

Advancing Research and Development of Sustainable Energy from Algae

**SENATE SELECT COMMITTEE ON
CALIFORNIA'S ENERGY INDEPENDENCE**

The Honorable Ben Hueso, Chair
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Sacramento, CA

INFORMATIONAL HEARING
SALTON SEA: RENEWABLE ENERGY AND RESOURCES
Testimony of Dr. Stephen Mayfield, UC San Diego
Director, California Center for Algae Biotechnology

Thank you Mr. Chairman. I would first like to thank you again for convening this hearing of your select committee on this important topic, and greatly appreciate the opportunity to participate in this dialogue. My remarks today will focus on the current state of RD&D on algae-based alternative transportation fuels and related co-products, and the environmental and economic potential they present to our state, and to the Imperial Valley in particular.

I am Stephen Mayfield, professor of biological sciences at UC San Diego, and director of the California Center for Algae Biotechnology (Cal-CAB). Cal-CAB was formed five years ago to help catalyze the development of algae as source of sustainable alternative transportation fuels, and to strengthen the working partnership between academic research and industry commercialization.

The mission and philosophy of the California Center for Algae Biotechnology is to work closely with commercial partners to transfer the basic research in algal biotechnology from lab to application as rapidly as possible, by promoting interactions and collaborations between academic and commercial sector partners. We have academic collaborators from a number of UC campuses including Berkeley, Davis, Riverside, Santa Barbara, and UCLA, as well as from Cal Poly San Luis Obispo and San Diego State University, and several community colleges. In this capacity, we hope that Cal-CAB can continue UC's proud history of acting as the research arm of the State of California.

Mr. Chairman, I know that you are well aware of many of the potential benefits of algae production at large scale – whether for fuels or other products – but I think it useful to restate some of these basic facts:

- All fossil fuels come from photosynthesis; petroleum is simply ancient fossil algae, while coal is fossil plants;
- Algae are the most efficient photosynthetic organisms on the planet (up to 20 times more efficient than crop plants at sequestering CO₂ and producing biomass);
- Algae require: flat land, water, CO₂, nutrients, and sunlight;
- Biomass production from algae does not compete with food crops;
- Algae can be grown in non-potable water on non-arable land (the water can be brackish, seawater, or waste water (which can also supply some of the required nutrients));
- Lipids extracted from algae make “green crude” which can go directly into existing petroleum refineries; gasoline, diesel, and jets fuels have already been produced from algae oils and demonstrated in successful commercial and military applications;

- Algae is already produced at scale in California for nutraceuticals and aquaculture feeds;
- The Imperial Valley and regions around the Salton Sea are some of the best algae producing regions in the US.

I point out these critical attributes, because if the State of California is to going to meet its mandated targets for production of alternative transportation fuels and reduction of GHG emissions, it needs to focus like a laser – in terms of both policy and resources allocation - on fuels that require the lowest natural resource inputs for production, that do not compete with the production of food, and that result in fungible, “drop-in” fuels that are immediately compatible with traditional fossil-based fuels and related refining and distribution infrastructure.

California is blessed with the right combination of ingredients for large-scale commercial production of algae. We have the geographical, environmental, intellectual and human resources all in place. As Chairman Hueso and others have already pointed out, and which the facts support unequivocally, the Imperial Valley is uniquely positioned to be at the forefront of commercial-scale production of algae. Because algae does not require fresh or potable water to thrive and reproduce, brackish or saline sources could be used, and production facilities could be sited as appropriate adjacent to the Salton Sea, to take advantage of proximity to those resources. This would provide the added advantage of helping to mitigate the “playa effect” along the Sea’s receding shoreline, where wind-generated dust clouds could threaten public health in adjacent communities and further up and down the Valley.

My perspective as director of both California Center for Algae Biotechnology and the CEC’s California Initiative for Large Molecule Sustainable Fuels – and one that is shared by the vast majority of my industry and academic colleagues - is that California has before it a unique opportunity to help catalyze an industry by encouraging the development and deployment of algae biotechnology within its borders. We have already seen the research side of this equation result in a meaningful economic impact in the San Diego region where more than 500 jobs have been created over the last five years. If successfully deployed at commercial scale in places like Imperial County, and the San Joaquin Valley, these technologies will also generate a significant number of well-paying jobs for the regional and state economy, in addition to helping to meet GHG reduction targets, and mitigating other environmental challenges.

However, time is of the essence, as other states are moving quickly to support and secure these production enterprises. Once they take root and become more robust, the likelihood of similar economic engines emerging here becomes less likely. If California can create an environment in which industry is incentivized and encouraged to consider production in places like the Imperial and San Joaquin Valleys, the long-term economic & environmental benefits could be significant.

