

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

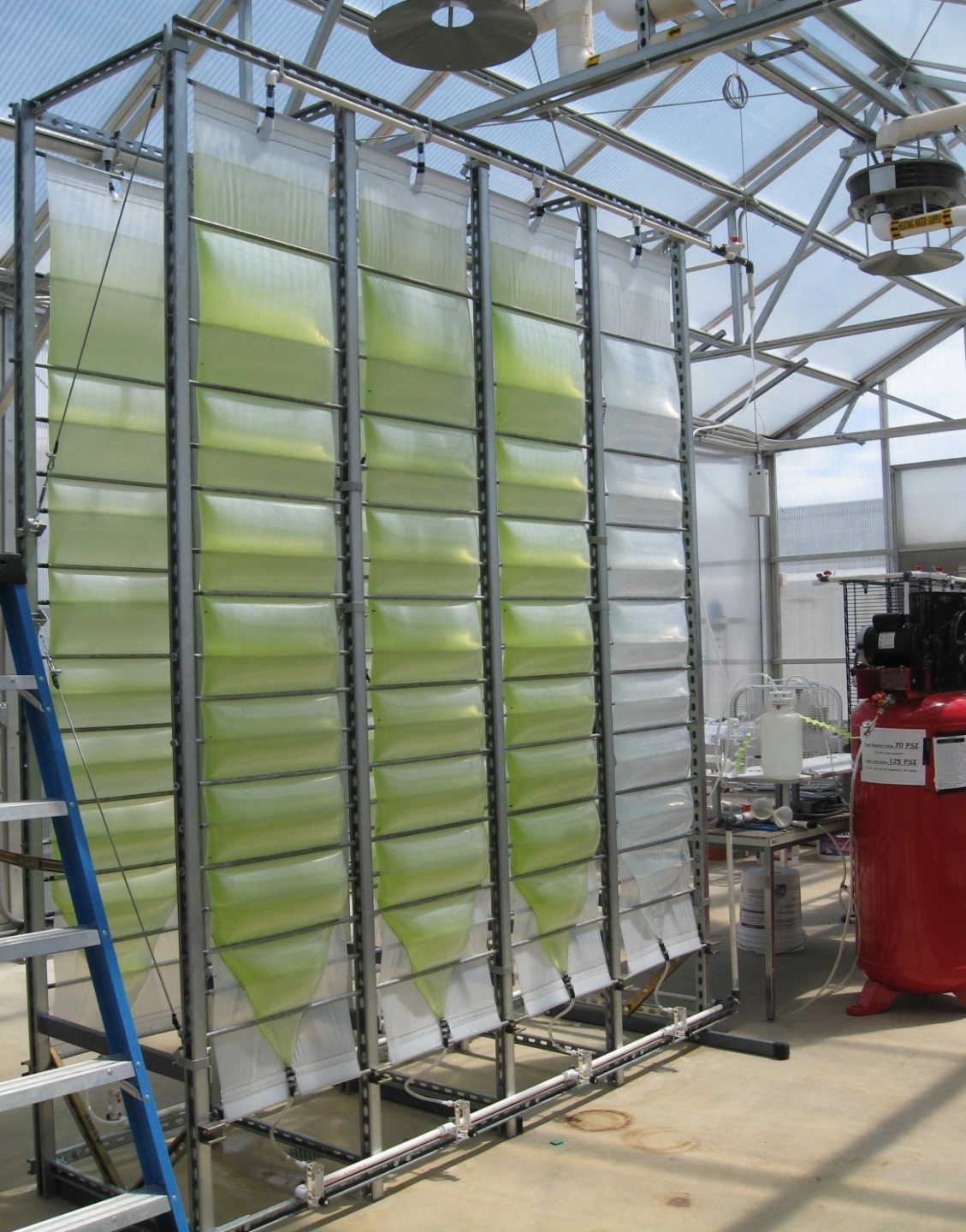
Health

Aging population

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

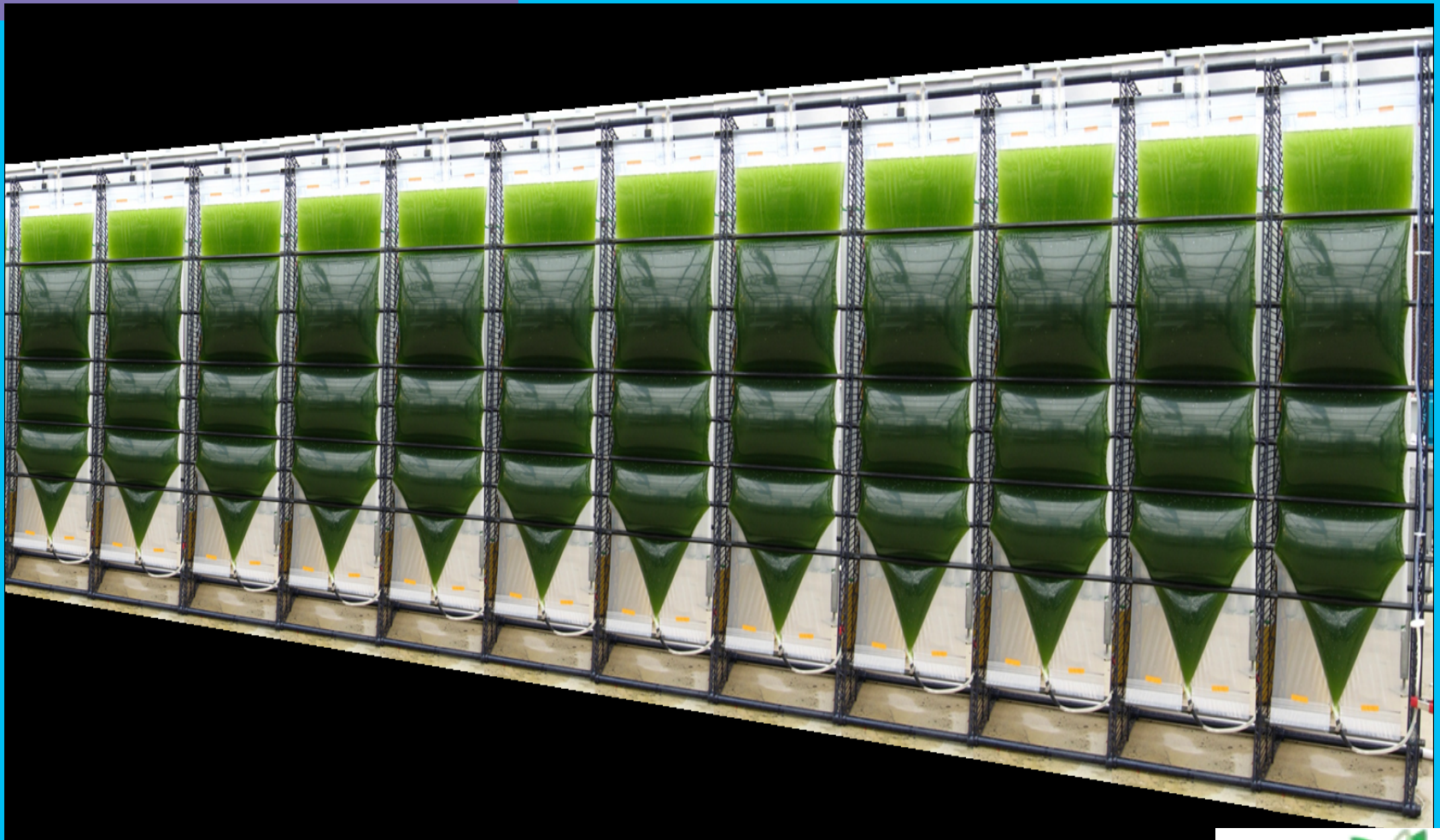
Biopharmia AS

- **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

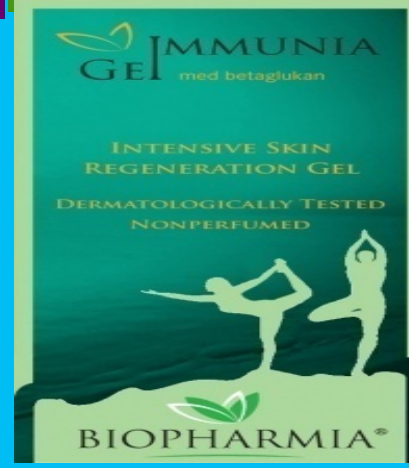


Biopharmia`s Designed Production, R&D and Pilot Plant



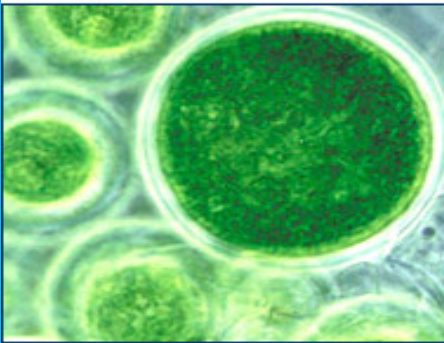
Biopharmia Pharmacy, Health and Cosmetics

The Immunia Patented Beta Glucan Products

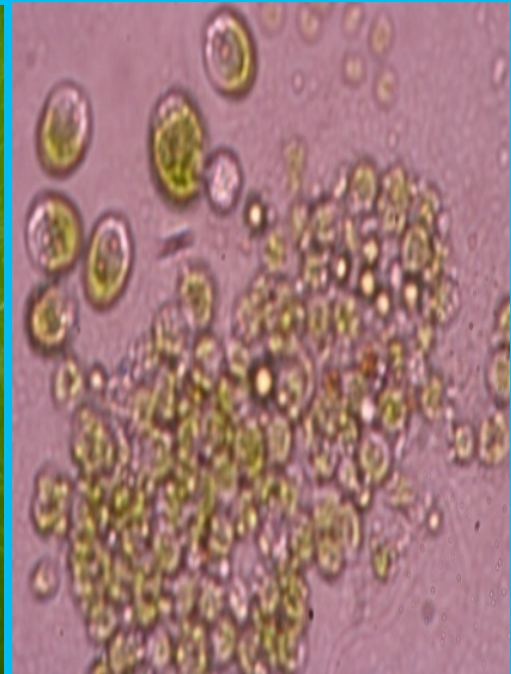
