Microalgal Biomass

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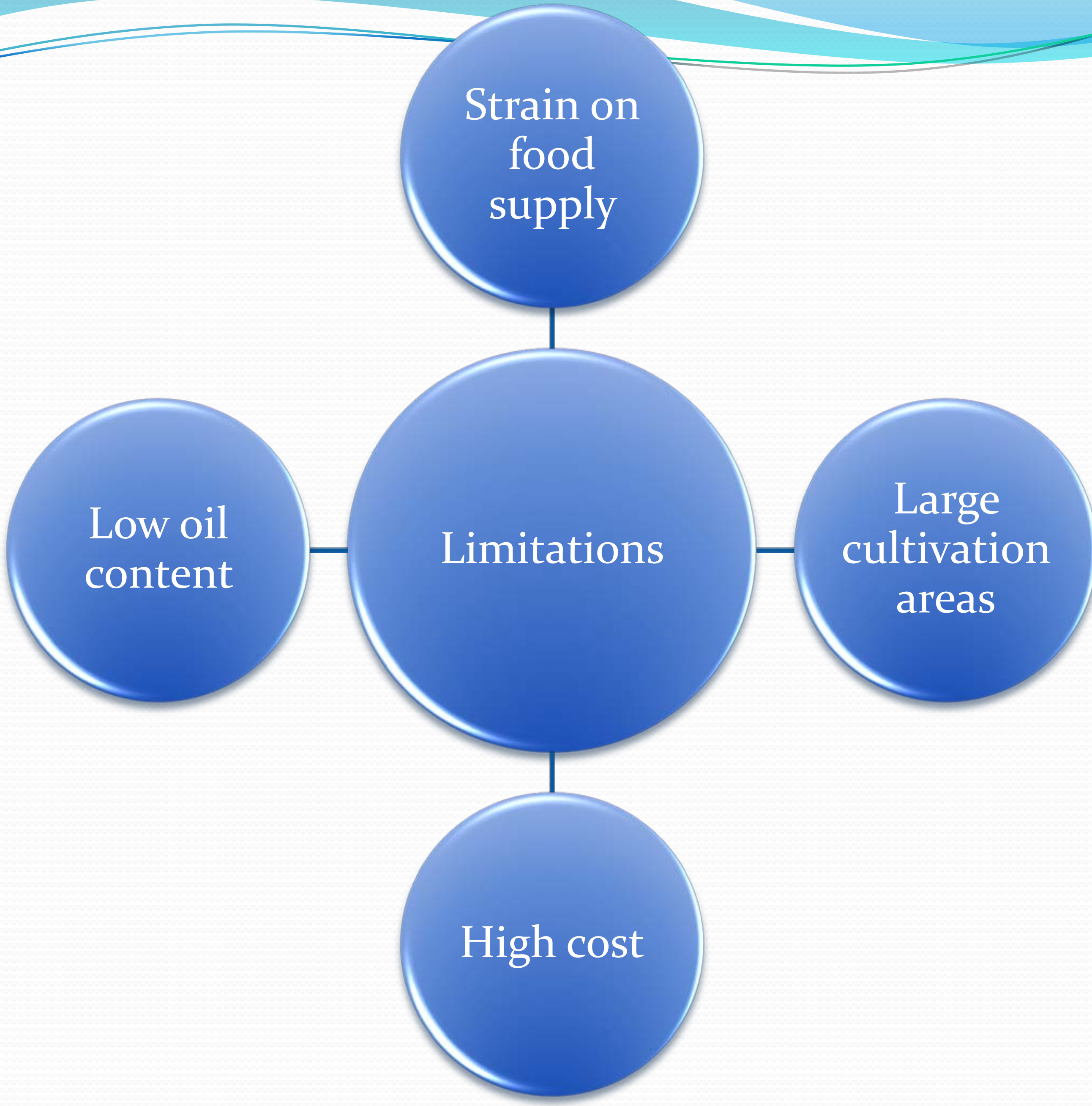
Contents

