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Flying Planes with Coal?

Sixteen tons, what do you get? Cleaner flights to NYC.

Airplanes powered by coal -- at first blush it sounds about as attractive as the toddler chainsaw. But Accelergy in Houston says it has come up with a way to convert the ubiquitous rock into an economical, clear, and arguably clean form of jet fuel.

The company will initially try to sell fuel to the U.S. military -- the Air Force has already begun initial testing -- and has also started to field inquiries from China and some commercial aircraft and engine manufacturers. Biomass can also be substituted for coal, or at least part of it, in the recipe, depending on the desired characteristics of the final fuel.

The Department of Defense will likely set its standards for synthetic jet fuels in 2013, and CEO Tim Vail claims that Accelergy's fuel will be able to meet those standards.

The key is a process fine-tuned at ExxonMobil in the mid-1990s that turns coal or plant matter directly into a liquid, according to Vail. Unlike the often-criticized Fischer-Tropsch process devised in the 1920s, Accelergy's process does not get convert coal into a synthetic gas before transforming it into a liquid. Eliminating gasification greatly reduces carbon dioxide emissions, as well as the total amount of coal (or biomass) consumed to produce liquids, he said. And it's cost-effective.

"You can be profitable in the $50-to-$60-a-barrel range," extrapolating from the mathematical models devised by Exxon in the '90s, Vail said. "In the crude environment we have today, you have the opportunity to create a very favorable business."

So what makes this environmentally friendly? It depends on how you look at the problem. While coal is a relatively dirty form of fuel, it's also one of the most pervasive. The world has an estimated 998 billion tons of proven coal reserves, with the largest reserves located in the U.S., China, India and Russia. While the U.S. and Europe have

begun to reduce coal consumption, emerging nations will invariably use large portions of theirs. Converting it into liquid jet fuel reduces carbon dioxide and particulate matter that would get released by burning it, Vail argues.

Just as important, Accelergy's fuel compares favorably to the biofuels touted for air transportation. Planes can fly on a fuel made entirely from Accelergy's process because it is somewhat energy-dense, Vail said. If Accelergy made a fuel that derived 70 percent from coal and 30 percent from biomass, it would have lower carbon emissions than a straight fossil jet fuel.

"You can have a CO2 footprint that's less than petroleum," he said. "Can we make it cheaper and with less CO2 than petroleum? That is where the commercial airline manufacturers are coming from. We think we can."

The fuel can also absorb heat generated by air friction at supersonic speeds, thereby allowing the fuel system to act as a radiator. The thermal range for Accelergy's fuel is higher than conventional petroleum.

By contrast, biofuels aren't as dense. The aviation biofuel tests conducted thus far have involved blends where biofuel represents 50 percent of the fuel at best.

"We are the only one that can go 100 percent jet. Everything else has to be blended 50/50," he said. "Think of a predator drone. You can have more energy in the same amount of weight. "

Another potential bonus: Accelergy's fuel can be made economically in modular plants. A 10,000-barrels-a-year facility will be feasible, he said.

Here is roughly how it works: A slurry of pulverized coal is mixed with hydrogen and a proprietary catalyst and is then subjected to high temperatures and pressures. The combination of the catalyst, hydrogen and heat break down the elaborate carbon/hydrogen molecules that make up coal into a petroleum distillate that can then be spun into a synthetic jet fuel or other liquid fuels.

The hydrogen comes from cracking methane found in coal seams and the catalyst, he added, gets consumed in the chemical reactions. Sludge that comes out the other end can be converted to asphalt.

The more traditional Fischer-Tropsch process requires turning coal or biomass into a synthetic gas and then converting the gas into a liquid. Because it is expensive, only companies facing severe oil embargoes -- Germany during the Third Reich, South Africa under Apartheid -- have embraced Fischer-Tropsch with much gusto. Sasol in South Africa still makes about 150,000 barrels a day using the process. The well-to-wheel pollution for F-T also exceeds the emissions of regular petroleum: a lifecycle analysis conducted by the U.S. EPA found that coal-to-liquid fuel actually releases 118.5% more greenhouse gases than conventional fuel.

"We don't use gasification anywhere in our system. It is all direct conversion," Vail said.

Exxon first began studying coal-to-liquids in the 70s during the first wave of oil crises and the formula began to gel in the 90s. Exxon had at that point invested nearly $1 billion in the process, and at the peak of the program, the company had 700 researchers and staffers working on it. The effort culminated with the development of a 1,000-barrel-a-day facility in Texas. (Shell, meanwhile, continues to work on a natural gas to liquids process.)

"In many areas, there was a focus on the nationalization of energy assets," Vail said. "They built it as a hedge and took it all the way through development."

But when oil prices declined, Exxon started losing interest. It spun the group off by licensing the intellectual property to Accelergy. The core of Exxon's coal-to-liquids technology team joined the new company, as well.

The question now is whether the process will work at scale and how it fares against the competition. Joshua Kagan, an analyst with GTM Research, estimates that the capital expenditures for coal or biomass to liquids facilities come to approximately $1.27 a gallon. With 42 gallons per barrel, that comes to $53 a barrel for capital expenses alone. Feedstocks, meanwhile, can cost $30 a ton for coal or $55 to $70 a ton for biomass. Three barrels a ton adds $10 to the cost. The system will also have to compete against the wide variety of companies both large and small that are promoting biofuel for aviation.

For his part, Vail adds that the company will have to overcome skepticism and doubt among fuel makers, financiers and even coal companies.