

# Microalgae Production From Lab to Science to Pilot to Industry

## Biopharmia AS

From NOK 100 Thousand to NOK 250 Mill in 4 Years

CEO Roald Audun Flo



# The Grand Challenges

Can Biotechnology be the Solution?

## Climate

- Sustainable industry production (white biotech)
- Food production (green/blue biotech)
- Feed production (agriculture/aquaculture)

## Energy

- Bioenergy
- Biofuel

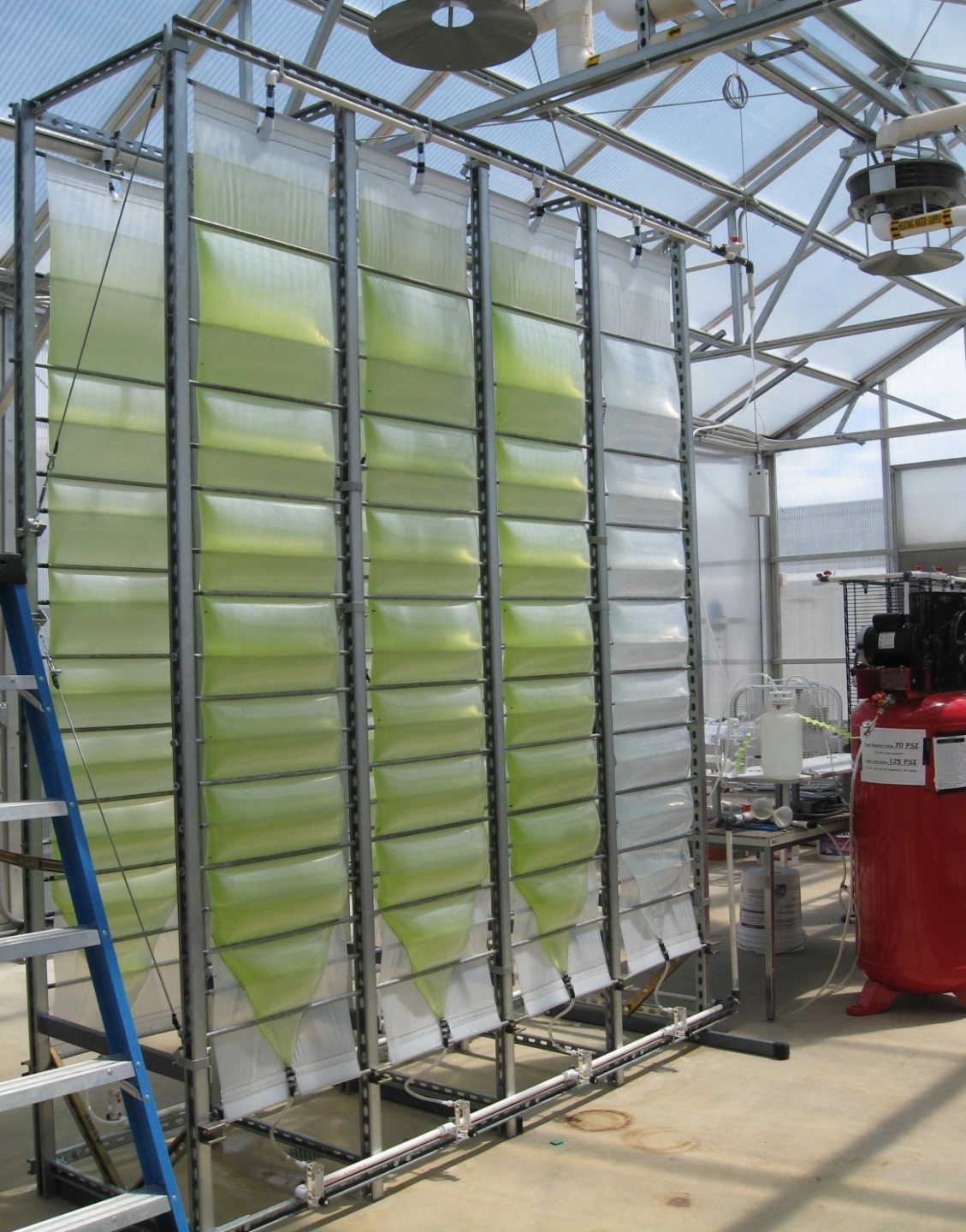
## Health

Aging population

Healthy (and enough) food (green/blue biotech)

