

2016 Algae Year in Review – Nothing has Changed

The Algae Fuel Debacle

How much more information does the Department of Energy really need?

2016 Funding Opportunities:

December 15, 2016 The U.S. Department of Energy Office of Energy Efficiency and Renewable Energy's (EERE's) Bioenergy Technologies Office announced a funding opportunity announcement (FOA) of up to \$8 million, subject to appropriations, for innovative technologies and approaches to help advance bioenergy and bioproducts from algae. The FOA is meant to help develop productivity-enhancing algal biology technologies that can enable doubling the current state of technology for seasonal algal biomass productivities.

This FOA, entitled "Productivity Enhanced Algae and Tool-Kits," has two topic areas: (1) algal strain improvements and (2) algal cultivation biology improvements. This FOA will allow the selection of a variety of projects and approaches that overcome species-specific, ecological, and practical challenges to improved algal productivity and biomass composition—two key metrics in achieving high fuel yields.

July 14, 2016 The Energy Department today announced up to \$15 million for three projects aimed at reducing the production costs of algae-based biofuels and bioproducts through improvements in algal biomass yields. These projects will develop highly productive algal cultivation systems and couple those systems with effective, energy-efficient, and low-cost harvest and processing technologies. This funding will advance the research and development of advanced biofuel technologies to speed the commercialization of renewable, domestically produced, and affordable fossil-fuel replacements.

The three projects selected, located in California and Florida, will include multi-disciplinary partners to coordinate improvements from algal strain advancements through pre-processing technologies (harvesting, dewatering, and downstream processing) to biofuel intermediate in order to reduce the production costs of algal biofuels and bioproducts.

Global Algae Innovations (San Diego, California)—Global Algae Innovations Inc., in collaboration with the University of California-San Diego, TSD Management Associates, Texas A&M University, General Electric, Pacific Northwest National Laboratory, and the National Renewable Energy Laboratory, will accelerate the commercialization of algal biofuels through development of an integrated, photosynthetic, open raceway pond system to produce algal oil. Their approach is to combine best-in-class cultivation and pre-processing technologies with some of the world's leading strain development laboratories.

Algenol Biotech LLC (Ft. Myers, Florida)—Algenol Biotech LLC, the National Renewable Energy Laboratory, Georgia Institute of Technology, and Reliance Industries Limited have formed a team to advance the state-of-the-art in algal production and biofuel processing with the end goal of a sustainable, economically viable biofuel intermediate through enhanced productivity of cyanobacteria, the conversion of the biomass to a biofuel intermediate, and the cost-sensitive operation of a photo-bioreactor system.

MicroBio Engineering, Inc. (San Luis Obispo, California)—MicroBio Engineering, Inc., in partnership with Cal Poly University, Pacific Northwest National Laboratory, Sandia National Laboratories, and Heliae will deliver integrated technologies that achieve high yields of biofuels, combined with treatment of wastewater, higher value co-products, and carbon-dioxide mitigation.

None of the projects mentioned above are in commercial production. How many more requests for information from the DOE for more 'innovative technologies', and how much more money will go to universities and government labs to get this job done? For how long will the US taxpayer continue to pay salaries and fund projects if the DoE doesn't know what to do with the results? Algae fuels were proven for automobiles and commercial airlines years ago. We witnessed a test flight during which the pilots did not want to land the plane because of the excellent flight they were having claiming better lubricity and better mileage. Industrial standards were written by university researchers and were promoted by lobbyists. So...how many more technologies do we need to line the shelves at the Department of Energy? Where are the promised algae fuels?

Opinions from commercially-minded algae researchers, algae producers and equipment companies around the world are that these are nothing more than false hopes for the commercial deployment of algae fuels, coupled with opportunities to continue to provide funding to universities and to give the government labs a reason to exist, and a reason to continue to pay salaries to people who have proven their inability to take this project to fruition. Some former DOE algae program employees tried to change the direction of the DOE algae research program; out of frustration and not wanting to be a part of what some call a fraud have left the world of bureaucratic mismanagement. Opinions from researchers around the world is that the current DOE algae research program is little more than an excuse to continue to provide federal funds to universities and to support government laboratories, and that its leadership, a group of researches that the lobbyists and the favored few love, needs to be replaced, starting at the top. At least one individual started working on this as an intern and she has worked her way to the top, never being held accountable for the failures of the program.

The consensus is that the US DOE Algae program/BETO, because of its leadership, is incapable of commercialization and deployment, but have kept their jobs by touting the latest and greatest algae technology and need for additional research rather than admit their failures and misplaced grant awards. Algae fuels have been researched to death for decades with no commercial deployment of fuels to date. Recommendations have been made over the years to take proven parts of algae fuel technologies derived from past algae pilot and demonstration facilities and use them in the commercial production deployment of algae fuels.

