THE MYTH OF THE GREAT "ENERGY TRANSISTION"

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For those who profess the belief that a great "energy transition" is underway, Tesla is the talisman. And why not? No single product that we use in everyday life consumes more energy than a car. The furnace in the average home basement is a distant second, and there are far more cars than homes. The car, with its ubiquity and importance, epitomizes how and why energy is used everywhere. It also epitomizes just how difficult and expensive it will be, and just how long it will take, to see any grand "energy transition" away from fossil fuels, regardless of politicians' promises, and regardless of the outcome of the Nov. 3 election.

Consider California, the self-appointed leader of a world in transition, and its plans to accelerate the charge to the "new energy" future. Last month, California's governor made the bold move of banning the sale of internal combustion engines by 2035, requiring that *only* electric cars be sold. The Democratic Party's platform is slightly more diplomatic, promising to "ensure" that 100% of new car sales are electric.

Neither Democrats nor other policymakers around the world could aspire to such a future without Elon Musk's much-celebrated achievements with Tesla. In the eight years since the Tesla S first went on the market for $60,000, America has gone from zero to 1 million electric cars on the road. Notably, nearly half are in California, where only 10% of the country lives. The rest of the world has gone from near zero to 6 million battery-powered cars in the same period. Seventy-eight percent of *every* electric car sold last year in America was a Tesla, even though there are some three-dozen models of electric cars available. If you exclude China, Tesla accounted for nearly 50% of the non-U.S. total. As one wag put it, people aren't buying electric cars — they're buying Teslas.

Despite that amazing growth rate, electric vehicles constitute just 0.5% of the domestic vehicle fleet. The share is similar worldwide. Still, EVs will get cheaper, and governments will likely *increase* mandates or subsidies. People may even buy non-Teslas. (Without generous federal emissions credits, Tesla would still be light-years away from actually making a profit.) So, it's worth considering what a complete switch to EVs might mean.

Assume that California's citizens comply so that after the 2035 deadline, all the state's 15 million cars are battery-powered. That would lead to, at best, a 0.3% reduction from today's global consumption of hydrocarbons. What if we think more expansively and assume that the most optimistic forecast actually happens and that there are 500 million EVs on the roads by 2040? That would constitute a remarkable one-third of all cars by then. But since cars account for only about 30% of petroleum use, the arithmetic for that scenario works out to a less than 10% reduction in world oil demand and a far smaller reduction in global carbon dioxide emissions.

This is because there are just so many other things and activities that use energy. As Fatih Birol, the head of the International Energy Agency, told the World Economic Forum this year, "to say that electric cars are the end of oil is definitely misleading." The IEA is no reluctant skeptic of the "energy transition"; it is an unabashed booster.

The point of this kind of exercise is not to argue that electric cars aren't viable (they are), nor to dispute that there will be many more of them (there will). The point is the broader implication for energy policy writ large: The constant drumbeat about a rapid "energy transition" ignores the sheer scale of the infrastructure and materials associated with fueling all vehicles, never mind all of humanity. And given the real possibility of a federal "Green New Deal" in one form or another, we're overdue for thinking seriously about the economic, geopolitical, and environmental consequences of pursuing such a deal.

Let's stick with the car challenge. The actual net effect on carbon dioxide emissions associated with using EVs depends on how the electricity is produced, where the batteries are fabricated (as opposed to where the components are assembled), and where the necessary "energy minerals" are mined. The latter two considerations are often ignored when "new energy" benefits are calculated.

Fundamentally, replacing a standard car with an EV is a swap from using a liquid as the primary energy source to a mélange of solid materials. A single EV battery weighs in at about 1,000 pounds. Its fabrication requires digging up roughly 500,000 pounds of materials somewhere. That constitutes a greater-than-tenfold increase in the quantity of material (liquids) that is used by a standard car over its entire operating life.