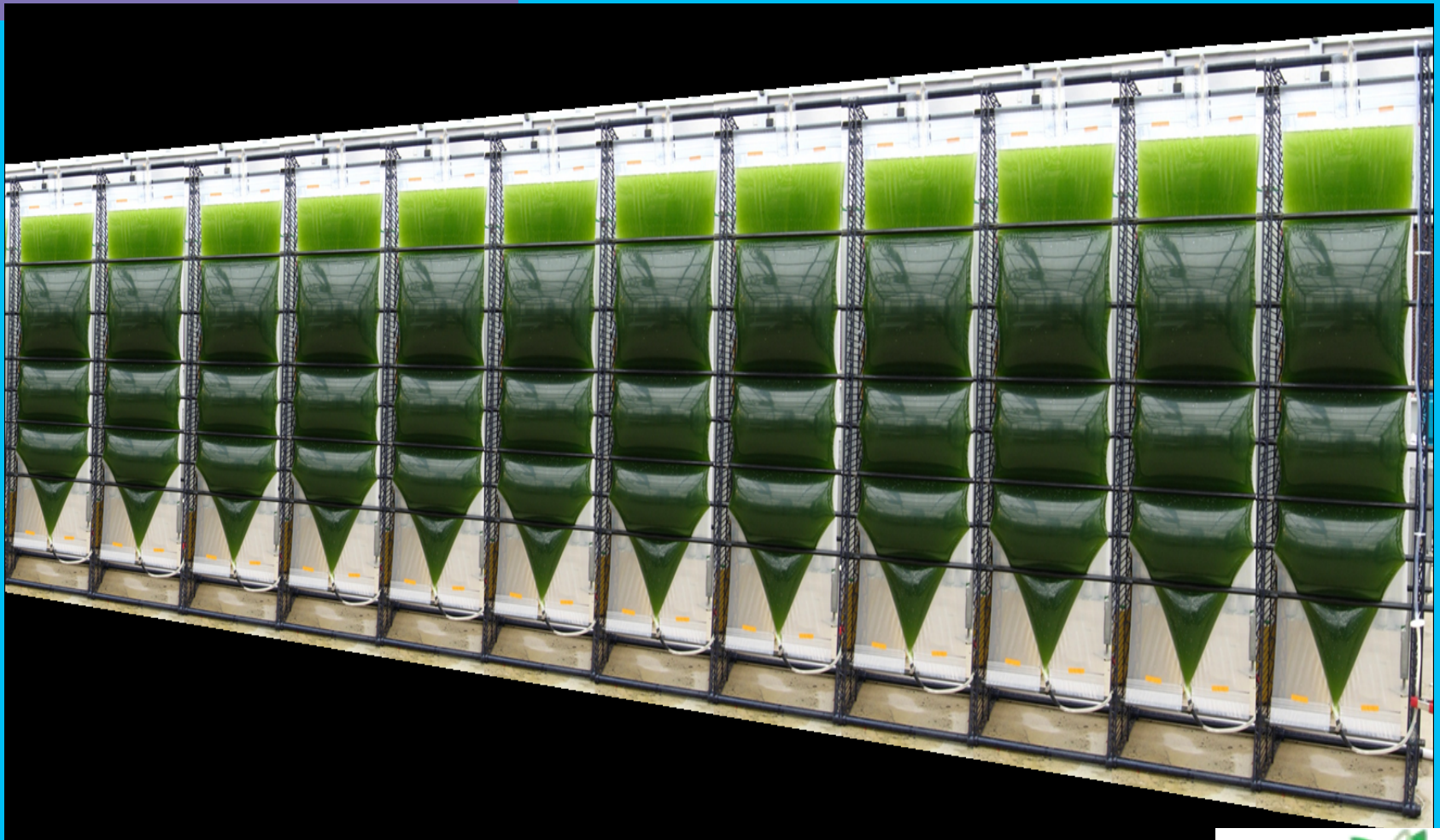
# Biopharmia AS

- **Biopharmia is mainly a Microalgae based Biotechnology company, but also involved in Microbiology, Pharmacy, Nutraceuticals, Health, Food, Cosmetics, Medicine**
- **Biopharmia USA, Inc., Tucson, Arizona, USA**
- **Biopharmia`s estimated market value is NOK 250 mill.**
- **No loan – No debt – No grants**
- **Own the exclusive worldwide Patent Rights for Accordion PhotoBioreactor, and Extraction of Phosphorous from rocks**



## Biopharmia`s Production and R&D Facilities

# Accordion Commercial Algae Production



# Biopharmia`s Designed Production, R&D and Pilot Plant



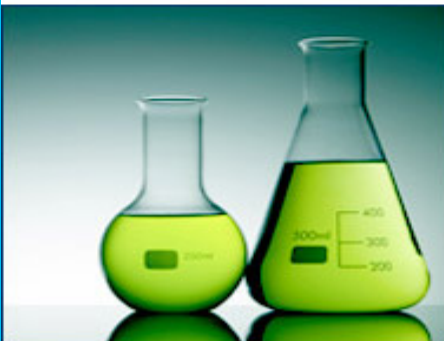
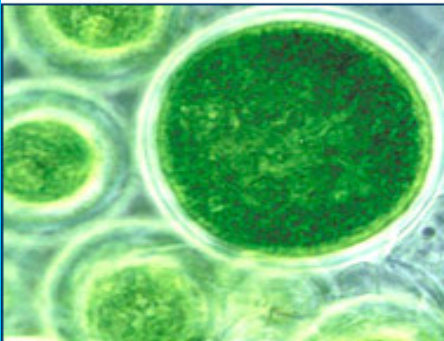
# Biopharmia Pharmacy, Health and Cosmetics

## The Immunia Patented Beta Glucan Products



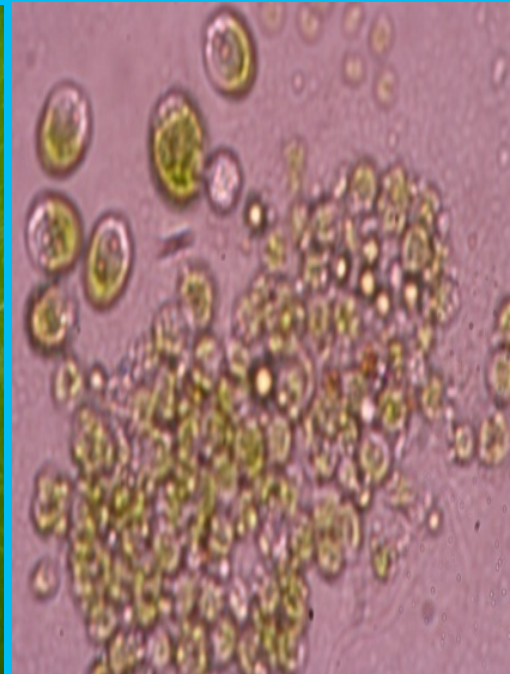
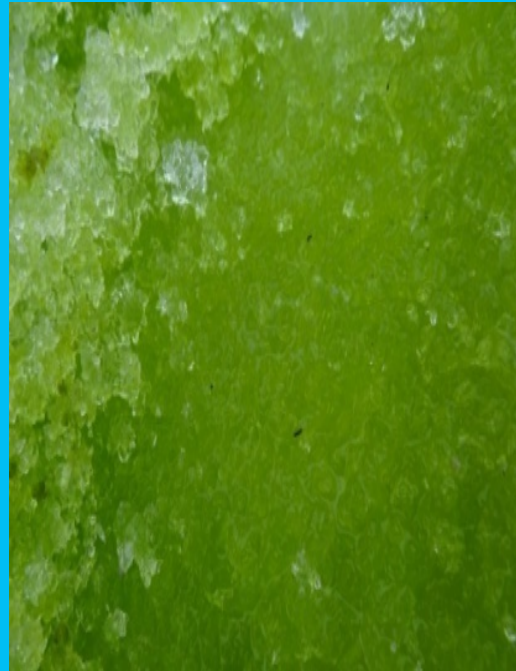
# Biopharmia - Microalgae

## Extensive Scientific Laboratory Scale R&D





# Microalgae collected near the Chilean Antarctic Base Bernardo O'Higgins in Antarctica (UA - Biopharmia)



## Why Microalgae?

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- Microalgae are the natural food for all life on Earth
- Microalgae; The best natural and sustainable enrichment source needed for human, fish and animals, containing proteins, carbohydrates, lipids, vitamins, minerals, astaxanthin, antioxidants, all amino acids, etc.
- Microalgae are an unlimited resource, and the *original* source for omega-3, etc.

