All the arguments against EVs are wrong

EVs are just going to win.

NOAH SMITH

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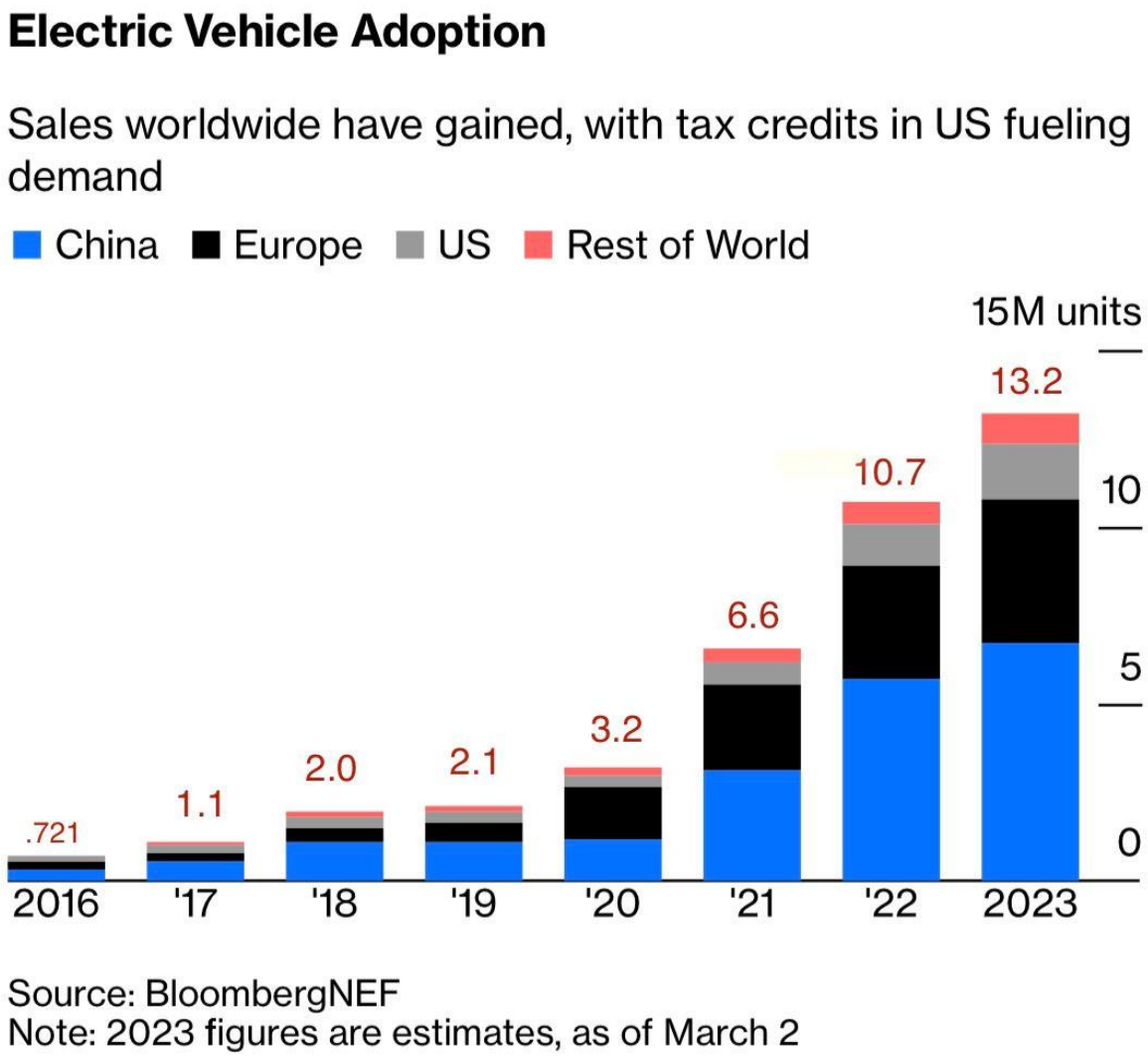
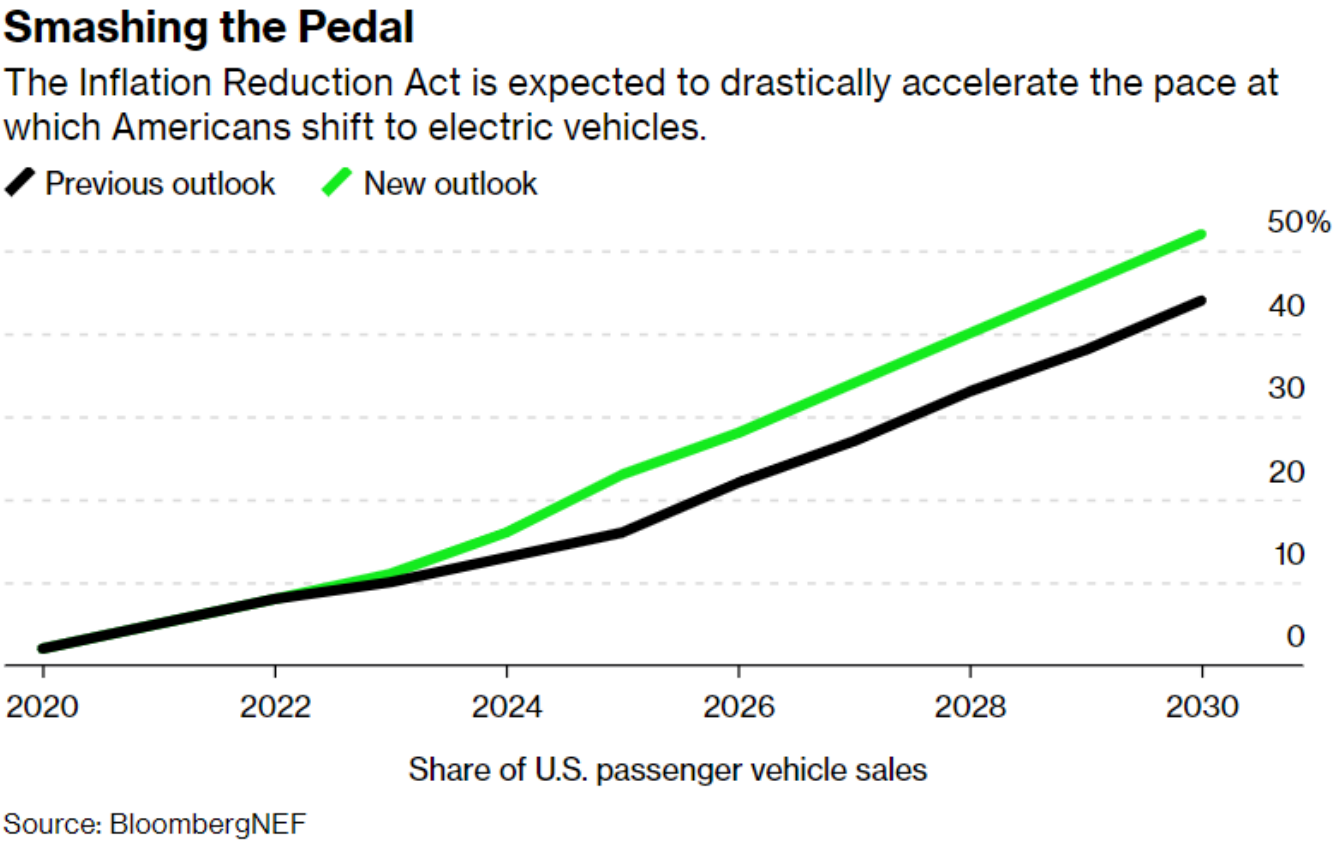
Photo by Adrian N on Unsplash

