BIO JET FUEL, ALGAE AND LEDS

LEAVING FOSSIL FUELS BEHIND by Mary Otte

From biofuel to plastics, Omega-3s to animal feed, growing algae via LED light panels lends itself to a bright, sustainable future according to a University of South Florida study. Mary Otte discusses process and the possibilities with lead researcher Ioannis Dogaris.

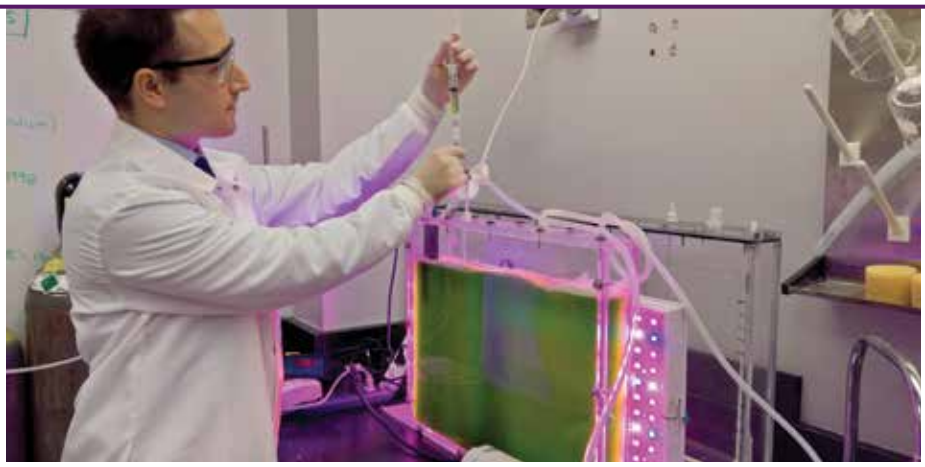
Finding an alternative to traditional transportation fuels has increasingly been the focus of many environmental scientists and has risen to a global concern in the last two decades. Nearly every industry is looking to reduce its carbon footprint and reduce its fossil fuel consumption.

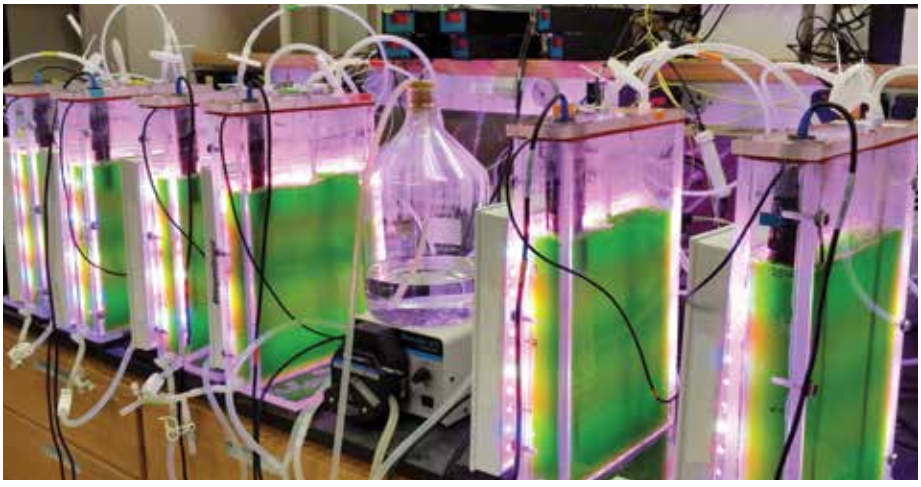
A ground-breaking microalgae study was recently conducted in the laboratories of the University of South Florida that turns the alternative fuel race up a notch. Picture everything from plastics to biofuel being produced with algae, conserving precious resources like freshwater or bypassing environmentally harmful resources like fossil fuels. The study delves into renewable diesel and jet fuel, the realities of cost-versus-benefit factors, and renewability.

The results suggest the horizon is bright.

At the beginning of the study, LED panels and metal halide lamps were observed. The LED panels required less than a quarter of the wattage and showed equal to greater results. It was also found that "the red and blue lights are considered preferable among green algae species for the purpose of photosynthesis," according to an article in *Biomass and Bioenergy Journal* article.

In this microalgae cultivation study, a "novel, cost-effective, and modular horizontal bioreactor (HBR) for algae cultivation was developed… The HBR was designed to keep costs low and was engineered to minimize water and energy use while enhancing CO_2 and nutrient uptake," says study lead Ioannis Dogaris.





> **PICTURE EVERYTHING FROM PLASTICS TO BIOFUEL BEING PRODUCED WITH ALGAE, CONSERVING PRECIOUS RESOURCES LIKE FRESHWATER OR BYPASSING ENVIRONMENTALLY HARMFUL RESOURCES LIKE FOSSIL FUELS."**

Many of the promising microalgal species love to grow, grow, and grow some more under the spectrum of LEDs. They double their cell mass in days and flourish in what humans would consider harsh environments, like wastewater. Although using artificial light may not be cost-effective in locations with abundant sunlight, it is critical during preparation for large scale algae production. That is when the algae 'seed' grows in a controlled and protected indoor environment, just like a plant nursery, until the algae population is big enough to be transferred to an outdoor environment where the sun provides the much-needed light energy for photosynthesis.

The study featured LED panels for the algae seed production by New England LED manufacturer BloomBoss. Dogaris said BloomBoss LED panels suited the study for a number of reasons.

"The main benefits are lower power consumption, increased energy efficiency, and low heat emission. In fact, the heat generated by the panels helps maintain the water temperature between 20-30°C," says Dogaris. "And the space saving aspects and low costs for their systems are additional benefits. We have tried other LEDs and we decided on the BloomBoss system because it addressed our needs."

Past challenges for growing algae included low production and low mass concentration. The new HBR system makes for a rich algae stew and lowers production costs significantly. It's estimated at USD$25,000 per hectare, a cost comparable to open ponds, and lower than other closed cultivation systems.

Algae doesn't just make jet fuel. It comes with the added benefits of high value byproducts like Omega 3, beta carotene, lipids, proteins for animal feed, food colorant, and fertilizer.

Using wastewater turned into artificial seawater eliminates the need for freshwater sources, and the algae that are produced sustainably carry out both biological waste treatment and production of valuable chemicals and biofuels.

The HBR showcases an eight-blade paddlewheel that mixes the cultures with half the power requirements of other mixing methods and lends the addition of a ceramic gas micro-diffuser to supply the cultures directly with CO_2. This blast of CO_2, paired with high-density cultivation of microalgae using LED illumination, has proven to be extremely efficient, especially where sunlight is not readily available.

The HBR is also built tough. Subjected to wind, resistance, leak, and hydraulic tests, it passed with flying colors; the eight-blade paddlewheel was able to operate constantly without issues or overheating.

Open ponds, though readily available, are difficult to control environmentally and have low productivity. The controlled HBR units eliminate these issues and only use a fraction of the cultivation water compared to the older, traditional methods.

It's new, and it's working.

"We know how to produce biofuels," says Dogaris. "But we also need bioproducts, and that's possible with algae. In addition to fuels, we need to focus also on alternatives to plastics from oil. Nature offers the algae and plant material (biomass) capable of producing molecules and compounds for the chemical industries. Thankfully, a lot of chemical companies are trying to reduce their carbon footprint and this is a step in that direction. Bioplastics, continued interest in biofuels, use of wastewater sources, and sustainability are the driving forces of our work," adds Dogaris. "That's what motivates me and why I like it and why I'm here, it's exciting to use different resources for fuel, learning through nature and its important compounds."