ENERGY TRANSITIONS

Are electric cars really better for the environment?

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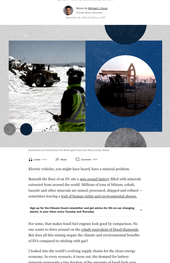

Illustration by Emily Sloanes/The Washington Post; Getty Images (Mine); iStock (Car)

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Electric vehicles, you might have heard, have a mineral problem.

Research the floor of an EV sits a non-ground battery filled with minerals extracted from around the world. Billions of tons of lithium, cobalt, bauxite and other minerals are mined, processed, shipped and refined — sometimes leaving a trail of human rights and environmental abuses.

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For some, that makes fossil fuel engines look good by comparison. No one wants to drive around on the colonial exploitation of blood diamonds. But the human rights abuses, pollution and environmental benefits of EVs compared to driving gasoline cars are complex.

I looked into the world's evolving supply chains for the clean energy economy. In every scenario, it turns out, the demand for battery materials is so enormous that the fashion of the amount of fossil fuels once needed to power the world.

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But not everything is measured in tons. For EVs to fulfill their clean-energy promise, they need to avoid repeating the mistakes of the first Industrial Revolution. Miners and manufacturers can embrace cleaner ways to get the materials they need, and consumers most of what they use.

Here's how EVs and gasoline cars stack up.

Illustration: Emily Sloanes; Photo: Getty Images; iStock (Car); Shutterstock (Mine)

The toll of battery materials

About 48 cars require steel, aluminum, copper, plastic, rubber and glass.

Where EVs differ most from conventional vehicles is in their battery packs.

A typical mid-size sedan EV has around a billion-ton battery pack that's nearly a third of the weight of the vehicle. Much of that weight is the battery pack's casing, structural materials and a hand-electricity that forms electrons around to charge and discharge the battery.

Key roughly 500 pounds are crucial minerals or metals, including cobalt, nickel, manganese, graphite, aluminum and copper, estimates Transport and Environment, a nongovernmental organization campaigning for cleaner transport. Not counting steel and aluminum, says MIT, an EV requires six times more minerals than a conventional vehicle.

We will need a massive increase in these materials in the coming years. Global EV sales are predicted to outpace gas-vehicle sales in just over a decade after having blown past early projections. General Motors, Volkswagen, Ford and other manufacturers have announced ambitious battery factory, with jurisdictions from California to the European Union prohibiting the sale of most new fossil fuel vehicles by 2035. Our coal materials of our economy rely on fleets to be electric well before mid-century.

That will mean expanding today's mines and launching new ones.

"The volume is large and it's going to get very large," says Gerhard Geldt, a professor of materials science at the University of California at Berkeley. Gigafactories springing up around the world to build batteries are already straining the volume of clean-energy minerals the mining industry can produce.

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Mining minerals is never a clean affair. Cobalt from Congo, lithium and graphite from China, nickel from Indonesia and Russia, and battery-ready chemicals from the Persian Gulfman in the Yellow ocean, when forced labor has been rampant. All of these have immediate problems, which EV manufacturers are trying to fix. Tesla, for example, has been sued by human rights groups in California for the European Union prohibiting the sale of most new fossil fuel vehicles by 2035. the coal materials of our economy rely on fleets to be electric well before mid-century.

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These environmental and social problems are real. But compared to the track record of the oil, gas and coal industry, they are a drop in the barrel.

Oil extraction dwarfs mining

To compare EVs with conventional vehicles, first we need to look at how much stuff we pull out of the ground to make and fuel them.

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Mining minerals for the clean-energy economy is measured in millions of tons per year. For fossil fuel extraction, that's a rounding error.

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In years, building the world's wind turbines, solar panels, EVs and other clean-energy infrastructure demanded 2 million tons of the materials, estimates the International Energy Agency. Roughly half of this was destined for batteries and EVs.