Main source of I-generation Biomass

- Forestry Resource
- Agricultural Resource
- Waste Water Resource
- Urban Solid Waste
- Animal Manure

http://conserve-energy-future.com/BioMassEnergy.php

http://baike.baidu.com/view/40476.htm

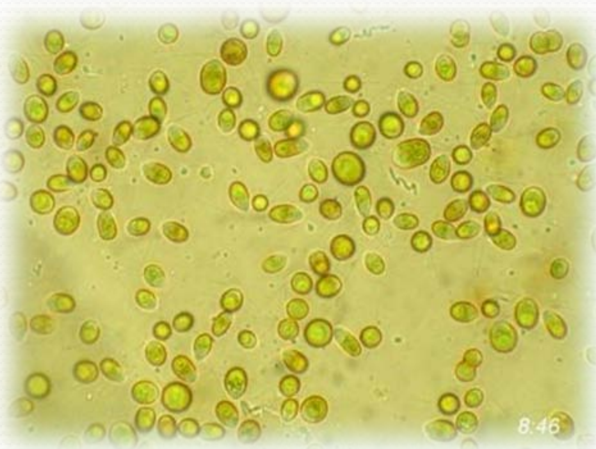

Strain on food supply
Low oil content
Limitations
Large cultivation areas
High cost

