Just how eco-friendly are electric cars really? Let's find out

Electric vehicles are all the rage right now for those looking to reduce their impact on the environment. But, are they actually better for nature?

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Electric vehicles are touted as one of the most sustainable means of transport currently available. Zero-emissions, and high-tech, EVs appear, on the surface, to be the silver bullet to freeing us from the need to burn liquid fuels to get around (especially if the electricity is generated through renewable methods).

But, there might be more than meets the eye in EVs. Tesla, for some, the flagship of EVs, has even seen its S&P 500 ESG rating impacted by its lack of a "low carbon strategy."

Consideration of the utility of ESG ratings aside (that's a tale for another day), are such criticisms of EV producers justified?

Let's take a look.

What are the benefits of electric cars for the environment?

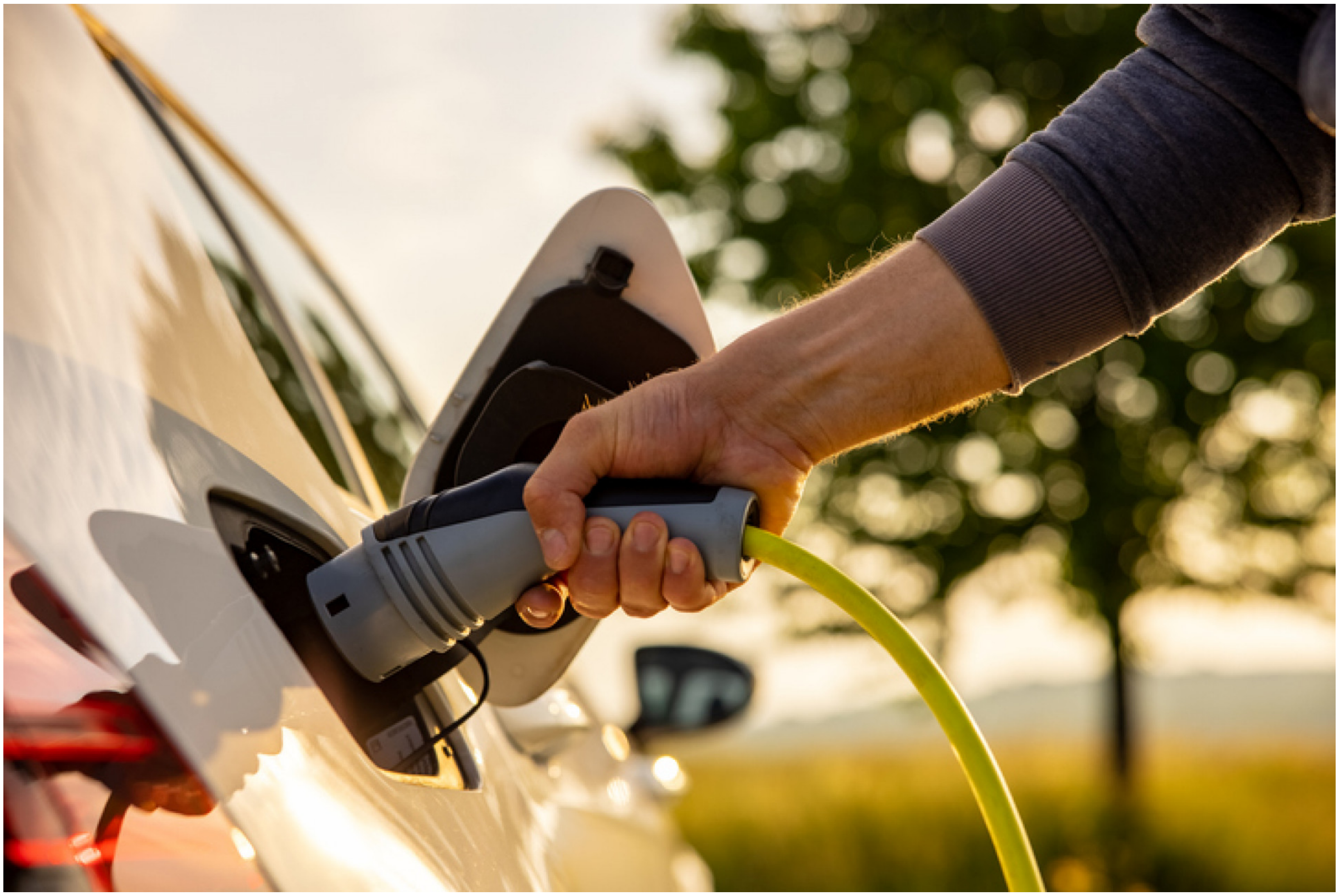
The first point is that electric cars have a non-negligible better environmental performance once built regarding the emission of carbon and other pollutants (we'll get into that further down this article). However, if this is your only "metric" for considering how environmentally friendly something is, you will not get the entire picture.

