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Winter 1-17-2020

## Algae Technology Educational Consortium's (ATEC) Algal-based Education and Training and Opportunities

Ira Levine

Gef Flimlin

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## **Algae Technology Educational Consortium's (ATEC) Algal-based Education & Training Programs & Opportunities**



**Ira Levine, Ph.D.  
Gef Flimlin  
Algae Foundation  
University of Southern Maine**

**January 17, 2020  
Belfast, ME**

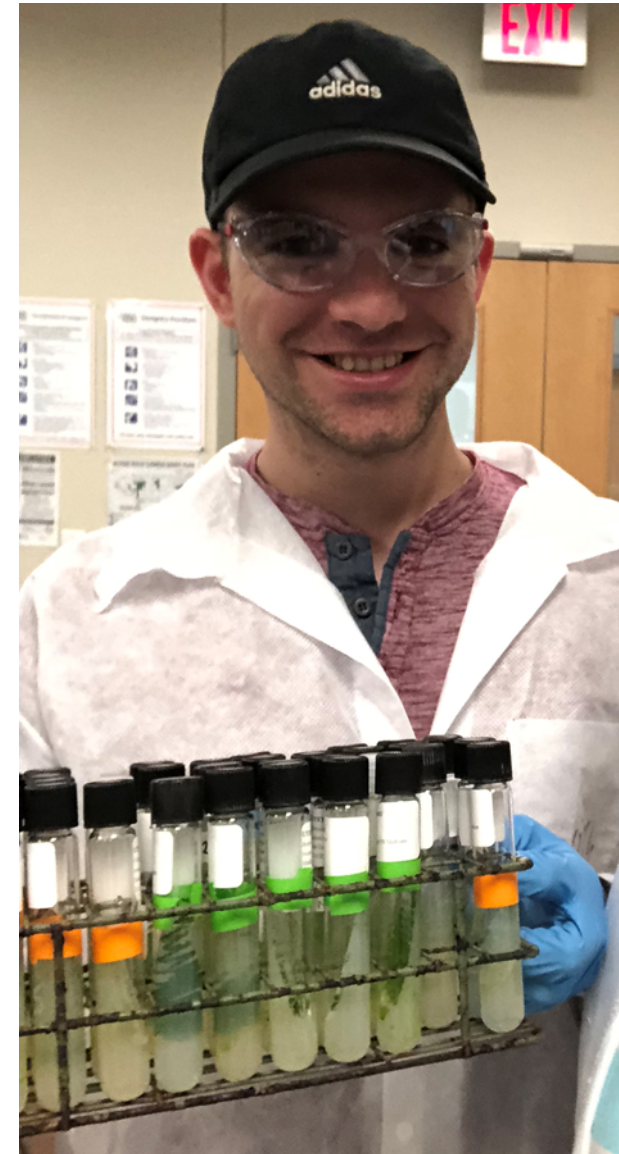


# Relevance

**Goal Statement:** Create and distribute algal-based curricula to develop a skilled workforce

## Algal Industry Jobs:

- Recent ATEC graduates earned university scholarships, national lab internships, and algal company positions
- 17% of Algal MOOC participants received pay raise or promotion
- 62% of Algal MOOC participants received tangible benefit
- Qualitas' Texas farm VP indicated desire to hire the entire 2019 ATEC graduating class
- ATEC's Intro to Algae Massive Open Online Course participation by existing staff was mandated by Cyanotech
- ATEC will provide training for crossover applications in wastewater, fermentation, and biotechnology industries
- Owner of 100 acre algal farm in Columbus, NM indicated a preference for ATEC graduates



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MASSIVE OPEN ONLINE COURSE  
"Introduction to Algae"

  
Algae Academy  
K-12 Student  
Interest Generator

*Community College  
Biotechnology Degree  
Austin Community College*

*Algae Cultivation  
Extension Short-Courses*

*Community College  
Farming Degree  
Santa Fe Community College*

Trained Workforce and Entrepreneurs

**JOBS**

Trained Workforce and Entrepreneurs





# Algae Academy

We are currently accepting applications for the 2019-2020 Academic Year!

