



ARE EVS REALLY ECO-FRIENDLY AND WILL TAKE OVER THE CAR MARKET?

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ABSTRACT

In almost every article we read about Electric vehicles (EVs), we read that they are eco-friendly and will help to improve the environment and reduce global warming. Today people are interested in investing in companies that are involved in developing Electric vehicles. One or the other day government is focusing on policy as to how to replace conventional cars with EVs. But upon research, I found that Electric vehicles pollute the environment so much even before running a mile that a conventional fuel car will pollute after travelling thousands of kilometres. A comparison of carbon emissions between a diesel car and an electric car is made for a distance of 96000 Km shows that both the type of cars pollute the environment somehow the same with respect to our country. Also, its effect on Indian economy is also discussed.

Introduction

So, recently I came across that manufacturing lithium-ion batteries befouls the environment to a much greater extent. Recently, the growing EV sector has been getting tremendous attention due to it being Environment friendly and obviously the low running cost. Indian Government also aims to have 30% EVs sale by 2030. But is this really going to cut carbon emissions and give other benefits it promises? Are there no negative effects it's going to create? Obviously, won't talk of the short-range, high initial cost, or lack of infrastructure, but something that holds more value in the long term when EVs will concur a good share in vehicle market.

How Electric Vehicles are powered?¹

As we all are aware Electric Vehicles need to be powered with a battery. The battery that is most commonly used in these cars is Lithium-Ion Battery. This is true that while the car is on road it does not emit Carbon Dioxide or any other harmful gases. So basically, how these Lithium-ion batteries work is, that there are two terminals in the battery i.e. positive and negative that are immersed in a liquid known as an electrolyte that

¹ How an electric car's lithium-ion battery works - Easy Electric Life - Renault Group. Renaultgroup.com. (2022). Retrieved 16 May 2022, from <https://www.renaultgroup.com/en/news-on-air/news/the-electric-car-how-does-its-lithium-ion-battery-work/#:~:text=The%20principle%20behind%20the%20lithium,ionic%20liquid%20called%20the%20electrolyte.>

produces ions. Ions are atoms or molecules that carry an electric charge on them due to the loss or gain of an electron. So, when these ions move from negative to positive terminal in the external circuit they supply energy to the motor of the vehicle providing it with the required Kinetic Energy to move. So, in an EV the electric energy is converted into Kinetic energy.

How are lithium-ion battery made? ²

While lithium-ion battery have many advantages over others, they can have 150 watt-hours of energy in one kilogram which is much more than other similar battery types like nickel-metal hydride batteries having just 60-70 watt-hour of energy per kilogram. However, we have to look at lithium-ion batteries from the perspective of the environment. As Electric Vehicle Brands claim that they are made in a way to save the environment and are the most eco-friendly vehicles. But where their lie is exposed is, due to the process by which Lithium-ion batteries are made.

A lithium-ion battery is made of lithium, graphite, cobalt, and manganese which are then used to make a set of electrodes and then assembled in a cell. But these metals are not available easily on earth, we can only find them in the form of Ores. An ore is a naturally occurring rock or sediment from which metal had to be extracted. But for extracting metals from this ore various complex process has to be followed as it is difficult to remove impurities from the ore and we have to extract the maximum pure metal that we can get from this ore. After going through various processes we finally get pure metal **but at the cost of the environment** as during these extraction process a lot of carbon dioxide and other harmful gases are released in the environment.

Let us look at the process of extraction of these metals used in lithium-ion batteries and the amount of carbon dioxide they release in the environment

Lithium – So lithium is extracted either from underground reservoirs of brine or from hard rock mines, in any process the energy used for extraction comes from Co₂ emitting fuels. For every ton of lithium extracted about 15 tons of Co₂ is emitted i.e 15 times the weight of metal. ³

Graphite – for every kilogram of graphite mined about 4.9 kilograms of Co₂ is released into the environment as graphite is mined either by open pit mining where rocks are extracted from open-pit or by the method of underground mining.⁴

²Unwin, J. (2022). *What are lithium batteries and how do they work?*. Power Technology. Retrieved 17 May 2022, from <https://www.power-technology.com/analysis/what-are-lithium-batteries-made-of>.