It’s time for another techno-optimist post! Instead of an as-yet-unproven technology like green hydrogen or battery-powered appliances, today’s post is about a technology that’s already taking over the world: battery electric vehicles, commonly known as EVs.

Electric vehicles are already taking over the world. You’ve probably seen charts like this, showing skyrocketing EV sales:



And you've heard about the tens of billions in spending on charging infrastructure around the world. Bloomberg New Energy Finance forecasts that half of all U.S. car sales will be electric by the end of this decade…and the U.S. is lagging *behind* China and the EU in EV adoption.



Another thing this chart shows — despite the subtitle — is that the impact of government subsidies on the transition is actually pretty modest. The reason EVs are taking over is that *the technology improved* — between 1990 and 2010, our scientists figured out how to make lithium-ion batteries about 2.5 times as energy dense, and then we scaled up factories and figured out how to make batteries much more cheaply, causing battery prices to fall 97% between 1990 and 2018. That's pretty much the whole story. When a new technology becomes cheaper than the old one, and can do all the same stuff, people switch to the new technology.

That's very good news, for two reasons. First and foremost, the EV revolution will help save the planet's environment, because it'll allow us to electrify most of transportation, which accounts for about a quarter of global CO2 emissions. Second, it'll give us cheaper transportation than before, which will boost economic growth and make life easier for lots of people; EVs will be part of the new age of abundance.

That's the basic story, which of course you've heard before. But circling around the EV triumphalism are a number of criticisms and pushbacks and uncomfortable questions. Some on the political right are still suspicious that EVs are a government-subsidized scheme to reduce their standard of living, while some on the left worry that EVs will cause exploitation and environmental destruction and suburban sprawl. And pretty much everyone is asking whether the world has enough minerals to complete the transition.

