Sapphire's Superior Strain Of Algae

Jim Lane Biofuels Digest *[1] — November 17, 2009*

[2]Thanksgiving approaches and holiday baking looms – a week when family recipes are swapped and downloaded in huge volumes. In the business of biofuels, one of the more elusive recipes is the one for making commercial-scale, affordable algae as a platform for conversion to biofuels.

But there's not too much mystery to it. By now, practically everyone in biofuels knows the basic recipe for making a gallon of algal fuel from an open pond environment. As great cooks advise, the potential is in the ingredients, but the flavor is in the execution.

Ingredients: One 320 ml beaker containing "secret sauce" – a superior strain of algae in solution 1500 gallons of water (recyclable) 45 pounds of CO2 Trace amounts of other nutrients, including iron and copper

Directions: Add all ingredients to water Stir continuously, and bake in sunlight until algae reaches 0.2 percent concentrations, then harvest continuously. Remove water, extract oil, recycle 99.8% of water Burn remnant biomass for power, or sell as protein – your choice

Serves: 1 VW Jetta TDI for approximately 50 miles.

(Note to readers – don't try this at home – the ratios are basically correct for an algal strain with 33 percent oil content, but you don't really make algae in one-pound "servings".)

Aside from the continuing challenges of extracting the water from the algae (or the algae from the water) and extracting the oil (excepting those who gasify the biomass — or have magic bugs who consume algae and excrete ethanol — the real trick is in the cost of engineering and in the production of the secret sauce, the superior strain of algae that will accomplish three things:

1. Reproduces rapidly. 2. Contains tons of BTUs. 3. Keep on going and going under conditions only an extremophile could love.

The very criteria for the Energizer and Duracell Bunnies. And so, the algal ventures are pursuing their microbiological version Survivor, developing candidate "magic strains" and then voting the losers off the island.

Meanwhile, a cabal of part-time observers and preternatural pessimists have concluded that, three years after serious ventures restarted the pursuit of algal fuels – the absence of millions of gallons of algal fuels at everyday low prices is an

indicator that microalgae will not succeed as a fuel until some time in the, say, 24th century. That the correct allegory for algal fuels is not, in fact, “Survivor” — but rather “Fantasy Island.”

The [3]industry’s penchant for secrecy, and global range, is partly to blame. Are algal fuels for real – are parity prices ever be a reality? Is algal fuel production really underway, or is this some orgiastic expenditure of public and private investment along the lines of cold fusion?

To help draw back the veil, the Digest recently visited the labs at Sapphire Energy with a goal of substituting images for words — showing a full-scale, industrial biotech development effort – what it is, and how it works.

Sapphire, like others, is developing an affordable, scalable commercial production system – its “above ground oil field,” as Sapphire’s Tim Zenk put it. At the same time, it has mounted a parallel effort to identify its “magic bunny” — the strains with the optimal combinations of high energy content, fast reproduction, and ability to tough it out in the wild, wild west of open ponds.

The Sapphire approach to finding the right “bunny” – amidst tens of thousands of microalgal species, and potentially an infinite number of strains: an industrial biotech approach to R&D: equal parts of discipline, throughput, and sense of adventure.

[4]**The Ideal Strain #1** The combinations of algal genetic traits would number in the billions. The first step is establishing a process by which strains can be identified, examined, selected for potential. In this case, they start at slide level.. The examination is industrial in its technology, and in scale. A few years back, an algal enterprise might examine a few dozen strains in a month. Today, Sapphire is processing 8,000 strains per day to find its perfect Bunny that breeds rapidly, survives in the wild, and is packed full of energy.

In our example here, Sapphire staff is looking at individual cells for favorable traits. Candidates with promise are moved from the slide and petri dish stage to the small beakers.

The Ideal Strain #2 At this stage, a number of unpromising strains have been “voted off the [5]island,” and the remaining candidates are transferred to small beakers. This has been captured on video, so that you can see the rotation that keep the water in motion (as opposed to the paddle wheels utilized in the larger raceway pond systems). Promising candidates are now moved to larger tubes, where analysis continues — note the heavy array of sensing equipment accompanying each small tube. Candidates are also tested in mini-raceway pond environments to test their ability to withstand a more industrial set of conditions.
The Ideal Strain #3 A smaller group of candidates, based on stability and yield among other factors, are moved into the greenhouse. There, larger soft plastic tubing is employed and final candidates are selected for transfer from the San Diego labs to the test ponds in Las Cruces, New Mexico.

The Ideal Strain #4 Here, Sapphire Energy is constructing a 100-acre R&D, engineering, and [6]pilot production facility. Ponds are already in place and Sapphire began growing “aggressively” as of November 2008, as well as continuing lab work at nearby New Mexico State University.

Our candidate “bunny” – 1 in at least 8,000 – has made it through the selection process, and has won a ticket east where a staff of at least 18 are now in place to test it in the ponds. What began as a cell on a slide – out of thousands of candidates – is now a contender to become a component part in a national energy solution.

Along The Way — Test Production Some notable firsts from Sapphire. The first gasoline produced from genetically modified algae, as well as drop-in, renewable diesel and drop-in renewable jet fuel. If green diesel from algae reaches it potential for epic scale, look for these samples to find a final home in the Smithsonian.

Next Steps Sapphire is reportedly raising $600 million in a revolving debt facility to facilitate its expansion to a 1 Mgy demonstration-scale facility by 2014, 100 Mgy commercial scale by 2018, and 1 billion gallons per year by 2025.

Meanwhile, its staff of 80 PhDs in the San Diego labs, as well as a growing staff, and 22 acres of ponds in place in Las Cruces, are keeping Sapphire’s visibility and credibility at high levels that indicate why the company was ranked #2 among the 50 Hottest Companies in Bioenergy for 2008-09.

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