Are Electric Vehicles Really Better for the Environment?

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Electric vehicles (EVs) are often advertised as the clean future of transportation, but the full picture isnt so simple. This paper looks at the environmental costs of EVs beyond just tailpipe emissions, like battery production, charging infrastructure, and the fossil fuels used to generate electricity. It compares these impacts to gas-powered cars using recent data and case studies from different regions. While EVs can reduce emissions in the long run, their real-world benefits depend on where the power comes from, how the batteries are made, and how they are disposed of. This research looks at both the problems and the progress being made, including better recycling, cleaner energy, and newer technologies like hydrogen fuel. The goal is to give a full view of the trade-offs, not just their popularity.

1 Introduction

EVs are often promoted as a way to lower CO2 emissions and fight climate change, but there are environmental downsides that dont get talked about enough. Sure, EVs dont release exhaust while driving, but thats just one part of the picture. The energy and materials needed to build them and the power that keeps them running still come with real environmental costs.

One big factor is the charging infrastructure. To support millions of EVs, we need a massive buildout of chargers across the country. But building these stations isnt exactly clean. It takes a lot of steel, concrete, and transportation, all of which produce emissions. On top of that, setting up new charging networks means using more land, which can disturb ecosystems and contribute to sprawl, especially in urban areas. These are the kinds of hidden impacts that get left out of the conversation when people talk about EVs as a perfect solution.

2 Methods

EV corporations have made rapid progress in the recent decade, starting from an idea no one believed would work, to a constant presence on the roads. This rapid spread of information was made possible due to todays technologically reliant world where advertisements are always lurking. We are always taught to fact check what we see on the internet and never trust something at first glance, so I dug deeper into the statements of these companies to unravel the hidden truths. To find areas which needed analysis I first started by reviewing EV companies advertisements and taking note of what aspects they were highlighting. This consisted of less environmental impact, simplicity and adaptation of charging infrastructure, and the economics behind it all. One by one I started to dig deeper and find 3rd party resources whose data and statistics were not skewed to make EV companies' promises seem better. Then I compared it to the data of larger companies and government resources looking for any similarities that I could base my judgement on. When comparing these differing sources, I tried to find the data that seemed to back each other up to come out with the most truthful research paper. This method works by comparing independent studies, corporate reports, and government data letting me verify claims from multiple perspectives: when sources agree, it boosts credibility, and when they differ, it reveals possible bias or error. Finally, I tried to come up with the best solutions which are realistic for our time frame.

3 Literature Review

3.1 Environmental Concerns

Making batteries for EVs is one of the biggest environmental concerns. Most EVs use lithium-ion batteries, which need a lot of raw materials like lithium, cobalt, and nickel. Getting these metals out of the ground takes a ton of energy and usually happens in places with weak environmental protections. This leads to deforestation, water pollution, and damage to local habitats[1]. After mining, the refining and processing stages release even more carbon emissions. Depending on the battery size and how it's made, producing one EV battery can release anywhere from 6,000 to 17,000 kilograms of CO2[2]. Thats just from the factory, before the car is even driven.

Recycling is another issue. A lot of used batteries end up in landfills because most places dont have the infrastructure to recycle them properly. While some companies are trying to fix that, recycling rates are still low, especially for lithium.

Its also important to look at how EV battery supply chains compare to oil. Theyre both complicated and have their own risks. Oil has been part of the U.S. economy for decades and

relies on domestic sources like Texas, North Dakota, and Alaska. Even with all that production, the U.S. still imported over 6 million barrels a day in 2022[3]. That leaves the U.S. vulnerable to price spikes caused by events like the Russia-Ukraine war. Oil extraction also creates serious environmental damage through methane leaks, land use, and pollution[4]. It still makes up around 40 percent of the countrys annual carbon emissions. The point is, neither option is perfect. Both systems have big environmental costs that need to be weighed honestly.

Most of the metals needed for EV batteries, like lithium, nickel, cobalt, manganese, and graphite come from other countries. Around 70 percent of the world's cobalt is mined in the Democratic Republic of the Congo, and China supplies over 65 percent of the worlds graphite[2]. Depending so heavily on foreign sources adds risk to the supply chain, especially when it comes to pricing, politics, and working conditions. On top of that, mining these materials causes serious environmental harm. It drains water supplies, destroys ecosystems, and pollutes nearby areas.