"If all you have is a hammer, then everything looks like a nail," if you like.

But, before we get into the details regarding the complete picture of electric vehicles, let's get their "benefits" out of the way first for balance.

Apart from the often quoted benefits of EVs for the environment, some other benefits may be more immediate and crucial to potential buyers. Here are a select few of them.

1. The costs of running an EV can offer some real benefits



Even while electric vehicle energy expenses are typically lower than those for comparable conventional vehicles, the cost to buy them in the first place can be a lot more (although many models are equal to or even cheaper than similar ICE vehicles).

As production volumes rise and battery technology develop further, prices for electric vehicles are projected to decrease even further. Additionally, fuel cost savings, government tax credits, and other types of incentives can all help offset the initial costs. On top of this, as EVs do not have an engine, the running and maintenance costs are typically much less than for ICE vehicles as there is less to go wrong - although replacing the batteries can be very expensive.

In the United States, for example, the federal Qualified Plug-In Electric-Drive Motor Vehicle Tax Credit is available for EV purchases from manufacturers who have not yet reached specific criteria for vehicle sales.

For brand-new purchases, this offers a tax credit ranging from $2,500 to $7,500, with the precise amount depending on the size of the vehicle and the battery capacity.

Many of the incentives may be found in the Laws and Incentives database and are provided by some states and electric providers. If you want to know more, it is recommended that you contact any relevant advisory bodies in your local area for more up-to-date information on incentives, etc.

2. Ultimately, they can help improve national energy security

Another indirect but significant benefit of electric vehicles concerns national energy security. Reliance on fossil fuels like petroleum, unless a nation has a domestic surplus, can be a potential pressure point for the economy and severely impact citizens' daily lives, as many European people are finding out in 2022.

Utilizing more energy-efficient vehicles, such as hybrid and fully electric vehicles, can promote the local economy while providing much-needed diversification.

For the electrified transportation industry segment, the numerous fuel sources used to produce electricity result in a more secure energy source. All of this can significantly increase national energy security.

Because hybrid electric vehicles (HEVs) also use electric-drive technologies to increase vehicle economy through regenerative braking (recapturing energy that would otherwise be lost while braking), they often use less gasoline than comparable conventional vehicles. (Fully electric vehicles also use regenerative braking.)

Both all-electric and battery-electric vehicles, also known as plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles (BEVs), can run entirely on the electricity generated from domestic sources from a variety of power plant technologies like natural gas, coal, nuclear energy, wind, hydropower, and solar energy.

Assuming, of course, that the fuel sources (like natural gas) aren't imported *en masse*.

Because electric-drive components are highly efficient, electric vehicles can significantly save energy expenditures. However, the fuel economy for PHEVs and all-electric vehicles is calculated differently from that for conventional vehicles because they either run entirely or primarily on electricity.

Kilowatt-hours (kWh) per 100 miles (160 km) and miles per gallon of gasoline equivalent (MPGe) are specific measures used for EVs and are important metrics to know. Modern light-duty all-electric vehicles (or PHEVs in electric mode) can achieve 130 MPGe (miles per gallon equivalent) or more and can travel 100 miles (160 km) on just 25 to 40 kWh, depending on how they are operated.

Compared to comparable conventional vehicles, HEVs often have lower fuel costs and better fuel economy. For instance, according to sources like FuelEconomy.gov, the combined city and highway fuel efficiency estimate for the 2021 Toyota Corolla Hybrid is 52 miles per gallon (MPG), compared to 34 MPG for the standard Corolla (four cylinders, automatic).

The duty cycle (the ratio of time a load or circuit is ON compared to the time the load or circuit is OFF) significantly affects the fuel economy of medium- and heavy-duty all-electric vehicles and PHEVs. Still, in the correct situations, all-electric vehicles continue to outperform their conventional counterparts in terms of fuel efficiency.

4. Low or no running emissions are one of the significant benefits of EVs

Comparing electric and hybrid vehicles to conventional ones, the former have dramatically less, if any, harmful emissions during operation. When operating in all-electric mode, PHEVs don't emit harmful tailpipe emissions; neither do all-electric vehicles.

Depending on the vehicle model and hybrid power system type, HEV emissions, and their respective benefits, can vary.

An electric vehicle's life cycle emissions are influenced by the source of the electricity that charges it, which varies by region.