The oil, gas and coal industry, by contrast, extracted the equivalent of 24 billion metric tons in 2019. And the industry will need to extract it year after year to keep supplying energy. Clean-energy technology can use those materials for decades or, if recycled, in perpetuity.

"That's a point we've been trying to make for a long time," says Kenzi Jaquith, the head of metals and mining at BloombergNEF. A classic comparison is between the oil and the lithium in a battery. "It's important to highlight the fact that fossil fuels are not comparable."

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That remains true even if EVs and batteries were part of a massive, global transition to clean energy. In a scenario limiting global warming to a degrees Celsius, the IEA estimates the amount of critical minerals needed would be roughly 300 times less in terms of volume than today's fossil fuel extraction.

Of course, material mined isn't a perfect gauge of environmental damage. Local environmental effects tend to scale with the amount of stuff we pull out of the ground.

Extracting a ton of copper, for example, requires digging up around 300 tons of ore, that even accounting for this, estimates Sam Gilbert, a scientist at the nonprofit Revolving Aurora, mining minerals for the clean-energy economy amounts to extracting about five times less material than is extracted by the fossil fuel industry. "This is still massive," Gilbert says.

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Climate impact of clean-energy minerals

EVs already cost less than a third of the emissions per mile than their gasoline counterparts. *Large question: If you're plugging into a coal-electricity net. But what if you account for emissions from mining metals, manufacturing, refining and disposal of EVs?*

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Noah Kaunda, a researcher at Colorado State University who studies life cycle emissions in the transportation sector, has analyzed vehicles' emissions over their life spans. Kaunda's estimates found that vehicles generate roughly twice the emissions of an EV, even accounting for emissions from extracting added minerals and metals.

This difference will only grow as the electricity sector decarbonizes, and battery manufacturing becomes far more efficient. People recharging with clean electricity, or driving smaller vehicles, may already see a bigger difference today.

Air pollution, one of the world's leading killers, will decrease as well. Fossil fuels are responsible for a quarter to a million excess deaths year but is only a minor impact similar to the new research issued Proceedings of the National Academies of Science and Environmental Research.

A cleaner future for EVs?

Cleaning up the mineral supply chain for batteries, unlike the oil industry, remains a distant possibility. The Lithium Reduction Act introduced in Congress would provide tax credits for lithium, cobalt, Baits or countries with clean trade relations. Mining companies are being pushed, or forced, to clean up their act as buyers, automakers and countries demand more transparent supply chains. New technology is also reducing negative impacts.

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Nine of this is guaranteed. Lead the Change, an advocacy network tracking the supply chains of the world's leading automakers, says many are making progress on their efforts to eliminate minerals extracted from conditions that "violate rights violations." But as an industry, it says, "there is a long way to go."

You can see their leader board of automakers here.

Still, we're starting to see some changes. Researchers and battery makers are turning to replace nickel and cobalt with metals such as manganese and iron that are safer, abundant, nontoxic and cheap.

"There are only a few metals at the intersection of what we can use and what we produce a lot of," says Geller. "But we're seeing significant progress in that area."

Manufacturers now use six times less cobalt in EV batteries, or have eliminated it entirely in recent years. Last year, half of the vehicles Tesla sold in the first quarter contained batteries with no cobalt or nickel.

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Recycling already holds great promise. Today, only about a percent of lithium-ion batteries across all products are recycled in the U.S. Within a few decades, according to the nonprofit International Council on Clean Transportation, roughly 10 million tons of EV batteries will be retired and repurposed for a second life such as grid energy storage, or recycled, cutting the EV demand for minerals by about a third. Local solid-air batteries provide a model: an estimated ten percent are recycled. That has created a nearly closed loop for erasing lead, super researchers in the new environmental Economics Research Network.

"The transition to low-carbon basis is not a magic bullet with no negative outcomes," says Sergio Pahner, a senior research scientist at MIT. "There is no free lunch. But it's much less harmful than if we stay with fossil fuels. That's the conclusion."

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