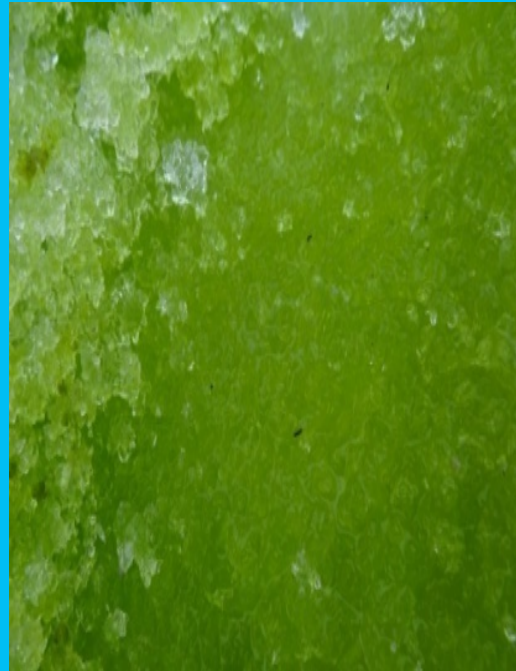


Biopharmia - Microalgae

Extensive Scientific Laboratory Scale R&D



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



Why Microalgae?

- 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

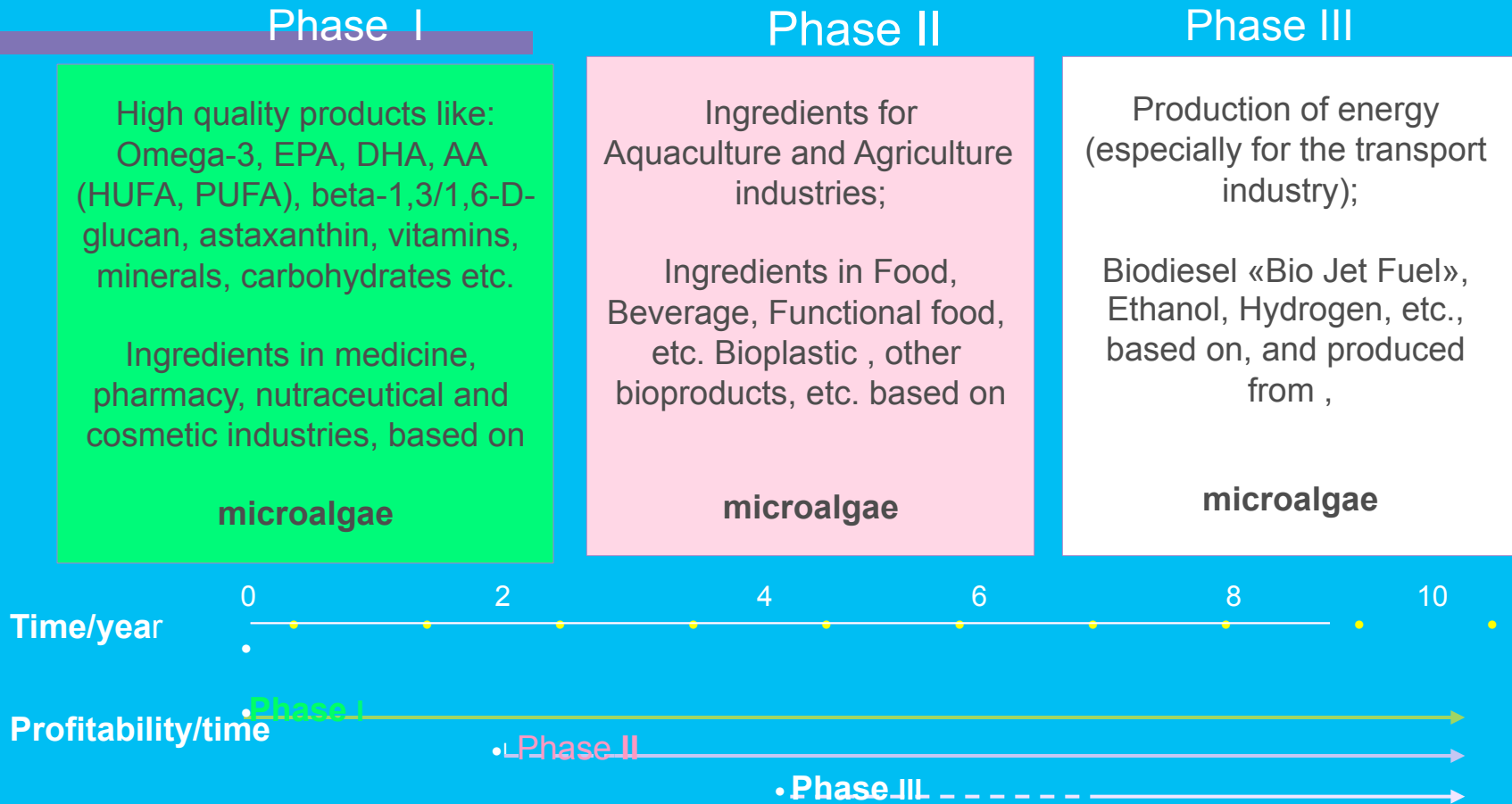
- Phytoplankton – Microalgae 94,5 % (100 bill. tons)
- Zooplankton 4,5 % (5 bill .tons)
- Global Fishery Resources 0,9 % (1 bill. tons)
- Norwegian Fishery Resources 0,1 % (40 mill. tons)
- (Source: Field et al. (1998): Science, vol 281. Longhurst et al. (1995) J. Plankt Res, vol 17)