Apply at [tinyurl.com/AlgaeAcademy2020](http://tinyurl.com/AlgaeAcademy2020)

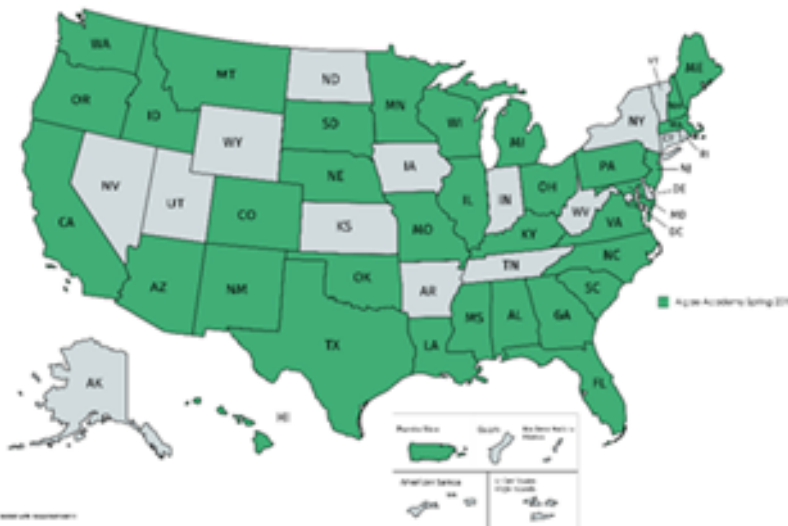


- 5-Day Curriculum
  - Algae 101 – basic and applied
  - Cultivation
  - Sampling
  - Microscopy
  - Data Visualization and Analysis
  - Entrepreneurship
- Aligned with National NGS





# Algae Academy



# of Students Served



Curriculum adapted to elementary and high school levels. Kits distributed twice an academic year.

11,000 Students in Spring 2020

Algal Biomass Summit, 2015 – Washington DC: Ike introduces the idea of “K-12 Initiative”

Algae Academy pilots curriculum in Aviara Oaks Middle School

Algae Academy curriculum is taught in 40 California, Michigan and Ohio Middle Schools

2015

2016

2017

2018

2019





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Trained Workforce and Entrepreneurs

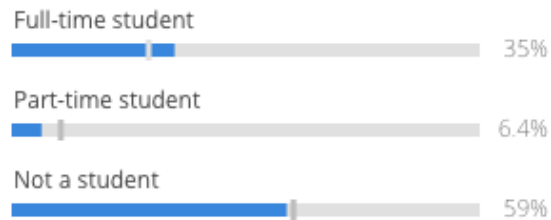
**JOBS**

Trained Workforce and Entrepreneurs

17% received a pay increase or promotion  
62% received a tangible career benefit  
from this course

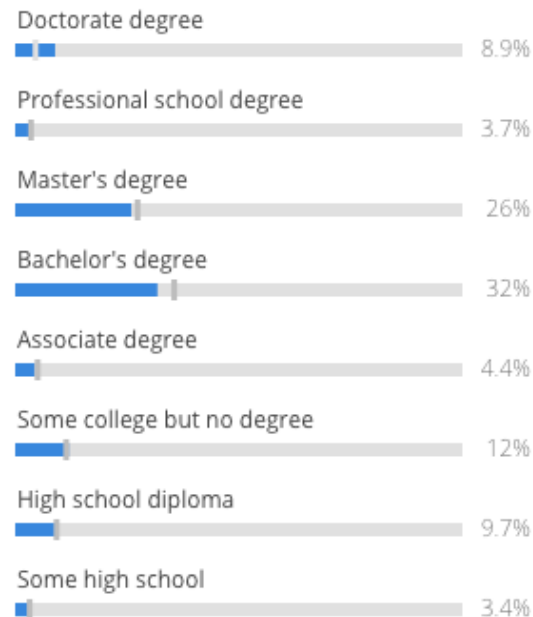


## Student Status



Based on data from 405 learners. Estimates accurate to ± 4.9 percentage points. ⓘ

## Highest Education



## Employment Status





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**JOBS**

Trained Workforce and Entrepreneurs

# ATEC Impact from coast-to-coast

## ATEC & Community College Collaboration

- Formalized ATEC relationships (signed mou):
  - Austin Community College (Texas)
  - Fresno State University (California)
  - Hawaii Community College (Hawaii)
  - Lenoir Community College (North Carolina)
  - Linn-Benton Community College (Oregon)
  - Lone Star College (Texas)
  - Midland College (Texas)
  - Santa Fe Community College (New Mexico)
  - Shoreline Community College (Washington)
  - Solano Community College (California)
  - South Texas College (Texas)
  - University of Texas, Austin
  - University of Texas, Rio Grande Valley