Even though metals can technically be reused, in contrast with oil, which is burned and gone forever, very little recycling is happening right now. Only about five percent of lithium gets recycled, so the environmental damage from mining keeps repeating[1].

Some research shows that making an EV battery can create as much or more pollution than driving a gas car for a year. Producing one kilowatt-hour of battery storage releases between 70 and 100 kilograms of CO2[5]. For a typical 75 kilowatt-hour battery, that means about 5,250 to 7,500 kilograms of CO2 just from production. By comparison, an average gas car releases about 4,600 kilograms of CO2 each year when driven around 12,000 miles. So EVs start with a higher carbon footprint even before they are driven.

Mining processes for materials like nickel and cobalt make this worse. They use massive amounts of energy, usually from fossil fuels, and release toxic chemicals into the soil and water. Producing one ton of nickel can create roughly 20 tons of CO2. Cobalt mining in the Congo has also caused major air and water pollution[1] Until the process of making batteries gets cleaner, the pollution saved during driving may not always make up for the damage caused earlier in the process.

EVs do have the potential to lower environmental impact in the long run, but right now their dependence on global mining and unstable supply chains makes that potential hard to reach. Getting metals like lithium and cobalt from around the world comes with economic risks and serious environmental costs. On the other hand, oil, while limited and polluting, still offers a more stable and familiar system for fuelling vehicles. That does not mean it is better overall, but it shows that EVs are not automatically the cleaner option people make them out to be. Making real progress will take better battery recycling and much more sustainable ways to get materials.

3.2 Electricity and Charging

Another piece of the puzzle is the electricity used to charge EVs. It is often marketed as clean, but that depends on where the electricity comes from. In 2022, about 60 percent of global electricity still came from fossil fuels like coal and natural gas[6]. Coal alone made up around 36 percent and is one of the biggest sources of carbon emissions, along with other pollutants like sulfur dioxide. Natural gas is sometimes considered cleaner, but it still accounts for 23 percent of electricity worldwide and releases large amounts of CO2[6]. On top of that, methane leaks during natural gas extraction are a big problem. Over a 20-year period, methane traps heat much more effectively than CO2.

Renewable energy is growing, but it is not fully reliable yet. In 2022, wind and solar made up about 29 percent of global electricity. Making solar panels and wind turbines also requires mining and a lot of energy, which damages the environment in different ways. Because renewable power is not always available when people need it, many places still fall back on fossil fuels for backup. Nuclear energy, which supplies about 10 percent of global electricity, has its own set of issues like radioactive waste, the environmental impact of mining uranium, and the challenge of safely running power plants[6].

Charging an EV in places that still rely heavily on fossil fuels can create more pollution than most people expect[4]. In states like West Virginia, where coal generates over 90 percent of the electricity, charging an EV can produce emissions almost equal to driving a fuel-efficient gas car. A study from the University of Michigan in 2021 found that the average total emissions of an EV, including both the manufacturing and the energy it uses, are only about 30 percent lower than those of a regular gas vehicle[7]. In some areas, the gap is even smaller. This shows how much the environmental impact of EVs depends on where the electricity comes from. If the grid is dirty, the car is not as clean as people think. A lot of the propaganda around EVs ignores this and gives a picture that is more hopeful than honest.

A separate issue is the lack of chargers. In a recent national survey, 80 percent of American adults said they were concerned about the lack of public charging stations[8]. Another 47 percent said they would not buy an EV for their next car because of this issue. This hesitation was consistent in both cities and rural areas, showing that the charging problem is not just limited to certain regions. In response, the U.S. government set aside 7.5 billion dollars through the Bipartisan Infrastructure Law to build 500,000 new public chargers by 2030[9].