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)

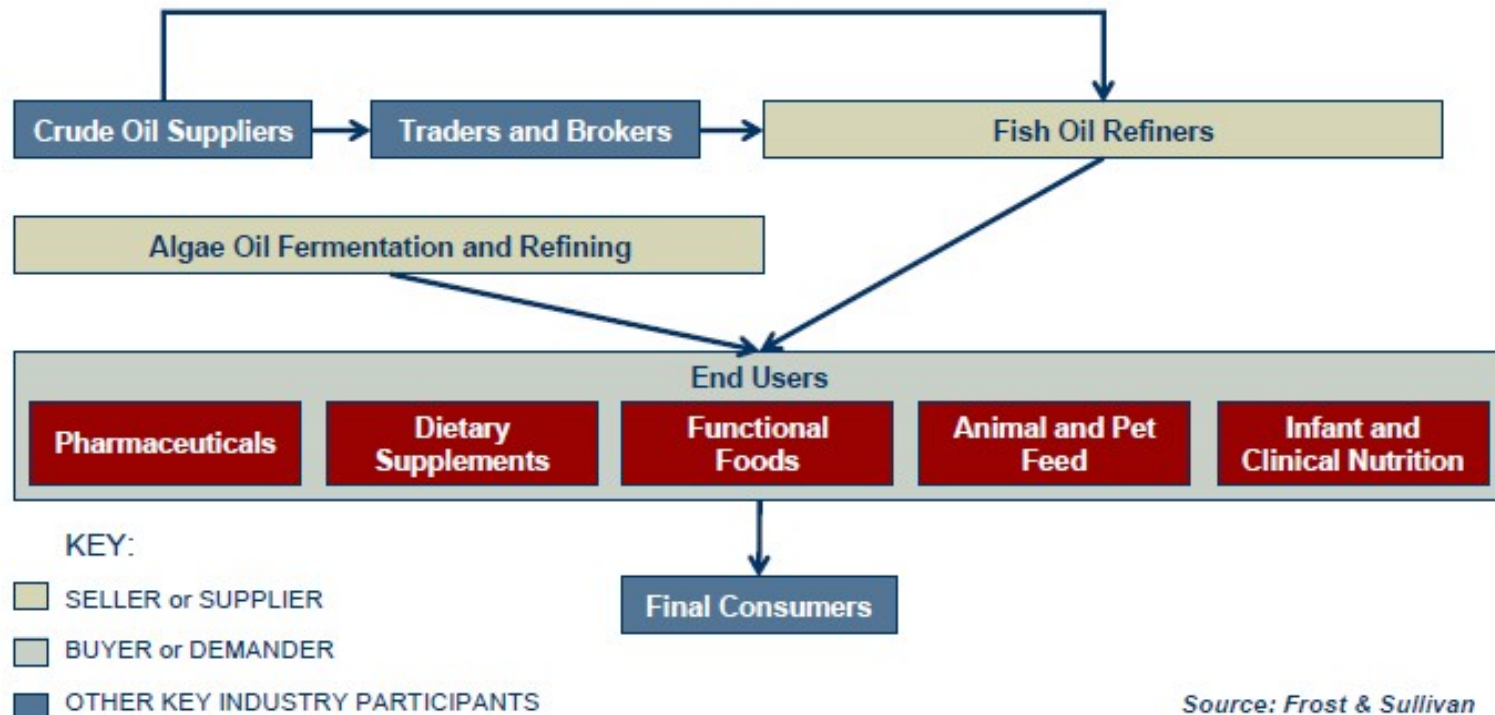
Biopharmia

Business Strategy - Time - Markets

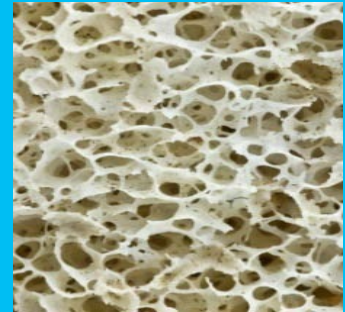


Market Strategies for Algae Products

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

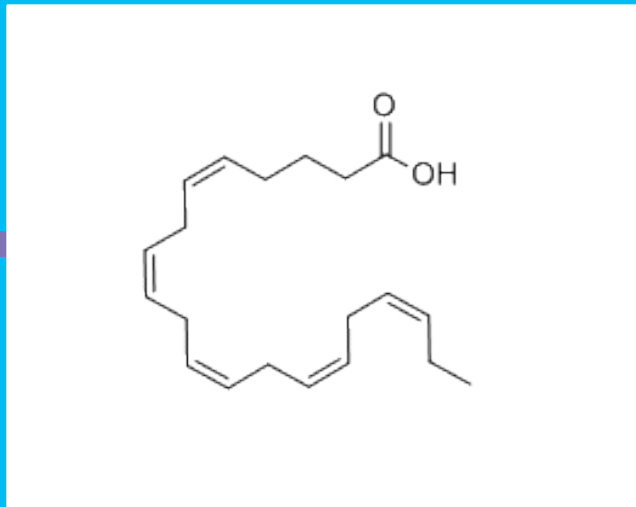


Markets in the Bio-/Life Sciences economies



Medicine – Pharmacy – Nutraceuticals – Infant Nutrition from Microalgae

Eicosapentaenoic Acid (EPA, 20:5n3)