University of Puerto Rico \*



	ALTF 161 Intro to Algae Cultivation	ALTF 261 Advanced Algae Cultivation	ALTF 262 Algae Harvesting	ALTF 298 Algae Internship	PLMB 141 Pumps & Motors	BIOL 111 Intro to Biology (for plants)	BIOL 111L Intro to Biology Lab (for plants)	WATR 166 – Microbiology for Water Operators	Bioinformatics for Algae	Short course (No Lab)
Media preparation, sterile techniques, microscopy	X	X				X	X	X		X
Culture inoculation	X	X					X	X		X
Scale-up: petri plate to 10L	X									X
Monitoring procedures for media and biomass analysis	X	X	X				X			X
Quality control analysis	X	X	X					X		X
Data Collection and operational awareness	X	X	X			X	X	X		X
Scale-up: 10L to 10,000L		X								
Biomass analysis and quality assessment		X	X				X			X
Biomass storage techniques		X	X							X
Lab and farm safety	X	X	X		X			X		X
Operations and maintenance	X	X	X		X			X		X
Heterotrophic and fermentation		X	X							X
Wastewater treatment utilization		X	X					X		X
Harvesting operations			X					X		X
Pump and motor operations					X			X		
Hydraulic sizing and electrical demand requirements					X			X		
Internship				X				X		

### Algae Cultivation Skill Standards Matrix 7 Micro Badges

### Algae Cultivation Badges

1. Algal Culture badge: biomass inoculation
2. Algal Culture badge: biomass analysis
3. Algal Culture badge: biomass scale-up
4. Operation and Maintenance badge: Microfarm
5. Operation and Maintenance badge: Algae Harvesting
6. Operation and Maintenance badge: Pumps and Motors
7. Algal Culture badge: Internship (or)  
Operations & Maintenance badge: Internship