# Ocean Biomasses

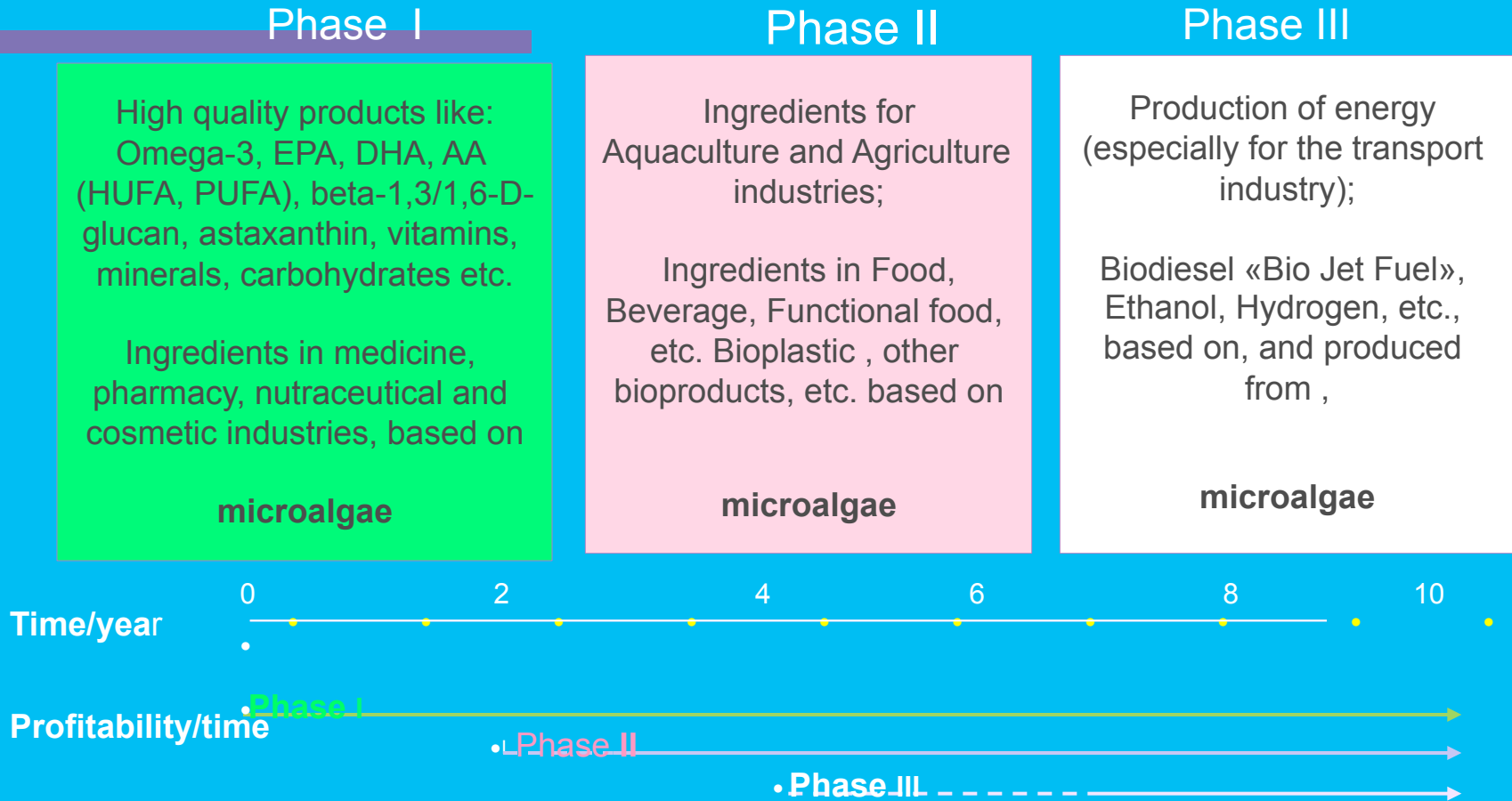
- Phytoplankton – Microalgae 94,5 % (100 bill. tons)
- Zooplankton 4,5 % ( 5 bill .tons)
- Global Fishery Resources 0,9 % ( 1 bill. tons)
- Norwegian Fishery Resources 0,1 % ( 40 mill. tons)
- (Source: Field er al. (1998): Science, vol 281. Longhurst et al. (1995) J. Plankt Res, vol 17)

# Microalgae Species

- 40.000 known species
- **Only a few thousands are in collections**
- Only a few hundreds have been researched for chemical content, and only a **handful** have been grown for industrial purposes
- **The real number of microalage are estimated to 5 – 10 millions**
- **Huge potential for Algae Research!**
- (Olaozola 2003, EMBO Reports 21, 462-464, Steininger 1996, Kleine Senckenberg-Reihe 22, 55 Seiten, Biomolecular Engineering 20, 459-466 & Moore 2001)

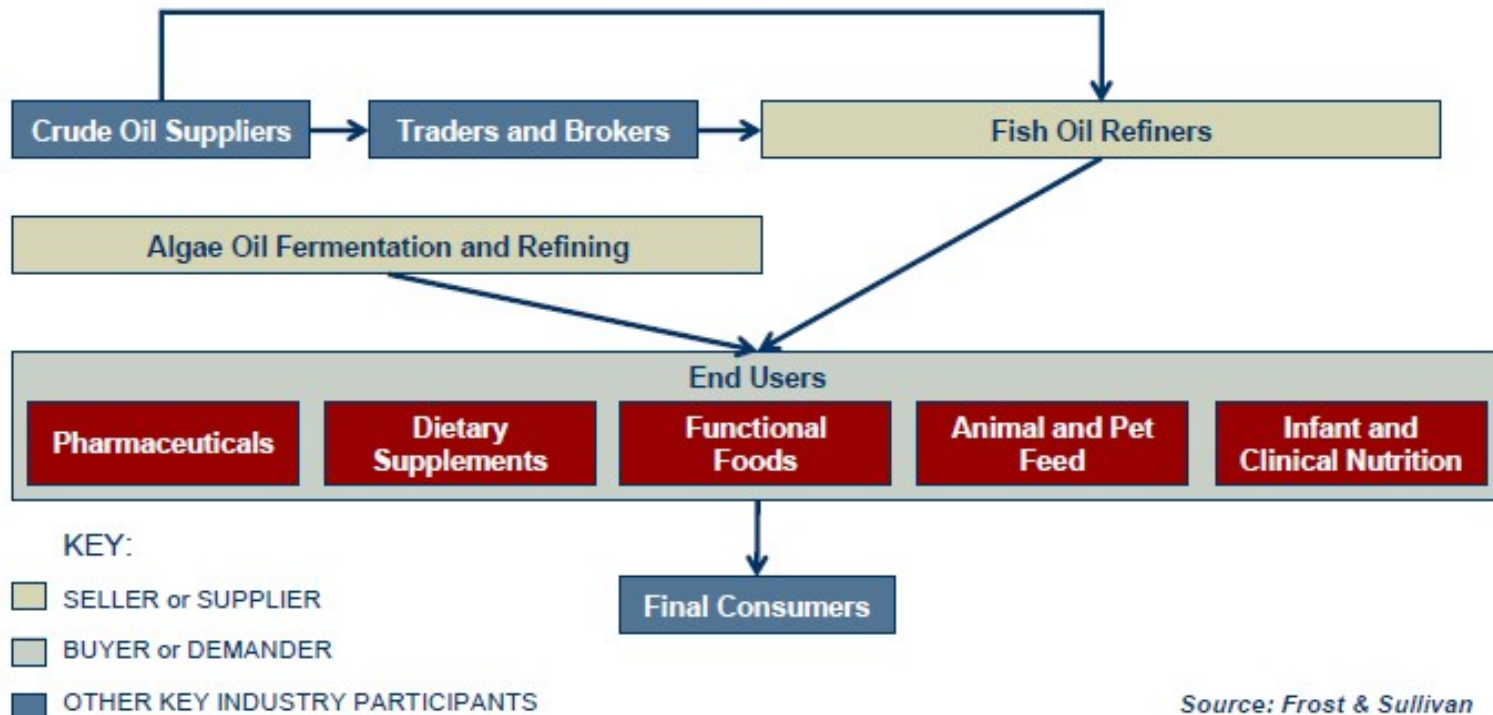
# Biopharmia

## Business Strategy - Time - Markets

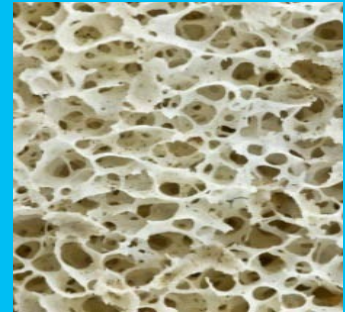


# Market Strategies for Algae Products

Total Marine and Algae Oil Omega-3 Ingredients Market: Industry Value Chain and Research Focus (Europe), 2008