Now, to be clear, I don't think these criticisms and doubts have any chance of stopping the EV transition; at worse they might slow it in the U.S. a bit, causing the country to fall behind China and Europe. Ultimately everyone who drives is going to drive an EV; the simple logic of cost, and the reverse network effect from gas stations becoming unprofitable and disappearing, will push the transition to completion. But I think it's worth addressing the criticisms and calming the fears. Many of these arguments have already been tackled by people like Hannah Ritchie, whose excellent Substack you should read, Zeke Hausfather, whose research you should follow, and several others. But I thought it would be useful to have a summary in one place.

Won't we run out of minerals?

This is obviously the most pressing concern, because if we don't have enough raw materials to actually make all the EVs we're planning to make, then that's the kind of glaring technological flaw that could bring the whole enterprise grinding to a halt. Batteries use a *lot* of metals, and some of those metals will also be in higher demand from the shift to solar and wind power, making supply especially tight. The world is going to have to scale up mining in a big way, which has raised some worries that the EV transition will be scuttled by resource bottlenecks.

Nor are those worries solely the province of cranks and ideologues — Simon Michaux of the Finnish Geological Survey has actually done extensive research raising doubts about the world's ability to produce enough lithium, nickel, cobalt, and graphite to electrify the transportation sector. He recommends abandoning decarbonization and embracing degrowth.

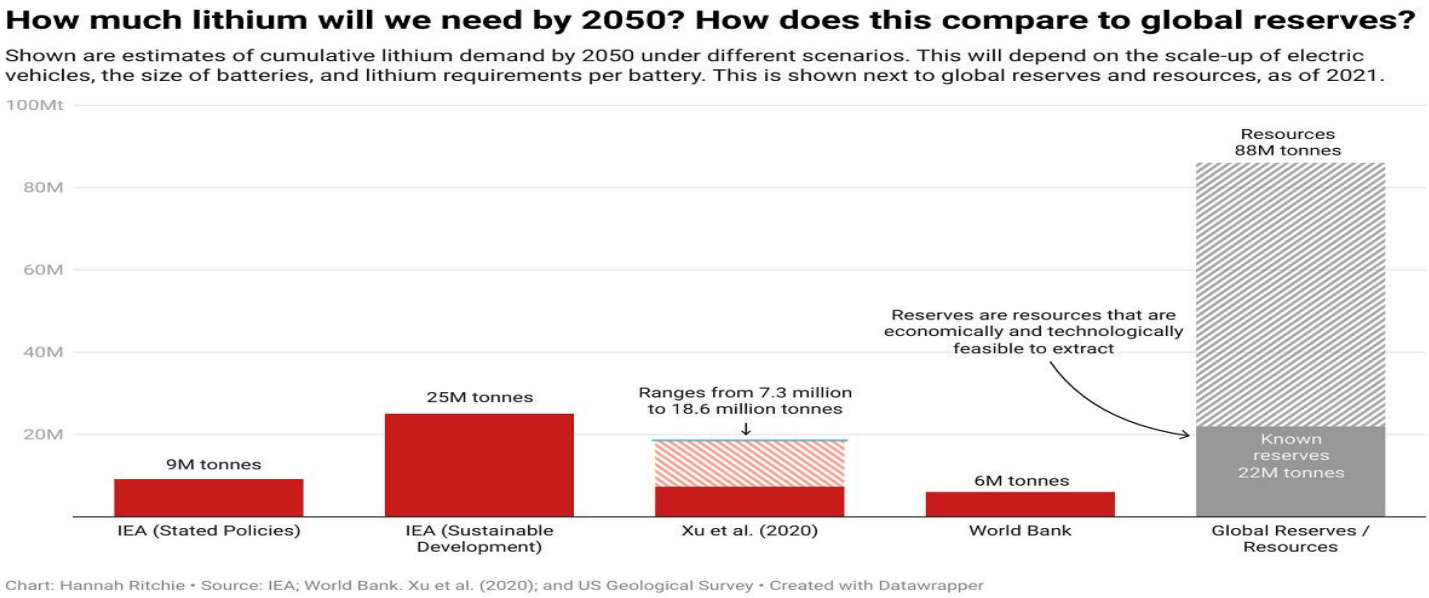
However, a closer look shows that Michaux's assumptions are deeply flawed. Auke Hoekstra, director of the interdisciplinary climate research program Neon Research, has a good thread debunking the assumptions. Michaux thinks most of the world's batteries will be used for power storage, leaving nothing left over for transportation; in fact, most researchers believe that the world will need orders of magnitude less storage than Michaux believes, and the batteries we use for that storage will not actually be the type that uses nickel and cobalt.

Anyway, it seems that while nickel, cobalt, graphite, and some rarer minerals will require big investments in mining, most people in academia and industry are only really worried about one metal: lithium. The current amount of lithium reserves is worryingly close to the total that we

might need to electrify transportation, and of course there will be competing demands for lithium from power storage, robots, appliances, and other applications.

But there's good reason to think that we will have enough. Hannah Ritchie explained why in an excellent post back in January.