# Skills linked to current job listings

## SKILLS



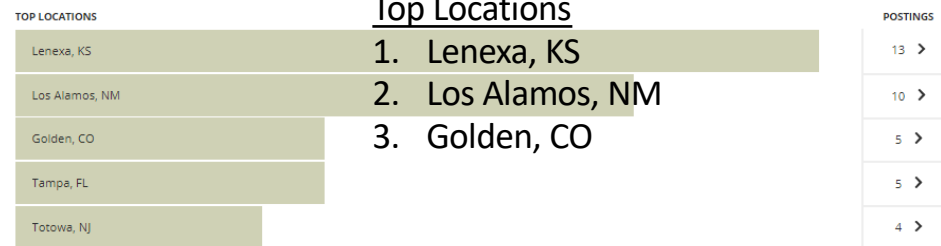
Endorsement July 22, 2019

claim

173 Job Openings for "Algae"

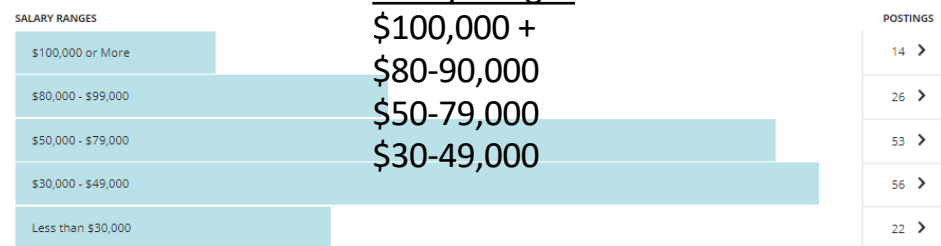
Insights

### Top Locations

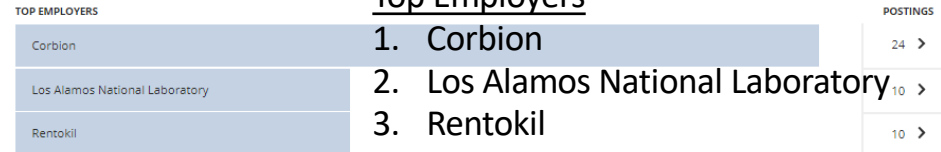


Show More

### Salary Ranges

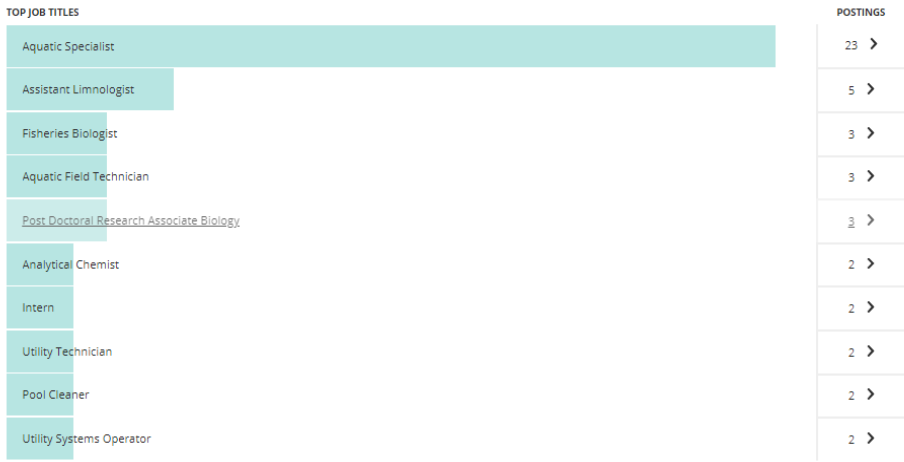


### Top Employers



## 173 Job Openings

Algae in [United States: All States](#)





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**JOBS**

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## NEW COURSES

**ALGE 111 – Introduction to Algaculture**  
**ALGE 211 – Advanced Algaculture**  
**ALGE 221 – Algae Harvesting & Processing**  
**ALGE 298 – Algaculture Capstone**  
**MOOC - Introduction to Algae**

**BIOL 252 – Algae Biotechnology 1**  
**BIOL 250 – Introduction to Algal Science**  
**BIOL 253 – Algae Bioprospecting Informatics**  
**PLMB 141 – Pumps and Motors**

*LEARNING OUTCOMES AND SKILL SETS for each class and program as a whole*

		ALTF 161	ALTF 261	ALTF 262	ALTF 268 ALTF 298	PLMB 141	BIOL 111	BIOL 111L	WATR 166	ALTF (Phyc)	Bioinformatics	BLDG 111	Short course
1	Media preparation	x	x					x	x				x
2	Sterile technique	x	x					x	x				x
3	Microscopy	x	x					x	x				x
4	Culture inoculation	x	x					x	x				x
5	Scale up: colony to 10L	x											x
6	Scale up: 10L to >500L		x										x
7	Monitoring procedures for biomass analysis	x	x	x					x				x
8	Lab and farm safety	x	x	x		x			x			x	x
9	Operations and maintenance	x	x	x		x			x				x
10	Harvesting operations			x					x				x
11	Biomass analysis and quality assessment		x	x					x				x
12	Biomass storage techniques		x	x									x
13	Heterotrophic growth and fermentation		x	x					x	x			x
14	Algae identification	x	x	x					x	x			x
15	Pathogen/predator identification	x	x	x					x				x
16	Treated wastewater utilization		x	x					x				x
17	Quality control analysis	x	x	x					x				x
18	Data collection and analysis	x	x	x				x	x				x
19	Internship				x								
20	Pump and motor operations					x			x				
21	Hydraulic sizing					x							
22	Electrical demand requirements					x			x			13	
23	Mechanical properties of water					x			x				

thealgaefoundation.org



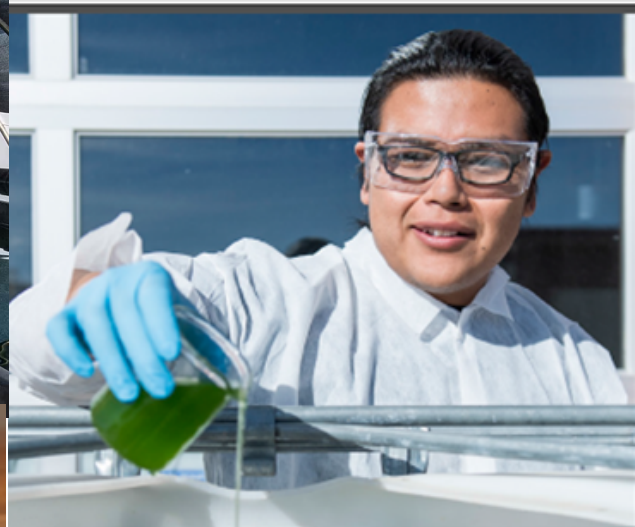
Providing a skilled workforce to meet the needs of the rapidly-growing bioeconomy.



