Floating Cultivation System for Low-Cost Production of Algae

George Philippidis, Ph.D., Ioannis Dogaris, Ph.D., and Michael Welch
Patel College of Global Sustainability, University of South Florida, Tampa, FL

Andreas Meiser, Ph.D. and Lawrence Walmsley
Culture Fuels, Inc., New York, NY

FESC Workshop
Gainesville FL, May 12 2014

Algae Cultivation Technologies

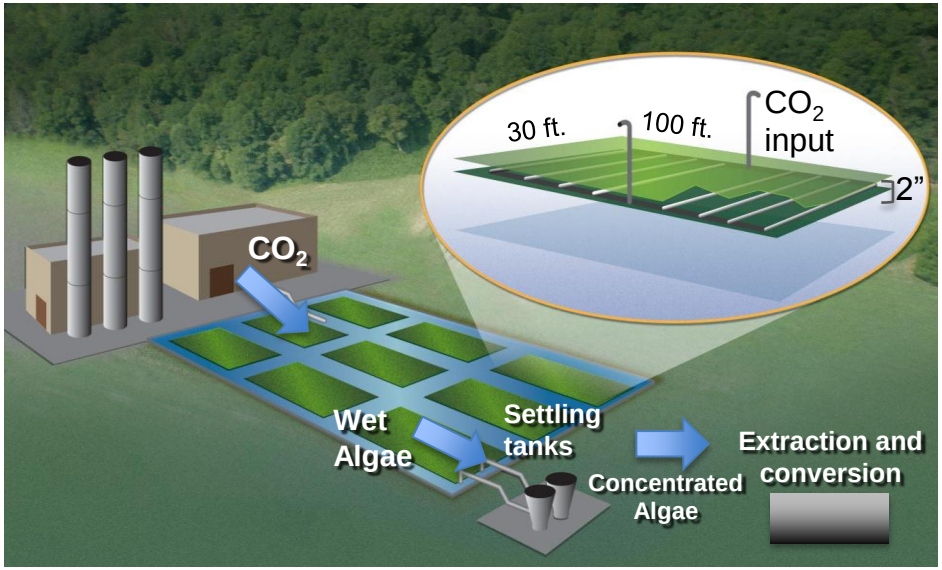
Open pond

- **Low investment**
- Low biomass density (huge water volume to process)
- Low yield

Closed photobioreactor (PBR)

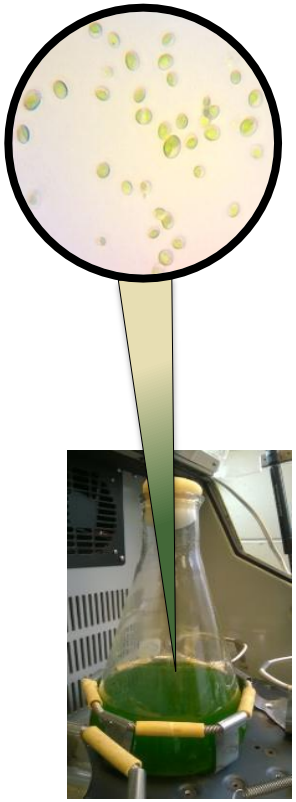
- High investment
- High biomass density
- **High yield**

Innovative Approach: Horizontal Bioreactor (HBR)



- **Low capital cost**
- **High cell density & productivity**
- A fraction of water use (< 1/4th)
- Lower cost of downstream processing
- Thermal control
- Contamination barrier
- Floating (or on the ground)
- Readily scalable (modular)

Experimental setup

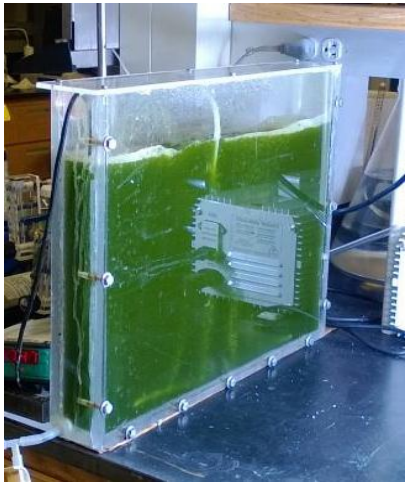


Micro-algae strain *Nannochloris atomus* CCAP 251/4A

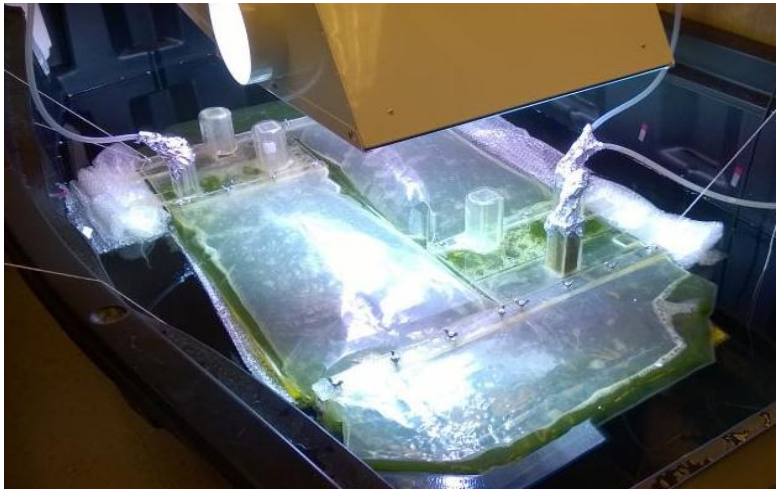
- Saltwater green algae
- Significant amounts of intracellular lipids for biofuel production

Algae culturing scheme

10%



10%



Flask
1-L volume

Vertical reactor
7.5-L volume

Floating HBR
65-L volume

HBR conditions

11-100 klux (16h:8h light:dark), 1.5-3% CO_2/air mix, pH = 7.5±0.2, T = 27±2^{o}C

Results & Conclusions

Light intensity (klux)	Bioreactor location	Max biomass concentration (g/L)	Average volume productivity (g/L/d)	Average areal productivity ($g/m^2/d$)
11	indoor	2.3	0.10	7.0
31	indoor	3.8	0.19	13.4
100 *	outdoor	4.3	0.26	16.1

* *preliminary outdoor growth results*

- Cultivation of micro-algae in 65-L novel **horizontal bioreactor (HBR)** was successfully performed
- High algae biomass concentration was achieved indoors, **3.8 g/L**; biomass productivity doubled when light intensity tripled
- Preliminary **high-biomass productivity and yield** achieved in semi-continuous outdoor operations over 14 months with no contamination problems
- Scale-up of HBR to commercial size currently underway

Acknowledgements

Office of Energy at the Florida Department of Agriculture and Consumer Services for its financial support (Grant Agreement SRD001)

USF
UNIVERSITY OF SOUTH FLORIDA

Patel College of Global Sustainability

FESC Florida Energy Systems Consortium
Universities Addressing Florida's Energy Needs