batteries to continue supplying power to the

grid years after they have finished serving their purpose in the car, thus reducing the emissions associated with their use. Even though electric vehicles demand larger batteries to enable long-distance travel, these advancements will allow for fewer life cycle emissions and will further boost electric vehicles' life cycle advantage over vehicles powered by internal combustion engines. The United States recycles lead acid batteries used in conventional automobiles powered by fossil fuels at a rate of 99%, according to a study by the International Council on Clean Transportation (ICCT). With lithium-ion batteries, however, this is not the case because they have a very specific chemical composition and only trace amounts of lithium, making them a less than ideal economic prospect. For instance, in the European market in 2011, just 5% of the lithium was recovered, while the other 95% was either burned or dumped in landfills (this particularly does not make electric cars greener at all).Due to their short lifespan, these batteries would eventually become dead, which would necessitate an efficient recycling method. The yearly recycling market in India is projected to be between 22 and 23 GWh in 2030, representing a $1 billion opportunity. The Indian government has stated that it was drafting a program for recycling lithium-ion batteries and offering tax breaks to recyclers as of October 2019. Additionally, this policy requires battery manufacturers to collect discarded batteries in accordance with Extended Producer Responsibility (EPR) standards. Additionally, it is anticipated that the proposed legislation will provide incentives for businesses to establish recycling facilities and require manufacturers to collect spent batteries.

Figure 6: Battery recycling market of India

The second life use and closed loop recycling processes have shown to be the two most logical ways to reuse and recycle spent lithium-ion batteries.

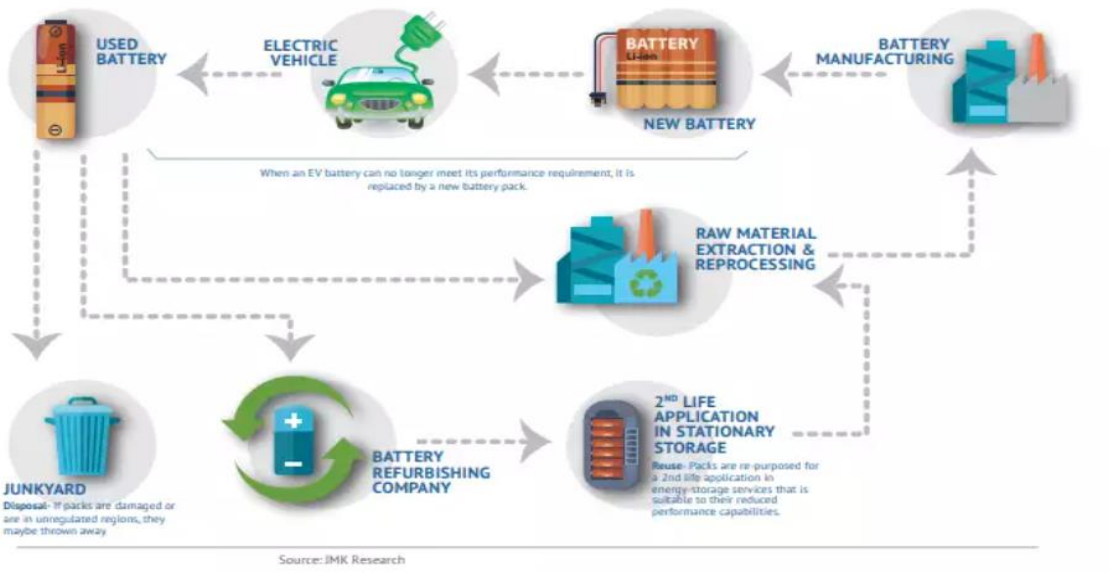

Figure7: Reuse and Recycling process of used batteries.

A lithium-ion batteries self-life is less than ten years when used in electric vehicles. The power produced by these batteries is no longer sufficient for an electric car to reach the specified range after 5-8 years of use. While lithium-ion battery recycling aids in the recovery of rare earth elements like cobalt, lithium, nickel, and other, once the capacity reduction is below 70-80%, they can still be used in various settings like homes or energy backups. The ability of these used batteries to enable developing electric grids and to store energy from wind or solar electricity sources should be another use for them. Additionally, this would assist in reducing the initial environmental effects of battery manufacturing due to the fact that they are amortized more slowly.

Electric Vehicle Scenario and Roadmap for India by Shukla et al., 2010, was one of the research papers cited to frame this paper. The graph in figure 2 was also derived from this paper. Business as Usual (BAU), Electric Vehicle, and Electric Vehicle + 2-degree Scenario were the three scenarios covered in that paper. Figure 2's graph depicts the percentage of four-wheelers that are electric, hybrid, and fuel cell-powered. According to the findings, tiny electric four-wheelers would be commercially viable starting in 2030 under the Business as Usual scenario, while electric vehicles with significantly larger batteries and cargo capacities would not be commercially viable starting in 2035.

On the other hand, in the case of electric vehicles, subsidies offered by the government would make electric automobiles economically viable starting in 2020.However, in the case of an electric vehicle plus 2-degree scenario, electricity is still generated from fossil fuels and used to power electric vehicles. As a result, until 2025, a high carbon price disadvantages four-wheeled electric vehicles. The figure 3's third graph, which depicts

the Mtoe region's electricity use for transportation, was also obtained from the same research paper. Additionally, three scenarios were considered here. First, in the scenario where things continue as they are, 15% of the total demand for electricity in 2035 will be used by two- and four-wheel electric vehicles. However, due to the rapid spread of electric two and four-wheelers, which account for up to 41% of the electricity consumption, in the scenario with electric vehicles, compared to a situation where business as usual prevails, there is a greater need for electricity from transportation. Additionally, by 2035, 47% of all two- and four-wheeled electric vehicles will be on the road. This is according to the Electric Vehicle plus 2-degree scenario.