Cosmetic Products from Microalgae

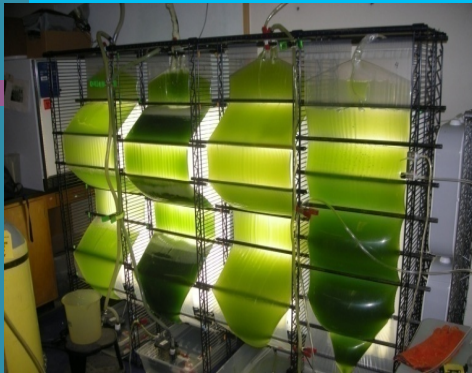


Aquaculture



**KNOWLEDGE
MAKES THE
DIFFERENCE**

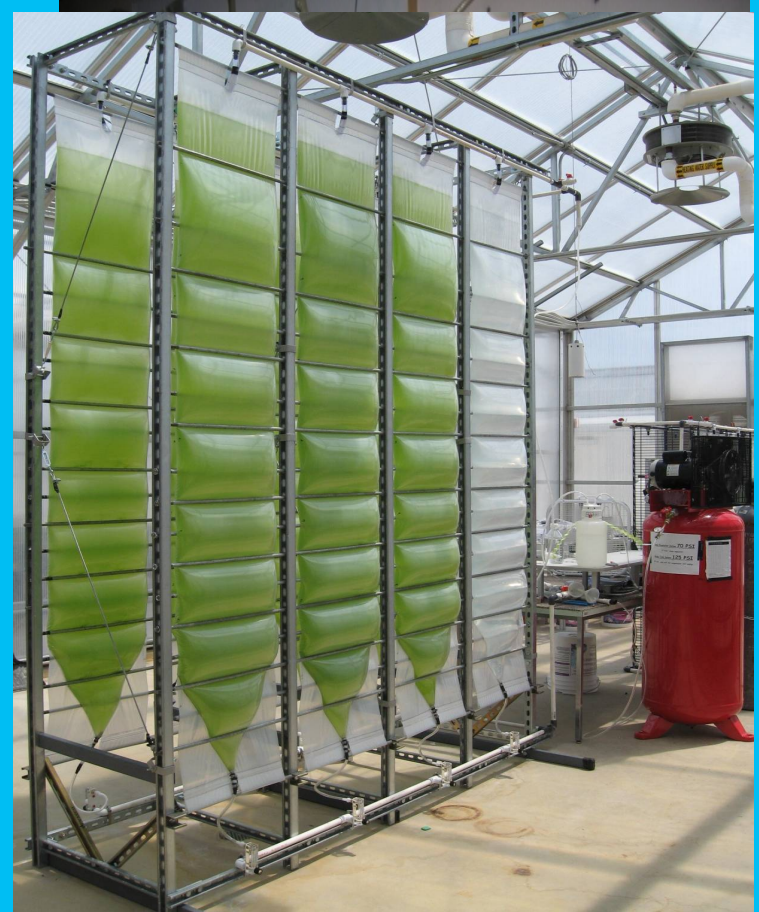
Agriculture

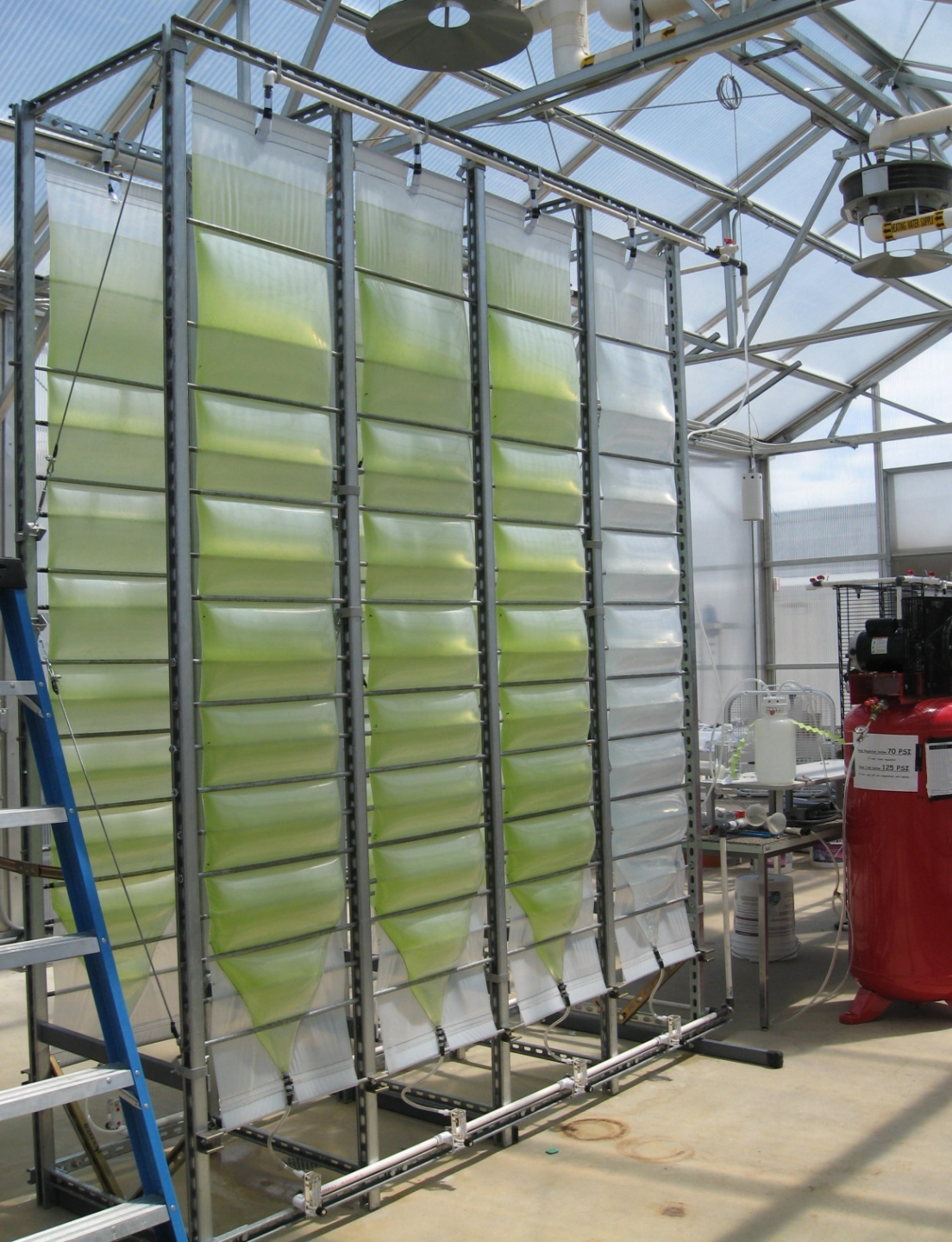


The Patented Accordion Photobioreactor – The *Novel* Technology

**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



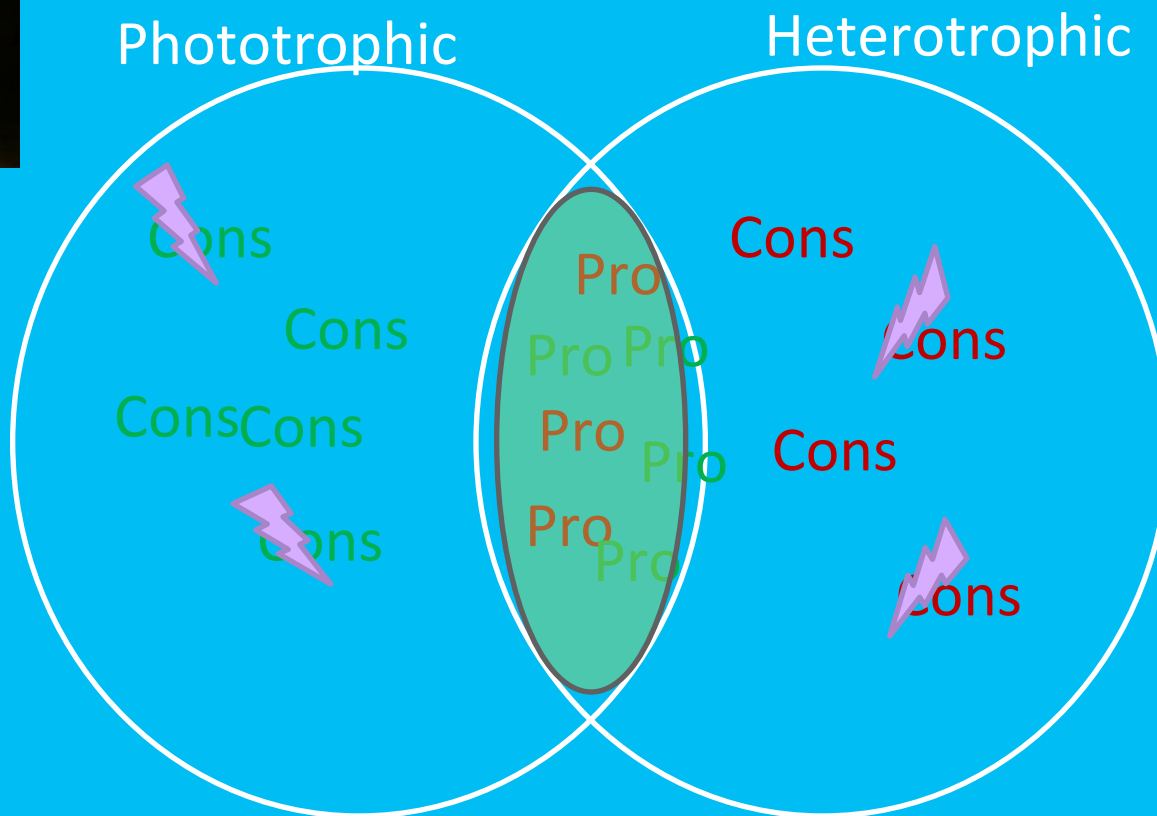
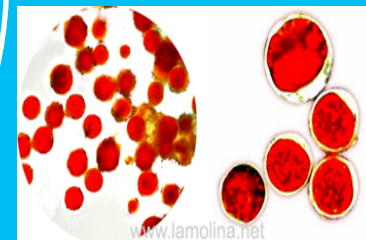