Private industry has been asking the DOE for over a decade to test the technologies paid for by the taxpayers that will work in commercial production of algae fuels with no success. To our knowledge, none have successfully scaled outside of laboratory settings. While the FOAs imply that commercialization is on the horizon, this has not been a priority of the DOE algae research program. Even past secretaries of energy ignored the facts that algae fuels were successfully tested in automobiles and commercial airlines, choosing to spend money on other feedstocks, and now a lot of the corn grown in the US is not fit for human or animal consumption. This endeavor should not require lobbyists, just common sense – something that has been lacking for years.

We have all reviewed the pristine algae fuel powerpoint presentations and projected high cost of algae fuel for decades including the 2010 Roadmap that has yet to be followed to the presentations describing projects that were 100% funded but, in some cases, less than 50% completed. University algae researchers have maintained for decades that algae fuels were too expensive and could not be achieved, all the while being given additional federal funds to bolster their claim that we need more research. None of which have ever been in commercial deployment of algae fuels. Private industry, private investment and the general public have never had any opportunities to witness past US taxpayer paid-for algae fuel pilot projects to be able to confirm the production let alone any of the purported costs.

Hopefully, the new Secretary of Energy and new President, a proven businessman, will take a no-nonsense business approach and redeploy the funds to allow private industry to take over the task that the government employees have failed to complete. Algae producers (not government research programs) have the ability, skills and experience to lower the projected CAPEX for fuels and to develop their own industrial standards. We have learned over the last decade that there is a huge learning curve and perspective between university researchers working in labs and commercially-minded algae researchers working with private industry, and it is amazing that the DOE has yet to figure out that what works in a lab rarely scales to a commercial basis – it just keeps throwing money into the labs, allowing them to purchase millions of dollars of equipment from other grant recipients that they later discard.

Mindsets at the DOE Algae Program/BETO must change if the US really wants to see algae fuels as one solution to get off foreign oil. Instead of hijacking algae technologies at government labs we need to take the proven parts of algae fuel technologies which have no value today and use them in deployment of commercial/industrial fuel production. This would create far more value than shelving the technologies and spending more money to create more technologies. Commercially-minded algae researchers, algae producers, private industry and private investment are in favor of an Algae Manhattan Project for Fuels, bringing together the best minds and using the proven algae fuel technologies all in one place. The consensus is that such a project would reveal the truth of the Biomass Program, and that is something the DOE will go out of its way to prevent.

If the DOE really wants to help reduce US dependency on foreign oil, a statement that is now being doubted by many, the Biomass Program leadership and the Algae Caucus, if it is more than another group created to create an illusion, both need to take a common sense business approach and use proven parts of algae fuel technologies and not dole out more money for more algae research until we

know what is really needed. It's time to give private industry the rights and benefits that the universities have been unsuccessful with.

With regard to algae co-products, research should not be a function of the DOE. Algae co-products were not the DOE's original energy mission, do not involve energy and should be handled by other more competent government departments. The Biomass Program has proven its incompetence with the fuel program so why should they be given more?

DOE algae program research should focus on all the rooms and rooms of existing algae fuel technologies sitting on shelves for decades. There is no value in any algae fuel IP to date because no one is using them in commercial production today. Thanks to the DOE leadership and the Algae Caucus, our tax dollars are being used to make these technologies obsolete.

DOE's algae programs leadership ability to pick winners and losers is very questionable when looking at past results. There is a huge difference between a research mentality and commercialization. Current leadership at the DOE algae research program needs to be replaced with commercially-minded algae researchers, algae producers, private industry and private investment produce industrial algae fuels. We can no longer afford more algae research grants without using existing proven algae fuel technologies today. We need commercially-minded algae researchers, algae producers and equipment companies to take over the algae fuel program, put the algae fuel puzzle together and get the job done. Otherwise they have wasted \$2.5 billion in taxpayer dollars over the last 70 years.

The DOE algae research program leadership claimed that they had rooms and rooms of algae technologies sitting on shelves decades ago and that, due to a 1976 Congressional Mandate, could only support more algae research but were prohibited from commercial production of fuels. Algae producers understood that 12 years ago and moved into producing co-products, but nobody at the DOE is willing to approach Congress to amend that mandate. Questions arise by many people around the world on why the DOE Algae Program and Algae Caucus didn't react when the price of oil was over \$100 a barrel? Until things drastically change at the DOE Biomass/BETO/NREL to allow private industry to use, test and scale-up proven parts of algae fuel technologies they will continue to sit on shelves and the tests using algae fuels in automobiles and commercial airlines will be all for naught, and this has been an exercise in how to waste money and not be held accountable.