The California Center for Algae Biotechnology and our academic and industrial colleagues throughout the state stand ready to assist this Committee, and the State, in any way we can to help realize this achievable goal. Thank you again for this opportunity to testify, and I’m happy to answer any questions.

END of STATEMENT

Additional comments on California’s role in developing low carbon fuels:

Under the Low Carbon Fuel Standard – LCFS - California is required to produce about 4 billion gallons per year of low carbon fuel, with at least 50% GHG reduction, by 2020; that is less than 7 years away, and will require the production of **11 million gallons of low carbon fuels per day.**

I am increasingly concerned that the State of California has yet to address what will be required to achieve these mandates, and instead continuing to provide support for non-scalable low carbon fuels, by funding multiple small awards for first-generation technologies that may indeed produce low carbon fuels, but which lack any meaningful commercial scale potential. This is not to be critical of these awards or technologies; my colleagues and I at Cal-CAB have long championed the concept of “silver buckshot”, meaning many small solutions that ultimately add up to a significant contribution. However, California is at a point where it is critical to consider allocation of future R&D resources in a manner that has the potential to meet our mandated requirements.

California leads the world as a direct result of **the innovations and inventions made here**, and biofuel deployment at the scale required under the LCFS will only be achieved after these innovations have reduced the price of low-carbon fuels to a level that competes with current fossil fuel costs. We are close, but we need a final push, and if when do achieve our LCFS goals, it will be a game changer for the planet.

I think it is equally important to understand the economic benefits to our state that will come with algae production at commercial scale. As the Chairman well knows, in the Imperial Valley, commercial production of algae (largely for nutraceuticals) has been well-established and successful for decades. The research performed by Cal-CAB and other academic labs, along with private sector entities, has dramatically improved the ability to produce algae at large scale in outdoor ponds. Current examples of this can be found in Texas, where Synthetic Genomics has a large production facility, and New Mexico, where Sapphire Energy (of which I am a founder) has 100 acres of algae ponds under production today. Just recently a major refiner (Tesoro) entered into a deal with Sapphire Energy to purchase the 100 barrels of green crude that this facility will produce every day, once production is at full scale. This crude will go directly into the refining and distribution chain of Tesoro’s existing commercial supply infrastructure.

Additional information on Cal-CAB and CILMSF

The California Center for Algae Biotechnology (Cal-CAB) is a consortium of academic researcher scientist working in close collaboration with private industry. Scientists from many campuses of the University of California including, San Diego, Los Angeles, Berkeley, Santa Barbara, Davis, and Riverside are represented, and joined by colleagues from the Scripps Institution of Oceanography (SIO), Stanford University, the Salk Institute, Cal State San Marcos, Cal Poly San Luis Obispo and San Diego State University. Established in 2008, Cal-CAB collaborates with the private sector in research and development efforts in biology, chemistry, and engineering, and facilitates the transfer of these lab discoveries into the commercial sector. Cal-CAB also acts as an advisory resource for information related to sustainable energy from algae for the public and policy makers.

The mission of Cal-CAB is to support development of innovative, sustainable, and commercially viable algae-based biotechnology solutions for renewable energy, green chemistry, bio-products, water conservation & reuse, and CO₂ abatement. SD-CAB incorporates internationally renowned research scientists from the fields of biology, chemistry, engineering, economics, and policy. It also trains young scientists and technicians, educates the public, collaborates with private sector partners, and serves as a resource for regional, state and national policy makers regarding the use of algae for energy independence and conservation of land and water. It is committed to do so based on the highest standards of academic excellence and objectivity.

The California Initiative for Large-Molecule Sustainable Fuels (CILMSF) was launched by the CEC in 2011, and I am pleased to inform the Committee that its output has exceeded the original expectations of what we initially thought might be possible. In the short time that CILMSF has been operational, the Institute’s researchers and students have generated over 30 published articles and patents, with a number of others

currently under review or awaiting publication. The topics of these papers range from metabolic engineering of algae for altered fatty acid (fuel) accumulation, to crop protection and co-product production – all important research areas critical to helping advanced alternative transportation fuels become economically viable. These publications demonstrate the rapid progress being made toward environmentally and economically sustainable drop-in fuels produced from algae, and represent research accomplishments of which the CEC can be proud. The spin-off technologies from these discoveries can also help to create additional high paying jobs in California in a sustainable and environmentally friendly manner, further demonstrating how public funds can be leveraged to support this important work. This productivity also demonstrates both the promise and potential of algae as a viable commercial-scale alternative fuel feedstock, as well as highlighting the need for sustained efforts to help bring it from the R&D phase into the commercial phase here in California, in places like the Imperial Valley or San Joaquin Valley.

Sincerely,



Stephen Mayfield