Basically, there are two reasons why we have a lot more lithium than many people realize. The first is that lithium *reserves* are only the amount that we've already located *and* which are economically feasible to extract right now; total estimated *resources*, which includes the amount we think is out there, are about four times as high. When we look at resources instead of reserves, things begin to look a lot more comfortable:



Source: Hannah Ritchie

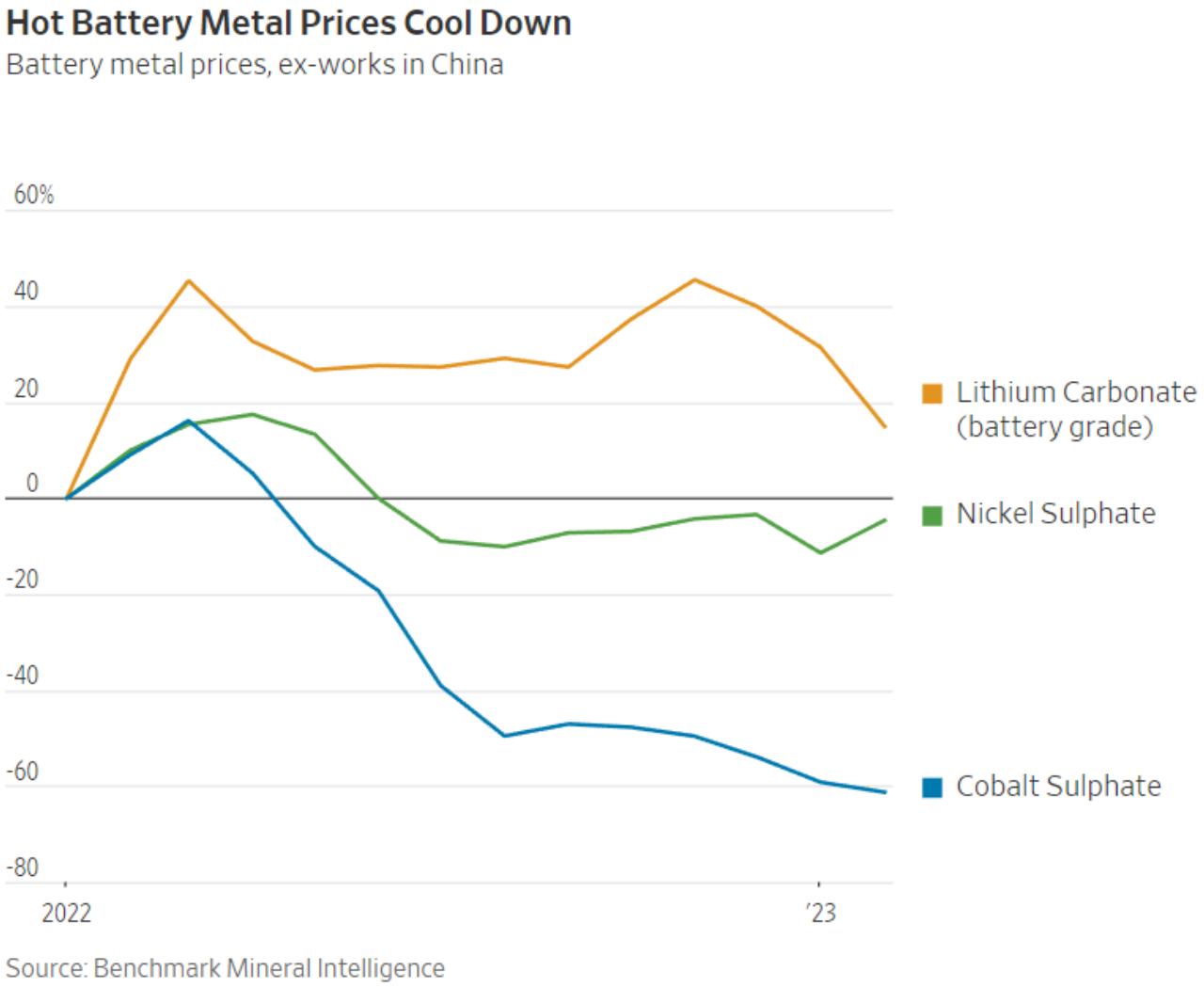
What's more, the amount of estimated lithium resources has continued to increase over time. In 2008, total global resources were estimated at just 13 million tons; now that number is 88 million tons. Chances are it will go higher. Reserves will increase, too; in 2008 they were just 4 million tons, and now they're at 22 million.

The reason these numbers keep going up is that we keep finding new lithium deposits, and we keep improving our ability to extract lithium. And the reason for that is demand — as the energy transition gathers force, everyone who explores for lithium and everyone who mines lithium knows that we're going to need a lot more, so they find ways to get more. *Price doesn't even have to go up* in order for this to happen; often, producers simply know that they'll be able to sell larger volumes in the future without *cutting* prices.