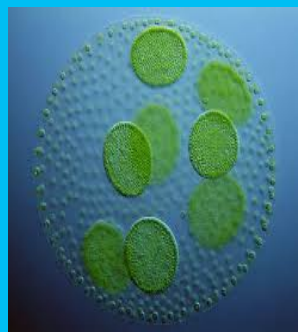


Accordion Patented Photobioreactor

Production of 1 kg algae
biomass, require 2 kg CO₂



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

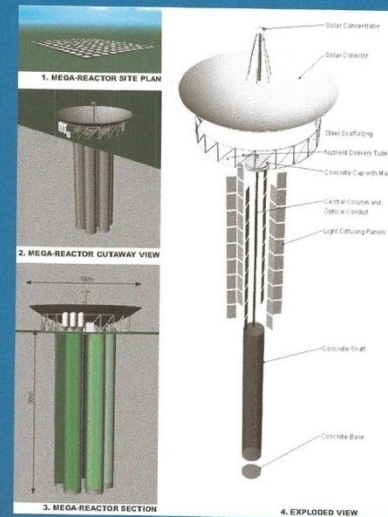
Recent progress in Photobioreactor Technology



Accordion Photobioreactor
(University of Arizona)

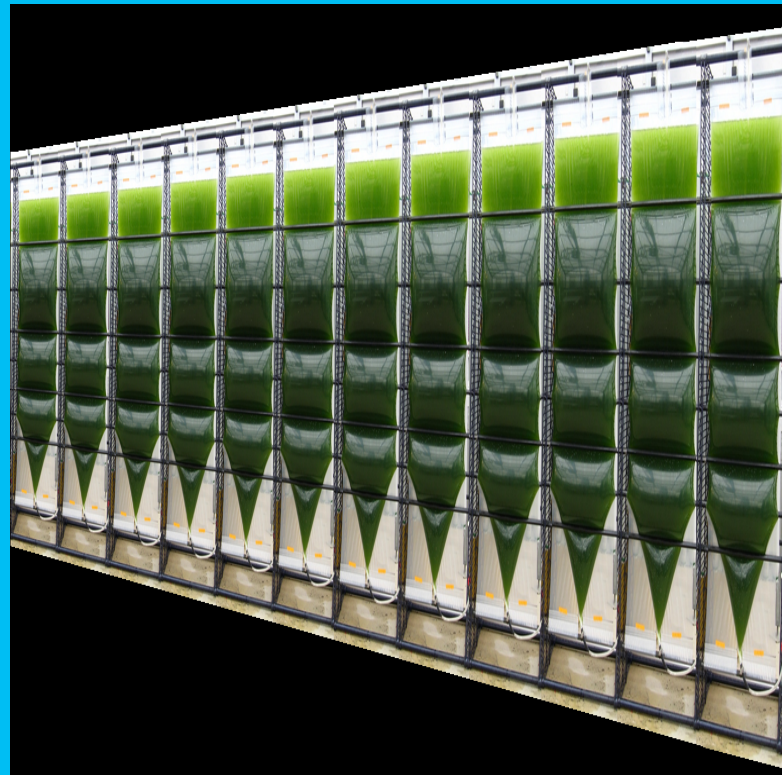
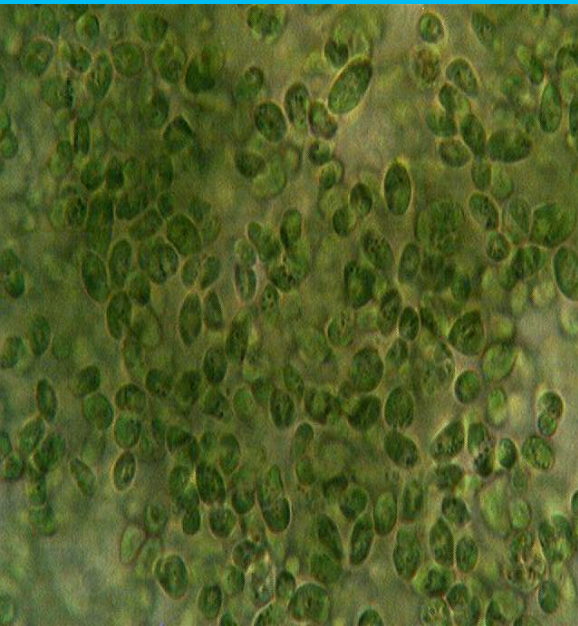