³ Crawford, I. (2022). *How much CO₂ is emitted by manufacturing batteries?*. MIT Climate Portal. Retrieved 17 May 2022, from <https://climate.mit.edu/ask-mit/how-much-co2-emitted-manufacturing-batteries#:~:text=Currently%2C%20most%20lithium%20is%20extracted,are%20emitted%20into%20the%20air>.

⁴ Wallach, O. (2022). *Natural Graphite: The Material for a Green Economy*. Elements by Visual Capitalist. Retrieved 17 May 2022, from <https://elements.visualcapitalist.com/natural-graphite-the-material-for-a-green-economy/#:~:text=According%20to%20one%20study%2C%20the,2%20per%20kg%20of%20graphite>.

Cobalt – The blasting method used in cobalt extraction is harming the environment by also releasing about 1.58 kg of carbon dioxide per kg extraction of cobalt in the environment. The carbon dioxide and nitrogen dioxide emissions are highest in the mining of Cobalt.⁵

Manganese- Manganese ore is mined in open pits then with the help of aluminium as reducing agent, magnesium dioxide is reduced to manganese, as aluminium is more reactive than manganese so it displaces it from its oxide. Coal and coke consumption during smelting are the main environmental concerns and about 6 kg of Carbon dioxide is released for producing 1 kg of manganese.

Now the process of making lithium-ion batteries involves many other processes too. According to Shao-Horn, manufacturing contributes to the environmental impact of these batteries. The heat between 800 and 1,000 degrees Celsius is required to synthesize the materials needed for production—a temperature that can only be attained cost-effectively by burning fossil fuels, which adds to CO₂ emissions. The amount of CO₂ released during the long process of manufacturing a battery varies greatly depending on the materials used, how they're sourced, and what energy sources are utilized. **The great bulk of lithium-ion batteries—roughly 77 percent of the global supply—are made in China, where coal is the dominant source of energy.** (Coal emits nearly twice as much greenhouse gas as natural gas, another fossil fuel suitable for high-heat production.)⁶

Getting the exact amount of Co₂ released in the process of making 1 kWh lithium-ion battery is difficult to ascertain as it depends on many factors. But Manufacturing a 1 KWH capacity Lithium-ion battery releases about 146 Kg (may vary) of CO₂.

How much CO₂ has been emitted by the lithium-ion battery used in Electric vehicle?

Manufacturing 1 KWH capacity Lithium-ion battery releases about 146 Kg (may vary) of CO₂. An EV battery ranges from 30-80 KWH capacity. In India, the electric car market is very small with only a few numbers of cars available in the market with a battery capacity of 30-40 KWH. The leading car in this electric market is TATA Nexon with 62% market share as of 2021. It has a battery capacity of 30.2 kWh. So the car had already emitted about 4500 kg of Co₂ plus the Co₂ emitted in another car-making process (similar to conventional fuel cars), before even being driven a single mile.

Tata Nexon vs Tata Nexon EV.

So as to know how eco-friendly an Electric vehicle is, we have to analyse and compare it with the same conventional fuel car in order to know whether it is really eco-friendly or not. For that purpose, the best-suited car for the Indian market is Tata Nexon (Diesel version, as people generally prefer diesel cars for long-distance

⁵ hisan, s., huda, N., & parvez, M. (2022). *Life cycle assessment of cobalt extraction process*. science direct. Retrieved 17 May 2022, from <https://www.sciencedirect.com/science/article/pii/S2300396018301836>.

⁶ Crawford, I. (2022). *How much CO₂ is emitted by manufacturing batteries?*. MIT Climate Portal. Retrieved 17 May 2022, from <https://climate.mit.edu/ask-mit/how-much-co2-emitted-manufacturing-batteries#:~:text=Currently%2C%20most%20lithium%20is%20extracted,are%20emitted%20into%20the%20air.>

driving) versus Tata Nexon EV. As both the car are very similar to each other, only the difference they have is with respect to the petrol engine and electric motor.