Another way of putting this is that the reason we didn't think we had that much lithium before was that we didn't know we'd need so much, so we never bothered to look.

Of course, we can never be 100% sure that the magic of the market and the awesome power of human ingenuity will overcome any and all resource constraints. But when resources rise by 7x and reserves 13x over a decade and a half, I think it's fair to say that we probably haven't reached the end of our rope when it comes to lithium.

In fact, despite the massive ramping up of demand for batteries, we already see the market responding. Prices for lithium, nickel, and cobalt ore rose in early 2022 but have fallen recently — partly because of China's slowdown, but partly because of investments in greater mining capacity, and partly because we started switching to batteries that don't use cobalt.



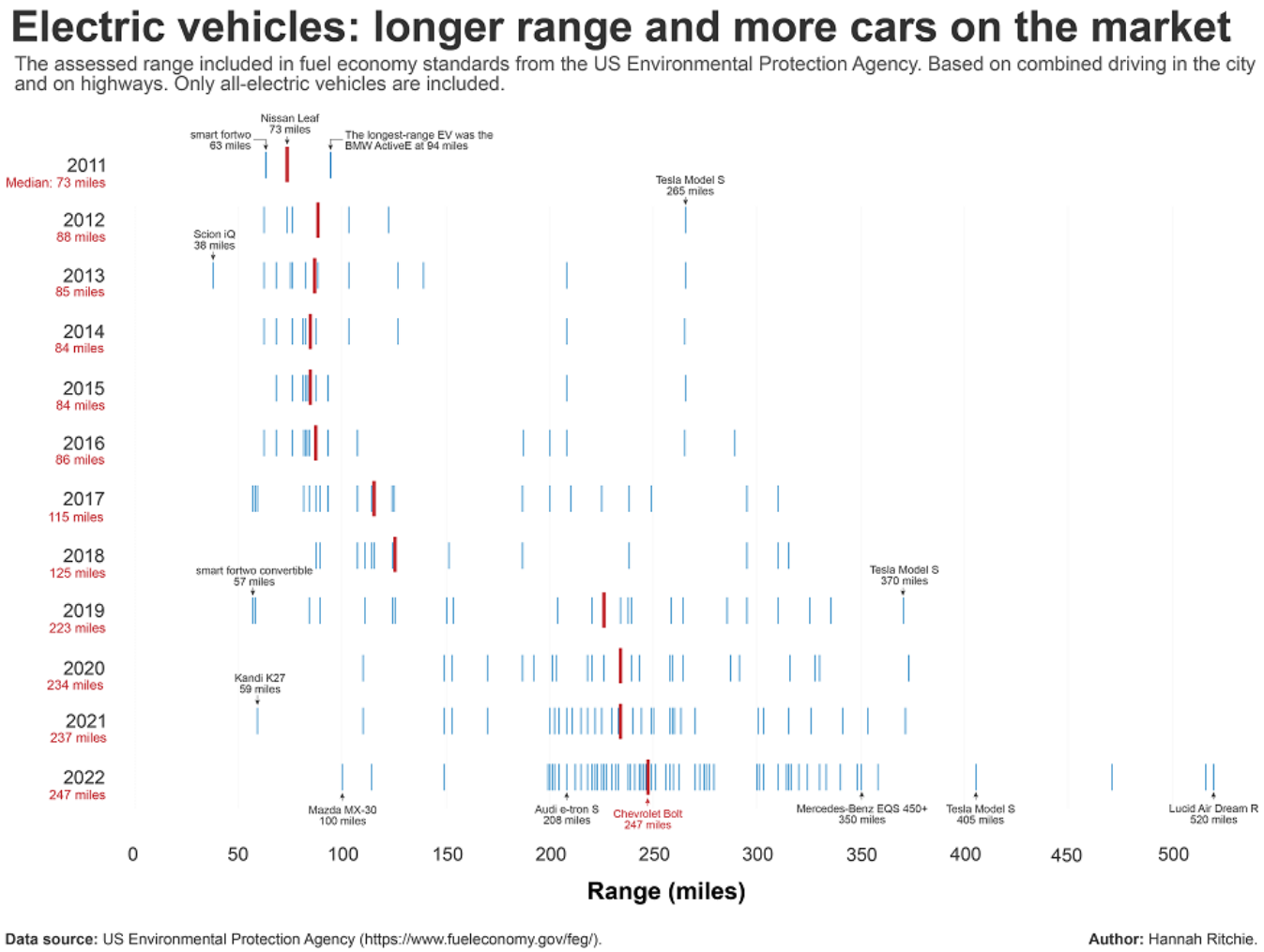
Source: WSJ

In other words, although the world is going to need to make big investments in mining capacity in order to switch to EVs, there's no reason to think we won't be able to pull it off.

What about range anxiety?