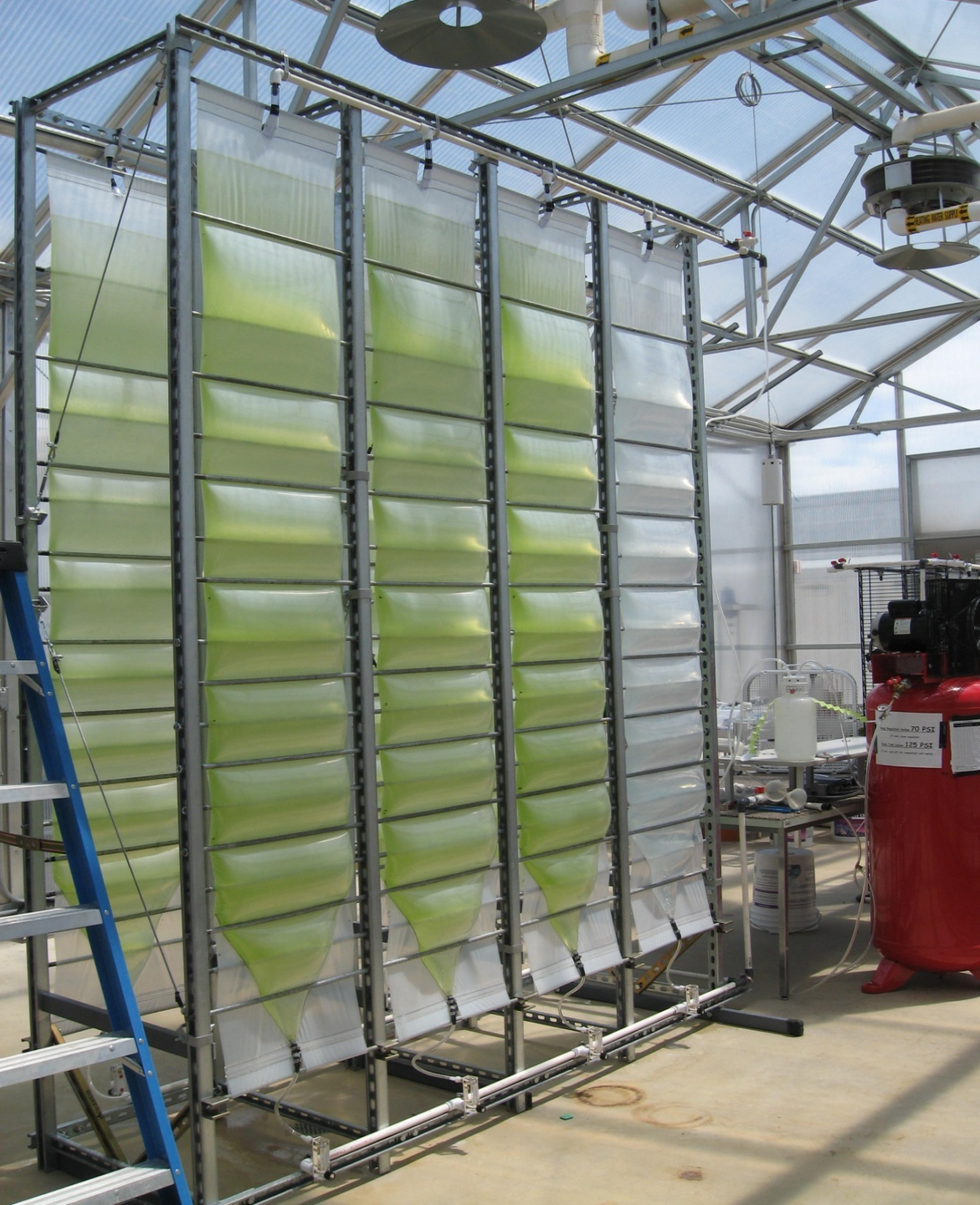
PNNL Photobioreactor
(Pacific Northwest Laboratories)



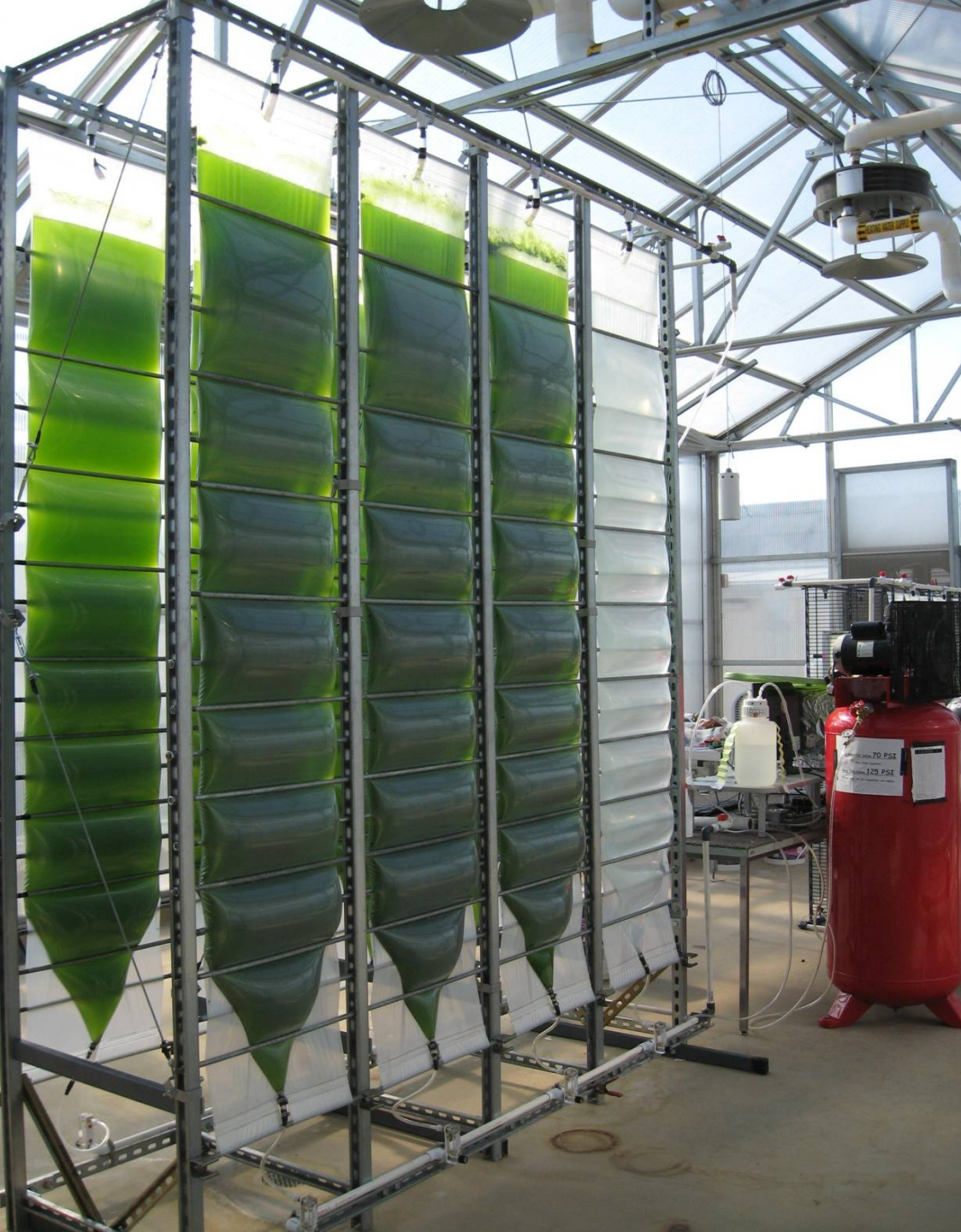
Bodega Photobioreactor
(Bodega Algae LLC)