Electric vehicles often offer a life cycle emissions advantage over comparable conventional vehicles running on gasoline or diesel in geographic areas where electricity is produced using relatively low-polluting or renewable energy sources.

However, electric vehicles might not significantly reduce life cycle emissions, in areas that rely heavily on traditional fossil fuel-generated electricity supply.

5. Battery life of EVs tends to be much longer than ICEs

Although the superior batteries in electric cars are built for long life, they will ultimately wear out. Several electric vehicle producers provide battery warranties of 8 years and 100,000 miles.

This makes sense since the battery is akin to an EVs fuel tank. So, they need to last as long as possible.

The National Renewable Energy Laboratory's predictive modeling shows that modern batteries might survive 12 to 15 years in areas with moderate temperatures (and 8 to 12 years in extreme climates).

Even though replacement battery prices can be pretty high, some manufacturers are providing extended warranty schemes for a monthly cost. Still, it could be expensive to replace the batteries if they need to be changed after the expired guarantee.

However, battery prices are anticipated to decline as battery technologies advance and production volumes rise.

Are electric cars better for the environment?

An EVs' life cycle (cradle-to-grave) was scrutinized in a 2012 peer-reviewed study published by The Norwegian University of Science and Technology to give you a birdseye view of the potential problem. It highlighted some very interesting and often overlooked issues with electrical car production.

We'll summarize their main findings below and then dig into some of the points in more detail later.

According to the study, using electric cars (EVs) with low-carbon electricity sources can reduce personal transportation's contribution to greenhouse gas emissions and exposure to exhaust emissions. However, as the study points out, It is crucial to consider "problem-shifting" issues when evaluating these sorts of things.

The production of the vehicle is also essential when comparing conventional and EVs, even though much research have concentrated on the use phase when comparing transportation options.

For this reason, the study created a transparent life cycle inventory of traditional and electric vehicles, made it available, and used it to evaluate both types of cars across several impact areas. They discovered that assuming a 'lifespan' of 150,000 km (which is likely very low - today's EVs are projected to have a lifespan of more than twice this), EVs fueled by the 2012 European energy mix offer a 10% to 24% reduction in global warming potential (GWP) compared to conventional diesel or gasoline vehicles.

Not bad, and things are looking great for EVs. But, of course, there is a catch. This improved carbon emission performance comes at a cost in other areas.

Remembers, there are never solutions to problems, only compromises.

For example, the study found that EV production can significantly enhance the impacts of human toxicity, eco-toxicity, eutrophication, and metal depletion.

Reported results on EV environmental impact performance at that time also tended to depend on assumptions about the type of electricity used, how much energy is used throughout different use phases, how long a vehicle will last, and when to replace the batteries. Assuming a vehicle lifespan of 124,274 miles (200,000 km), which is more realistic, but possibly still low, the GWP benefits of EVs rise to between 27 percent and 29 percent relative to gasoline vehicles or 17 percent to 20 percent compared to diesel vehicles, since manufacturing impacts are more significant for EVs than conventional vehicles.

The benefit of EVs compared to gasoline vehicles is reduced from 9 percent to 14 percent under the assumption of 62,137 miles (100,000 km). In this case, the environmental effects are the same as those of a diesel vehicle. Engaging in efforts to lessen the results of the vehicle production supply chain and encouraging clean electricity sources in decisions regarding electrical infrastructure would further improve the environmental profile of EVs.

So a bit of a mixed bag there.

Let's look at these highlighted issues in more detail, shall we?

How does electric car production affect the environment?

So for all the good stuff that electric vehicles provide, they come with high environmental costs. Let's look at a few of the most notable during an EVs production, use, and end-of-life stages.

1. Battery production and end-of-life processing

We covered the environmental impact of EV battery production in a previous article, but needless to say, it is not the best for the planet.

To summarize: -

- EV batteries require rare earth elements and minerals like lithium, cobalt, and nickel, which tend to be found in countries with substandard environmental and human rights regulations.
- The extraction of these minerals can require vast water consumption and energy, often resulting in severe pollution/ecosystem damage. This is especially the case for cobalt mines that can leach large quantities of sulfur into the surrounding environment.
- Some minerals, like cobalt, can also release delicate and toxic particulate matter into the air.
- At present, it is difficult and expensive to recycle EV batteries, so the resources they consume need constant resupply from nature.
- Because of the difficulty in recycling the batteries effectively, many older batteries are disposed of, locking away the energy/resource cost invested and further compounding potential land contamination.

