



The Man Who Wrote the Book on Algal Biodiesel

Posted by [Robert Rapier](#) on May 17, 2007 - 11:22am

Topic: [Alternative energy](#)

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The following is a guest post by John Benemann. John has many years of expertise in biomass conversion, and previously [co-wrote a guest piece on cellulosic ethanol](#). On the subject of biodiesel from algae, he literally wrote the book.

I originally [wrote an article over a year ago in which I mentioned the potential of algal biodiesel](#). I still believe, as I did then, that biodiesel (or more broadly, renewable diesel) is a far superior fuel to ethanol for reasons I outlined in that essay. However, over the past year, the more I learned about the prospects of biodiesel from algae, the more it started to look to me like cellulosic ethanol: Technically feasible? Yes. Commercially feasible? Nowhere close, and the prospects don't look good any time soon. (However, as in the case of cellulosic ethanol, I believe the technology has some potential, so the government should fund the research).

This was a bit disheartening for me, because I had high hopes that we had an option for replacing a large amount of our fossil fuel usage. I no longer believe that, and [recent work by Krassen Dimitrov](#) (PDF warning) had reinforced my doubts. When I read the guest post by [fireangel](#), "[Has the Algae Cavalry Arrived](#)", my first thought was "Nice work." My second thought was, "I should have jumped on this and investigated thoroughly eight months ago when those nagging doubts started to creep in." One nagging question I have had since I first read about biodiesel from algae is "Why would NREL terminate the project if the prospects really were good?"

But should there be any further doubts, here is a guest post from a man who knows as much about this subject as anyone else in the world. And he bears bad news for those who had visions of driving around in algae-fueled transportation.

I saw with some interest the guest post on "[Has the Algae Cavalry Arrived](#)" posted by [Heading Out](#) and written by [fireangel](#) about the claims being made by [GreenFuel Technologies](#) (GFT) Corporation. I have some standing in this matter, both as [Manager of the International Network on Biofixation of Carbon Dioxide and Greenhouse Gas Abatement with Microalgae](#) (operated by the Int. Energy Agency, Greenhouse Gas R&D Programme) and also as a researcher in this field for over 30 years. My comments here are my own, of course, and don't necessarily reflect those of the GhG R&D Programme or others involved in the Biofixation Network. In brief:

1. The post by [fireangel](#), based on the analysis by Dr. Krassen Dimitrov's, is generally correct, although some details regarding algae physiology and mass culture are arguable. However, those would not change the general conclusions of this posting. Well done!
2. The claims for biodiesel production rates being made by GFT, among many others in this field,

exceed anything based on biological or physical theory, as also pointed out in this posting. They are truly bizarre.

3. The use of closed photobioreactors ($>\$100+/\text{m}^2$) for such applications is totally absurd.

4. I am on the record as stating that this is "It's bizarre; it's totally absurd." (see below article from the American Scientist last year, which quotes me to that effect. This was a correct quote, and in context).

5. Open ponds, at $<\$10/\text{m}^2$ can be as productive as closed photobioreactors. The arguments that closed systems are better than open ponds are incorrect - they both have their particular applications and benefits/drawbacks. It all depends on the situation and applications. The main difference is that open ponds are much cheaper.

6. Open ponds may plausibly be considered for algae biofuels production, but this assumes that indeed the required R&D is successful, a very BIG IF (but that is true of all R&D). But it is worthwhile trying, as we must try all plausible options. But we must also reject those that, as pointed out in this posting, violate first principles and have other major up-front failings.

7. I was the Principal Investigator and main author of the U.S. DOE Aquatic Species Program (ASP) Close-Out Report [RR: *You can download this 328 page PDF, which I have actually read, [here](#)*], and thus am rather familiar with it. The report was published by NREL with their own introduction that paints a perhaps somewhat too-positive picture in light of the actual data and results. Thus it should be used with some caution. This report was meant to just summarize the work done by the ASP, which spent about \$100 million, (in today's dollars) over about a decade and a half.

8. Microalgae biofuels generally, and algae biodiesel production specifically, is still a long-term R&D goal (likely about 10 years), that will require at least as much funding as the ASP, if not more, and success is, as for any R&D effort, rather uncertain.

9. Some near term applications can be considered, in wastewater treatment specifically (but, wait, do not rush to your nearest algae wastewater treatment ponds - there are thousands of these around, but they are mostly very small and their algae have little or no oil, at least the way that we operate those systems at present. Making oil from algae grown on wastewaters also still requires significant R&D).

10. There are now scores of venture-financed companies, university research groups, government labs, garage start-ups, GFT licensees, web sites, and on and on claiming that they have, can, may and/or will produce algae biodiesel, at low cost, high productivity, soon, etc. None are based on data, experience, reality or even a correct reading of the literature.

11. I am not aware of any work in this field done by Prof. Briggs at U. New Hampshire, outside from an old website that quotes the Aquatic Species Program Close Out Report. There is no basis for the projections he makes for very high biodiesel production rates.

12. Even if R&D proves successful and we can actually produce algae biofuels (maybe even biodiesel) economically (whatever the economics may be a decade or so from now), even then, I am sorry to say that due to resource (land, water, etc.) limitations, algae will not replace all our (or their) oil wells, cannot solve our entire global warming problem, or make me rich quick, at least not honestly. But maybe this technology could be developed in the next few years so that in the future it can make a contribution to our energy supplies, our environment and human

welfare.

We will in the future need all such technologies and must in the present study and develop all those that appear at least on their face plausible. But we also must reject those, as in the present case, that are based on absurd claims (such as in this case of productivity) and bizarre contraptions (e.g. closed photobioreactors).

There are no silver bullets, no winner-take-all technologies, no technological fixes, the solution to our energy and environment crisis can only come from, in order, 'demand' management, efficiency improvements, and new energy supplies, to which, maybe, algae processes can contribute.

I hope that this posting helps persuade GFT, and all others in this "business", to CEASE AND DESIST from the absurd and totally bizarre claims they are making. PLEASE!!

Cheers.

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American Scientist Article Excerpt

The full article is:

[Grow Your Own?](#)

The excerpt to which Dr. Benemann referred:

The people now working on these and several similar commercial ventures are clearly eager to make growing algae a going business in this country. Yet it's not hard to find experts who view such prospects as dim indeed. John R. Benemann, a private consultant in Walnut Creek, California, manages the International Network on Biofixation of CO₂ and Greenhouse Gas Abatement with Microalgae for the International Energy Agency. He helped author the final report of the Aquatic Species Program and has decades of experience in this field. "Growing algae is cheap," he says, but "certainly not as cheap as growing palm oil." And he is particularly skeptical about attempts to make algal production more economical by using enclosed bioreactors (rather than open ponds, as were used for the Aquatic Species Program). He points out that Japan spent hundreds of millions of dollars on such research, which never went anywhere. Asked to comment about why there is so much effort in that direction now, he responds, "It's bizarre; it's totally absurd."



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