Microalgal Biofuel

http://gigaom2.files.wordpress.com/2010/07/exxonsynthetictestsite54.jpg

http://www.cawthron.org.nz/aquatic-biotechnologies/overview.html

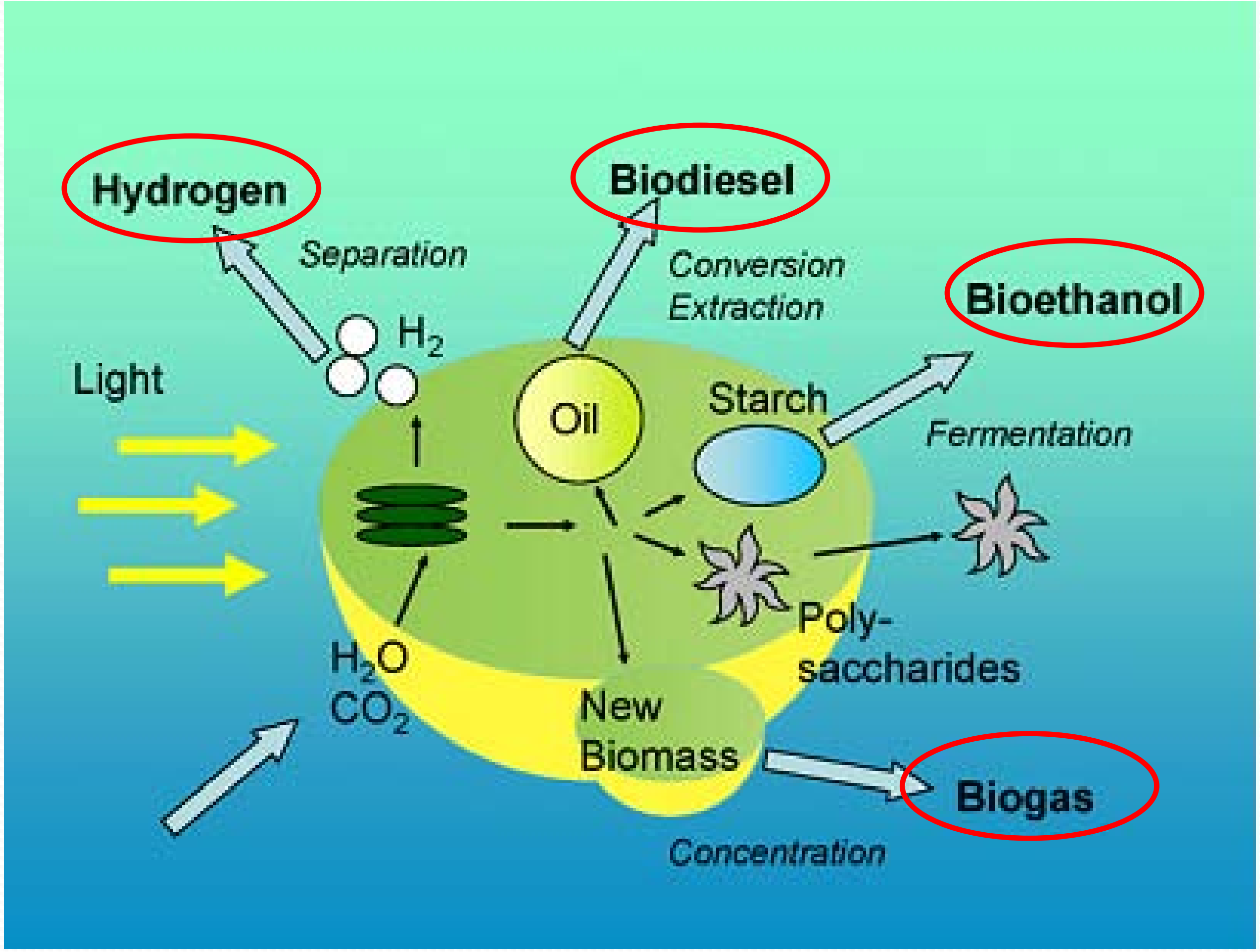
Microalgae



Macroalgae

http://www.algae.wur.nl/UK/factsonalgae/difference_micro_macroalgae/
http://www-csgc.ucsd.edu/NEWSROOM/NEWSRELEASES/2009/AlgaeForBiofuels.html