Interestingly the United States Environmental Protection Agency (EPA) lists the environmental impact of EV battery production as a "myth." However, this verdict is based on carbon and greenhouse gas (GHG) emissions, not on other equally severe ecological consequences like those detailed above. As we said earlier, be careful to have more than a hammer when casting a skeptical eye on subjects.

However, the Biden administration has recently announced a $60m program for battery recycling that would create a secondary domestic supply chain for materials like lithium, independent of the mining supply chain. According to analysts Allied Market Research, the global EV battery recycling market is expected to grow from around $139m in 2017 to $2.27bn by 2025.

2. Assembling an EV consumes resources and generates waste too

Other than parts common to both EVs and conventional cars, the former also require a larger quantity of different electrical components other than those required for their batteries. Electrical motors, sensors, and associated electrical components also require large amounts of toxic minerals like nickel, copper, and aluminum.

Before they even hit the open road, EVs and conventional cars also use a lot of energy. Because so many materials must be produced before a new vehicle is ready for the road, such as steel, rubber, glass, plastics, paints, and many more, making both types of automobiles has a substantial environmental impact.

Similarly, an automobile's environmental impact continues long after its useful life is up. Products like plastics and metals might persist in the environment for a long time if not recycled.

Thankfully, junkyard pile-ups are getting considerably less frequent than they formerly were. Most steel frames and about three-quarters of the average car today can be recycled.

The environmental costs of production, recycling, and disposal are challenging to measure and are mainly outside most customers' control. It is important to stress that a similar ecological impact is also created by the construction of conventional ICE vehicles too.

3. EV production can result in air pollution, freshwater eco-toxicity, and eutrophication

According to an in-depth 2018 study from the European Environment Agency (EEA), emissions of SO2, NOx, particulate matter (PM), and other pollutants from energy use in component manufacturing and vehicle assembly are the primary sources of air pollution associated with the manufacturing of EVs (downstream of raw material supply).

The primary sources are the electricity generated in combustion facilities or burning fuels directly to produce heat or propulsion.

The exhaust fumes from these processes result in acidification, eutrophication, and effects on human health due to the SO2 and NOx components of these fumes.

Regarding human health, PM is the most dangerous air contaminant and can result in severe respiratory diseases.

According to the study, NOx, SO2, and PM emissions from EV manufacturing are 1.5–2.5 times greater than those from ICE production over the entire production process (including raw material supply).

However, it is essential to note that ICE vehicles contain a number of parts, such as catalytic converters, which are not needed in EVs, which are energy intensive to make and consume platinum group elements. Some of these are incredibly toxic. So, converting entirely to EV production will reduce pollution from manufacturing these parts.

4. EVs have some significant in-use environmental impacts

The first point is obviously that EVs require an electricity supply to "refuel." For most of the world, this is derived from non-renewable power plants that run on coal, gas, or oil.

These processes, like during the production stage of an EV, pump large amounts of GHGs, Nitrogen and Sulfur oxides, and PM into the air. We won't go into further detail on this as it has been done to death in many other studies and articles.

There are, however, other less considered in-use impacts of EVs that are worth discussing. One of the first is noise pollution.

While electric cars are quiet when driving at slow speeds, the noise they generate at higher speeds can be comparable to that of regular combustion-engined vehicles. This is due to the friction caused by the tires on road surfaces.

Another pollutant from EVs is the particulate matter from their braking systems. Again, this is comparable to ICEs, but newer systems like regenerative braking can offer important ways to reduce this. It is also important to note that EVs tend to be heavier than comparable ICE vehicles (due to the weight of their batteries), so the "pressure" on braking systems is relatively higher than traditional ICE vehicles.

Yet another critical consideration is the auxiliary power consumption (and, by extension, the need to recharge) can be more significant in EVs than compared to ICEs. This includes or systems like heating and air conditioning.

The impact on energy usage for most auxiliary systems, such as cooling air conditioning, appears to be roughly comparable across ICEs and EVs.

EVs must, however, use power from the battery to provide warmth, as opposed to ICEs, which can recycle engine exhaust heat. In one study, the heating increased energy consumption in a Nissan LEAF test by 40%, from 13.1 to 18.3 kWh/100 km (equivalent to 39–55 gCO2e/km under typical driving conditions).

Therefore, the efficiency advantage of EVs over ICEs is decreased in cold climates where heating of the cabin and other components is required.

5. EVs end-of-life might be a looming problem

As we have already discussed, EVs contain many potentially toxic chemicals that, if not appropriately treated when a car is scrapped, could be a ticking environmental time bomb. One of the main issues is, of course, the batteries.