Fig. 5 in this paper also contains a graph that compares the tonnage of car emissions under each of the three possible outcomes. According to the "Business as Usual" scenario, the grid's carbon dioxide intensity reduces from 0.80 million tons of CO2 per Gwh in 2010 to 0.75 million tons of CO2 per Gwh in 2035. The reason for this decline is the diversification of the fuel mix towards bio fuels and natural gas. However, because the production of power is still reliant on fossil fuels, the carbon dioxide emission in the scenario with electric vehicles is only marginally reduced (Fig. 5). However, in the Electric Vehicle Plus 2-Degree scenario, the greater reduction in carbon dioxide is mainly attributable to two factors: first, the electricity generated to power electric vehicles is carbon dioxide intensive, which means that it is generated using renewable energy sources like solar, wind, and nuclear; second, the overall energy demand is low because more energy-efficient vehicles are being adopted, which use less power to operate.

5. Conclusions

So to conclude, it may come as a shock to many that electric vehicles, which were once thought to be a practical and environmentally friendly substitute for carbon-emitting vehicles, are actually just as harmful to the environment as those vehicles, unless the energy needed for their production and operation is provided by renewable energy sources. Even while electric automobiles don't produce a lot of harmful greenhouse gases or nitrogen oxide, they might still utilize power generated by burning dirty fossil fuels, which would negate any climate gains. The production of batteries from raw minerals like lithium, cobalt, and manganese demands a tremendous amount of energy. Batteries are the main component of an electric vehicle. Despite the fact that electric vehicles produce less carbon 2 when they are moving on the road, the power plants that supply them electricity do. As a result, producing an electric vehicle requires more than twice as much energy as producing a conventional one. It's also vital to remember that electric vehicles are simply too expensive and that there aren't many of them on the market. The battery technology is one of the most significant elements raising the price. A vehicle

powered by electricity costs half as much because of the batteries. Concerns have also been expressed concerning what happens to harmful battery materials at the end of an electric vehicle's lifespan.

In this paper, we have attempted to address each of these concerns, and in summarizing, a solution to every issue relating to electric vehicles. The key, however, is to create a cleaner grid that relies more heavily on renewable energy production in order to ensure that electric vehicles are as clean as possible throughout their entire life cycles. The manufacture of batteries and vehicles is stepping up in response to the growing demand for electric fleets. These producing businesses might be greatly improved by switching to clean energy sources and using renewable energy to power them. Only by employing renewable electricity will it be feasible to completely eliminate the carbon footprint of industry. The same theory holds true for refuelling electric vehicles. Although their tanks are not directly fuelled with fossil fuels, large portions of the electricity grid still rely on coal and natural gas, which means that the electricity that powers the batteries may still be derived from a dirty energy source. The energy sources used to produce the electricity vary by location and include both renewable and non-renewable sources. As a result, even though an electric vehicle doesn't actually burn fossil fuels while in use, depending on the energy mix, the environmental impact of a single electric vehicle can vary greatly. This is true even if you fill up your car in a location that still uses fossil fuels to run. The environmental advantages of electric automobiles will also increase as new battery technology that uses less material in production is developed and as grids switch more and more to renewable energy. Since batteries can be utilized extremely successfully for other purposes, the issue of how to dispose of them after their useful life cycle is addressed. The longer an electric battery may be utilized after the life of a vehicle, the less of an environmental impact that car will have throughout the course of its lifetime. Scientists are working on techniques to recycle and reuse electric batteries for industrial applications. There are issues with the electric vehicle infrastructure for charging as well. By the way, charging an electric car is as simple as opening the door to your petrol tank and inserting the nozzle. However, if you use four separate public chargers in one city and receive varied charging speeds, your electric car's battery may suffer. Furthermore, it is well acknowledged that there are not enough charging stations in countries like India. When compared to China, which had about 500 thousand charging stations, India had only 600 in 2018. The truth is that there isn't enough power to charge a small battery for your phone, so stop thinking about charging such a large battery for your electric vehicle. If one is planning to travel to some tourist destinations in India that are in the mountains or in remote rural areas, finding a charging station there is impossible. The Indian government has launched numerous programs to encourage the creation, acceptance, and use of electric vehicles in India. Governments at all levels, including the federal and state, have been working to encourage the use of electric vehicles through both financial and

non-financial efforts. The Goods and Service Tax (GST) for electric vehicles has been decreased from 12% to 5%, and interest paid on loans for the purchase of electric vehicles may be deducted from income for tax purposes, to name a few initiatives on the purchase of electric vehicles. To encourage the usage of electric cars, the Central Government also wants to set up at least 69,000 charging stations for them around the nation. The installation of parking spaces will also be considered, in addition to charging stations. As a result, we can state with certainty that electric cars are more environmentally friendly than vehicles that run on gasoline. The future of electric vehicles appears more bright despite the fact that batteries are made to endure for a very long time thanks to research into additional energy sources including fuel cells and renewable energy (wind and solar).

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