So TATA Nexon EV claims a range of 312 km per charge (ARAI-certified), but this is not true when the car is made to run on Indian roads, as many factors like Speed, braking, traffic, AC consumption affects the range of EV. On Indian roads an average range of 220 Kilometres can be achieved on a single charge, so we will take that value for our calculation.⁷

An average Indian Drives around 12000 kilometres annually⁸. Tata Nexon provides a warranty of 8 years on the EV battery and thus we can safely assume that the battery will work for at least 8 years before needing to be changed. So this makes 96000 kilometres of run in a period span of 8 years.

An electric car will need 30 units of electricity for a single run of 220 Kilometres, this means that around 13,100 units of electricity would be needed for it to run 96,000 Kilometres. As we all are aware that India fulfills its demand for electricity consumption with the help of coal and coal is a fossil fuel and thus emits Co₂ when it burns. As per the data by the central electricity authority and Ministry of coal 75% of electricity in India is generated through coal thermal power plants.⁹ For generating 1 kilo-watt hour of power i.e. 1 unit of electricity about 0.95 kg of carbon dioxide is released into the environment.¹⁰ So for producing 13,100 units of electricity required to run an EV for 96000 Kilometres, 0.95×13100 i.e. 12445 equivalent to 12500 kg of carbon dioxide would be released into the environment. But since only 75% of electricity is produced from coal, we would take only 75% of 12500 to calculate the Co₂ produced by driving 96000 km of EV I.e., 9,375 kg of Co₂. So a total of 9,375 + 4,500 (from the manufacturing of lithium-ion battery), **a total of 13,875 kg of Carbon dioxide will be released in the environment.**

Now taking the conventional Tata Nexon diesel car it gives a milage of 22.07 kilometres per litre (ARAI-Certified), but on actual road conditions, we get around 20kmpl of milage from a diesel Nexon car.¹¹ So for driving a car for a distance of 96,000 Kilometres, we would require fuel of 4800 litres (96000 km/ 20 kmpl). Now Diesel is a conventional fossil fuel that releases an enormous amount of Co₂ into the environment. Researchers claim that about 2.6 kg of CO₂ is released from burning 1 litre of diesel¹². So, the total amount of Co₂ released in the environment after driving the diesel car for 96,000 Kilometres using 4800 litres of fuel would be 12,480 Kg of Co₂ (4800 * 2.6).

⁷ Merchant, A. (2022). *Tata Nexon EV Max vs Nexon EV: Top 10 differences* | Autocar India. Autocar India. Retrieved 17 May 2022, from <https://www.autocarindia.com/car-news/top-10-differences-between-tata-nexon-ev-max-and-nexon-ev-424431>.

⁸ Allirajan, M. (2022). *Drive 12,000km a year? Cheaper to call cab* - Times of India. The Times of India. Retrieved 17 May 2022, from <https://timesofindia.indiatimes.com/business/india-business/drive-12k-km-a-year-cheaper-to-call-cab/articleshow/59979877.cms>.

⁹ Ministry of Coal, GOI. Coal.nic.in. (2022). Retrieved 17 May 2022, from <https://coal.nic.in/en/major-statistics/generation-of-thermal-power-from-raw-coal#:~:text=%E0%A4%95%E0%A5%8B%E0%A4%AF%E0%A4%B2%E0%A4%BE%20%E0%A4%AE%E0%A4%82%E..>

¹⁰ *Electricity Generation and Related CO₂ Emissions*. Planète Énergies. (2022). Retrieved 17 May 2022, from <https://www.planete-energies.com/en/medias/close/electricity-generation-and-related-co2-emissions#:~:text=Electricity%20generation%20is%20responsible%20for,gas%2Dfired%20power%20plants3..>

¹¹ *Tata Nexon - Explore Nexon Reviews, Images, Interiors, Exteriors & More*. Cars.tatamotors.com. (2022). Retrieved 17 May 2022, from <https://cars.tatamotors.com/suv/nexon>.