Some of those EV materials are the rare-earth elements such as neodymium that have been in the news in recent years. China supplies about 90% of those for the world. But the issue is far broader than that. There are many other, more familiar elements needed, such as copper and nickel. An average EV uses twice as much copper as a conventional car, and the demand for nickel for batteries is forecast to rise 1,500% in the coming decades. Such mineral demands have consequences.

This past summer, the world experienced, to nearly no media attention, an example of the environmental realities involving the battery supply chain. An accident at one of the world's biggest nickel mines in Siberia caused a 6 million-gallon oil spill. That's almost as big as the infamous 10 million-gallon Exxon Valdez spill of 1989, in a similarly delicate northern ecosystem.

The mining industry necessarily uses oil for heavy machinery, often to generate electricity in remote locations. Global mining already uses nearly twice as much petroleum as the entire country of Germany, and that's before the emerging "gold rush" for energy minerals. The global push for EVs will drive up demand for a variety of other energy minerals from 200% to 8,000%. Mining can be done responsibly, but new mines aren't likely to open in America or Europe. Consequently, a handful of environmentalists have begun to worry about the invasion of pristine and fragile ecosystems around the world in hot pursuit of mineral wealth.

None of this says anything about how we will obtain the electricity needed to charge up the batteries for EVs. California's and every other "Green New Deal"-type plan is to use far more wind and solar hardware. Again, if digging up the earth is a measure, building wind and solar machines requires at least 10 times the amount of materials that building standard power plants does to produce the same quantity of energy. The only materials that will be domestically sourced are low-value concrete, stone, and some steel. The United States is, in general, 100% dependent on imports for 17 critical minerals, including those used in green machines, and over half of our domestic needs are imported for another 29.

And if we don't import the green minerals, we'll import products made from them. At the moment, America imports 90% of solar panels and 80% of the key power components of wind turbines. Asian companies utterly dominate global production of batteries. Tesla's Nevada factory and other aspirations for domestic fabrication directly or indirectly import essentially all preprocessed materials such as graphite and cobalt. And all that overseas fabrication uses energy: The equivalent of 80 to 300 barrels of oil is needed, for example, to fabricate a battery that can hold a quantity of energy equivalent to only *one*barrel. Since electricity is a big share of that energy, it's relevant that two-thirds of the world's supply of kilowatt-hours comes from burning coal and natural gas.

This means that buying green-machine components is essentially an export of both jobs and hydrocarbon consumption. Nonetheless, all EVs and all wind-solar is the stated goal in California. It's also a key plank in the Democratic Party's energy plan, as it is with many states and governments around the world. This is magical thinking. For example, in 2018, the Netherlands's government sponsored an analysis of mineral demands associated with its own green energy goals. The study concluded that following a "Green New Deal"-style plan in the Netherlands would require the country alone to consume a major share of current global minerals production. And the Netherlands has just half of California's population. It also concluded that an "exponential growth in [global] renewable energy production capacity is not possible with present-day technologies and annual metal production."

For the U.S., the practical effect of implementing a Green New Deal would be a complete reversal of import dependencies. America is essentially self-sufficient in petroleum and a net exporter of natural gas as a direct consequence of the shale-fracking revolution. But virtually all of the new demand for "energy materials" will come from imports, either directly or indirectly in the form of the green machine hardware and components manufactured elsewhere.

This is to say nothing of economics. All the facts above are simply the physical realities of existing technologies and global supply chains. As for what seems like a daily news feed about energy “breakthroughs” in the lab, it bears noting that any plans put into motion now will necessarily use current technologies, not things that will purportedly emerge in coming years. There will be economic consequences to shifting from domestic energy supplies to imports.

Even if the green alternatives were equal in cost to hydrocarbon machines — and they’re not — mandates to buy battery-powered cars, install wind and solar farms, or require electricity use for heating water and air in homes all have the practical effect of banning fracking. Some policymakers, such as Sen. Bernie Sanders and Rep. Alexandria Ocasio-Cortez, propose an outright ban of U.S. fracking by 2025.

