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Current events seem to be pushing us toward a future that's fueled by something other than traditional petroleum-based hydrocarbons.

A major U.N. report out earlier this month says humankind still has a chance to avoid the worst impacts of global warming if we move quickly to start implementing carbon-reduction technologies that already exist. However, we've reached a point where "it's now or never," said a British researcher who oversaw the report.

At the same time, the war in Ukraine has got the Western industrialized nations — particularly in Europe — looking for ways to wean themselves off their

dependence on cheap oil and natural gas from places like Russia.

these next generation fuels.

We've been down this road before

Here's a fun fact you can drop at a post-COVID-19 holiday gathering: Rudolf Diesel's first prototype internal combustion engine, which debuted at the world's fair in Paris in 1900, ran on peanut oil. Tax policies, in fact, played a big role in determining what fuels would power the automotive revolution.

Many early prototypes for automobiles ran on plant-derived alcohol or ethanol, but in the United States, those fuels fell under federal alcohol taxes (a legacy of taxes that paid for the Civil War) while petroleum-derived kerosene and gasoline did not. That led inventors like Charles Duryea and Henry Ford, in the 1890s, to focus their initial efforts on petroleum-powered vehicles.

President Theodore Roosevelt lifted the tax on alcohol-based fuels in 1906, but ethanol producers were slow to scale up to meet demand — and when huge oil reserves were found in Texas, gasoline became the readily available fuel of choice for automobiles in the United States. In 1911, the state of Oregon levied the first excise tax on it; by 1932, every then-existing state, the District of Columbia, and finally the federal government all followed suit.

21st century petroleum problems

There is political debate over climate change, but the science seems pretty clear: Either we do something quickly to reduce the amount of carbon we put in the atmosphere, or our grandchildren and great-grandchildren will face the consequences of living on a hotter planet.

Cars are a huge source of carbon — the average car emits 4.6 metric tons of carbon dioxide a year into the atmosphere, and there are more than 1.4 billion vehicles in the

world. That's led a big push toward zero-emission vehicles, which we discussed in a

Energy independence = national security

The war in Ukraine also has underscored a major problem with Europe's dependence on petroleum-based fuels: Most of them are coming from Russia. So while it may be desirable to "defund" Russia's war effort by cutting off exports of its biggest source of cash, that's hard to do when you're Europe and you're importing nearly 2.2 million barrels of oil a day. Germany, in particular, gets 30% of its oil from Russia, and bankers warn that cutting that to zero would send the country into a recession.

Even so, Poland has announced plans to end Russian oil imports by year's end, and Lithuania has already ended them. Other European Union member states are looking to replace Russian fuel with petroleum from other sources — or perhaps next-generation fuel substitutes.

Currently, the most common biomass-derived fuel is ethanol. In the United States, it's typically mixed into gasoline at ratios that vary from state-to-state and by time of year, but typically range from 10% to 15%. Ethanol is used this way in Europe too, but in Brazil — where ethanol from sugarcane is cheap and relatively abundant — it's often used on its own in cars adjusted to run on that fuel.

Next-generation fuels do put carbon into the environment, no doubt. But overwhelmingly, it is carbon that the plants extracted from the environment while they were alive. Thus, the ethanol burned is a net neutral, in terms of carbon — as opposed to petro-fuels, which release ancient carbon that has been locked underground for millions of years.

The big drawback to ethanol is that most of it is made from plants that humans eat — corn, wheat, oilseeds. Critics accuse affluent Western nations of taking food that

could go to impoverished children and making it into fuel to power their cars,

trash — specifically upcycled plastics, textiles, and wood — into biofuels using chemical catalysts.

Other researchers are focusing on using animal carcasses as a feedstock. If you've ever made beef or chicken broth from scratch, you'd recognize the process: boil the bones and other remains to extract the fats from them, and those lipids become the feedstock for generating biodiesel.

There are even efforts aimed at converting animal waste into biofuels. (One of the more ick-inducing proposals involves feeding housefly larvae on hog manure, then processing the bodies of the larvae — which are more than 20% lipids at that stage – to create feedstock for biodiesel.) Livestock in the United States generate more than 1 billion tons of manure a year, which means there's an abundant supply of feedstock – plus the process has the added benefit of short-circuiting the release of methane into the atmosphere. Methane, which is a more potent greenhouse gas than carbon, is created by the natural breakdown of manure in the environment.

Hydrogen is not hot air

Hydrogen is another potential non-petroleum energy source. We're already seeing hydrogen-powered cars in California, and the beginnings of an infrastructure to support them. Without diving too deep into the physics of it, hydrogen fuel cells work when you combine hydrogen and oxygen atoms in a controlled way. The resulting reaction produces a steady stream of electrons, which can power a battery or electric motor and water. (You know, good old H20.)

Again, this is not new technology. The first hydrogen fuel cell demonstrations were in the 1950s. Advocates point out that hydrogen is the most abundant element in the universe, so it's inconceivable that we'll ever run out of it, and since they emit water, hydrogen-powered vehicles don't add to our climate problems.

There are two major drawbacks, however. For starters, hydrogen is violently

To make hydrogen work, we'll need major investments in zero-emission, or carbon-neutral, electrical generation.

Next-generation fuels are coming, and so are taxes

Modern science has sharpened these processing techniques and made them more efficient. But as we've discussed, the idea of creating ethanol fuels from plant material or biodiesel fuels from animal fats are not new. It's just been that for most of the last century, petroleum-based fuels were relatively cheap and abundant, so there was little incentive to implement any of these processes.

That's changing, and the costs of using petroleum-based carbon fuels is increasing — whether we're talking about the financial cost, the environmental cost, or the political cost.

For the moment, these next-generation fuels are not being taxed, at least with the same kinds of excise taxes that we're used to with oil and gas.

But it's only a matter of time. Just as we saw 15 years ago, when ethanol fuel additives were new, once regulators and legislatures begin to see that revenues from excise taxes on fuel are falling because of these alternative fuels, they'll act to extend taxes to them. After all, states and local governments will have to keep paying for road construction and maintenance, whether the fuel in our tanks comes from the ground, or from a tree.

What those taxes will look like is still unknown, but it would be no surprise if Oregon or one of its West Coast neighbors — particularly California — is the first to take action, just like Oregon was the first to levy a tax on gasoline more than a century ago. The West Coast states are leaders in developing next-generation fuels and zero-emission vehicles, so it stands to reason that the first tax policies addressing next-generation fuels will come from there.

Technology