Types of Renewable Biofuels



http://www.montana.edu/energy/biofuel.php

http://www.biohydrogen.nl/hyvolution/32350/9/0/20

Production Process

Flocculation: 絮凝 綿状沈殿
Air flotation: 浮选 浮選
Centrifugation: 离心分离 遠心分離

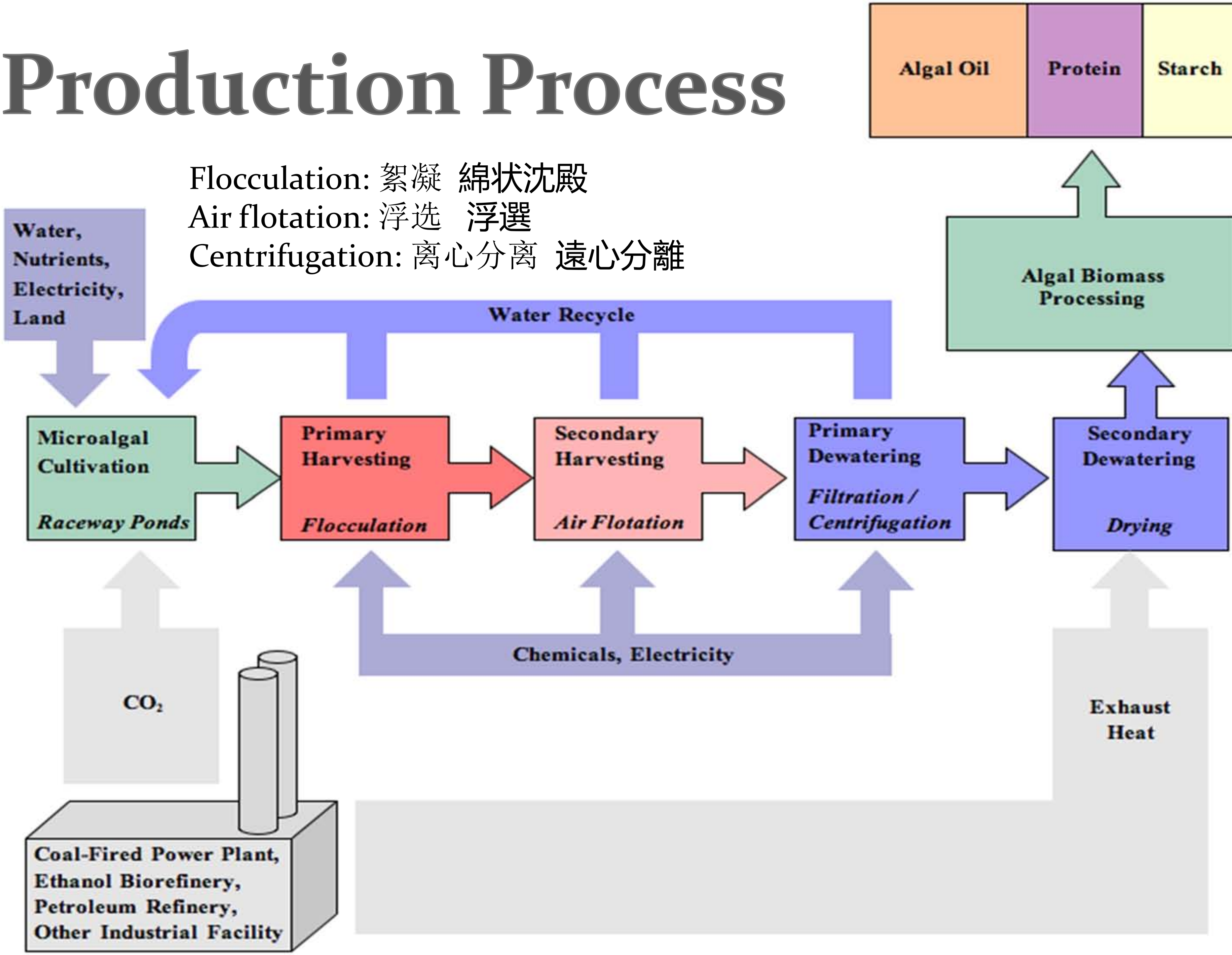
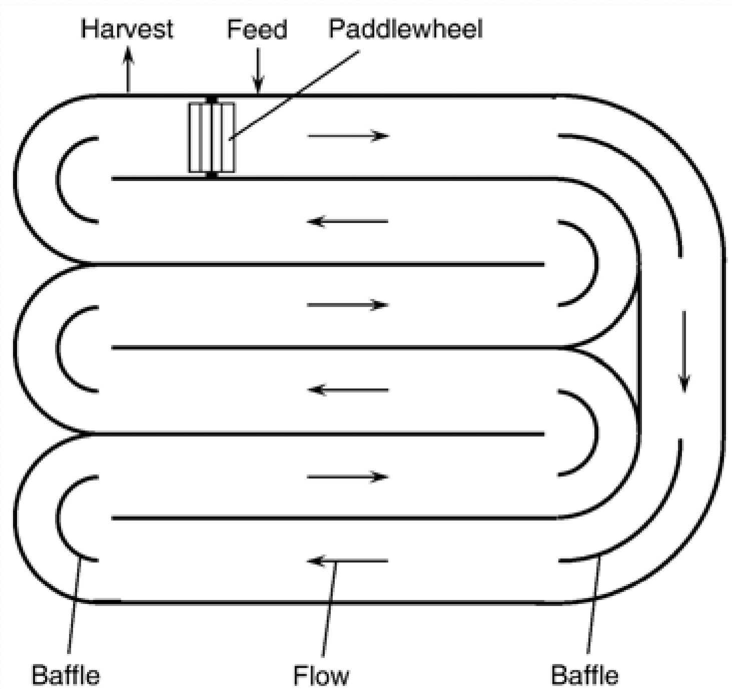
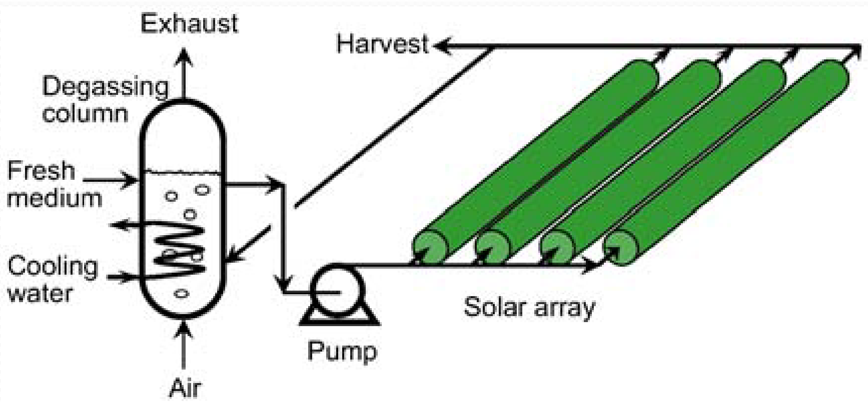


Fig. 5. Microalgal biomass recovered from the culture broth by filtration moves along a conveyor belt at Cyanotech Corporation (www.cyanotech.com), Hawaii, USA. Photograph by Terry Luke. Courtesy of Honolulu Star-Bulletin.