¹² *Kg CO₂ per litre of diesel vehicles*. Comcar. (2022). Retrieved 17 May 2022, from <https://comcar.co.uk/emissions/co2litre/?fueltype=diesel.l>

So to conclude the comparison, **by driving a diesel car for a distance of 96000 Kilometres in a period span of around 8 years we are releasing about 12,480 Kilograms of Carbon dioxide** in the environment, but as we all this can be saved by shifting to Electric power vehicles then we are entirely wrong. **As the same Electric Vehicle would emit 13,785 kilograms of carbon dioxide in an environment in India, more than a Diesel car would have emitted.**

Now a car battery has about 5-8 years of life span. The battery will then become an EV-waste that needs to be recycled. If not recycled or disposed of properly this **may contaminate our waters with hazardous chemicals**. For that, a large infrastructure of battery recycling will need to be set up after some years when EVs will flourish the market. Also, we will have to find a more efficient recycling process for this.

Factors that can hinder the success of Electric vehicles.

The major factor for people opting for Electric Vehicles is the increasing prices of Petrol and Diesel. As EVs are very much cost-effective to run at less than 1.5 Rs. a kilometre, people prefer to buy it. Also, the government is providing subsidies so as to encourage people to buy Electric Vehicles. But the question is, will the EV market even flourish when the price of Petrol and Diesel would decrease.

As we all are aware that conventional fuels are obtained after the purification and separation of Crude oil. So it's the crude oil that determines the price of fuels. The price of crude oil is based on the demand and supply chain¹³. OPEC (Organization of the Petroleum Exporting Countries) is a group of 13 countries, that artificially controls the crude oil price by limiting the supply chain. Let's assume if EV takes over the car market, then these countries will have to suffer a great loss. So they would increase the supply of crude oil to decrease the price of Petrol and Diesel. Also in India both Central and State government earns a lot from the tax levied on these fuels, so would not prefer to suffer the loss.

Economic losses that EVs can cause.

Another point that is stuck is related to the Economic disadvantage that EVs are going to cause. It is evident that filling fuel in our vehicles is another way of paying direct tax to the government. The tax on petrol is 57.2 Rs. Per litre and for diesel is 45.6 Rs. Per litre (In Delhi, as of May 2022). If the Indian government achieves its target of EV sales by 2030, then it will cut 1160 million barrels of crude oil as stated by Mr. Nitin Gadkari, Minister for Road Transport & Highways in the Government of India. 1 barrel of crude oil produces 75.7 litres of petrol and 41.6 litres of diesel. So a loss of 7200 billion to the Indian economy if this situation occurs.

Another major loss to the government is by the tax on car they collect. On an average a car is taxed 45-50% in India (with 28% GST + Cess + other tax). But on EVs, the GST is less than conventional cars + Road tax

