

# Bio-fuels Reboot

*By John Benson*

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## 1. Introduction

I recently posted the following paper:

***Blueprint for Transportation Decarbonization:*** *I write about the title subject frequently. There are several reasons I do this:*

- *In spite of my frequent posts on this subject, it is my most popular subject (based on the number of views per post.)*
- *The transportation sector is the largest source of greenhouse gas emissions in the United States.*
- *One of the most important tools will use to accomplish the title task is to convert this sector from petroleum-based fuels to electric energy or clean fuels that are mostly generated using electric energy.*
- *I post on Energy Central, and implementing the prior bullet will force the greatest changes in the history of the energy segment.*

*When I discovered that the U.S. Federal Government had released an extremely important document regarding the title subject in January, I decided that I must create a post summarizing this document.*

<https://energycentral.com/c/cp/blueprint-transportation-decarbonization>

As I wrote the above post, I discovered that U.S. Government currently intends to use many “Sustainable Liquid Fuels,” especially in the Maritime and Aviation subsectors. A few days later I was reading my latest issue of Scientific American, and came across an excellent article on these fuels, and you can probably guess the rest of the story.

## 2. Bio-fuels First Flops

*Russia's invasion of Ukraine is squeezing global oil supplies and inflation is jacking up prices at the pumps. Although petrol prices have started to fall in recent months, the situation has delivered a powerful reminder of the world's dependence on fossil fuels.<sup>1</sup>*

*It also means biofuels are having a moment. The corn-ethanol industry boasts that blending its product into petrol is saving consumers money and creating jobs in the farming communities that supply its distilleries.*

*Refiners producing renewable diesel fuels for long-distance semi-trucks are expanding as fast as they can. Some are building bio-refineries designed to process palm, soy and canola oils, whereas others are adding vegetable oils and animal fat to their petroleum feedstocks.*

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<sup>1</sup> Peter Fairtey, Scientific American, “The biofuel course correction,” Jan 2023 Issue (Hardcopy), The Circular Economy Supplement, page S15. To Order a Copy of a Scientific American Issue: Call (800) 333-1199.

*Petrochemical producer Phillips 66 is investing \$850 million in its refinery in Rodeo, California (in Contra Costa County, in the eastern San Francisco Bay Area), to convert it to exclusively process bio-feedstocks. And, according to market analysts, US refinery expansions that have been announced could boost the demand from bio-fuel manufacturers for soy bean oil beyond the country's total supply. If filling fuel tanks with these plant-derived liquids reduces carbon emissions by decreasing the demand for fossil-fuels, it would help to tackle the climatic shifts that threaten humanity and biodiversity.*

*In principle, the sustainability of biofuels seems obvious. Carbon cycles in and out of the atmosphere as biofuel crops grow and vehicles burn the fuel they produce. But claims by industry that biofuels deliver greener transport have been battered by a relentless flow of reports. Indeed, the first-generation bio-fuels that are the market leaders seem to be little better for the climate than fossil fuels.*

*A 2022 assessment of the US Renewable Fuel Standard found that the program – which requires that transportation fuel contain a minimum volume of renewable fuel, and which drives nearly half of global biofuel production – has probably increased greenhouse-gas (GHG) emissions. That counter-intuitive outcome is a result of farm operations involving diesel-fueled tractors and fertilizers made from natural gas. The fertilizers release nitrogen oxide, a greenhouse gas that is nearly 300 times more potent than carbon dioxide. Even farm soils can release stored carbon that is essential to their resilience and fertility.*

*Worse still, the increase in demand for biofuel crops has extended farming onto marginal lands, damaged biodiversity and increased water use and contamination, as well as pushed up the price of agricultural commodities and thereby exacerbated food insecurity. The authors of the 2022 assessment conclude that only "profound advances" in practice and policy will make the US program sustainable.*

*Agronomists, crop geneticists and carbon emission life-cycle scientists agree. To make agriculture smarter, farmers need to pay close attention to what crops work best where, and how those crops are grown. Embracing regenerative farming methods, such as reduced tilling of the soil, can retain carbon and nutrients. So, too, can planting an emerging set of winter oil seeds that can be grown seasonally between food-crop rotations. This would generate revenues that could pay for a soil-saving practice called cover cropping that few farmers have embraced so far.*

*"We cover crop less than 2% of our land. If you go to 40-50%, you're meeting this huge global demand for low-carbon feedstocks, says Glenn Johnston,<sup>2</sup> referring to the process of growing a crop to protect and improve the soil - a crop that, in this case, can also be used to make bio-fuel...*

*A decade ago, a transition to better biofuels seemed imminent. A new generation of commercial-scale bio-refineries was coming online in the United States, Brazil and Europe. They were designed to make ethanol from fibrous cellulose-rich feedstocks such as agricultural leftovers, grasses or fast-growing trees that generally thrive on marginal farmlands and require less intensive cultivation than corn or soy beans. By now, these cellulosic biofuels made from sustainable feedstocks were supposed to be gushing into the fuels market, trimming transport-emissions, the fastest-growing source of CO<sub>2</sub> worldwide.*

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<sup>2</sup> Glenn Johnston leads regulatory and sustainability programs for agri-business firm Nuseed at its research center near Sacramento, California.