Until very recently, EVs had relatively short ranges. This made people worry that if they had an EV, they'd run out of charge on the road and be stranded. That's especially a worry in a country without many charging stations. And even if the stations existed, charging up takes a lot longer than filling a gas tank.

But two big things have changed over the last five years. As Hannah Ritchie notes, EV ranges have just exploded since 2018, with almost all vehicles getting over 200 miles per charge, and many getting over 300 miles:



Source: Hannah Ritchie

Range has increased for two reasons. First, carmakers just put in bigger batteries. But they've also managed to improve the efficiency of the cars' motors and other energy extraction machinery quite a lot, which means they can go a lot farther with the same amount of energy. Companies are now promising 500-mile ranges in the near future, which would be as good as a gas car.

The second thing that has changed is that there are a LOT more charging stations than before. A map of charging stations across the U.S. shows that there are very few areas left with no

stations, and the Inflation Reduction Act is going to add a lot more. So the chances of being stranded in your EV have really dwindled to a very low level.

That leaves just the minor annoyance of having to wait to charge your car. Charging is a lot slower than pumping gas, so if you take your EV on a long road trip, you might have to go eat or hang out at the rest stop for 20 minutes. But for almost everyone, this occasional minor annoyance will be far outweighed by the fact that with an EV, *you almost never actually have to go to a charging station, ever*.

EVs charge at your house. So if you drive less than the EV's total range each day, you'll actually never have to fill up your "tank" — you just plug it in overnight, and in the morning it's full and ready to go. That's something you can't do with a gas car! Except on long trips, you'll be forever freed from the regular, tedious task of filling up your car every few days.

So instead of increasing people's anxiety over their car's fuel level, EVs will actually *eliminate* that anxiety for all but a tiny handful of long-distance road-trippers.

Don't EVs release a lot of carbon?

EVs will soon be a better experience for drivers than gas cars in every way that matters, if they aren't so already. But of course one of the biggest selling points of the EV revolution is that it'll cut carbon emissions. And one of the biggest knocks on EVs is that while they don't burn gasoline, they do *indirectly* release some carbon into the atmosphere. They do this in two ways:

1. EVs use power from the power grid, which often burns fossil fuels to produce electricity.
2. Building EVs and EV infrastructure requires energy, which often comes from fossil fuels.

By some calculations, the largest electric vehicles emit as much carbon per mile as the smallest gas-powered cars.

So, first of all, if the biggest and heaviest EVs emit only as much carbon as the smallest and lightest internal combustion cars, that's already a huge environmental win for EVs. On average, EVs currently cut carbon emissions in half relative to gas cars, and over their lifetime this number goes up and up. The reason this is true, btw, is that EVs are much more efficient than gas cars in terms of converting energy into motion, so even if they're indirectly burning fossil fuels, they're burning less. We could just leave it at that and call it a day.

But in fact, EVs will be *even better* for the climate than they currently appear. One reason is because as the grid shifts to solar and wind, less and less of the energy that powers electric cars, and goes into making electric cars, will come from burning fossil fuels. The second reason is that as the country shifts to electric cars, less of the energy that goes into making an electric car will

come from burning gasoline to drive workers around. And the third reason is that EV infrastructure is a one-time expense — once you build it, that source of emissions is mostly over, except for upkeep. In the very long run, EVs and their infrastructure will be totally zero-carbon.

In other words, the idea that EVs are actually bad for the climate is a complete canard.

Doesn't mining minerals for EVs exploit poor countries?

Now we get to the main leftist critique of EVs, which is that they will lead to the exploitation of poor people in the countries that mine the resources. This is thought to happen in two ways:

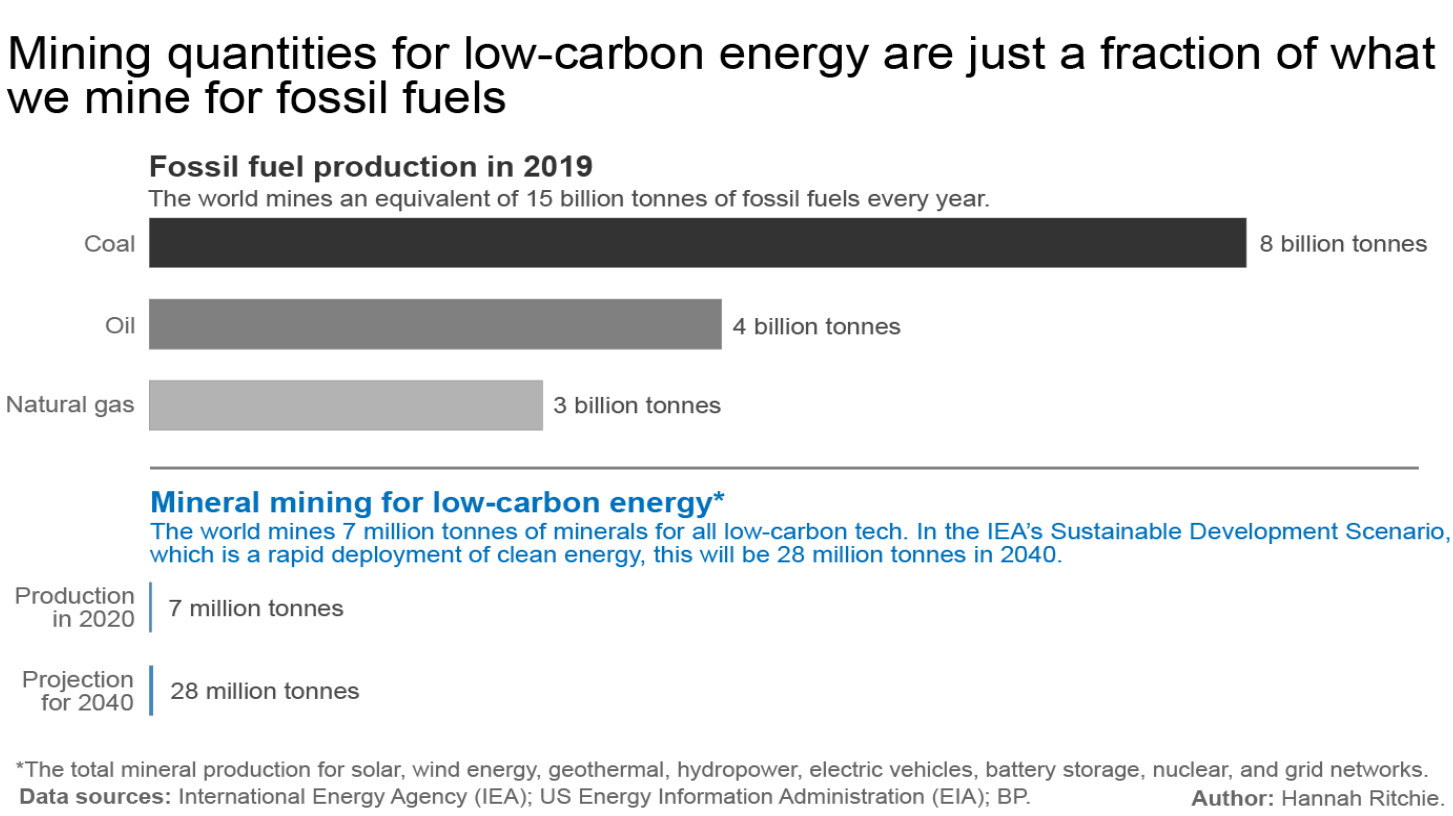
1. Poor miners will be exploited, and
2. Communities near to the mines will experience environmental harm via industrial runoff from the mines.

A key example of the former is how quasi-slave labor in the Democratic Republic of Congo is used to mine cobalt, which is used in electric cars. And there are many examples of industrial pollution from lithium and copper mines.

But there are at least two big problems with this argument. First, extracting and exporting mineral wealth is the main economic activity that many poor countries *do*; it is what supports them at more than a subsistence standard of living. Demanding that rich countries refuse to buy minerals from poor countries on humanitarian grounds would actually just impoverish those countries, with the blow falling hardest on the poor and marginalized. In fact, in the mid 20th century leftists spent decades arguing that poor countries should get a *better price* for their mineral exports (and this, unlike degrowth, was largely a good idea). Having rich countries refuse to buy those exports would be the exact opposite — a moral blow to Earth's most vulnerable.

Second, we shouldn't compare the exploitation and pollution of EV mineral mining to some imaginary degrowth utopia where everyone becomes a subsistence farmer with no need for lithium or cobalt. That is simply fantasy-land. Instead we should compare it to *the economic system we have now*. The system we've set up to extract coal, natural gas, and oil is far more exploitative and damaging to the environment than a system based on EV mineral mining.

Even taking into account the quadrupling of mineral demand that will be necessary for the green energy transition, the amount of mining that goes into extracting fossil fuels is just orders of magnitude larger than what we'll need to do to make EVs. We're talking millions vs. billions here.