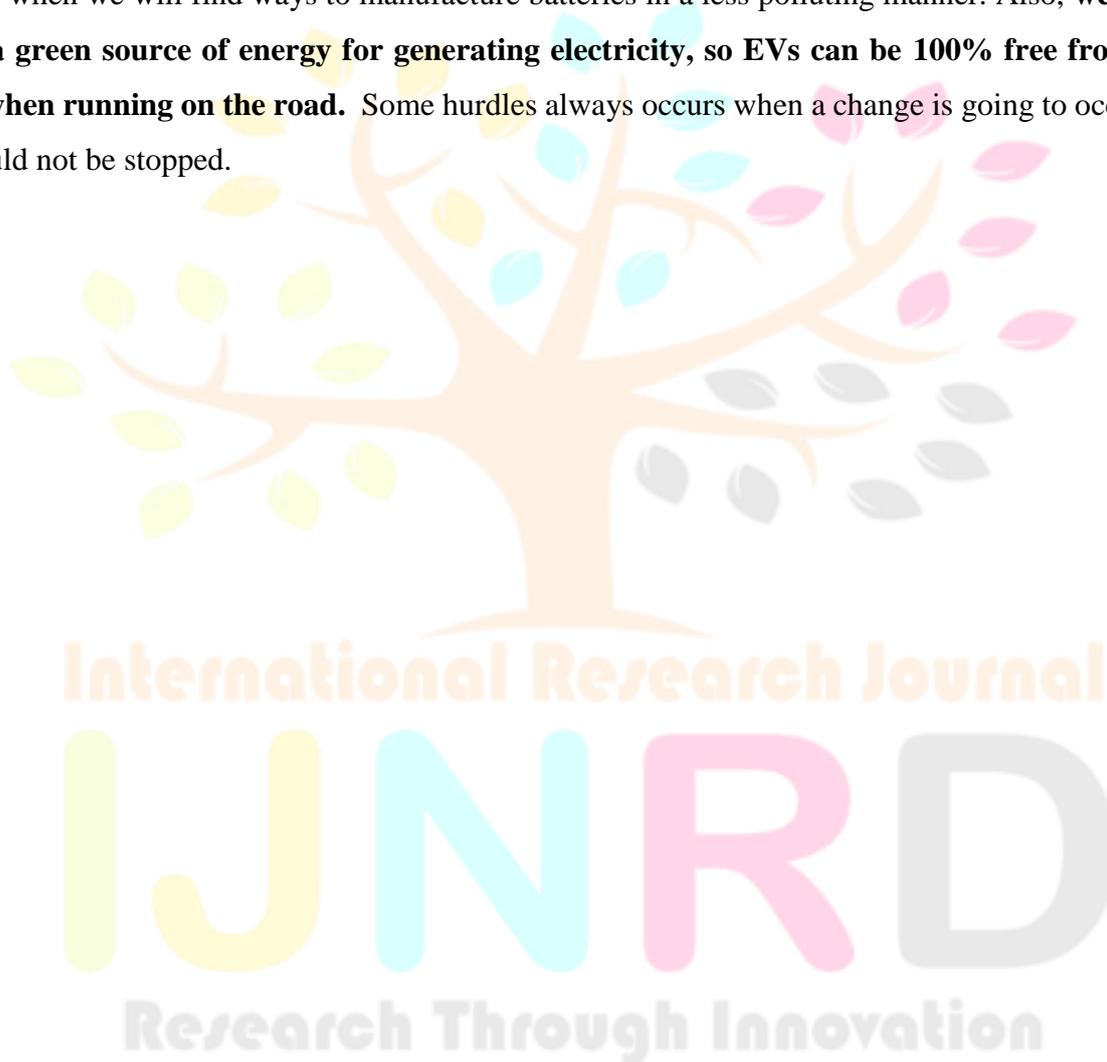
¹³ KOSAKOWSKI, P. (2022). *What Determines Oil Prices?*. Investopedia. Retrieved 17 May 2022, from <https://www.investopedia.com/articles/economics/08/determining-oil-prices.asp>.

exemption + benefits under FAME II subsidy + other tax benefits (like tax deduction up to 1.5 lakh)¹⁴. The automobile sector contributes **7.1 % to the Indian GDP**,¹⁵ thus a great loss will be incurred if most cars sold are EVs. Else if government evades this subsidy and levies the same tax as on conventional cars then the price of these cars would rise exponentially, thus will discourage people from buying EVs.

Conclusion

After listing all the disadvantages of EVs it is untrue that the EV market will not flourish. As we can see big giants are investing for building the electric charge infrastructure in India, and there is a hope that the EV market will continue to grow.

These were some relatable points that need to be known. But the future of EVs is bright and it will be more eco-friendly when we will find ways to manufacture batteries in a less polluting manner. Also, **we will need to shift to a green source of energy for generating electricity, so EVs can be 100% free from carbon emissions when running on the road.** Some hurdles always occurs when a change is going to occur but the growth should not be stopped.



¹⁴You can get tax exemption of up to 1.5 lakh on electric car; here's how. DNA India. (2022). Retrieved 17 May 2022, from <https://www.dnaindia.com/personal-finance/report-you-can-get-tax-exemption-of-up-to-15-lakh-on-electric-car-here-s-how-2926716#:~:text=The%20rule%20of%20tax%20exemption,both%20personal%20and%20business%20use.>

¹⁵ India, P. (2022). Govt aims to raise auto sector contribution to GDP, job creation: Gadkari. Retrieved 17 May 2022, from https://www.business-standard.com/article/automobile/govt-aims-to-raise-auto-sector-contribution-to-gdp-job-creation-gadkari-121082501375_1.html#:~:text=The%20contribution%20of%20the%20automobile%20sector%20to%20the%20overall%20GDP,o f%20Rs%203.5%20lakh%20crores.