Comprehensive education that combines concepts with hands-on training in our A.A.S. in Controlled Environment Agriculture and embedded Algae Cultivation Certificate.



- Biological Technician
- Plant Technician
- Lab Technician
- Engineer
- Project Developer



## CERTIFICATE ALGAE CULTIVATION

Algae production provides a sustainable source of biomass for bio-based products, feed, fuel and foods, creating high-quality jobs for an educated workforce. This Web-blended program provides that education and combines concepts with hands-on training. The Certificate in Algae Cultivation counts toward the Associate in Applied Science in Controlled Environment Agriculture.

**CAREER OPPORTUNITIES INCLUDE**  
Biological Technician, Engineer, Entrepreneur, Lab Technician, Plant Technician, Project Developer

**LEARN MORE**  
[www.sfcc.edu](http://www.sfcc.edu)  
505-428-1641





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# Biotechnology AAS Degree Plan

## Semester I

- BIOL 1414 Introduction to Biotechnology I

## Semester II

- **BIOL 1415 Introduction to Biotechnology II**  
**RESEARCH PROJECT ON MANUFACTURE OF AN ALGAL BIOTECHNOLOGY PRODUCT**
- BITC 1340 Quality Assurance

## Semester III

- BITC 2350 Bioinformatics (generated the sequences from 2441)
- **BITC 2441 Molecular Techniques**  
**DNA BARCODING LAB and SEQUENCE ANNOTATION (ALGAL STRAINS FROM UTEX)**
- **BITC 2411 Laboratory Instrumentation**  
**TOTAL LIPID EXTRACTION**  
**TOTAL SAPONIFIABLE LIPIDS (FAME) ANALYSIS**

## Semester IV

- **BITC 2431 Cell Culture Techniques** **ALGAE AS TEST ORGANISM**
- **BITC 1491 Special Topics in Biological Technology/ Technician: BioManufacturing**  
**MICROALGAE CULTURING METHODS: GROWTH KINETICS & BIOMASS METRICS (Summer 2018)**

## Semester V

- BITC 2487 Biotechnology Internship

# New Curriculum: Heterotrophic Algae Cultivation

- New module under development to be inserted into BIOT 057 Synthetic Biology and Algae Biotechnology at Solano Community College
  - Bill Barclay (formerly of Martek and DSM)
  - Jim Dekloe (Solano Community College)
- Coursework to include:
  - History and applications of heterotrophic algal biomass production
  - Commercialization of heterotrophic algal production
  - Cultivation and downstream processing of key strains
- Expected to be incorporated into SCC curriculum in 2020



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ALGAE TECHNOLOGY  
EDUCATIONAL CONSORTIUM



# Algae Culture Extension Short-course



## Macroalgae



[www.algaefoundationatec.org](http://www.algaefoundationatec.org)



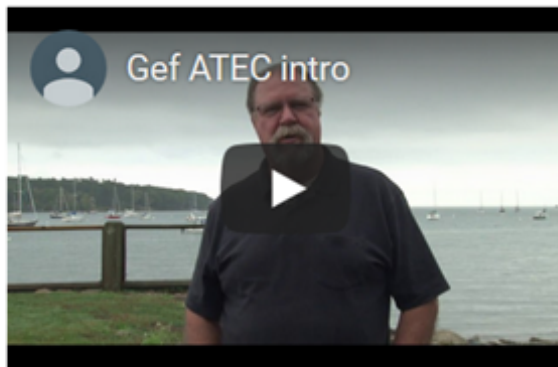
~ 400 participants in 3 months

## ACES PART 2: MICROALGAE

ACES: [Part 1: Macroalgae](#) [Part 2: Microalgae](#)

### Chapter 1: Introduction

After you have viewed a video, hit ESC on your keyboard to return the the chapter page.



Time  
0:58

Welcome to the Algae  
Cultivation  
Extension Short-Course:  
Gef Flimlin



Time  
2:18

Welcome to the Algae  
Cultivation  
Extension Short-Course:  
Stephen M. Gómez

## ACES PART 2: MICROALGAE COURSE CHAPTERS

### Chapter 1

Introduction to microalgae

[View chapter](#) [>](#)

### Chapter 2

### Chapter 3

### Chapter 4

### Chapter 5

### **Aquaculture Introduction**

- Overview: What is aquaculture, why is it important
- Dana Morse “What is Aquaculture?”
- International Mariculture of Seaweeds; An introduction to Seaweed Aquaculture. Dr. Charles Yarish
- From Sea to Table, University of Connecticut Research Benefits
- Seaweed Culture in New England: Overview of Seaweeds and Their Uses
- Seaweed in New England: A Seaweed Visionary. Interview with Shep Erhart, Maine Coast Sea Vegetables