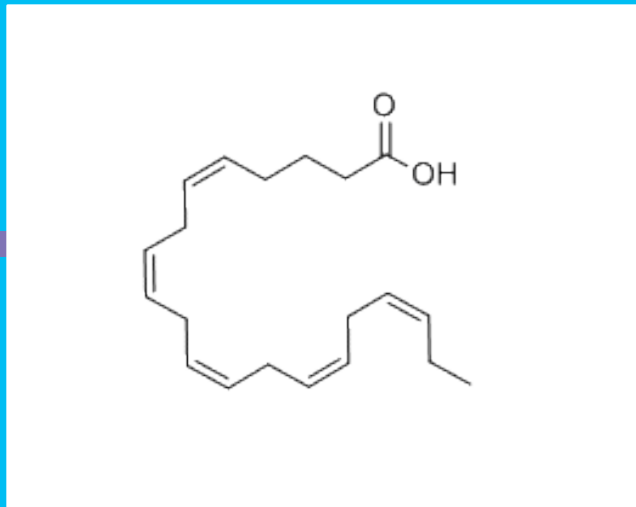


# Markets in the Bio-/Life Sciences economies



# Medicine – Pharmacy – Nutraceuticals – Infant Nutrition from Microalgae

## Eicosapentaenoic Acid (EPA, 20:5n3)





# Cosmetic Products from Microalgae

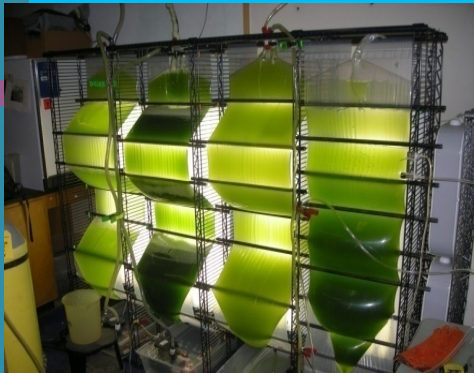


# Aquaculture



**KNOWLEDGE  
MAKES THE  
DIFFERENCE**

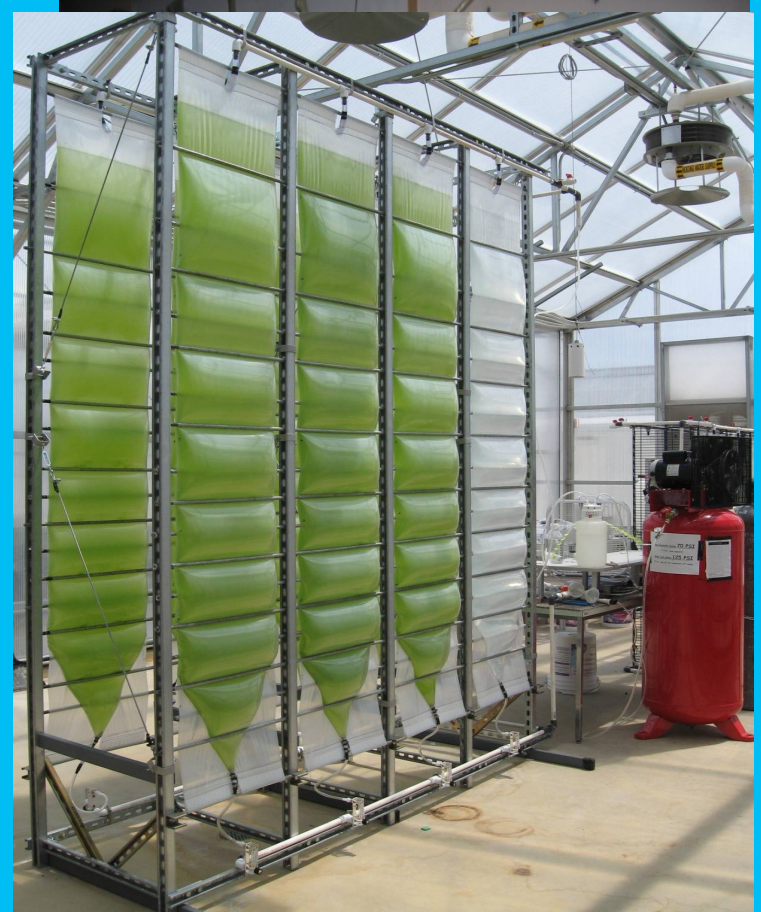
# Agriculture

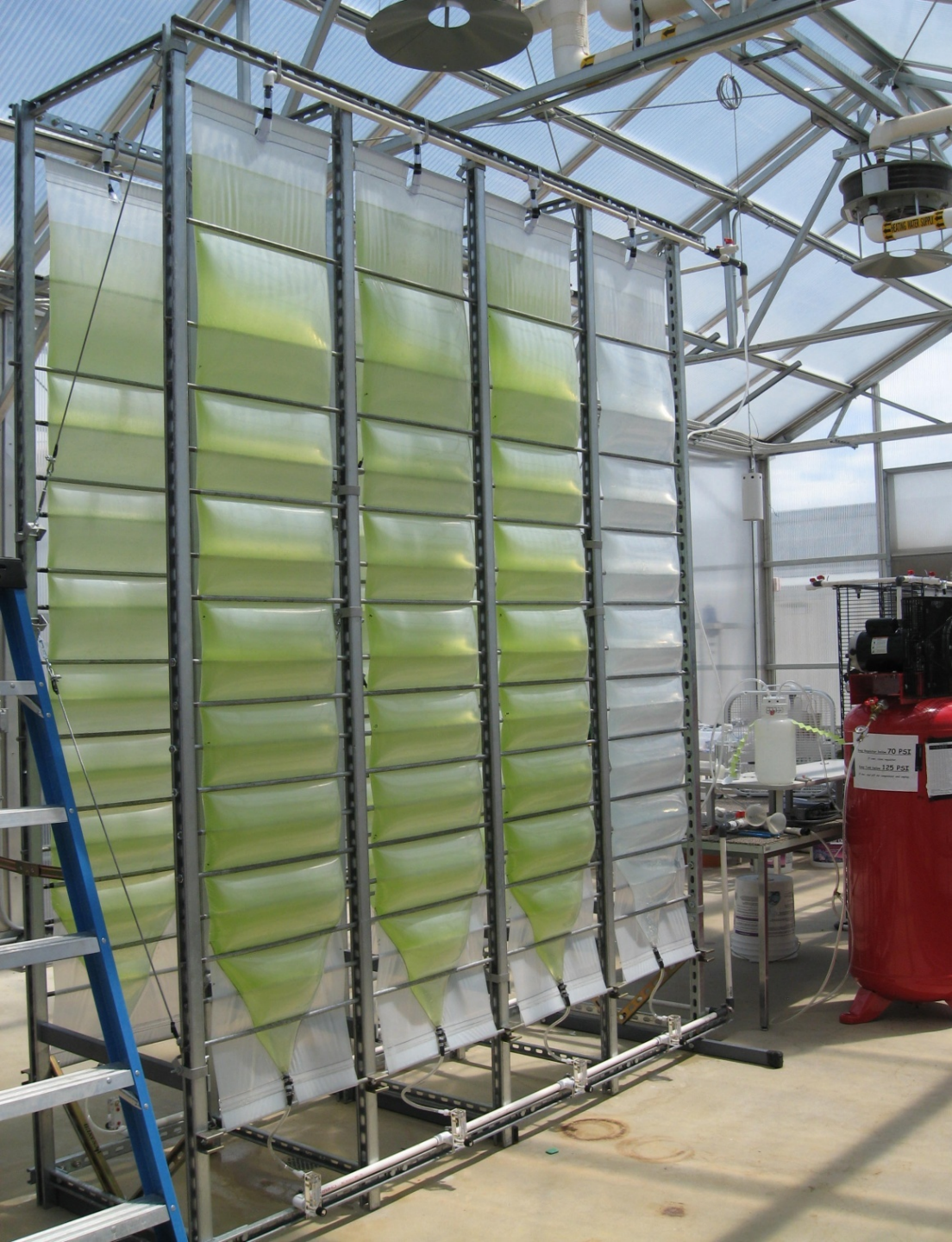


# The Patented Accordion Photobioreactor – The *Novel* Technology

**A vertical series of angled  
flat plates**

Low-cost  
Simple design  
Simple maintenance  
Lower power requirement  
Adjustable light incidence  
Adjustable flow  
Modular  