Source: Hannah Ritchie

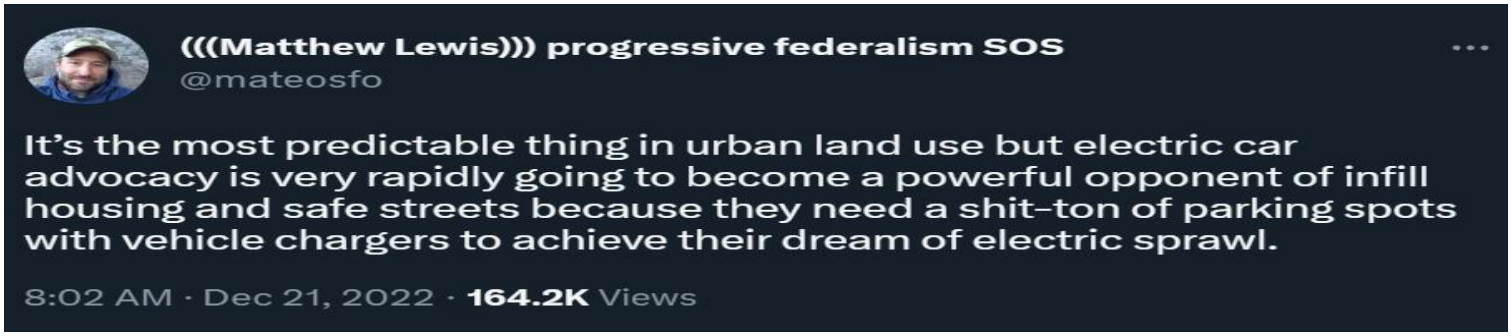
It's fine to complain about the environmental harms from lithium and copper mining, but we need to put these into perspective here. Even without considering climate change, the total global environmental harm from extracting billions of tons of oil a year is significant. And, uh…you really should include climate change. The whole point of transitioning to EVs is to save the planet from changes that will do, to put it mildly, a *lot* more harm to both poor communities and natural habitats than all the lithium and copper mines ever created.

The leftists who treat EVs as just another capitalist monster are thus playing directly into the hands of the people who want to go on using fossil fuels and ignoring climate change. The alternative to EVs isn't some pastoralist fantasy where we all grow our little sustainable gardens and sing songs all day; it's a world that keeps on digging up and burning billions tons of petroleum per year.

Yes, we should try to stop labor and environmental abuses in resource-mining nations. But we shouldn't let worries about those abuses prompt us to commit *far greater crimes* against the poor and against the global environment.

Won't EVs just entrench suburbia?

The final major argument I've seen against EVs is that they'll entrench America in a car-centric suburban development pattern. For example, climate pundit and urbanist Matthew Lewis writes:



And urbanist Sam Deutsch writes:

From a geometric standpoint, dense cities are simply incapable of accommodating mass car ownership, and cities built around cars are less pleasant and more sprawling. Shifting to EVs without denser, pedestrian/transit-oriented land use will exacerbate trends of suburban sprawl, leading to more traffic, expensive rents, and unpleasant urban areas.

I'm no fan of suburban sprawl, but I think the urbanists should take a few points into account.

First of all, Europe is one of the leaders in EV adoption. Europe's development pattern is much less car-centric than the U.S.', and I don't expect the advent of EVs to turn Europe into Southern California anytime soon. So it's far from clear that the political economy of EVs pushes countries toward car-centric suburbia; if anything, it probably leaves things unchanged.

A second, related point is that even the densest, most transit-centric countries in the world actually have a ton of cars. People use trains somewhat more and cars somewhat less in Japan or the Netherlands than in the U.S., but car ownership is still extremely widespread. So any hope of phasing out cars as a major mode of transportation is probably in vain.

Third, although I personally am not a huge fan of suburbia, Americans in general love it. Right now, Millennials are moving to the burbs en masse, much as their parents once did. Trying to hold back the progress of EVs would do precisely nothing to stop this trend, so seeing EVs as a culprit here makes little sense.

Given Americans' enduring demand for leafy streets and large houses, what we have to do is make suburbia denser and more efficient by adding missing-middle housing, commuter rail, and dense development next to rail hubs. We should also take advantage of the EV revolution to add electrified buses, e-bikes, and other alternative modes of transportation to make suburbs easier to get around. But we simply aren't going to rip up the suburbs and turn the country into Hong Kong anytime soon.

Anyway, these are the main arguments I see against the EV transition, and as far as I can tell, they all clearly miss the mark. (There's also the question of whether we can build enough transmission

lines to charge our EVs, but in fact I'm not worried about this; if anything, widespread EV ownership will create more political will to build the transmission lines we need anyway.) The EV revolution is simply a clear-cut case where the human race invented a better technology than what we were using before, and now we're going to switch to that better technology. Electric vehicles are going to win; just sit back and watch.

Update: A few people have also claimed that because EVs are generally heavier than gas cars of similar sizes, this represents a danger to pedestrians. In fact, as former physics teacher Andy Masley explains in great detail, weight itself makes relatively little difference here, and the increased danger to pedestrians from large vehicles is almost entirely from their greater height rather than their greater weight. Basically, any car is already so much heavier than a human that making it even heavier doesn't do much; if you're hit by *any* car, it's basically like hitting a brick wall.

Meanwhile, David Roberts has a thread in which he argues that an excessive focus on EVs could detract from a focus on reducing sprawl. I guess I can't show you data rebutting this hypothetical, but I can definitely say that I have never heard anyone claim that because we have EVs, we don't need to change our land use patterns.