### **Economically important species**

- Seaweed culture in New England: Kelp, Gracilaria, Chondrus, Porphyra, Palmaria (Dulse), Kappaphycus and Eucheuma

### **Seaweed Aquaculture: Nursery**

- Elements of a Seaweed Lab
- Introduction to Sugar Kelp Nursery Methods. University of New England

### **Seaweed Aquaculture: Leasing**

- Permits/Leases/Regulations. Jon Lewis, Maine Dept. of Marine Resources

### **Seaweed Farm design and gear**

- A Simple Method of Setting Seaweed Long Lines, Tollef Olson, President, Ocean’s Balance

### **Outplanting seaweed seed :**

- Field clips of outplanting seaweed lines with Maine Sea Farms

### **Seaweed Husbandry:**

- Winter on a Kelp Farm, Ocean Approved

### **Seaweed Aquaculture: Farming**

- Seaweed Farms of Maine
- Maine Sea Farms Explains Kelp Farming
- Seaweed Farming, Tollef Olson, Oceans Balance Inc.

### **Harvesting :**

- Pulling Seaweed Lines (Ocean Approved)
- Harvesting Kelp with Maine Sea Farms, spring 2018

### **Seaweed Processing/marketing:**

- Greenhouse drying of seaweed with Maine Sea Farms
- Seaweed Product Forms, Lisa Scali, Ocean Approved Inc



# ACES Intent

- Develop a short course to **educate people in techniques** needed to move into the microalgae biomass and seaweed farming industry.
- The short-course is for **Workforce Development** through a no cost online focused program.
- The course sections are **developed in appropriately timed modules**. This **keeps the students' attention** and allow breaking when needed, to return later.

How to find it

**Google:**  
**ATEC ACES Algae**



# Let's take a look!

<http://www.algaefoundationatec.org/aces/aces.html>

[http://www.algaefoundationatec.org/aces/aces2\\_micro.html](http://www.algaefoundationatec.org/aces/aces2_micro.html)

# Acknowledgements

## ATEC Team Members

First name	Last name	Organization
Ike	Levine	Algae Foundation Univ of Southern Maine
Marissa	Nalley	Algae Foundation
Tom	Dempster	Arizona State University
Linnea	Fletcher	Austin Community College
Poornima	Rao	Austin Community College
Brendan	Scott	Enkidu Engineering
Tiffany	Cannis	Global Algae
Valerie	Harmon	Harmon Consulting
Danny	Kainer	Lone Star College
Cindy	Gerk	NREL
Phil	Pienkos	NREL
Rebecca	White	Qualitas Health
Jakob	Nalley	Qualitas Health
Gef	Flimlin	Rutgers University
Ondine	Fraueglass	Santa Fe Community College
Luke	Spangenburg	Santa Fe Community College
Steve	Gomez	Santa Fe Community College
Jeff	Granger	SFCC Online
N. Jan	Chalupny	Shoreline Community College
Jim	DeKloe	Solano Community College
Steve	Mayfield	University of California, San Diego
Charlie	Yarish	Univ of Connecticut
Schonna	Manning	University of Texas at Austin

## ATEC Industrial Advisory Board

First name	Last name	Organization
Jacques	Beaudry-Losique	Algenol, Biotech, LLC.
Martin	Sabarsky	Cellana, Inc.
Charles	O'Kelly	Cyanotech, Inc.
Ross	Zirkle	DSM Nutritional Products
		Earthrise Nutritionals, Inc.
Amha	Belay (Chair)	Algae4ALL, LLC
Dave	Hazelbeck	Global Algae Innovations, Inc.
Bren	Smith	GreenWave, Inc.
John	Benemann	MicroBio Engineering, Inc.
Rebecca	White	Qualitas Health, Inc.

## BETO

First name	Last name	Organization
Christy	Sterner	BETO Technology Manager
Colleen	Tomaino	BETO Technical Monitor
Shaina	Aguilar	BETO Intern



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**This presentation was developed in part, based upon funding from the Alliance for Sustainable Energy, LLC managing and operating contractor for the National Renewable Energy Laboratory for the U.S. Department of Energy's Bioenergy Technologies Office**