Ease of scale up  
Ease of harvesting  
Space Saver



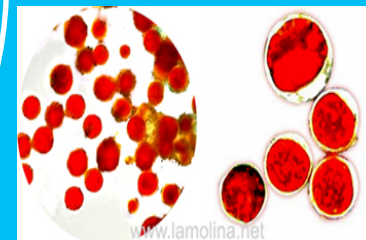
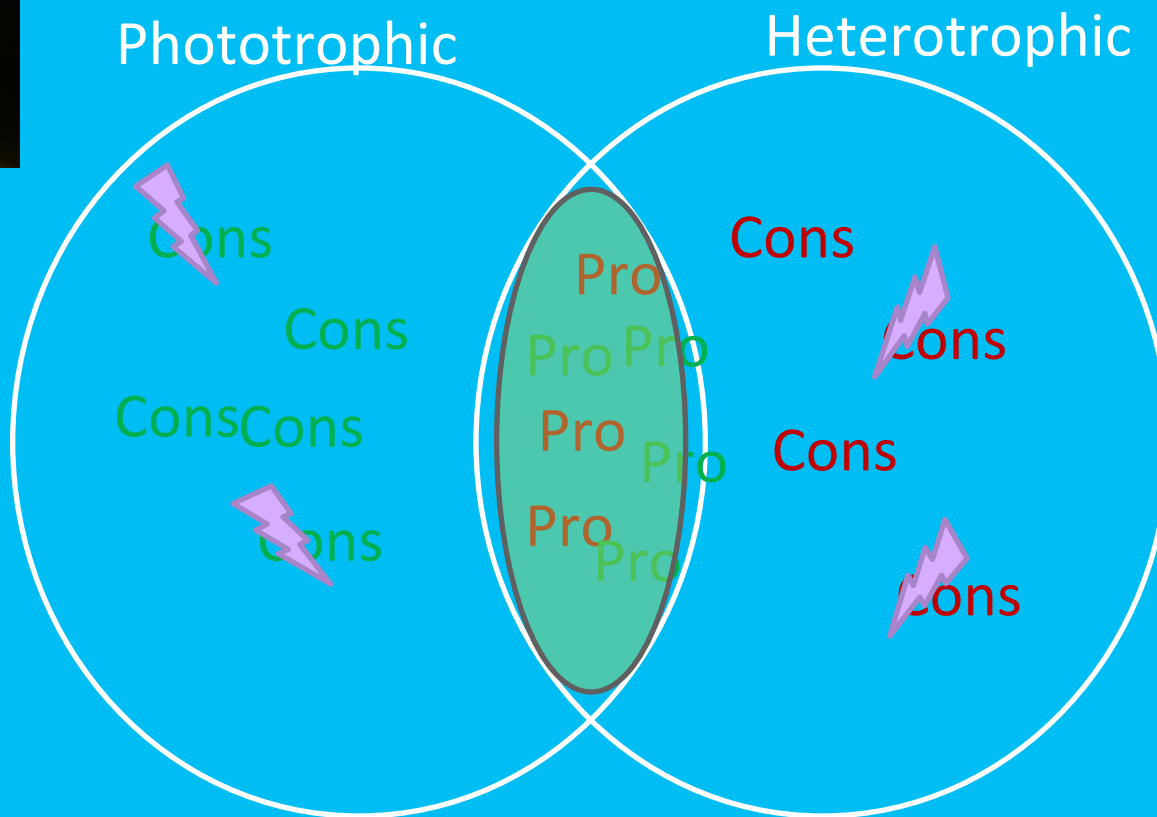
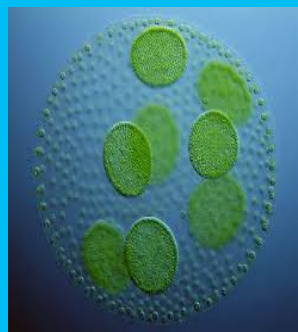
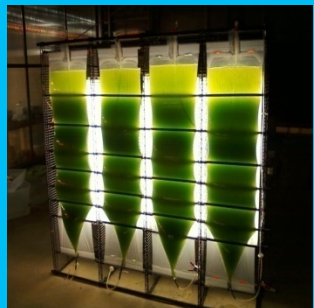


## Accordion Patented Photobioreactor

Production of 1 kg algae  
biomass, require 2 kg CO<sub>2</sub>



# Accordion Phototrophic and Heterotrophic Production



# Microalgae Dry Weight, Lipid & Paste Produced by Accordion



# Accordion nominated NO 1 in an international study by Heriot Watt University

## Algae Technology

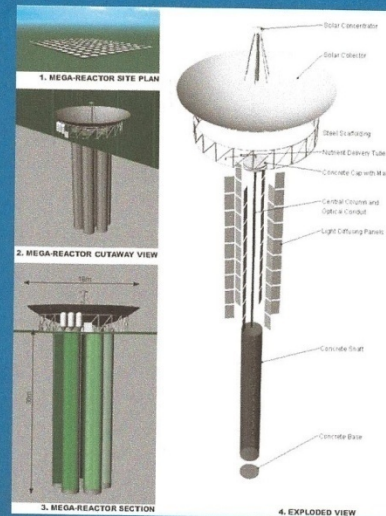
### Recent progress in Photobioreactor Technology



Accordion Photobioreactor  
(University of Arizona)