That sounds like a solid investment, but some experts believe it is nowhere near enough. By 2030, the number of EVs on the road is expected to reach between 20 and 30 million[10]. To support that many vehicles, the National Renewable Energy Laboratory estimates that the country will need more than 1.2 million public chargers. If the infrastructure cant grow fast enough to match the demand, EV owners could be left waiting

in long lines or driving far out of their way just to find a place to plug in.

Building EV chargers has its own environmental cost that people rarely think about. For example, making and installing a level 2 charger, which charges a car in about one to four hours, releases around 500 to 1000 kilograms of CO2. Fast chargers, which are getting more popular because they cut charging time down to 30 minutes or less, are even worse. Producing one of these can release between 5000 and 10,000 kilograms of CO2[11]. To put that in perspective, a gas car would need to drive close to 2000 miles to match the emissions from a level 2 charger, and nearly 20,000 miles to equal the impact of building one fast charger.

Even though these chargers will eventually help reduce long-term emissions, the short-term pollution from making them is still a problem. If we are not using cleaner materials or cleaner energy to build them, the benefits get cancelled out. Right now, the emissions tied to manufacturing chargers can end up being just as bad, or sometimes worse, than continuing to use gas-powered cars.

3.3 Economics

There is also an economic side that people do not talk about much. Many owners of EVs bring up a similar issue. When they stop to charge, they end up spending money on food or shopping just to pass the time. Charging takes a lot longer than filling up a gas tank. You can pump gas in five minutes and be on your way. Charging an EV can take forty to sixty minutes, especially on longer road trips. Feeding an average family of four during every charging stop adds up fast. These extra purchases make a difference when comparing the long-term cost of owning an EV versus a gas car. People assume electricity is cheaper, but the time it takes to charge has a hidden price.

Charging costs can vary a lot depending on where you are and what time it is. Most EV companies advertise that it costs around 15 to 20 dollars to fully charge your vehicle. That might be accurate in places with lots of chargers or at home overnight. But in more remote areas with limited options, the prices often go up. In towns like Groveland, about fifty miles from Yosemite, there are fewer stations and higher demand. Because drivers have no other choice, they are willing to pay more. In places like that, charging your car can cost anywhere from 35 to 50 dollars.

3.4 Potential Solutions

There are different ways to improve the environmental impact of EVs. Some solutions require big changes to current systems while others could be made with smaller adjustments. One of the more realistic short-term goals is to lower emissions during the manufacturing process. This includes improving how materials are mined, how batteries are produced, and how much of each car can be recycled and reused. These improvements would reduce the amount of pollution created before the car is driven.

Electric vehicles are often seen as the future of clean transportation, but the reality is more complicated. From battery production and mining to electricity sources and charging infrastructure, there are serious environmental challenges that come with EVs. While they have potential to reduce emissions, that depends on how the power is made, how the cars are built, and what happens to them after. EVs are not a perfect solution, but they are part of a bigger shift. If we want them to truly help the environment, we need cleaner manufacturing, better recycling, and stronger energy systems. Other technologies like hydrogen fuel and nuclear power may also play a key role in building a more sustainable future.

Some newer technologies also show promise. BMW and Toyota are working together to release a hydrogen-powered car in 2028[12]. Their first model, the IX5, is expected to travel up to 310 miles without producing any emissions. This could be a strong alternative to traditional EVs and may help solve some of the problems caused by battery production.

Another solution that has existed for a long time is nuclear power. Nuclear energy creates large amounts of electricity without releasing carbon into the atmosphere. It is also one of the cleanest energy sources when it comes to long-term emissions. If used correctly, it could provide a steady supply of power for both electric and hydrogen-powered vehicles while avoiding the pollution caused by coal and natural gas.

4 Discussion

This research shows that while EVs can help lower emissions, their real benefits depend on several factors, the biggest being where the electricity comes from. In areas that still rely heavily on coal and natural gas, an EV might not be much cleaner than a fuel-efficient gas car due to those cities power grids running on those fossil fuels. This means the environmental impact changes heavily based on location[13].

Building the car is another major factor. Making EV batteries creates a large amount of pollution before the car is even driven. Without cleaner mining, more efficient battery designs, and more efficient production, this initial carbon cost will stay high. In addition to that, the lack of battery recycling plants means we keep repeating the same environmental damage every time new materials are mined.