If they have their way, there is no scenario in which enough green machines and energy minerals could be imported fast enough to fill the gap. Oil and gas supply 69% of America’s energy, while wind and solar together supply 4%. A ban would simply mean either shortages or more imports, or both. And in due course, it would also trigger a more rapid, and possibly unprecedented, oil price spike once the post-COVID recovery is rolling. Both OPEC and Russia would appreciate such an outcome.

The economic fallout from global pandemic shutdowns caused the biggest drop in energy demand since World War II. But economies everywhere will recover eventually. When supply and demand are mismatched significantly, we see wild swings in prices. (This is a reality for all commodities, including green energy minerals.) We saw the effect of unprecedented oversupply in oil this past March when, even if briefly, contract prices went *negative*.

Let’s consider the most charitable future hypothetical. The IEA’s “sustainable development” scenario assumes a massive expansion in green subsidies and mandates. In this future, oil demand will slowly shrink over the coming decades as green energy expands.

On the supply side, we know that all oil wells experience a slow decline curve. On average, global oil output shrinks about 5% a year from all existing wells combined. Money needs to be deployed to drill new wells even without demand growth. But global spending on new production has already collapsed because of the recession. In many Green New Deal scenarios, the goal is to depress access to capital for oil drilling further. Thus, as the IEA points out, there is a point in the near future, more than a year, less than a few, when there won't be enough supply for even declining oil demand.

Global oil prices swing widely when markets are surprised by even a 1% to 2% shortfall in supply. A fracking ban would entail a loss of 7% in global oil production and, if implemented, would accelerate the day when the world has more demand than supply. Consider that the world saw a 7% loss in supply with the 1973 Arab oil embargo that sent world oil prices soaring by 400%, triggering a global recession. A few years from now, even in the most dewy-eyed Green New Deal vision, America will still be using roughly as much oil as it is today. But in the frack-ban scenario, that oil will be increasingly imported, and likely at far higher prices.

For most citizens, jacking up oil prices is a serious matter, something that is easy to forget in a time of low-cost abundance, largely courtesy of our shale industry. "Just" doubling gasoline prices puts the public's transportation expenses in the range of average home mortgage expenses and above the cost of housing for the average renter. And that says nothing about how high-cost oil would ripple, destructively, throughout the economy. That's because the primary drivers of future oil demand are found with trucks, aircraft, and petrochemicals.

Truck fuel use, for example, continued largely unchanged through the economy-destroying COVID shutdowns because that's how all the essential products are delivered, and something that e-commerce accelerated. UPS spends over $3 billion a year on fuel. If fuel prices double, you can expect to pay for that in "surcharges" on all your e-commerce deliveries. High fuel prices will also ripple through all the supply chains because it is shipped by big, oil-burning machines from ships and rail to trucks.

Then there are the petrochemicals that today account for just 12% of oil demand but where the IEA believes the fastest growth will come for using liquid hydrocarbons. Petroleum is used to produce a panoply of precursor chemicals for "plastics, fertilisers, packaging, clothing, digital devices, medical equipment, detergents and tyres."

The story looks essentially the same for natural gas, with an additional feature. Losing the share of electricity generation that is now fueled from (fracked) natural gas would push many utilities either to enforce blackouts or to increase the use of any available underutilized power plants. Ironically, most of those underused assets are coal-fired. Using those to keep lights and computers on, or EVs refueled, would increase carbon dioxide emissions far more than all emissions avoided from the wind and solar installed thus far on U.S. grids.

Many regions of the country depend heavily on natural gas for electricity where there aren't any idle coal plants. There, rolling blackouts can end up being the only option, from New England, where gas supplies nearly 50% of electricity, to the mid-Atlantic region (38%) and the Pacific Coast (30%). Some of that shortfall could be made up by burning (imported) oil in the gas-fired turbines that are dual-fuel designs. Using that fleet of fuel-fuel plants would add 1 million barrels per day of oil demand, roughly 400% more oil than is currently displaced by all of California's EVs.