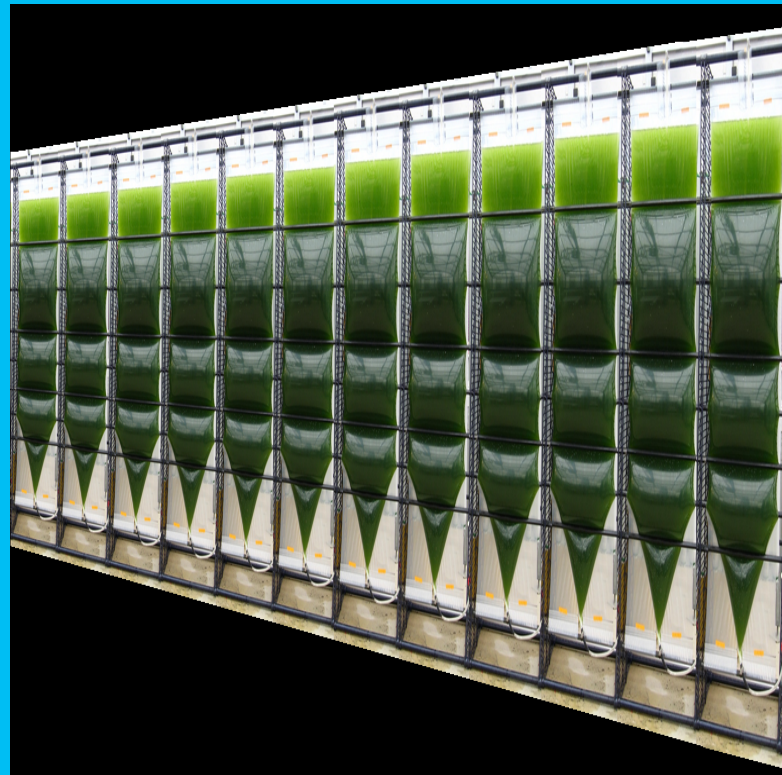
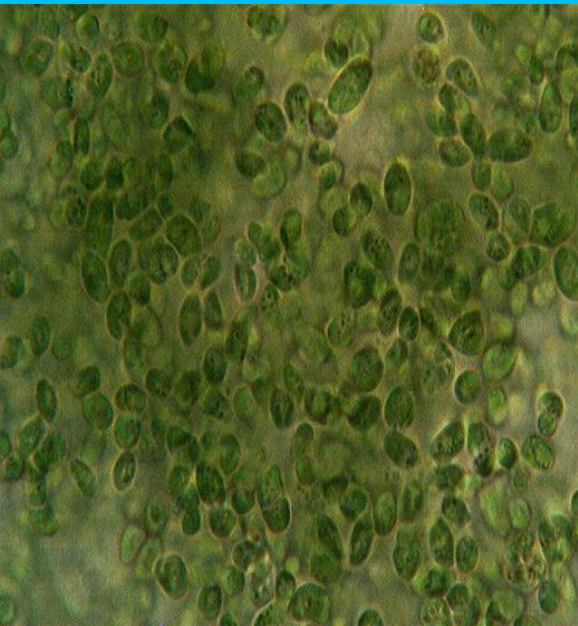
PNNL Photobioreactor  
(Pacific Northwest Laboratories)

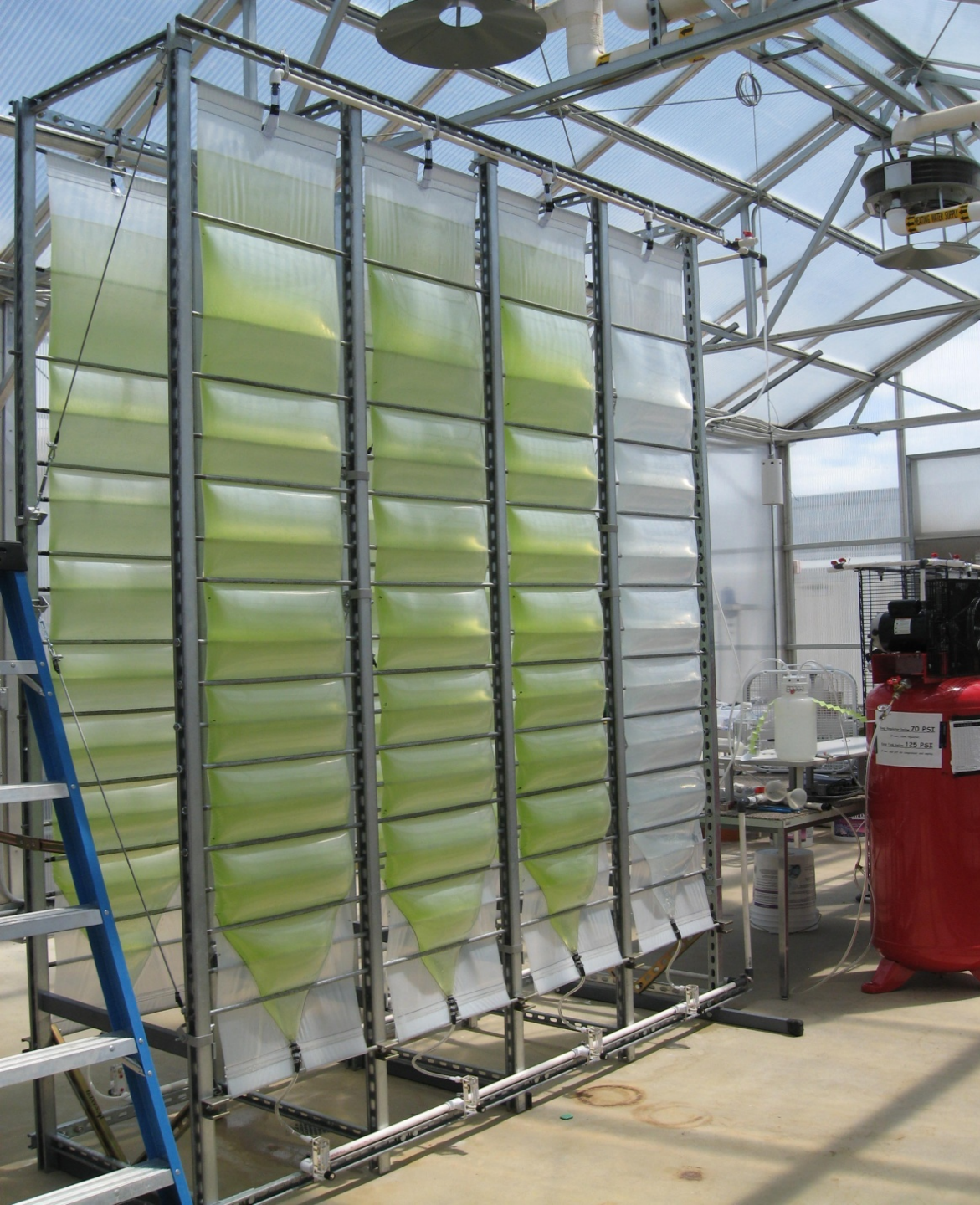


Bodega Photobioreactor  
(Bodega Algae LLC)