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



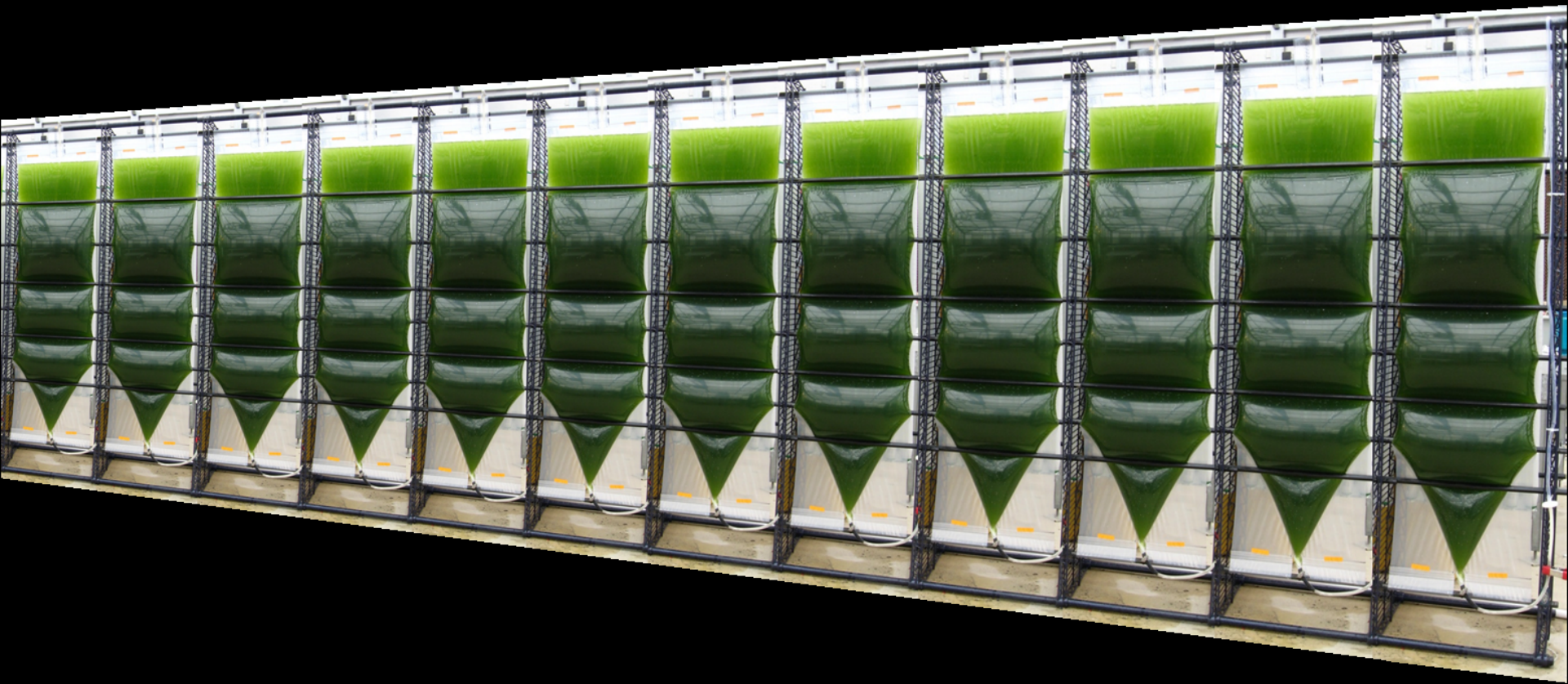


Day 1:
Approx. 24 hours of growth
in Accordion

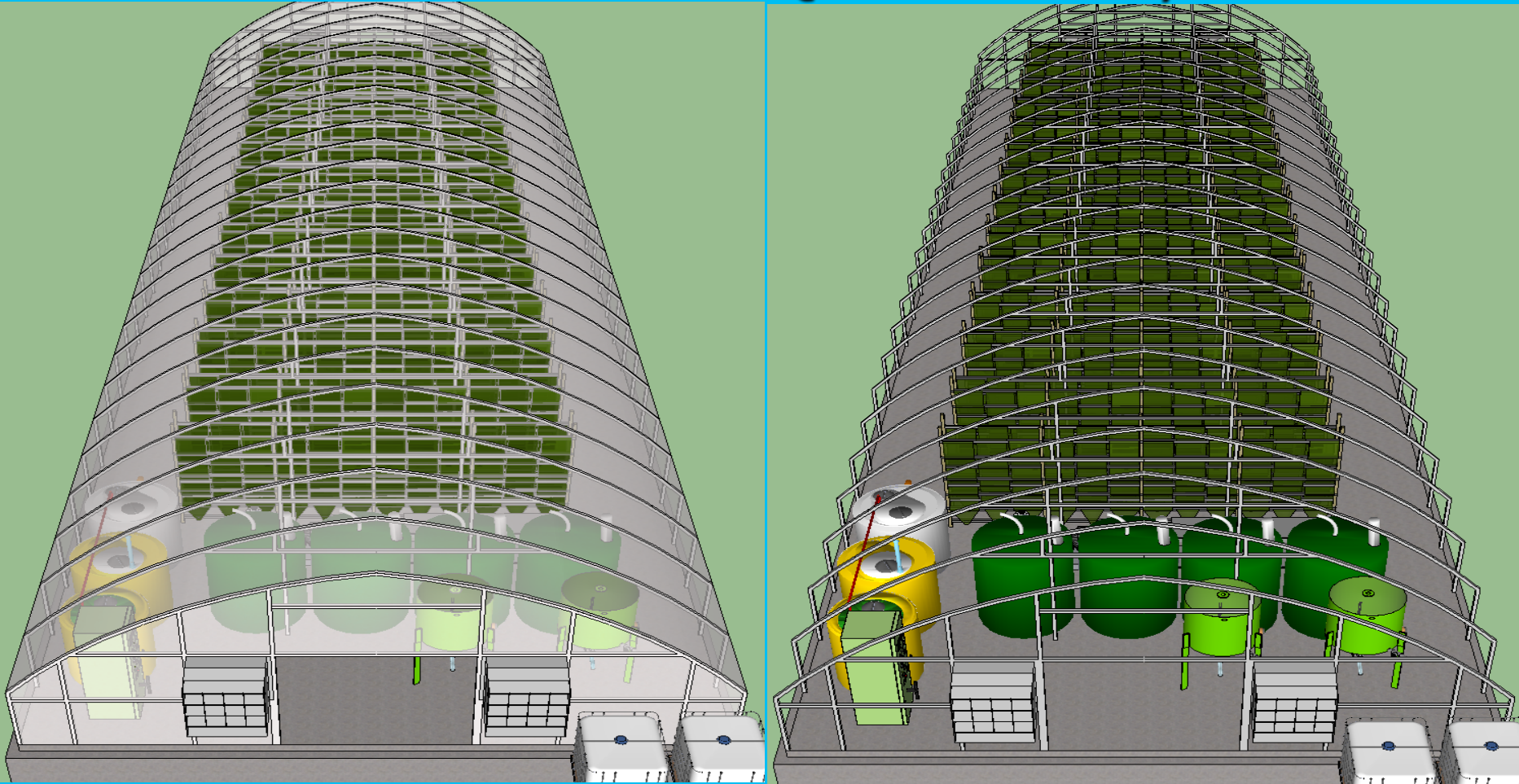


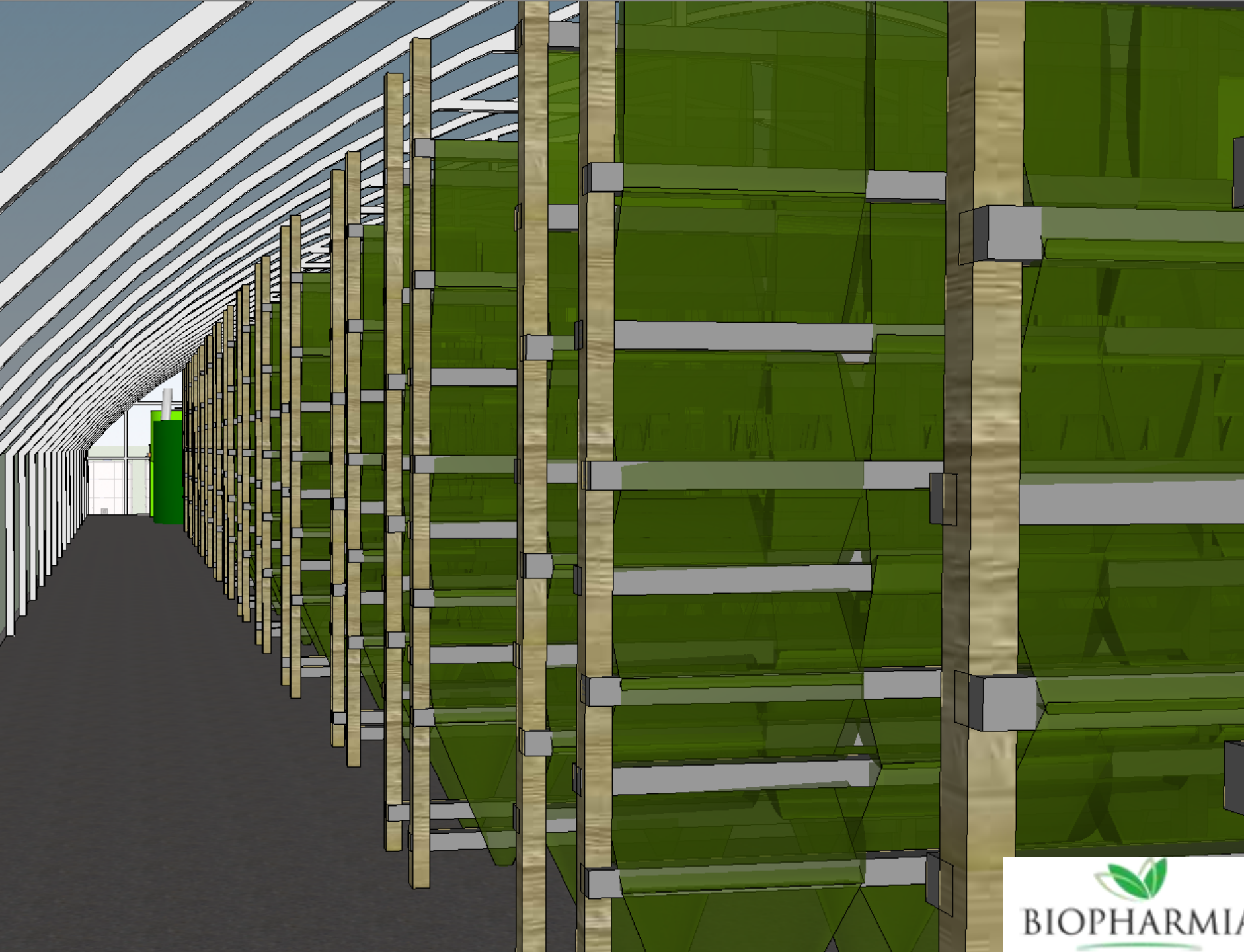
Day 6:
Approx. 144 hours of
growth in Accordion -
Ready for harvesting