Raceway ponds

Photobioreactor





0.3m

0.1m

http://www.tamu.edu/faculty/tpd8/BICH407/AlgaeBiodiesel.pdf

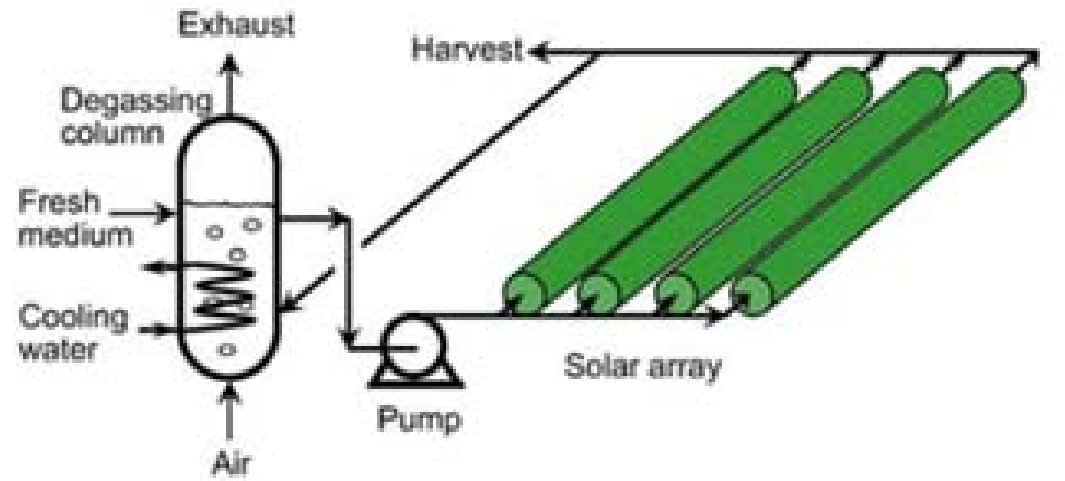


Fig. 2. A tubular photobioreactor with parallel run horizontal tubes.

Illumination

Sedimentation

pH rise

http://www.tamu.edu/faculty/tpd8/BICH407/AlgaeBiodiesel.pdf

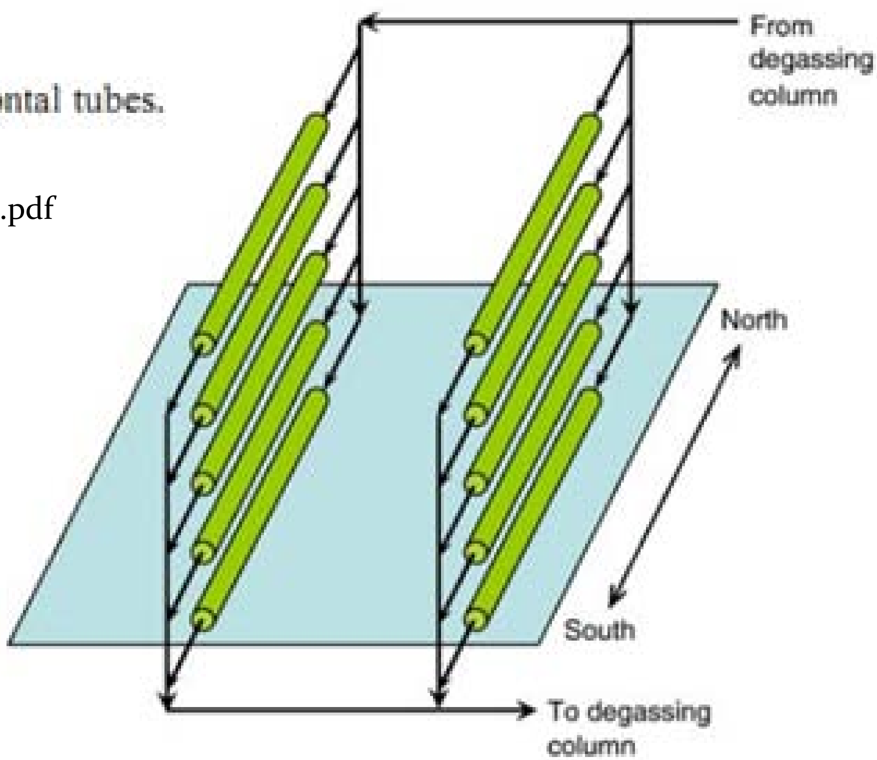


Fig. 3. A fence-like solar collector.