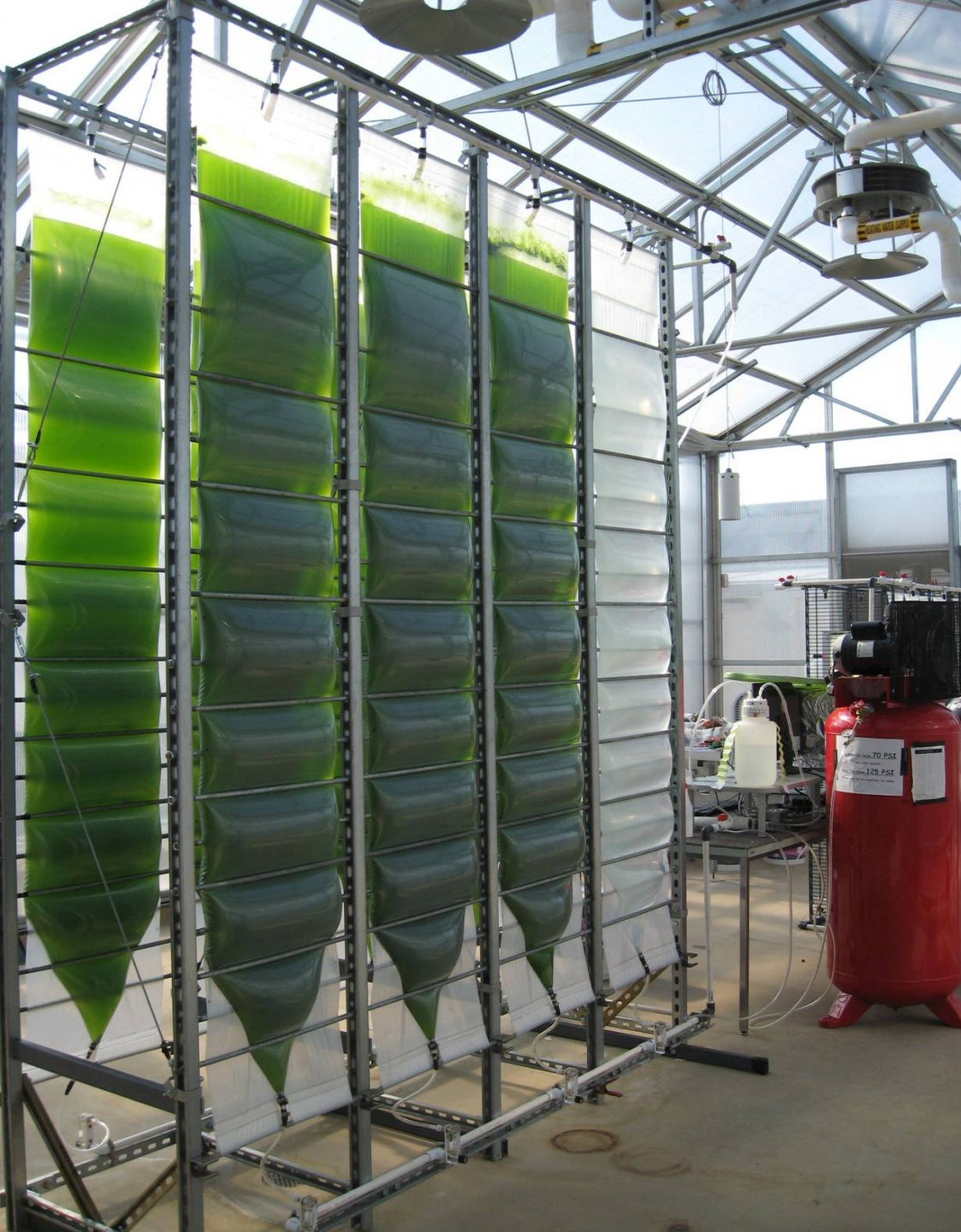


# The Accordion Photobioreactor with documented lower Capex, Opex and higher productivity, compared with other PBR Technologies