The Guardian discussed this looming problem in 2021 when they reported that millions of electric car batteries would be retired in the next decade.

According to them, between 2021 and 2030, it's predicted that more than 12 million tons of lithium-ion batteries will be retired.

The manufacture of these batteries not only uses a lot of raw materials, such as lithium, nickel, and cobalt, whose mining has an influence on the climate, the environment, and human rights, but they also pose the threat of creating a mountain of electronic garbage once they reach the end of their useful lives.

To lessen dependency on mining and maintain materials in circulation, experts have warned that severe planning for what will happen to batteries at the end of their useful lives must be made before the issue manifests itself.

Whether this is effective recycling or, as most experts hope, reuse or refurbishment of the batteries. In fairness, this is also a problem for conventional lead-acid batteries in traditional vehicles, but the end-of-life processes for ICEs are very mature.

“There is a lot of [battery] capacity left at the end of first use in electric vehicles,” Jessika Richter, who researches environmental policy at Lund University, told the Guardian. While they are not helpful for EVs, they could be used for other things like excess solar or wind storage. Innovations in this area are expected to pick up pace in the next few years as EVs become more popular.

Other parts, like electrical motors, DC/AC converters, bodywork, tires, glass, wiring, etc., can be recovered and reused in much the same way as a regular car. Other parts, like lubricants, paints, oils, etc., are also a perennial issue for retired ICE vehicles but can also be handled in environmentally friendly ways.

Are there any genuinely zero-emissions cars?

The previously cited peer-reviewed life-cycle study comparing conventional and electric vehicles found that the claimed benefits of EVs in generating reduced carbon emissions appear to be somewhat overblown.

To begin with, the energy used to build an electric automobile, particularly in the mining and processing raw materials needed for the battery and other components, accounts for nearly half of the vehicle's lifetime carbon dioxide emissions.

This is unfavorable compared to the construction of a gasoline-powered car, which is responsible for 17% (as cited above) of the vehicle's lifetime carbon dioxide emissions (although this is partly because ICE vehicles emit a lot more CO2 over their lifetime, so the construction accounts for less of a much larger amount). A new electric vehicle (EV) emits 30,000 pounds (13,608 kg) of carbon dioxide before entering the showroom.

The comparable weight of CO2 used to produce a typical automobile is 14,000 pounds (6,350 kg).

The amount of power generation fuel consumed to recharge an EV's battery determines how much carbon dioxide the vehicle emits while on the road. It will produce around 15 ounces (425 grams) of carbon dioxide for every mile it is driven if this electricity is mainly generated by coal-fired power plants, which is three times more than a comparable gasoline-powered automobile. This will change as energy mixes incorporate greener sources like nuclear, traditionally cited solar, wind, etc.

But that would also require simple calculations on the life cycle carbon intensity of production for these energy generation systems. But that is a story for another time.

Suppose an electric vehicle (EV) is driven 50,000 miles (80,467 km) throughout its lifetime, regardless of the type of electricity used to charge the batteries. In that case, the EV will have released more carbon dioxide into the atmosphere than a comparable-sized gasoline-powered car that has traveled the same number of miles.

If the EV travels 90,000 miles (144,841 km) and the battery is charged at power plants powered by cleaner natural gas, it will emit 24% less carbon dioxide than a car that runs on gasoline. Although, as respected field experts like Bjorn Lomborg, that is a long way from "zero emissions."

And that is your lot for today.

As we have seen, EVs offer some significant advantages to ICEs throughout their lives. However, those advantages come with some important compromises that make them more polluting in some aspects of their production, use, and end-of-life stages not seen in ICE vehicles.

The need for large amounts of electricity through an EVs life cycle is probably the most significant, but, as most studies point out, this will likely reduce as the energy mix of electrical grids become more reliant on less GHG-intensive solutions like nuclear hydrogen or other.

It is also anticipated that as the EV market matures, similar recycling, reusing, repairing, and reclamation services common to ICEs will spring up as more and more people buy and use them. This will significantly reduce the need for virgin raw materials to make them in the first place and then provide replacement parts throughout their life.

Alternative technologies and materials will likely also be developed as replacements for "dirtier" components already in use.

So, for now, EVs offer some significant environmental benefits over conventional vehicles, but they are also more polluting in other areas. Unless these are also addressed, the so-called "rebound effect" of increased takeup and EV production might produce unforeseen environmental impacts that could easily be avoided.

But that will require some honest and fair conversations on the subject. This will be tricky in a world where policymakers are after quick fixes and lack the confidence to criticize the consensus.