



# Algal Biomass Organization

January 13, 2011

January 2011 - Vol I

## Member Spotlight: Ben Cloud, President and Chief Executive Officer, Phyco BioSciences



### **ABO: Can you tell us about Phyco BioSciences?**

Ben Cloud: We began our work in algal biomass in 2006 under the name XL Renewables, Inc. At that time, we were looking at algal biomass as an alternative feedstock to corn-based ethanol that could be grown on-site and utilize the CO<sub>2</sub> gases and digester effluent from a planned biorefinery project in western Arizona. When the biorefinery was put on the shelf due to difficulties securing financing for the project, we made the decision to focus on algae as we felt we had made clear advances in open system designs. We established our pilot facility in 2007 in Casa Grande, Arizona and quickly evolved into the Super Trough System we have today. In 2009, XL Renewables, Inc. formed Phyco BioSciences, Inc. to implement a commercialization strategy for algal biomass. However, our objective is much broader than simply the production technology. Believing we have a solid large-scale production approach, we have spent considerable time and effort planning how to scale production to meet the supply chain needs of customers and develop markets. Even though we are focused on production technology, we see Phyco as a processor and marketer of algal biomass for food, feed and fuel. Our strategy is built around product development, risk management, capital efficiency and quality control.



### **ABO: What makes the Super Trough System effective for algal biomass production?**

Cloud: To understand the Super Trough System, you have to first begin with the premise that any photosynthetic organism is subject to stresses that limit yield. If you eliminate some of these stresses, you increase yields and mature faster. In crop production, the irrigation wet/dry cycle is an ideal example: Flood-irrigated fields subject the crop root zone to saturation; when flooded that displaces oxygen on one hand and then moves to the wilting point where moisture is lacking on the other end of the scale. This cycle stresses the crop and significantly lowers the yield potential. In the late 1970's with the evolution of sub-surface drip irrigation systems, the ideal combination of moisture, nutrients and oxygen could be maintained in the root zone. This caused yields to go up significantly and crops to mature sooner. The ultimate system includes hydroponics, where a greenhouse is added to eliminate weather-related stresses to the crop.

The same principles of stress reduction apply when we talk about algal biomass, ranging from open pond systems all the way to photo bioreactors. The Super Trough System is the drip irrigation system for the production of algal biomass. It eliminates many of the stresses by providing excellent mixing and motive force characteristics. This helps ensure the algal culture is optimized all the way through, yet remains economical on a large scale. The V-shape of the trough optimizes the fluid dynamics. Also, it provides greater operator control of inputs like nutrients, CO<sub>2</sub> and especially crop protection inputs. This is critically important in 40-acre algae fields.

**ABO: You recently announced that you have partnered with a Chinese firm, China Biological Engineering, for two algae-to-biofuel projects. Can you tell us more about that agreement and how Phyco's technology will be utilized?**

Cloud: We are very excited about our relationship with China Biological Engineering Limited (CBEL). I have to give credit to Mr. Eric Tso and Mr. Lie Djiauw of CBEL for aligning our interests so we could proceed. Both Mr. Tso and Mr. Djiauw understand our concerns relative to technology and doing business in China. Mr. Djiauw is a retired polymer chemist from Shell Oil. Mr. Tso spent most of his career in the US and Chinese oil industry. Both are dedicated to the development of algal biomass production in China.

CBEL demonstrated their commitment to working with Phyco by purchasing common stock. In return, we agreed to provide our production system and support for an equity stake in CBEL projects. System components will come from Phyco. CBEL is initially funded to develop the first projects at \$5 million and is planning for aggressive growth. However, they are not looking to hit a home run right away, but expect to see yield averages emerge over a number of years and allow time to adapt to the production areas. A third project site is now moving forward as well.

CBEL is using the Super Trough System. However, the first two locations will be challenging as the winters are harsh and there is also a rainy season. Since the Super Trough System is designed to utilize a mechanically-installed solar cover, we will have to rely upon the cover to protect the culture for part of the growing season. This is also an opportunity for us to further develop the solar cover, especially color spectrums and UV effects.

CBEL and Phyco share a common goal: to produce product for food, feed and fuel. Our job is to provide the means of production as well as market the algal biomass in non-biofuel markets. They do have a strong emphasis on utilizing algal biomass for biofuels in the future. CBEL is also looking to Phyco to provide a solid biofuels pathway.

**ABO: What is your impression of the work being done in algae in China?**

Cloud: China is currently the largest producer of algae in the world; it is also the largest consumer. Leaders clearly see the benefits of further developing this industry for both proteins and fuels to meet their domestic needs and, potentially, for export. Since China has the world's largest aquaculture industry, it will likely consume large quantities of algal biomass as fish feed. We toured the new facilities at the Chinese National Academy of Sciences in Qingdou in early 2010. This is a very large facility with state-of-the-art lab facilities. We met with six researchers who lead the various labs that are focused on algal research. They are working on photo bioreactor development, algal cultivar development, hydrogen production, biogas, biofuels, and much more.

**ABO: What's next for Phyco?**

Cloud: Most important is the completion of our commercial production facility in Chandler, Arizona as we have orders to fill for our first products by summer. Second, we are looking to complete an arrangement with a strategic partner for algal biomass production in India, similar to what we have done in China. Since our ultimate objective is meeting the supply chain requirements of algal biomass customers, we are looking to have a presence in these key growth regions of the world. Third, we have finalized our pathway to biofuels. Since we began for the purpose of developing a biorefinery project, we have continued to focus on technology advances and strategies to produce biofuels. We have developed IP for a crucial step that speeds the process to convert biomass to liquid fuels and facilitates the use of algal biomass as a feedstock. We are moving forward with the engineering of a modest 10 mgy biorefinery development that will primarily produce biodiesel.

**ABO: Where do you expect the U.S. algae industry to be in the year 2020?**

Cloud: While the industry is evolving rapidly and many variables are involved, I believe that by 2020 algal biomass will be a significant food and industrial crop and next-generation biofuels feedstock. I also believe in ten years worldwide sales will be in excess of \$10 billion for both non-biofuel and biofuel uses.

Why? We have an aligning of the stars: growing demand for Omega 3 Fatty Acids and other

nutritional components in food and feeds; the decline and/or slowed growth of ocean supplies for fish meal; rapid expansion of aquaculture; and a shortage of proteins worldwide necessary to support the production of all forms of animal proteins for a world population that will double in the next 30 years and is growing in prosperity. Further, our governments can no longer afford to subsidize (directly or militarily) cheap oil that has inhibited the emergence of algal biomass production in the past. I think the door is wide open for our industry. It's a very exciting time.