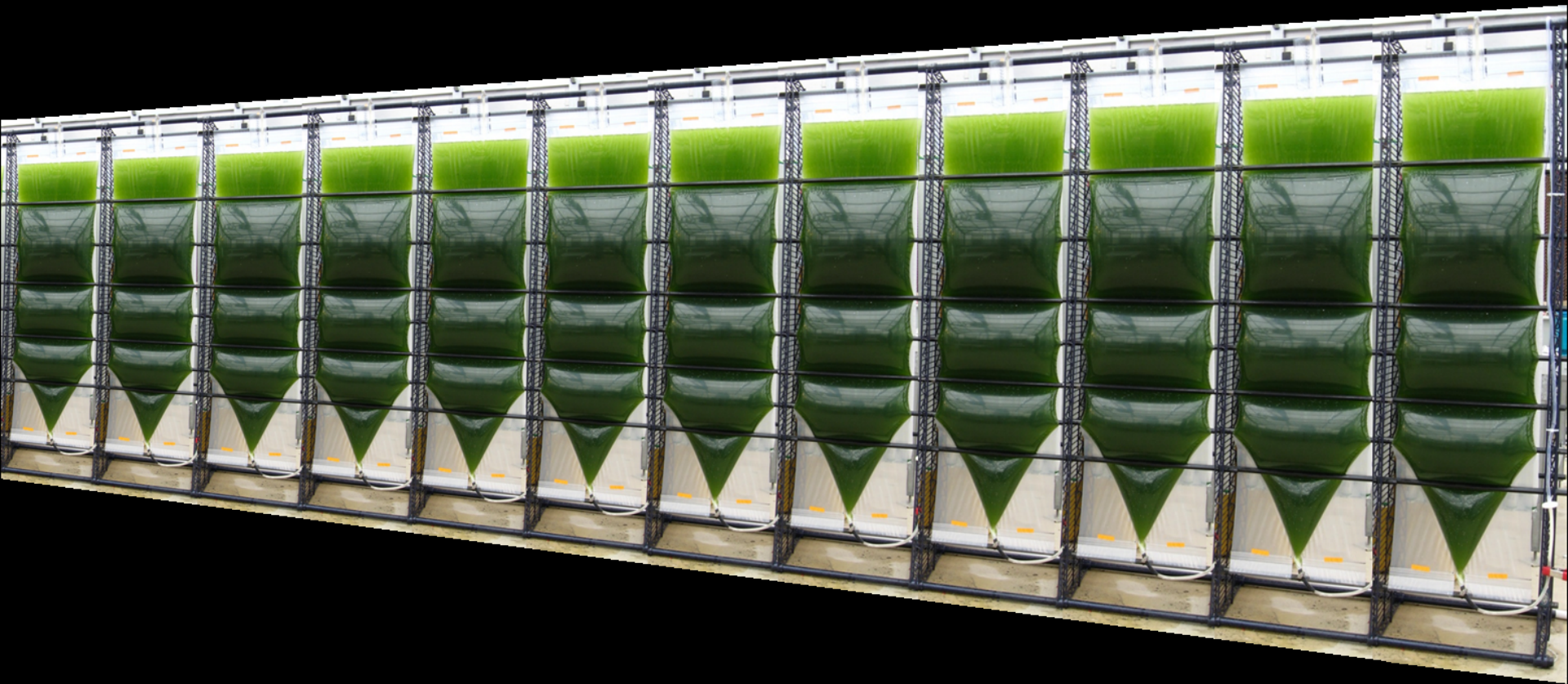


Day 1:  
Approx. 24 hours of growth  
in Accordion

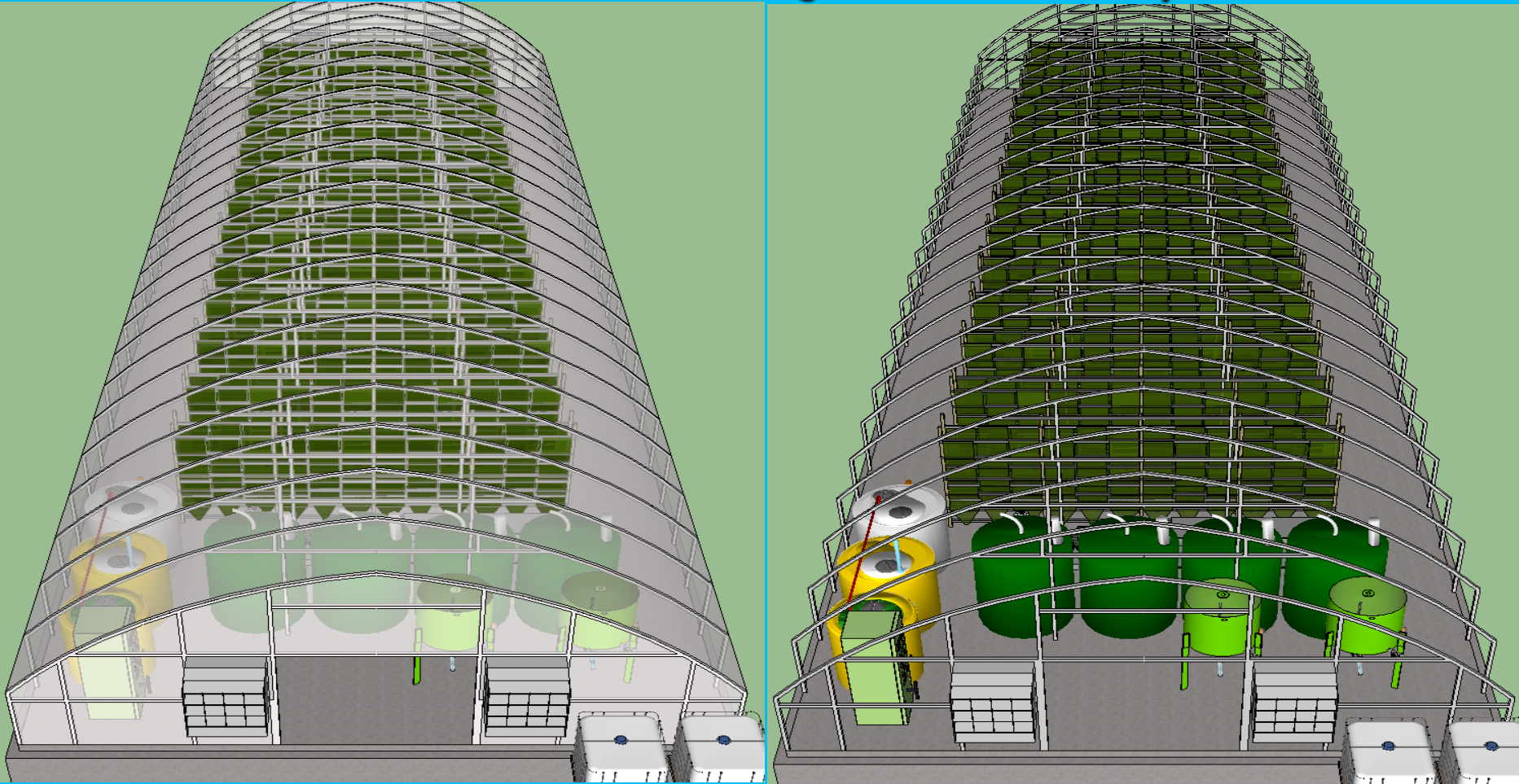


**Day 6:**  
Approx. 144 hours of  
growth in Accordion -  
Ready for harvesting

# Accordion Industrial Production Scale of Microalgae



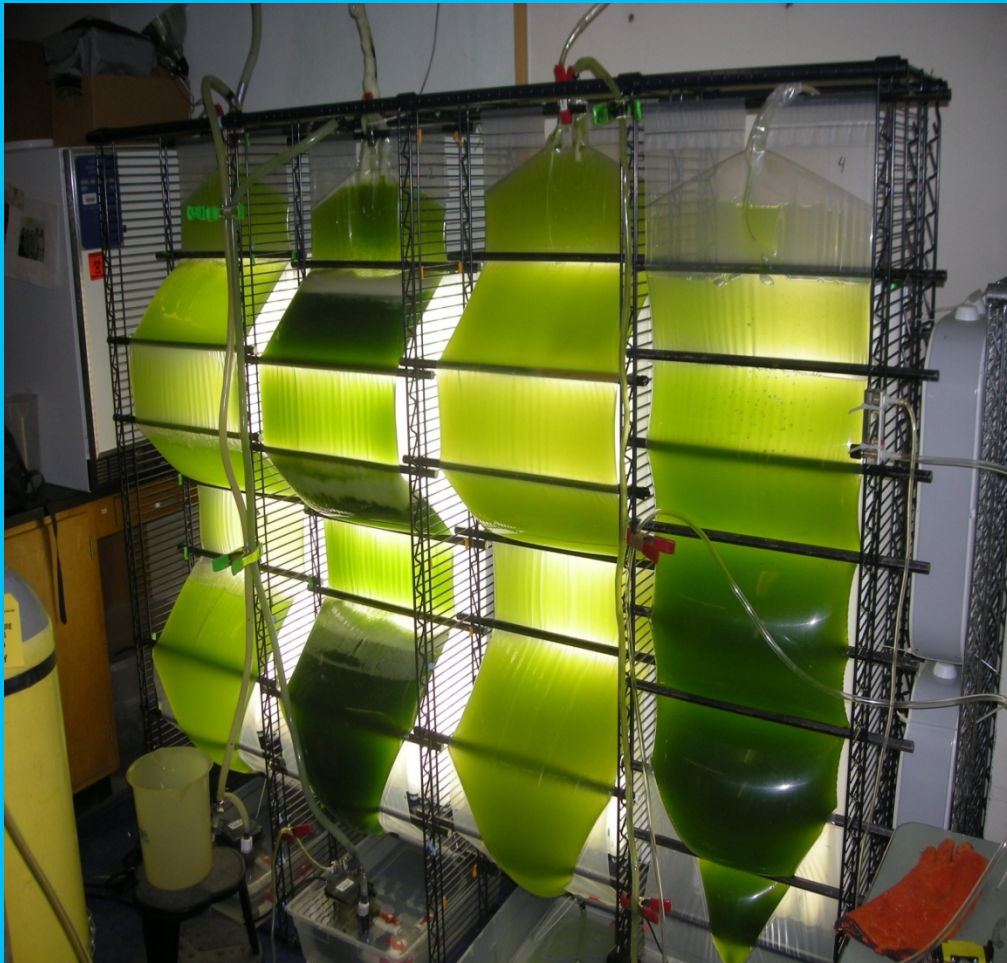
# Biopharmia`s Production and R&D Facilities in USA – Saudi Arabia – Qatar - Norway







# Accordion Pilot at University of Agder, Norway



Production of omega3  
DHA/EPA and H2

3 students at UiA  
earned their BA-  
degrees at University  
of Arizona based on  
Accordion

Sponsored by  
Biopharmia





# Accordion Algae Production in Greenhouse – Norway



# Partners in Florida – Texas – Arizona – California - USA



# Biopharmia

*"The Nature`s Wisdom"*

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- *"We are not taking over The Earth from our forefathers –  
We are borrowing it from our children"*

**Thank you for your attention!**

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**Roald Audun Flo**

Chairman CEO

**Biopharmia AS**

Tel +47 22711840

Mobile +47 917 56305

[roald@biopharmia.no](mailto:roald@biopharmia.no)

[www.biopharmia.no](http://www.biopharmia.no)