After spending hundreds of millions on algae fuels research the last decade, where are the promised algae biofuels from all DOE selected companies like Sapphire Energy ("the golden child") who in 2009 claimed they would be producing 1 million gallons of diesel and jet fuel per year and in January 2010 were awarded a \$50 million grant by DOE and a \$54.5 million loan guarantee from USDA to substantiate these claims), Solazyme, General Atomics, Algenol, Solix Biofuels, Aurora Biofuels, Synthetic Genomics, Phycal, the government labs like NREL and Sandia, and the universities? In 2010, Solazyme was able to deliver 100% algae-based jet fuel to the Department of Defense and received millions from the DoE for the construction of an integrated biorefinery project. The fuel allegedly met all of the requirements for Naval renewable fuel, aviation fuel, and purportedly met the fuel requirements of the US Air Force and

the standards for commercial jet fuel. So, where is it 7 years later? Several companies have replaced all or most of their management teams and have been liquidated, but, with all due respect, we still don't have commercial production.

Commercial algae producers along with private investment were precluded from the deployment of algae fuels due to the DOE Algae Programs leadership's unwillingness or inability to go to Congress with proven parts of algae fuel technologies in hand to tell them it was time for commercial deployment. Deployment by commercially-minded algae researchers, algae producers and equipment companies using proven parts of algae fuel technologies would have been profitable when the price of oil was over \$100 a barrel. Due to a dysfunctional DOE algae biofuel program there have been more US public sector and government jobs created than ever in the private sector. Private industry and the investment community can only hope the new Secretary of Energy along with our new president-elect can 'drain the swamp' and allow private industry to deploy the purported 'proven' algae technologies in commercial deployment and scale-up. Once accomplished will finally create value in algae fuel IP/fuel technologies that currently does not exist.

DOE algae research grant programs, lobbyists and the pay-for-play media claims need to be held to a higher standard, accountability and most importantly provide results. Greed, avarice and self-serving interests on the part of those who have access to government grants have not produced commercial deployment of algae fuels to date. We continue to propose an Algae Manhattan Project for Fuels using the proven parts of algae fuel technologies to make algae fuels a reality. We are confident that the new Secretary of Energy and the new president will take a no-nonsense common sense approach to allow private industry working with select algae fuel experts put all of the proven algae fuel technologies commercial deployment and fuel production. If not, all the algae fuel technologies we have heard about for decades will continue to sit on shelves collecting dust.

ALGAE BIOPRODUCTS: Given the decades of failures in deployment of any algae fuels technologies the DOE has changed its direction to algae co-products. Questions arise if the DOE Algae Biomass Program in algae co-products (ie; nutraceutical Omega 3 EPA/DHA, cosmetics, food, feed, biofertilizer and bioplastics research). Are algae co-products the mission of the Department of Energy? Other government departments have much more experience, knowledge and capabilities in collaboration with private industry and private investment with algae co-products. Taxpayer funds were originally designated for algae biofuel research not algae co-products. After decades of algae research why should the DOE need more information?

While lobbyists and university algae researchers attend expensive conferences, commercially-minded algae researchers, algae producers, equipment companies, in collaboration with private industry and private investment have been producing and selling quality and quantities of algae biomass for co-products throughout the world using existing proven technologies. We see this through NAA's Algae Biomass Exchange. We receive algae biomass samples with COA's every month from all over the world from qualified algae producers and requests from potential off-takers with various specs and requirements. There is an increase in demand for algae biomass around the world to be used in ingredients and materials. Due to these needs and requirements we are helping to build new supply

channels everyday throughout the world. Whether a commercial algae producer is cultivating *Botryococcus braunii*, *Chlorella*, *Dunaliella*, *Haematococcus pluvialis*, *Nannochloropsis*, *Spirulina*, *Scenedesmus* microalgae, *Euglena gracilis* or any other macroalgae/seaweeds, our Algae Biomass Exchange is a meeting place for qualified algae producers and potential off-takers with specific needs and requirements.

Private investment in algae based ingredients and materials are on the rise around the world. Large international companies are investing in algae based co-products ie; nutraceutical Omega 3 EPA/DHA, cosmetics, food, feed and bioplastic materials. Think how far we might be if we were awarded some of the millions and millions of dollars that the universities and government labs were handed.

National Algae Association's Incubator Program - Update

We established the first Algae Incubator Program in the world for algaepreneurs and private industry interested in the emerging commercial algae production industry, and was told a year or two ago that NAA had more algae growing at one of its incubator facilities than at 4 labs funded by the DoE combined. Both students and private industry learn and receive hands-on training on methods and technologies used in commercial algae cultivation, harvesting, extraction for potential co-products, and to experience the challenges, solutions, markets and opportunities. We currently have new Algae Production Incubator Programs starting throughout the country, but due to the DOE requirements, we cannot let them view our sites. In the new year, NAA plans are to continue working with commercial algae producers throughout the world producing algae co-products.

Have a Happy Algae New Year, and here's hope to a more productive 2017!