Charging infrastructure is also a mixed picture. More chargers are needed for EVs to be practical, but building them comes with its own environmental costs. These impacts are rarely mentioned when people talk about predicted EV growth. Using cleaner materials, renewable energy during construction, and encouraging more at home charging could lower these effects. However, all of these solutions come with their own drawbacks.

Economically, EVs are not always as cheap to operate as advertised. While electricity can cost less than gas, factors like charging time, higher prices in rural areas, and extra spending during charging stops can make ownership more expensive in the long run. The construction of the car also severely affects the maintenance cost. Heavy batteries cause more wear on tires and brakes calling for owners to more often visit the mechanic.

The potential solutions in this research, such as cleaner production methods, better recycling, hydrogen vehicles and nuclear power, show that EVs should not be seen as the only solution to greenhouse gasses. A mix of many clean technologies as well as changes in how energy is produced and used will be needed to make transportation truly sustainable.

Conclusion

The shift to cleaner transportation is not just about one type of vehicle. It is part of a much larger effort to rethink how we produce energy, manage resources and design the system that can keep the world moving. EV companies are focusing too much on one aspect of a much larger interconnected system. While they are trying to perfect the EVs themselves, they overlook other major parts like the energy grids: most of which are run using fossil fuels. So, while the car produces minimal pollution, if you trace the energy back, it all ties to natural gasses. These potential shifts will dictate the health of our planet for generations to come.

References

1 I. Energy Research, *Environmental Impacts of lithium-ion Batteries*, https://www.instituteforenergyresearch.org/renewable/environmental-impacts-of-lithium-ion-batteries/.

2 R. B and L., *The Environmental Impact of Battery Production for Electrical Vehicles. Earth.org; Earth.org*, https://earth.org/environmental-impact-of-battery-production/.

3 U. I. Administration, *Imports and Exports*, www.eia.gov/energyexplained/oil-and-petroleum-products/imports-and-exports.php.

4 *United States Environmental Protection Agency*, https://www.epa.gov/greenvehicles/electric-vehicle-myths.

5 J. Persson and G. Erselius, *Life Cycle Assessment of the charging station GARO LS4*, https://www.garo.se/storage/A79528C58638EAA0793A059DCD25F5DA6754DAAA0548152E3E0817C2EA109143/082fa5e2e77748c192d92bd360f7da9a/pdf/media/665c3f96136744c3b93299a97e4f18ac/LS4%20%28EN%29%20Life%20cycle%20assessment.pdf.

6 J. McLaren, J. Miller, E. OShaughnessy, E. Wood and E. Shapiro, *CO2 emissions associated with electric vehicle charging: The impact of electricity generation mix, charging infrastructure availability and vehicle type*.

7 U. Michigan Energy Institute, *EVs Lower Emissions in Every U.S. County, Study Finds*.

8 S. Zargary, *Addressing EV Charging Infrastructure Disparities in the US — GenCell — Fuel Cell Generators. GenCell Energy*, https://www.gencellenergy.com/resources/blog/addressing-ev-charging-infrastructure-disparities-in-the-u-s/.

9 H. Boushey, *Full Charge: The Economics of Building a National EV Charging Network. The White House*, https://www.whitehouse.gov/briefing-room/blog/2023/12/11/full-charge-the-economics-of-building-a-national-ev-charging-network/.

10 E. Wood, B. Borlaug, M. Moniot, D.-Y. Lee, Y. Ge, F. Yang and Z. Liu, *The 2030 National Charging Network: Estimating U.S.*

11 A. Mohammed, O. Saif, M. Abo-Adma, A. Fahmy and R. Elazab, *Strategies and sustainability in fast charging station deployment for electric vehicles*.

12 A. J. Hawkins, *BMW Will Launch Its First Hydrogen-Powered Production Car in 2028*.

13 *The Environmental Impact of EV Charging: Analyzing the Carbon Footprint of Charging Stations - Career Statiq*, https://career.statiq.in/2023/04/24/the-environmental-impact-of-ev-charging-analyzing-the-carbon-footprint-of-charging-stations/.