*Alas, the flow of cellulosic fuel is barely a trickle. Processing equipment proved hard to operate, petrol prices fell and governments eased mandates designed to force the pricier cellulosic fuels into the market. "Ultimately all of those facilities struggled. Most are either producing at very low levels today or not producing at all," says John Field, who studies the climate mitigation potential of bioenergy systems at Oak Ridge National Laboratory.*

*What didn't stop were the generous incentives pushing food-based biofuels, and their short-comings. Europe's renewable energy directive drove logging and slash burning of tropical rainforests in Brazil, Indonesia and elsewhere to 'make way for soy bean and oil palm plantations, displacing Indigenous communities and wildlife and releasing the rainforests massive carbon stocks. And the carbon does not only come from the trees; even more can be released from soil as it heats up and dries. Indeed, soil holds roughly three-quarters of the organic carbon in Earth's biosphere...*

**Author's comment:** The best-laid plans of mice and men often go awry.<sup>3</sup>

The reference 1 text expands on the bad moves that the bio-fuels industry made in the past, but you get the message. I believe the reference 3 poet said it best. However the next section (still from reference 1) may define a path out of this mouse's maze.

### 3. The Reboot

*In spite of powerful headwinds, researchers continue working to improve biofuels' sustainability. "Short of returning land to a completely wild state, we will always be balancing impacts against the needs of society," says Rowe<sup>4</sup>, whose work is helping the UK government to implement plans to expand the planting of bioenergy crops from close to nothing to about 3% of the UK's land area by 2050.*

*And Field's<sup>5</sup> research suggests that biofuels still have the potential to be more than a necessary evil. In a 2020 paper he and his colleagues showed through simulation that, under certain conditions, cellulosic ethanol can rival or exceed the climate benefits of ecosystem restoration. The best results occurred for the case of land use transitioning from food crops or pasture to the cultivation of switchgrass (*Panicum virgatum*), a popular feedstock for cellulosic biofuel. In those cases, Field and his co-authors estimated that the carbon mitigation potential was comparable to that for reforestation. If crop yields and bioprocessing technologies can be improved, and if CO<sub>2</sub> from bio-refineries can be permanently sequestered deep underground, the researchers predict that supplying cellulosic feedstocks could ultimately store up to four times more carbon than does reforestation. "It's aspirational, but these are areas where there's a lot of research and development attention right now" says Field.*

*The best candidates for sustainability are the cover crops in development that seem to be a good response to arguments against dedicating land to biofuels. Soil in fallow fields tends to compact, and is susceptible to erosion by wind and rain. A cover crop puts roots down to secure the soil and its nutrients, and creates channels that help water to sink rather than drain off. Farmers might be convinced to plant oilseed cover crops because the crop can pay for itself by producing oils that can be supplied to bio-refineries.*

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<sup>3</sup> Robert Burns, "To a Mouse." Literally this reads: The best laid schemes o' mice an' men Gang aft agley, [https://allpoetry.com/To-A-Mouse,-\(The-best-Laid-Schemes-O%27-Mice-An%27-Men\)](https://allpoetry.com/To-A-Mouse,-(The-best-Laid-Schemes-O%27-Mice-An%27-Men))

<sup>4</sup> Rebecca Rowe, who studies soil carbon at the Centre for Ecology and Hydrology in Lancaster, UK.

<sup>5</sup> John Field, who studies the climate mitigation potential of bioenergy systems at Oak Ridge National Laboratory in Tennessee.

*Nuseed's crop carinata - adapted from Brassica carinata, a towering cousin of rapeseed (Brassica napus) - produces an energy-rich, inedible oil. And it packs a punch: Johnston<sup>2</sup> says carinata excels at storing carbon in soil and contains about 2.5 times more oil than soy beans, the dominant crop for renewable diesel. Most important, he says, carinata does not compete with food supplies or cause climate-harming land-use changes. The latter advantage means that although land-use effects alone add an extra 4-26 grams of CO<sub>2</sub> emissions per mega-joule of energy delivered from soy-based fuels according to Field<sup>6</sup>, carinata cuts 9-13 grams of emissions per mega-joule from fuels. Land use changes goes from being a highly uncertain but potentially large liability to having a small but positive effect," says Field, who is part of a consortium partnered with Nuseed on carinata Research and development.*

*A 2022 report ' by Field and his colleagues shows that carinata could support a major biofuels industry in the Southeast United States. Simulating application of carinata every third year across southern Georgia, southern Alabama and northern Florida-a few percent of US cropland- they project annual harvests exceeding 2 million tonnes (2.2 million tons). That's enough seed to make about one billion liters (264 million gallons) of aviation fuel.*

*Nuseed started commercial planting in Argentina in 2019 and is sending enough oilseed to the French biofuels producer Saipol this year for the company to generate millions of liters of renewable fuel. Nuseed plans to expand to the southeastern United States by the end of 2023 and to Brazil by 2024. It intends to scale up fast thereafter, aided by a ten-year supply and market-development deal with energy giant BP, and to be supporting billions of liters of fuel production per year by 2030.*

*For carinata to occupy a larger role in the bio-fuels scene smarter policies are needed, says Johnston<sup>2</sup>. Government programs for biofuels, he says lack the breadth and specificity to recognize and reward the crop's benefits.*

*Lilliston<sup>6</sup> concurs, in that refineries selling soy-derived fuels to California pay no penalty for soil carbon depletion caused by industrial farming practices, he says. California and other jurisdictions are planning more sophisticated carbon accounting, but not fast enough for oilseed cover crop developers. What's racing forwards instead are poorly regulated markets for offsetting carbon - financial instruments that threaten to give regenerative agriculture a bad name. Offsets pegged to soil carbon, created by brokers as well as some agricultural giants, pay farmers to adopt carbon-friendly practices. Corporations purchase most of the offsets to claim progress towards emission reduction pledges such as 'net-zero-by-2050...*

**Final author's comment:** Yes, the offset games continue, but perhaps we are moving the metrics in the right direction. Both offsets and bio-fuels can be useful climate change mitigation strategies, IF our greenhouse gas emission accounting is fair.

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<sup>6</sup> Ben Lilliston, director of rural strategies and climate change at the Institute for Agriculture and Trade Policy in Minneapolis, Minnesota.