[Vocabulary]
Broth: an artificial medium for the growth of microbes, plants, etc.
Albedo: reflection rate

Fig. 4. A 1000 L helical tubular photobioreactor at Murdoch University, Australia. Courtesy of Professor Michael Borowitzka, Murdoch University.

Helical coil tubular photobioreactors

Comparison

Table 3
Comparison of photobioreactor and raceway production methods

Variable	Photobioreactor facility	Raceway ponds
Annual biomass production (kg)	100,000	100,000
Volumetric productivity ($kg\ m^{-3}\ d^{-1}$)	1.535	0.117
Areal productivity ($kg\ m^{-2}\ d^{-1}$)	0.048 [a] 0.072 [c]	0.035 [b]
Biomass concentration in broth ($kg\ m^{-3}$)	4.00	0.14
Dilution rate (d^{-1})	0.384	0.250
Area needed (m^2)	5681	7828
Oil yield ($m^3\ ha^{-1}$)	136.9 [d] 58.7 [e]	99.4 [d] 42.6 [e]
Annual CO_2 consumption (kg)	183,333	183,333
System geometry	132 parallel tubes/unit; 80 m long tubes; 0.06 m tube diameter	978 m^2/pond; 12 m wide, 82 m long, 0.30 m deep
Number of units	6	8

[a] Based on facility area.
[b] Based on actual pond area.
[c] Based on projected area of photobioreactor tubes.
[d] Based on 70% by wt oil in biomass.
[e] Based on 30% by wt oil in biomass.

Merits

High oil productivity

Occupying low agricultural acreage

Net carbon-nuetral

Reusing waste water resources

No sulfur
non-toxic

Highly biodegradable

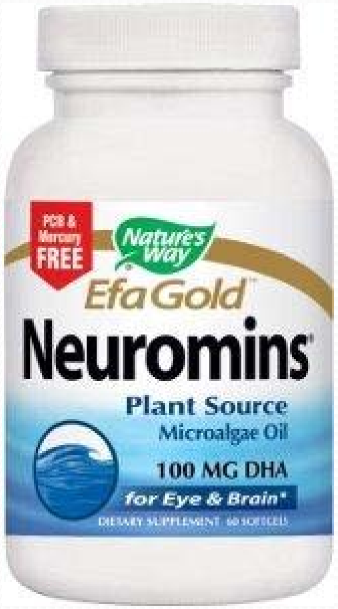
High oil content

Short growth cycle

$1.4
$2.8
$0.52

Difficulties

- High costs
  - Capital infrastructure costs
  - Harvesting and drying costs
- Eutrophication in water systems
- Fuel property
- Carbon limitation
- Contamination



Conclusion

Development of the technology

+

Usage of the remaining biomass components

=

Realistic & Promising

References

- **http://www.tamu.edu/faculty/tpd8/BICH407/AlgaeBiodiesel.pdf**
- http://automotivehorizon.sulekha.com/algal-oil-a-solution-to-falling-fuel-reserves_newsitem_4823
- http://baike.baidu.com/view/1115476.htm
- http://www.nasa.gov/centers/ames/research/OMEGA/index.html
- http://www-csgc.ucsd.edu/NEWSROOM/NEWSRELEASES/2009/AlgaeForBiofuels.html
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- **http://www.intechopen.com/books/biofuel-s-engineering-process-technology/paving-the-road-to-algal-biofuels-with-the-development-of-a-genetic-infrastructure**
- **http://www.researchalgae.com/**
- http://greeneconomypost.com/algal-biodiesel-pros-and-cons-9573.htm

THANK YOU