Accordion Industrial Production Scale of Microalgae



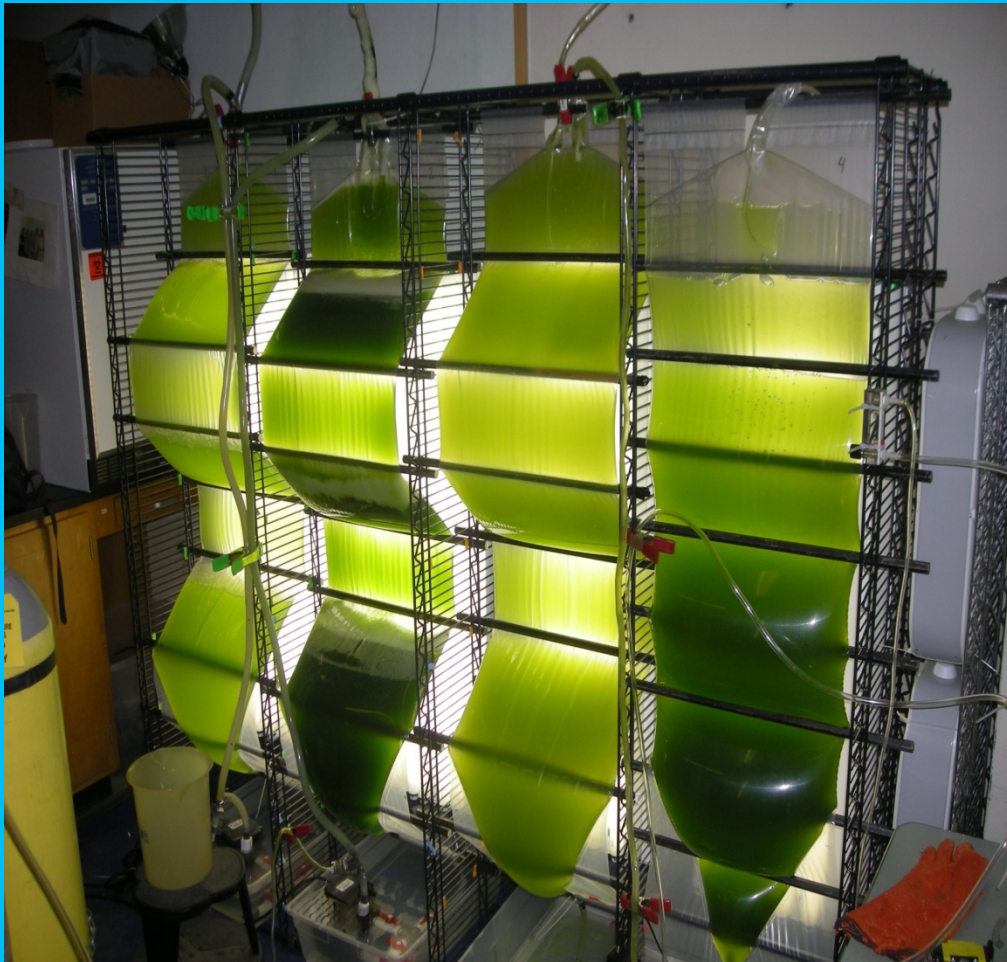
Biopharmia`s Production and R&D Facilities in USA – Saudi Arabia – Qatar - Norway







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"

- *"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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