None of this sounds like an outcome that any serious policymaker, green or otherwise, would want. But a frack-ban would cause such a fallout because there's no prospect for importing enough wind-solar-battery hardware to fill the gap. The idea that subsidies or mandates can quickly expand wind/solar by the 1,000% that's needed to replace the oil/gas share of energy isn't just wishful thinking. It's Bernie Madoff-style energy accounting, a total fiction.

Simply consider what the past two decades of climate awareness and spending have actually achieved. The world has collectively deployed more than $2 trillion for alternative energy over the past decade. And the share of the world's energy coming from hydrocarbons has declined about 2 percentage points, from 86% to 84%.

The pace of this transformation has not escaped the attention of Saudi Arabia and Russia. That the world will continue to use very significant quantities of oil and natural gas for decades is simply unavoidable, regardless of pledges and policies to pursue a “transition.” There is nothing subtle about the “soft power” aspects of trade in commodities that are essential for economies everywhere. Russia’s $55 billion natural gas pipeline, unsubtly called the “Power of Siberia,” started operation at the end of last year to allow China to mitigate dependence on the Middle East and the U.S. Saudi Arabia, in the meantime, has been selling China oil at a discount to already depressed prices to capture market share during stressful times for other producers. Then there’s the Nordstream 2 natural gas pipeline, which will, if completed, dramatically increase Europe’s dependency on Russia. Whether or not the last 100 miles of that 760-mile pipe get finished (currently sanctioned by the Trump administration) is likely dependent on the outcome of America’s November election.

One basic fact illuminates the future of geopolitical tensions. Over 75% of the world’s GDP and a roughly equal share of world energy use is associated with five regions: China, Europe, India, Japan, and the U.S. Of those, the U.S. is the only major supplier of hydrocarbons to the world. The other four regions are steadily (even with green plans) increasing dependence on imports to meet from 50% to 90% of domestic needs. It was the rise of shale fracking technology that ended the duopoly of Russia and Saudi Arabia as pivotal suppliers. A multitude of private companies in the U.S., collectively, now comprise the swing producer. The other two big producers are monopolies in their respective states enjoying the support of their home governments, including often massive subsidies from sovereign wealth funds. Meanwhile, America’s market-centric producers are not only subjected to the withering “creative destruction” of commodity and capital markets but face increasingly hostile domestic policies.

Returning to the talisman: Aside from the fact that Tesla buyers get fat subsidies — $7,500 from the feds, with some states adding more, up to another $7,000 in California — Tesla corporate gets some $400 million in revenues from selling emissions credits to other automakers. That money, supplied by non-Tesla-owning taxpayers, is a “hidden” subsidy courtesy of federal policy. Getting to hundreds of millions of EVs with those kinds of subsidies adds up to trillions of dollars. You find similar numbers in the subsidies for wind and solar. That explains why honest brokers of green deals talk about spending trillions of dollars. How long taxpayers will tolerate such scales of subsidies is the political question of the decade.

For anything like a real energy tech revolution, we'll need machines that produce and use energy that don't require subsidies and that consumers buy enthusiastically at scales that dwarf even Elon Musk's achievement. For perspective, compare the velocity of Tesla's growth, selling over 500,000 cars in the first six years after introduction, with the introduction of the Ford Mustang 56 years ago. Ford sold 2.5 million of those in the first six years, without subsidies.

In a sign of the times, Ford will introduce an all-electric Mustang in 2021. Every automaker wants to compete in that $60,000 car category. But that e-Mustang will cost 300% more than the first Mustang (in inflation-adjusted terms). It's an easy bet that neither Ford nor all the other Tesla wannabes combined will trigger an "energy transition" with machines like that. The Ford of yesteryear knew what it took: sizzle at an affordable price.

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